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SECTION 01 14 00

WORK RESTRICTIONS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for work and site restrictions.

1.2 WORKING DAYS DEFINITION

In all sections of these specifications the term "working days" shall refer to the Government's working days: 5 days per week excluding holidays.

1.3 CONTRACTOR ACCESS AND USE OF PREMISES

1.3.1 Activity Regulations

Permission to interrupt any Activity roads, and/or utility service shall be requested in writing a minimum of 10 working days prior to the desited date of interruption.

Ensure that Contractor personnel employed on the Activity become familiar with and obey Activity regulations including safety, fire, traffic and security regulations. Keep within the limits of the work and avenues of ingress and egress. Wear hard hats in designated areas. Do not enter any restricted areas unless required to do so and until cleared for such entry. The Contractor's equipment shall be conspicuously marked for identification.

1.3.2 Entry to Radiologically Controlled Areas

Contractor personnel shall not, under any circumstances, enter a radiologically controlled area or cross any posted radiological boundary. This paragraph applies to all phases of contract work. Radiation areas are posted with signs consistent with OSHA requirements. Ensure that employees are familiar with the radiation signs and symbols.

Should contract workers encounter radiological postings and/or boundaries which appear to limit their ability to access or carry out their intended work, they shall notify their contract administrator for resolution of the problem.

1.3.2.1 Radioactive Materials and Equipment

All testing equipment, containing a radioactive source, shall be operated in accordance with an approved radioactive equipment plan. This plan shall be submitted to the COR and approved by the Radiation Officer, prior to bringing the equipment on-site. This plan shall include:

a. The name and type of equipment.

b. The type and size of radiation source.

c. The dates and locations of the equipment's usage.

d. The radiological controls that the Contractor will use while operating the equipment.

A different radioactive equipment plan will be required for each different type of equipment, type of radioactive source, or size of radioactive source. A data sheet of for each piece of new radioactive equipment shall be submitted to the COR to forward to the Government's Radiation Safety Officer. The data sheet shall contain the following information:

a. Name of equipment.

b. Name and address of equipment manufacturer.

c. Type and size of radiation source.

d. The location of the installed radioactive equipment (i.e. building no., floor, code/shop area).

1.3.3 Working Hours

Regular working hours shall consist of a period established by the COR, between 7 a.m. and 5:00 p.m., Monday through Friday, excluding Government holidays.

1.3.4 Work Outside Regular Hours

Work outside regular working hours requires COR approval. Make application 10 working days prior to such work to allow arrangements to be made by the Government for inspecting the work in progress, giving the specific dates, hours, location, type of work to be performed, contract number and project title. Based on the justification provided, the COR may approve work outside regular hours. During periods of darkness, the different parts of the work shall be lighted in a manner approved by the COR.

1.3.5 Occupied and Existing Buildings

Provide temporary closures as required to maintain security as directed by the COR.

Provide dust covers or protective enclosures to protect existing work that remains and Government material during the construction period.

Relocate movable furniture away from the Contractor's working area as required to perform the work, protect the furniture, and replace the furniture in its original location upon completion of the work. Leave attached equipment in place, and protect it against damage.

1.3.6 Utility Cutovers and Interruptions

a. Make utility cutovers and interruptions after normal working hours or on Saturdays, Sundays, and Government holidays unless otherwise approved by the COR. Conform to procedures required in the paragraph "Work Outside Regular Hours."

b. Ensure that new utility lines are complete, except for the connection, before interrupting existing service.

c. Interruption to water, sanitary sewer, storm sewer, telephone service,

electric service, air conditioning, heating, fire alarm, compressed air, and shall be considered utility cutovers pursuant to the paragraph entitled "Work Outside Regular Hours."

d. Utility power outages and building-wide shutdowns shall require 15 working days advanced written notice to the COR.

1.4 SECURITY REQUIREMENTS

1.4.1 Employment Restrictions

All personnel who perform any work on this contract must be either a U.S. citizen or a permanent resident alien.

1.4.2 Contractor Regulations

a. For contracts with a duration of longer than 90 days, the Contractor's Project Manager and Superintendent shall apply for a PIV Badge (a.k.a., a "hard badge") within 10 working days of the Contract Award date.

b. The Contractor shall submit a Temporary Badge Request to the COR for any worker scheduled to come on-site at lest two working days prior to the work scheduled.

c. Employees shall wear and display the badge in the chest area at all times while entering, remaining in, and exiting Ames and each badge shall be used only by the specific individual named on the badge.

d. Maintain strict accountability over identification badges and passes issued by the Pass and ID office. Immediately report to the Pass and ID Office, any badges/passes missing or lost and the circumstances. Return badges/passes to the COR immediately upon termination of any employee, expiration, completion of contract, or when no longer required. The COR will ensure that all badges/passes are returned and forwarded to the Visitors Office.

e. Restrict hours of work to 7:00 a.m. - 5:00 p.m. Monday through Friday, work days only. When operational needs require scheduling of work after 5:00 p.m. (Monday through Friday) or on weekends and holidays, provide written notification at least 10 working days in advance to the COR. Such notifications will include specific dates, hours of work, location of work, type of work to be performed, contract number and project title.

f. Restore all traffic/parking/security signs and markings, including space numbers, designations, and lines, to their original form if such signs/markings are defaced or deleted during construction/repair.

g. Be responsible for control and security of Contractor-owned equipment and materials at the work site. Report immediately, missing/lost/stolen property to the Ames Police Department (phone 650/604-5416) as each case occurs.

h. Ensure that no material is stacked within 10 feet of the perimeter. Remove from the work site, or secure ladders or other such equipment which could be used to climb the perimeter fence. Ensure that no vehicles are parked within 10 feet of the perimeter.

i. Provide written notification to the COR 10 working days prior to actual

start of work to allow for notification of the appropriate departments, offices, and shops of the impact resulting from the contract work. Such notifications will include specific details such as work schedules (including actual start date for entry) and impact.

j. Ensure that no opening in the roof/walls/windows/fence of the building exist at the end of the work day and do not exist where penetration is possible during non-working hours. If the building cannot be secured at the end of the work day, coordinate action with the Contracting Office to notify the cognizant code to arrange for a security watch by their personnel.

k. Five working days prior to working in a restricted area, contact the COR to make arrangements for a security guard or other measures required to meet all security requirements. Cost of security guard will be charged to the Contractor.

l. The Contractor must have a representative on-site during all work performed under the contract to maintain security, safety, and quality control requirements.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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PART 2 PRODUCTS

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SECTION 01 20 00.00 20

PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for payment instruction paragraphs required for use in all projects.

1.2 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Schedule of Values

1.3 SCHEDULE OF VALUES

1.3.1 Data Required

Within 10 working days of notice to proceed, prepare and deliver to the COR a Schedule of Values as directed by the COR. Provide a detailed breakdown of the contract price, giving quantities for each of the various kinds of work, unit prices, and extended prices. Costs shall be summarized and totals provided for each construction category.

1.3.2 Schedule Instructions

Payments will not be made until the Schedule of Values has been submitted to and accepted by the COR. Identify the cost for site work, and include incidental work to the 5 ft line. Identify costs for the building(s), and include work out to the 5 ft line. Work out to the 5 ft line shall include construction encompassed within a theoretical line 5 ft from the face of exterior walls and shall include attendant construction, such as pad mounted HVAC cooling equipment, cooling towers, and transformers placed beyond the 5 ft line.

1.3.3 Design Build Services

Design build services shall be no more than 10% of the total contract value on the schedule of values. Any increase beyond 10% shall require justification and is at the discretion of the COR.

1.3.4 Mobilization and Demobilization Costs

The schedule of values shall include reasonable mobilization and demobilization costs. The value of demobilization shall be at least 50% of the mobilization cost.

1.4 CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT

1.4.1 Final Invoice

a. A final invoice shall be accompanied by the Contractor's Final Release. If the Contractor is incorporated, the Final Release shall contain the corporate seal. An officer of the corporation shall sign and the corporate secretary shall certify the Final Release.

b. For final invoices being submitted via NSSC, the original Contractor's Final Release Form must be provided directly to the respective COR prior to submission of the final invoice. Once receipt of the original Final Release Form has been confirmed by the COR, the Contractor shall then submit final invoice and attach a copy of the Final Release Form.

c. Final invoices not accompanied by the Contractor's Final Release will be considered incomplete and will be returned to the Contractor.

1.5 PAYMENTS TO THE CONTRACTOR

Payments will be made on submission of itemized requests by the Contractor which comply with the requirements of this section, and will be subject to reduction for overpayments or increase for underpayments made on previous payments to the Contractor.

1.5.1 Payment for Work

The Government shall only accept invoices for work in place unless specially authorized by the Government elsewhere.

1.5.2 Obligation of Government Payments

The obligation of the Government to make payments required under the provisions of this contract will, at the discretion of the COR, be subject to reductions and/or suspensions permitted under the FAR and agency regulations including the following in accordance with "FAR 32.503-6:

a. Reasonable deductions due to defects in material or workmanship;

b. Claims which the Government may have against the Contractor under or in connection with this contract;

c. Unless otherwise adjusted, repayment to the Government upon demand for overpayments made to the Contractor; and

d. Failure to provide up to date record drawings not current as stated in Contract Clause "FAC 5252.236-9310, Record Drawings."

1.5.3 Payment for Onsite and Offsite Materials

Progress payments may be made to the contractor for materials delivered on the site, for materials stored off construction sites, or materials that are in transit to the construction sites under the following conditions:

a. FAR 52.232-5(b) Payments Under Fixed Price Construction Contracts.

b. Materials delivered on the site but not installed, including completed preparatory work, and off-site materials to be considered for progress payment shall be major high cost, long lead, special order, or

specialty items, not susceptible to deterioration or physical damage in storage or in transit to the construction site. Provide inspection or testing reports and/or documentation showing contract compliance. Materials not acceptable for payment include consumable materials such as nails, fasteners, conduits, gypsum board, glass, insulation, and wall coverings.

c. Materials to be considered for progress payment prior to installation shall be specifically and separately identified in the Contractor's estimates of work submitted for the COR's approval in accordance with Schedule of Values requirement of this contract. Requests for progress payment consideration for such items shall be supported by documents establishing their value and that the title requirements of the clause at FAR 52.232-5 have been met.

d. Materials are adequately insured and protected from theft and exposure.

e. Provide a written consent from the surety company with each payment request for offsite materials.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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PART 2 PRODUCTS

PART 3 EXECUTION

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SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for general administrative paragraphs.

1.2 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Samples

1.3 SAMPLES

Samples shall be large enough to verify contract requirements. COR has the discretion to request larger samples or a different sample format.

1.4 CONTRACTOR SPECIAL REQUIREMENTS

1.4.1 Asbestos Containing Material

All contract requirements of Section 02 82 14.00 10, ASBESTOS HAZARD CONTROL ACTIVITIES assigned to the Private Qualified Person (PQP) shall be accomplished directly by a first tier subcontractor.

1.5 SUPERVISION

Have at least one qualified supervisor capable of reading, writing, and conversing fluently in the English language on the job site whenever work is being performed under the contract. In addition, if a Quality Control (QC) representative is required on the contract, then that individual shall also have fluent English communication skills.

Provide at least one (1) qualified Project Manager and one (1) on-site Project Superintendent. Both shall comply with English speaking requirements.

In addition to the above experience requirements, the Project Manager and on-site Project Superintendent shall complete the course entitled "Construction Quality Management for Contractors" prior to the start of construction. Contact the COR to schedule attendance in the course.

The Project Manager in this context shall mean the individual with the responsibility for the overall management of the project and the Project Superintendent shall mean the individual with the responsibility for quality and production. Both the Project Manager and Project Superintendent are subject to removal by the COR for non-compliance with requirements specified in the contract and for failure to manage the project to insure timely completion. Furthermore, the COR may issue an

order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders shall be made the subject of claim for extension of time for excess costs or damages by the Contractor.

Approval of Project Manager and on-site Project Superintendent is required prior to start of construction. Provide resumes for the proposed Project Manager and on-site Project Superintendent describing their experience with references and qualifications to the COR for approval. The COR reserves the right to interview the proposed Project Manager and on-site Project Superintendent at any time in order to verify the submitted qualifications.

1.6 PRECONSTRUCTION CONFERENCE

After award of the contract but prior to commencement of any work at the site, meet with the COR to discuss and develop a mutual understanding relative to the administration of the value engineering and safety program, preparation of the schedule prices, shop drawings, and other submittals, scheduling programming, prosecution of the work. Major subcontractors who will engage in the work shall also attend.

1.7 ELECTRONIC MAIL (E-MAIL) ADDRESS

The Contractor shall establish and maintain electronic mail (e-mail) capability along with the capability to open various electronic attachments in Microsoft, Adobe Acrobat, and other similar formats. Within 10 days after contract award, the Contractor shall provide the COR a single (only one) e-mail address for electronic communications from the COR related to this contract including, but not limited to contract documents, invoice information, request for proposals, and other correspondence. The COR may also use e-mail to notify the Contractor of base access conditions when emergency conditions warrant, such as hurricanes, terrorist threats, etc. Multiple e-mail addresses will not be allowed.

It is the Contractor's responsibility to make timely distribution of all Government initiated e-mail with its own organization including field office(s). The Contractor shall promptly notify the COR, in writing, of any changes to this e-mail address.

1.8 COMPUTER AND INTERNET CONNECTION

The Contractor shall maintain a computer and internet connection capable of accessing and using NASA's online construction management system.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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SECTION 01 32 16.00 20

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL REQUIREMENTS

1.1 SUMMARY

This section covers the requirements for the preparation and use of Design-Bid-Build Schedules.

1.2 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction schedule

1.3 ACCEPTANCE

Prior to the start of work, prepare and submit to the COR for acceptance a construction schedule in the form of a Network Analysis Schedule (NAS) in accordance with the terms in Contract Clause "FAR 52.236-15, Schedules for Construction Contracts," except as modified in this contract. Acceptance of an error free Baseline Schedule and updates is a condition precedent to processing the Contractor's pay request.

1.4 SCHEDULE FORMAT

1.4.1 Network Analysis Schedule (NAS)

The Contractor shall use the critical path method (CPM) to schedule and control project activities. The schedule shall be built as follows:

The Project Schedule shall show submittals, government review periods, material/equipment delivery, utility outages, all on-site construction, inspection, testing, and closeout activities. Government and Contractor on-site work activities shall be driven by calendars that reflect Saturdays, Sundays and all Federal Holidays as non-work days.

With the exception of the Contract Award and End Contract milestone activities, no activities shall be open-ended; each activity shall have predecessor and successor ties, duration of activities, and shall show float for each activity. All major milestones shall be shown.

Date/time constraint(s) and/or lags, other than those required by the contract, shall not be allowed unless accepted by the COR. The Contractor shall include as the last activity in the contract schedule, a milestone activity named "Contract Completion Date". The "Contract Completion Date" milestone shall have a "Mandatory Finish" constraint equal to the contract completion date.

1.5 UPDATED SCHEDULES

Update the Construction schedule at monthly intervals or when the schedule has been revised. The COR may require that the construction schedule be resubmitted for approval whenever there are major revisions to the schedule. The updated schedule shall be kept current, reflecting actual activity progress and plan for completing the remaining work. Submit copies of purchase orders and confirmation of delivery dates as directed.

1.6 3-WEEK LOOK AHEAD SCHEDULE

The Contractor shall prepare and issue a 3-Week Look Ahead schedule to provide a more detailed day-to-day plan of upcoming work identified on the Construction Schedule. The work plans shall be updated each week to show the planned work for the current and following two-week period. Additionally, include upcoming outages, closures, preparatory meetings, and initial meetings. Identify critical path activities on the Three-Week Look Ahead Schedule. The detail work plans are to be bar chart type schedules, maintained separately from the Construction Schedule on an electronic spreadsheet program and printed on 8 ½ by 11 or 11 by 17 sheets as directed by the COR. Activities shall not exceed 5 working days in duration and have sufficient level of detail to assign crews, tools and equipment required to complete the work. Hard copies for each attendee of the weekly Progress Meeting, and one electronic file of the 3-Week Look Ahead Schedule, shall be delivered and reviewed during the weekly Progress Meeting.

1.7 CORRESPONDENCE AND TEST REPORTS

All correspondence (e.g., letters, Requests for Information (RFIs), e-mails, meeting minute items, Production and QC Daily Reports, material delivery tickets, photographs, etc.) shall reference Schedule activities that are being addressed. All test reports (e.g., concrete, soil compaction, weld, pressure, etc.) shall reference schedule activities that are being addressed.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 DIRECTED CHANGES

If the NTP is issued for changes prior to settlement of price and/or time, submit proposed schedule revisions to the CO within 10 working days of the NTP being issued. The CO will approve proposed revisions to the schedule prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the CO may furnish the Contractor with suggested revisions to the project schedule. Include these revisions in the project schedule until revisions are submitted, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the CO, advise the CO within 10 working days of receipt of the revisions. Regardless of the objections, continue to update the schedule with the CO's revisions until a mutual agreement in the revisions is reached. If the Contractor fails to submit alternative revisions within 10 working days of receipt of the CO's proposed revisions, the Contractor will be deemed to have concurred with the CO's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

3.2 WEEKLY PROGRESS MEETINGS

a. Meet weekly with the Government (or as otherwise mutually agreed to) between the meetings described in paragraph PERIODIC SCHEDULE UPDATE MEETINGS for the purpose of jointly reviewing the actual progress of the project as compared to the as planned progress and to review planned activities for the upcoming two weeks. The then current and approved schedule update shall be used for the purposes of this meeting and for the production and review of reports. The Contractor's Project Manager and the Authorized Representative of the COR shall attend. The weekly progress meeting will address the status of RFI's, RFP's and Submittals.

b. Provide a bar chart produced by the scheduling software, organized by Total Float and Sorted by Early Start Date, and a two week "look-ahead" schedule by filtering all schedule activities to show only current ongoing activities and activities schedule to start during the upcoming two weeks, organized by Work Area Code (AREA) and sorted by Early Start Date.

c. The Government and the Contractor shall jointly review the reports. If it appears that activities on the longest path(s) which are currently driving the calculated completion date (driving activities), are not progressing satisfactorily and therefore could jeopardize timely project completion, corrective action must be taken immediately. Corrective action includes but is not limited to: increasing the number of work crews; increasing the number of work shifts; increasing the number of hours worked per shift; and determining if Government responsibility coded activities require Government corrective action.

3.3 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

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SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for general procedures regarding submittals, data normally submitted for review to establish conformance with the design concept and contract documents.

1.2 GENERAL

The COR may request submittals in addition to those specified when deemed necessary to adequately describe the work covered in the respective sections.

Units of weights and measures used on all submittals are to be the same as those used in the contract drawings.

Each submittal is to be complete and in sufficient detail to allow ready determination of compliance with contract requirements.

Contractor's Quality Control (CQC) System Manager and the Designer of Record, if applicable, to check and approve all items prior to submittal and stamp, sign, and date indicating action taken. Proposed deviations from the contract requirements are to be clearly identified. Include within submittals items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including (but not limited to) catalog cuts, diagrams, operating charts or curves; test reports; test cylinders; samples; O&M manuals (including parts list); certifications; warranties; and other such required submittals.

Submittals requiring Government approval are to be scheduled and made prior to the acquisition of the material or equipment covered thereby. Pick up and dispose of samples not incorporated into the work in accordance with manufacturer's Material Safety Data Sheets (MSDS) and in compliance with existing laws and regulations.

1.2.1 NASA's Online Construction Management System

All construction documents including but not limited to submittals, requests for information (RFIs), daily reports, field clarifications, schedules, change orders, and progress payment requests shall be submitted and approved electronically through NASA's online construction management system.

Adobe Digital Signatures or other digital signatures as mutually agreed upon by the Government and the Contractor shall be considered legally binding and the equivalent of pen and ink signatures.

The Government reserves the right to select which electronic format is used in documents submitted online provided that format is in widespread public use (such as PDF) and is commercially available for no more than a nominal fee.

Whenever practical the text in documents submitted online shall be electronically searchable information as opposed to scanned or digitally photographed information.

The Government reserves the right to establish naming conventions for any documents submitted to the online construction management system.

The Government reserves the right to provide a form that shall be used for any document submitted online including but not limited to: requests for information and submittal transmittal forms. The text in these documents shall remain electronically searchable when submitted.

1.3 DEFINITIONS

1.3.1 Submittal Descriptions (SD)

Submittals requirements are specified in the technical sections. Submittals are identified by Submittal Description (SD) numbers and titles as follows:

SD-01 Preconstruction Submittals

Submittals which are required to be submitted prior to start of construction (work) issuance of contract notice to proceed or commencing work on site or the start of the next major phase of the construction on a multi-phase contract, includes schedules, tabular list of data, or tabular list including location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

Certificates of insurance

Surety bonds

List of proposed Subcontractors

List of proposed products

Construction Progress Schedule

Submittal register

Schedule of values

Health and safety plan

Work plan

Quality Control(QC) plan

Environmental protection plan

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

Diagrams and instructions from a manufacturer or fabricator for use in

producing the product and as aids to the Contractor for integrating the product or system into the project.

Drawings prepared by or for the Contractor to show how multiple systems and interdisciplinary work will be coordinated.

Design drawings require the stamp of a licensed engineer.

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work.

Samples of warranty language when the contract requires extended product warranties.

SD-04 Samples

Fabricated or unfabricated physical examples of materials, equipment or workmanship that illustrate functional and aesthetic characteristics of a material or product and establish standards by which the work can be judged.

Color samples from the manufacturer's standard line (or custom color samples if specified) to be used in selecting or approving colors for the project.

Field samples and mock-ups constructed on the project site establish standards by which the ensuring work can be judged. Includes assemblies or portions of assemblies which are to be incorporated into the project and those which will be removed at conclusion of the work. Evidence of Energy Star qualification or FEMP designation where applicable.

SD-05 Design Data

Design calculations, mix designs, analyses or other data pertaining to a part of work.

Design submittals, design substantiation submittals and extensions of design submittals.

Design data requires the stamp of a licensed engineer.

SD-06 Test Reports

Report signed by authorized official of testing laboratory that a material, product or system identical to the material, product or system to be provided has been tested in accord with specified requirements. (Testing must have been within three years of date of contract award for the project.)

Report which includes findings of a test required to be performed by the Contractor on an actual portion of the work or prototype prepared for the project before shipment to job site.

Report which includes finding of a test made at the job site or on

sample taken from the job site, on portion of work during or after installation.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

SD-07 Certificates

Statements printed on the manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements. Must be dated after award of project contract and clearly name the project.

Document required of Contractor, or of a manufacturer, supplier, installer or Subcontractor through Contractor, the purpose of which is to further quality of orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel qualifications.

Confined space entry permits.

Text of posted operating instructions.

SD-08 Manufacturer's Instructions

Preprinted material describing installation of a product, system or material, including special notices and (MSDS)concerning impedances, hazards and safety precautions.

SD-09 Manufacturer's Field Reports

Documentation of the testing and verification actions taken by manufacturer's representative at the job site, in the vicinity of the job site, or on a sample taken from the job site, on a portion of the work, during or after installation, to confirm compliance with manufacturer's standards or instructions. The documentation must be signed by an authorized official of a testing laboratory or agency and must state the test results; and indicate whether the material, product, or system has passed or failed the test.

Factory test reports.

SD-10 Operation and Maintenance Data

Data that is furnished by the manufacturer, or the system provider, to the equipment operating and maintenance personnel, including manufacturer's help and product line documentation necessary to maintain and install equipment. This data is needed by operating and maintenance personnel for the safe and efficient operation, maintenance and repair of the item.

This data is intended to be incorporated in an operations and maintenance manual or control system.

SD-11 Closeout Submittals

Documentation to record compliance with technical or administrative requirements or to establish an administrative mechanism.

Special requirements necessary to properly close out a construction contract. For example, Record Drawings and as-built drawings. Also, submittal requirements necessary to properly close out a major phase of construction on a multi-phase contract.

1.3.2 Approving Authority

Office or designated person authorized to approve submittal.

1.3.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, except those SD-01 Pre-Construction Submittals noted above, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submittal Register

1.5 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.5.1 Submit for Approval

Government approval is required for all submittals described in these specifications, including, but not limited to, extensions of design, critical materials, deviations from the Solicitation, Accepted Proposal or design, substitutions, variations and other items equipment whose compatibility with the entire system must be checked, and other items as designated by the COR. Government approval is required for any as designated by the COR. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction,"they are considered to be "shop drawings."

The Government will review all intermediate and final Design-build design submittals for conformance with the technical requirements of the solicitation. Review will be only for conformance with the applicable codes, standards and contract requirements. Generally,design submittals should be identified as SD-05 Design Data submittals.

1.5.1.1 Deviations to the Accepted Design

The Government's concurrence is required for any proposed deviation from the accepted design which still complies with the contract before the Contractor is authorized to proceed with material acquisition or installation. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction", they are considered to be

"shop drawings." If necessary to facilitate the project schedule, the Contractor and the COR may discuss a submittal proposing a deviation prior to officially submitting it to the Government. However, the Government reserves the right to review the submittal before providing approval. The Government reserves the right to non-concur with any deviation from the design, which may impact furniture, furnishings, equipment selections or operations decisions that were made, based on the reviewed and concurred design.

1.5.1.2 Substitutions

Unless prohibited or provided for otherwise elsewhere in the Contract, where the accepted contract proposal named products, systems, materials or equipment by manufacturer, brand name and/or by model number or other specific identification, and the Contractor desires to substitute manufacturer or model after award, submit a requested substitution for Government concurrence. Include substantiation, identifying information, as meeting the contract requirements and that it is equal in function, performance, quality and salient features to that in the accepted contract proposal. If the Contract otherwise prohibits substitutions of equal named products, systems, materials or equipment by manufacturer, brand name and/or by model number or other specific identification, the request is considered a "variation" to the contract. Variations are discussed below in paragraph: "1.10 VARIATIONS".

1.5.2 For Information Only

At the COR's discretion a submittal may be designated "For Information Only". Such submittals are part of the project record but do not require government review or approval.

1.5.3 Government Conformance Review of Design (CR)

The Government will review all intermediate and final design submittals for conformance with the technical requirements of the solicitation. Section 01 33 16 DESIGN AFTER AWARD covers the design submittal and review process in detail. Review will be only for conformance with the applicable codes, standards and contract requirements. Design data includes the design documents described in Section 01 33 16 DESIGN AFTER AWARD. Generally, design submittals should be identified as SD-05 Design Data submittals.

1.5.4 Designer of Record Approved/Government Conformance Review (DA/CR)

1.5.4.1 Deviations to the Accepted Design

Designer of Record approval and the Government's concurrence are required for any proposed deviation from the accepted design which still complies with the contract before the Contractor is authorized to proceed with material acquisition or installation. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction", they are considered to be "shop drawings." If necessary to facilitate the project schedule, the Contractor and the DOR may discuss a submittal proposing a deviation with the COR's Representative prior to officially submitting it to the Government. However, the Government reserves the right to review the submittal before providing an opinion, if deemed necessary. In any case, the Government will not formally agree to or provide a preliminary opinion on any deviation without the DOR's approval or recommended approval. The Government reserves the right to non-concur with any deviation from the design, which may impact furniture, furnishings,

equipment selections or operations decisions that were made, based on the reviewed and concurred design.

1.5.4.2 Substitutions

Unless prohibited or provided for otherwise elsewhere in the Contract, where the accepted contract proposal named products, systems, materials or equipment by manufacturer, brand name and/or by model number or other specific identification, and the Contractor desires to substitute manufacturer or model after award, submit a requested substitution for Government concurrence. Include substantiation, identifying information and the DOR's approval, as meeting the contract requirements and that it is equal in function, performance, quality and salient features to that in the accepted contract proposal. If the Contract otherwise prohibits substitutions of equal named products, systems, materials or equipment by manufacturer, brand name and/or by model number or other specific identification, the request is considered a "variation" to the contract. Variations are discussed below in paragraphs: "Designer of Record Approved/Government Approved" and "VARIATIONS"

1.5.5 Designer of Record Approved/Government Approved (DA/GA)

In addition to the above stated requirements for proposed deviations to the accepted design, both Designer of Record and Government Approval and, where applicable, a contract modification are required before the Contractor is authorized to proceed with material acquisition or installation for any proposed variation to the contract (the solicitation and/or the accepted proposal), which constitutes a change to the contract terms. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction," they are considered to be "shop drawings." The Government reserves the right to accept or reject any such proposed deviation at its discretion.

1.5.6 Information Only

Submittals not requiring Government approval will be for information only. For Design-build construction all submittals not requiring Designer of Record or Government approval will be for information only. They are not considered to be "shop drawings" within the terms of the Contract Clause referred to above.

1.6 FORWARDING SUBMITTALS REQUIRING GOVERNMENT APPROVAL

1.6.1 Submittals Required from the Contractor

As soon as practicable after award of contract, and before procurement of fabrication, forward to the COR, submittals required in the technical sections of this specification, including shop drawings, product data and samples.

1.7 PREPARATION

1.7.1 Transmittal Form

Transmit each submittal, except sample installations and sample panels to the COR. Transmit submittals with transmittal form prescribed by the COR and standard for project. On the transmittal form identify Contractor, indicate date of submittal, and include information prescribed by transmittal form.

Use the transmittal form provided by the COR for submitting both Government approved and information only submittals. Properly complete this form by filling out all the heading blank spaces and identifying each item submitted. Exercise special care to ensure proper listing of the specification paragraph and sheet number of the contract drawings pertinent to the data submitted for each item.

1.7.2 Identifying Submittals

When submittals are provided by a Subcontractor, the Prime Contractor is to prepare, review and sign with Contractor's approval, the transmittal form prior to submitting for Government approval.

1.7.3 Format for SD-02 Shop Drawings

Shop drawings are not to be formatted at less than 8 1/2 by 11 inches nor more than 30 by 42 inches, except for full size patterns or templates. Prepare drawings to accurate size, with scale indicated, unless other form is required. Drawings are to be suitable for reproduction and be of a quality to produce clear, distinct lines and letters with dark lines on a white background.

Include on each drawing the drawing title, number, date, and revision numbers and dates, in addition to information required in paragraph entitled, "Identifying Submittals," of this section.

Number drawings in a logical sequence. Contractors may use their own number system. Each drawing is to bear the number of the submittal in a uniform location adjacent to the title block. Place the Government contract number in the margin, immediately below the title block, for each drawing.

Reserve a blank space, no smaller than 3 by 3 inches on the right hand side of each sheet for the Government disposition stamp.

Dimension drawings, except diagrams and schematic drawings; prepare drawings demonstrating interface with other trades to scale. Use the same unit of measure for shop drawings as indicated on the contract drawings. Identify materials and products for work shown.

Include the nameplate data, size and capacity on drawings. Also include applicable federal, state, industry and technical society publication references.

1.7.4 Format of SD-03 Product Data and SD-08 Manufacturer's Instructions

Present product data submittals for each section as a complete volume. Include table of contents, listing page and catalog item numbers for product data.

Indicate, by prominent notation, each product which is being submitted; indicate specification section number and paragraph number to which it pertains.

Supplement product data with material prepared for project to satisfy submittal requirements for which product data does not exist. Identify this material as developed specifically for project, with information and format as required for submission of SD-07 Certificates.

Include the manufacturer's name, trade name, place of manufacture, and catalog model or number on product data. Also include applicable federal, state, industry and technical society publication references. Should manufacturer's data require supplemental information for clarification, submit as specified for SD-07 Certificates.

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), ASTM International (ASTM), National Electrical Manufacturer's Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the COR. State on the certificate that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

Collect required data submittals for each specific material, product, unit of work, or system into a single submittal and marked for choices, options, and portions applicable to the submittal. Mark each copy of the product data identically. Partial submittals will be accepted for expedition of construction effort at the COR's discretion.

Submit manufacturer's instructions prior to installation.

1.7.5 Format of SD-04 Samples

Furnish samples in sizes below, unless otherwise specified or unless the manufacturer has prepackaged samples approximately same size as specified:

a. Sample of Equipment or Device: Full size.

b. Sample of Materials Less Than 2 by 3 inches: Built up to 8 1/2 by 11 inches.

c. Length of Linear Devices or Materials: 10 inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.

d. Sample of Non-Solid Materials: Pint. Examples of non-solid materials are sand and paint.

e. Color Selection Samples: 2 by 4 inches. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified. Sizes and quantities of samples are to represent their respective standard unit.

f. Sample Panel: 4 by 4 feet.

g. Sample Installation: 100 square feet.

Samples Showing Range of Variation: Where variations in color, finish, pattern, or texture are unavoidable due to nature of the materials, submit sets of samples of not less than three units showing extremes and middle of range. Mark each unit to describe its relation to the range of the variation.

Reusable Samples: Incorporate returned samples into work only if so specified or indicated. Incorporated samples are to be in undamaged condition at time of use.

Recording of Sample Installation: Note and preserve the notation of area constituting sample installation but remove notation at final clean up of project.

When color, texture or pattern is specified by naming a particular manufacturer and style, include one sample of that manufacturer and style, for comparison.

1.7.6 Format of SD-05 Design Data and SD-07 Certificates

Provide design data and certificates sized at 8 1/2 by 11 inches.

1.7.7 Format of SD-06 Test Reports and SD-09 Manufacturer's Field Reports

Indicate by prominent notation, each report in the submittal. Indicate specification number and paragraph number to which it pertains.

1.7.8 Format of SD-10 Operation and Maintenance Data (O&M)

Comply with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA for O&M Data format.

1.7.9 Format of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

When submittal includes a document which is to be used in project or become part of project record, other than as a submittal, do not apply Contractor's approval stamp to document, but to a separate sheet accompanying document.

1.8 QUANTITY OF SUBMITTALS

1.8.1 Number of Samples SD-04 Samples

a. Submit two samples, or two sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by approving authority and one will be returned to Contractor.

b. Submit one sample panel or provide one sample installation where directed. Include components listed in technical section or as directed.

c. Submit one sample installation, where directed.

d. Submit one sample of non-solid materials.

1.9 for INFORMATION ONLY SUBMITTALS

Normally submittals for information only will not be returned. Approval of the COR is not required on information only submittals. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications; will not prevent the COR from requiring removal and replacement of nonconforming material incorporated in the work; and does not relieve the Contractor of the requirement to furnish samples for testing by the

Government laboratory or for check testing by the Government in those instances where the technical specifications so prescribe.

1.10 VARIATIONS

A contract modification is are required before the Contractor is authorized to proceed with material acquisition or installation for any proposed variation to the contract (the solicitation and/or the accepted proposal), which constitutes a change to the contract terms. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction," they are considered to be "shop drawings." The Government reserves the right to accept or reject any such proposed deviation at its discretion.

Variations from contract requirements require Government approval pursuant to contract clause FAR 52.236-21 and will be considered where advantageous to Government.

1.10.1 Considering Variations

Discussion with COR prior to submission will help ensure functional and quality requirements are met and minimize rejections and re-submittals. When contemplating a variation which results in lower cost, consider submission of the variation as a Value Engineering Change Proposal (VECP).

Specifically point out variations from contract requirements in transmittal letters. Failure to point out deviations may result in the Government requiring rejection and removal of such work at no additional cost to the Government.

1.10.2 Proposing Variations

When proposing variation, deliver written request to the COR, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to Government, including the DOR's written analysis and approval. If lower cost is a benefit, also include an estimate of the cost savings. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation.

1.10.3 Warranting That Variations Are Compatible

When delivering a variation for approval, Contractor, including its Designer(s) of Record, warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.10.4 Review Schedule Is Modified

In addition to normal submittal review period, a period of 5 working days will be allowed for consideration by the Government of submittals with variations.

1.11 SUBMITTAL REGISTER AND DATABASE

Prepare and maintain submittal register, as the work progresses. Use electronic submittal register program furnished by the Government or any other format. Do not change data which is output in columns (c), (d), and (e) as delivered by Government; retain data which is output in columns (a), (f), (g), and (h) as approved. A submittal register showing items of

equipment and materials for which submittals are required by the specifications is provided as an attachment. This list may not be all inclusive and additional submittals may be required. Maintain a submittal register for the project in accordance with Section 01 45 00.00 40 QUALITY CONTROL.

Column (c): Lists specification section in which submittal is required.

Column (d): Lists each submittal description (SD No. and type, e.g. SD-02 Shop Drawings) required in each specification section.

Column (e): Lists one principal paragraph in specification section where a material or product is specified. This listing is only to facilitate locating submitted requirements. Do not consider entries in column (e) as limiting project requirements.

The Contractor shall develop a complete list of submittals when preparing the Submittal Register and identify required submittals based on those listed in the specifications and as required by other parts of the contract. The Contractor is required to complete the submittal register and submit it to the COR for approval within 30 calendar days after Notice to Proceed. The approved submittal register will serve as a scheduling document for submittals and will be used to control submittal actions throughout the contract period. Coordinate the submit dates and need dates with dates in the Contractor prepared progress schedule. Submit monthly or until all submittals have been satisfactorily completed, updates to the submittal register showing the Contractor action codes and actual dates with Government action codes. Revise the submittal register when the progress schedule is revised and submit both for approval.

1.11.1 Use of Submittal Register

Submit submittal register in electronic form. Submit with QC plan and project schedule. Verify that all submittals required for project are listed and add missing submittals. Coordinate and complete the following fields on the register database submitted with the QC plan and the project schedule:

Column (a) Activity Number: Activity number from the project schedule.

Column (f) Contractor Submit Date: Scheduled date for approving authority to receive submittals.

Column (g) Contractor Approval Date: Date Contractor needs approval of submittal.

Column (h) Contractor Material: Date that Contractor needs material delivered to Contractor control.

1.11.2 Copies Delivered to the Government

Deliver one copy of submittal register updated by Contractor to Government with each invoice request. Deliver in electronic format, unless a paper copy is requested by COR.

1.12 SCHEDULING

Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to

be submitted with the pertinent drawings at the same time. No delay damages or time extensions will be allowed for time lost in late submittals.

a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential resubmittal of requirements.

b. Submittals called for by the contract documents will be listed on the register. If a submittal is called for but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the COR does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the register or marked "N/A."

1.12.1 Constraints

Conform to provisions of this section, unless explicitly stated otherwise for submittals listed or specified in this contract.

Submit complete submittals for each definable feature of work. Submit at the same time components of definable feature interrelated as a system.

When acceptability of a submittal is dependent on conditions, items, or materials included in separate subsequent submittals, submittal will be returned without review.

Approval of a separate material, product, or component does not imply approval of assembly in which item functions.

1.13 GOVERNMENT APPROVING AUTHORITY

The Government will:

a. Review submittals and RFIs and provide pertinent disposition within 10 working days after receipt. Failure by the Government to complete review within this time may be grounds for a time extension but not a change in contract price, unless the delay is over 30 calendar days.

b. Note date on which submittal was received from the Contractor.

c. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.

d. Identify returned submittals with one of the actions defined in paragraph entitled, "Review Notations," of this section and with markings appropriate for action indicated.

1.13.1 Review Notations

The Government review will be completed within 10 working days after date of submission. Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "Approved" or "Accepted" authorize the Contractor to proceed with the work covered.

b. Submittals marked "Approved as Noted", "Approved as Corrected", "or

"Approved Except as Noted, Resubmittal Not Required," authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.

c. Submittals marked "Not Approved", "Disapproved," "Resubmit" or "Revise and Resubmit," indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.

d. Submittals marked "Not Reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "Not Reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

1.14 REVISE AND RESUBMIT SUBMITTALS

Contractor shall make corrections required by the Government. If the Contractor considers any correction or notation on the returned submittals to constitute a change to the contract drawings or specifications; notice as required under the clause entitled, "Changes," is to be given to the COR. Contractor is responsible for the dimensions and design of connection details and construction of work. Failure to point out deviations may result in the Government requiring rejection and removal of such work at the Contractor's expense.

If changes are necessary to submittals, the Contractor shall make such revisions and submission of the submittals in accordance with the procedures above. No item of work requiring a submittal change is to be accomplished until the changed submittals are approved.

1.15 APPROVED SUBMITTALS

The Government's approval or acceptance of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing and other information are satisfactory. design, general method of construction, materials, detailing and other information appear to meet the Solicitation and Accepted Proposal.

Approval or acceptance will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work design, dimensions, all design extensions, such as the design of adequate connections and details, etc., and the satisfactory construction of all work.

After submittals have been approved or accepted by the Government, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.16 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract

requirements. Before submitting samples, the Contractor to assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

Match the approved samples for materials and equipment incorporated in the work. If requested, approved samples, including those which may be damaged in testing, will be returned to the Contractor, at his expense, upon completion of the contract. Samples not approved will also be returned to the Contractor at its expense, if so requested.

Failure of any materials to pass the specified tests will be sufficient cause for refusal to consider, under this contract, any further samples of the same brand or make of that material. Government reserves the right to disapprove any material or equipment which previously has proved unsatisfactory in service.

Samples of various materials or equipment delivered on the site or in place may be taken by the COR for testing. Samples failing to meet contract requirements will automatically void previous approvals. Contractor to replace such materials or equipment to meet contract requirements.

Approval of the Contractor's samples by the COR does not relieve the Contractor of his responsibilities under the contract.

1.17 WITHHOLDING OF PAYMENT

Payment for materials incorporated in the work will not be made if required approvals have not been obtained. No payment for materials incorporated in the work will be made if all required approvals have not been obtained. No payment will be made for any materials incorporated into the work for any conformance review submittals or information only submittals found to contain errors or deviations from the Solicitation or Accepted Proposal.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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SECTION 01 35 26

GOVERNMENTAL SAFETY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for safety and occupational health requirements for the protection of Contractor and Government personnel, property and resources.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.32	Fall Protection
ASSE/SAFE A10.34	Protection of the Public on or Adjacent to Construction Sites
ASSE/SAFE Z359.1	Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components

ASME INTERNATIONAL (ASME)

ASME B30.22	Articulating Boom Cranes
ASME B30.3	Tower Cranes
ASME B30.5	Mobile and Locomotive Cranes
ASME B30.8	Floating Cranes and Floating Derricks

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA NP/R 8621.1	NASA Mishap Reporting, Investigating and Record Keeping Policy
NASA NPG 8715.3	NASA Safety Manual
NASA-STD 8719.12	Safety Standard for Explosives,

	Propellants, and Pyrotechnics
APR 1700.1	Ames Health and Safety Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	Standard for Portable Fire Extinguishers
NFPA 241	Standard for Safeguarding Construction,Alteration, and Demolition Operations
NFPA 306	Standard for Control of Gas Hazards on Vessels
NFPA 51B	Standard for Fire Prevention During Welding, Cutting, and Other Hot Work
NFPA 70	National Electrical Code
NFPA 70E	Standard for Electrical Safety in the Workplace

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Accident Prevention Plan (APP)

Activity Hazard Analysis (AHA)

Crane Critical Lift Plan

Proof of qualification for Crane Operators

SD-06 Test Reports

Reports

Submit reports as their incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."

Accident Reports

Crane Reports

Gas Protection for NASA projects

SD-07 Certificates

Confined Space Entry Permit

Hot work permit

License Certificates

1.4 SITE QUALIFICATIONS, DUTIES AND MEETINGS

1.4.1 Personnel Qualifications

1.4.1.1 Site Safety and Health Officer (SSHO)

The contractor shall provide a Safety oversight team that includes a minimum of one (1) Competent Person at each project site to function as the Safety and Health Officer (SSHO). The SSHO shall be at the work site at all times, unless specified differently in the contract, to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Contractor, and their training, experience, and qualifications shall be as required by EM 385-1-1 paragraph 01.A.17 and all associated sub-paragraphs. A Competent Personal shall be provided for all of the hazards identified in the Contractor's Safety and Health Program in accordance with the accepted Accident Prevention Plan, and shall be on-site at all times when the work that presents the hazards associated with their professional expertise is being performed. The credentials of the Competent Persons(s) shall be approved by the COR in consultation with the Safety Office.

The Contractor Quality Control (QC) person can be the SSHO on this project.

1.4.1.2 Crane Operators

Meet the crane operators requirements in USACE EM 385-1-1, Section 16 and Appendix I. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacitates of 50,000 pounds or greater, designate crane operators as qualified by a source that qualifies crane operators (i.e., union, a government agency, or and organization that tests and qualifies crane operators). Provide proof of current qualification.

1.4.2 Personnel Duties

1.4.2.1 Site Safety and Health Officer (SSHO)

a. Conduct daily safety and health inspections and maintain a written log which includes area/operation inspected, date of inspection, identified hazards, recommended corrective actions, estimated and actual dates of corrections. Attach safety inspection logs to the Contractors' daily report.

b. Conduct mishap investigations and complete required reports. Maintain the OSHA Form 300 and Daily Production reports for prime and sub-contractors.

c. Maintain applicable safety reference material on the job site.

d. Attend the pre-construction conference, pre-work meetings including preparatory inspection meeting, and periodic in-progress meetings.

e. Implement and enforce accepted APPS and AHAs.

f. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. Post a list of unresolved safety and health deficiencies on the safety bulletin board.

g. Ensure sub-contractor compliance with safety and health requirements.

h. Maintain a list of hazardous chemicals on site and their material safety data sheets.

Failure to perform the above duties will result in dismissal of the superintendent, QC Manager, and/or SSHO, and a project work stoppage. The project work stoppage will remain in effect pending approval of a suitable replacement.

1.4.3 Meetings

1.4.3.1 Preconstruction Conference

a. Contractor representatives who have a responsibility or significant role in accident prevention on the project shall attend the preconstruction conference. This includes the project superintendent, site safety and health officer, quality control supervisor, or any other assigned safety and health professionals who participated in the development of the APP (including the Activity Hazard Analyses (AHAs) and special plans, program and procedures associated with it).

b. Discuss the details of the submitted APP to include incorporated plans, programs, procedures and a listing of anticipated AHAs that will be developed and implemented during the performance of the contract. This list of proposed AHAs will be reviewed at the conference and an agreement will be reached between the Contractor and the COR's representative as to which phases will require an analysis. In addition, establish a schedule for the preparation, submittal, review, and acceptance of AHAs to preclude project delays.

c. Deficiencies in the submitted APP will be brought to the attention of the Contractor at the preconstruction conference, and the Contractor shall revise the plan to correct deficiencies and re-submit it for acceptance. Do not begin work until there is an accepted APP.

d. The functions of a Preconstruction conference may take place at the Post-Award Kickoff meeting for Design Build Contracts.

1.4.3.2 Safety Meetings

Conduct and document meetings as required by EM 385-1-1. Attach minutes showing contract title, signatures of attendees and a list of topics discussed to the Contractors' daily report.

1.5 ACCIDENT PREVENTION PLAN (APP)

Use a qualified person to prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of USACE EM 385-1-1 and as supplemented herein. Cover all paragraph and subparagraph elements in USACE EM 385-1-1, Appendix A, "Minimum Basic OutRG 8715.3. Specific requirements for some of the APP elements are described below. The APP shall be job-specific and address any unusual or unique aspects of the project or activity for which it is written. The APP shall interface with the Contractor's overall safety and health program. Include any portions of the Contractor's overall safety and health program referenced in the APP in the applicable APP element and made site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Contractors are responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance,

coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer, the Contractor Quality control Manager, and any designated CSP and/or CIH.

Submit the APP to the COR 10 working days prior to the date of the preconstruction conference for acceptance. Work cannot proceed without an accepted APP.

Once accepted by the COR, the APP and attachments will be enforced as part of the contract. Disregarding the provisions of this contract or the accepted APP will be cause for stopping of work, at the discretion of the COR, until the matter has been rectified.

Once work begins, changes to the accepted APP shall be made with the knowledge and concurrence of the COR, project superintendent, SSHO and quality control manager. Should any severe hazard exposure, i.e. imminent danger, become evident, stop work in the area, secure the area, and develop a plan to remove the exposure and control the hazard. Notify the COR within 24 hours of discovery. Eliminate/remove the hazard. In the interim, take all necessary action to restore and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public (as defined by ASSE/SAFE A10.34,) and the environment.

Copies of the accepted plan will be maintained at the COR's office and at the job site.

Continuously reviewed and amended the APP, as necessary, throughout the life of the contract. Incorporate unusual or high-hazard activities not identified in the original APP as they are discovered.

1.5.1 EM 385-1-1 Contents

In addition to the requirements outlines in Appendix A of USACE EM 385-1-1, the following is required:

a. Confined Space Entry Plan. Develop a confined and/or enclosed space entry plan in accordance with USACE EM 385-1-1, applicable OSHA standards 29 CFR 1910, 29 CFR 1915, and 29 CFR 1926, OSHA Directive 2.100, and any other federal, state and local regulatory requirements identified in this contract. Identify the qualified person's name and qualifications, training, and experience. Delineate the qualified person's authority to direct work stoppage in the event of hazardous conditions. Include procedure for rescue by contractor personnel and the coordination with emergency responders. (If there is no confined space work, include a statement that no confined space work exists and none will be created.)

b. Crane Critical Lift Plan. Prepare and sign weight handling critical lift plans for lifts over 75 percent of the capacity of the crane or hoist (or lifts over 50 percent of the capacity of a barge mounted mobile crane's hoists) at any radius of lift; lifts involving more than one crane or hoist; lifts of personnel; and lifts involving non-routine rigging or operation, sensitive equipment, or unusual safety risks. Submit 10 working days prior to on-site work and include the requirements of USACE EM 385-1-1, paragraph 16.H. and the following:

1. For lifts of personnel, demonstrate compliance with the requirements of 29 CFR 1926.550(g).

2. For barge mounted mobile cranes, barge stability calculations identifying barge list and trim based on anticipated loading; and load charts based on calculated list and trim. The amount of list and trim shall be within the crane manufacturer's requirements.

c. Fall Protection and Prevention (FP&P) Program Documentation. The program documentation shall be site specific and address all fall hazards in the work place and during different phases of construction. Address how to protect and prevent workers from falling to lower levels when they are exposed to fall hazards above 6 feet. A qualified person for fall protection shall prepare and sign the program documentation. Include fall protection and prevention systems, equipment and methods employed for every phase of work, responsibilities, assisted rescue, self-rescue and evacuation procedures, training requirements, and monitoring methods. Revise the Fall Protection and Prevention Program documentation every six months for lengthy projects, reflecting any changes during the course of construction due to changes in personnel, equipment, systems or work habits. Keep and maintain the accepted Fall Protection and Prevention Program documentation at the job site for the duration of the project. Include the Fall Protection and Prevention Program documentation in the Accident Prevention Plan (APP).

d. Lead Compliance Plan. The safety and health aspects of lead work, prepared in accordance with Section 02 83 13.00 20 LEAD IN CONSTRUCTION.

e. Asbestos Hazard Abatement Plan. The safety and health aspects of asbestos work, prepared in accordance with Section 02 82 14.00 10 ASBESTOS ABATEMENT 02 82 14.00 10 ASBESTOS HAZARD CONTROL ACTIVITIES.

f. Site Safety and Health Plan. The safety and health aspects prepared in accordance with Section 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES.

g. PCB Plan. The safety and health aspects of Polychlorinated Biphenyls work, prepared in accordance with Sections 02 84 33 REMOVAL AND DISPOSAL OF POLYCHLORINATED BIPHENYLS and 02 61 23 REMOVAL AND DISPOSAL OF PCB CONTAMINATED SOILS.

h. Site Demolition Plan. The safety and health aspects prepared in accordance with Section 02 41 00 DEMOLITION and referenced sources. Include engineering survey as applicable.

i. Excavation Plan. The safety and health aspects prepared in accordance with Section 31 00 00 EARTHWORK.

1.5.2 Construction Safety Hazard Awareness Training

The training requirements for the Site Safety and Health Officer (SSHO) must include the successful completion of the course entitled "Construction Safety Hazard Awareness Training for Contractors". If the SSHO does not have a current certification, they must obtain the course certification within sixty (60) calendar days from award. For Construction Safety Requirements refer to NASA Ames Policy Requirements APR 1700.1 Chapter 27 regarding Construction Safety Requirements and Procedures.

1.6 ACTIVITY HAZARD ANALYSIS (AHA)

The Activity Hazard Analysis (AHA) format shall be in accordance with USACE EM 385-1-1, Section 1. Submit the AHA for review at least 10 working days prior to the start of each phase. Format subsequent AHAs as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

The AHA list will be reviewed periodically (at least monthly) at the Contractor supervisory safety meeting and updated as necessary when procedures, scheduling, or hazards change.

Develop the activity hazard analyses using the project schedule as the basis for the activities performed. Any activities listed on the project schedule will require an AHA. The AHAs will be developed by the contractor, supplier or subcontractor and provided to the prime contractor for submittal to the COR.

1.7 DISPLAY OF SAFETY INFORMATION

Within 1 working day after commencement of work, erect a safety bulletin board at the job site. Where size, duration, or logistics of project do not facilitate a bulletin board, an alternative method, acceptable to the COR, that is accessible and includes all mandatory information for employee and visitor review, shall be deemed as meeting the requirement for a bulletin board. Include and maintain information on safety bulletin board as required by EM 385-1-1, section 01.A.06. Additional items required to be posted include:

a. Confined space entry permit.

b. Hot work permit.

c. Emergency phone numbers.

d. MSDS

1.8 SITE SAFETY REFERENCE MATERIALS

Maintain safety-related references applicable to the project, including those listed in the article "References." Maintain applicable equipment manufacturer's manuals.

1.9 EMERGENCY MEDICAL TREATMENT

Contractors will arrange for their own emergency medical treatment. Government has no responsibility to provide emergency medical treatment.

1.10 REPORTS

1.10.1 Mishap Reports

a. Conduct a mishap investigation for recordable injuries and illnesses, as defined in 1.3.h and property damage mishaps resulting in at least $2,000 in damages, to establish the root cause(s) of the accident, complete the report and provide the report to the COR within 1 working day of the mishap. The COR will provide copies of any required or special forms.

1.10.2 Accident Notification

Notify the COR as soon as practical, but not later than 4 hours after any accident meeting the definition of Recordable Injuries or Illnesses or High Visibility Accidents, property damage equal to or greater than $2,000, or any weight handling equipment accident in accordance with NASA NPR 8621.1. Within notification include contractor name; contract title; type of contract; name of activity, installation or location where accident occurred; date and time of accident; names of personnel injured; extent of property damage, if any; extent of injury, if known, and brief description of accident (to include type of construction equipment used, PPE used, etc.). Preserve the conditions and evidence on the accident site until the Government investigation team arrives on-site and Government investigation is conducted.

1.10.3 Crane Reports

Submit crane inspection reports required in accordance with USACE EM 385-1-1, Appendix I and as specified herein with Daily Reports of Inspections.

1.10.4 Certificate of Compliance

Provide a Certificate of Compliance for each crane entering an activity under this contract (see COR for a blank certificate). State within the certificate that the crane and rigging gear meet applicable OSHA regulations (with the Contractor citing which OSHA regulations are applicable, e.g., cranes used in construction, demolition, or maintenance comply with 29 CFR 1926 and USACE EM 385-1-1 Section 16 and Appendix I. Certify on the Certificate of Compliance that the crane operator(s) is qualified and trained in the operation of the crane to be used. Also certify that all of its crane operators working on the DOD activity have been trained in the proper use of all safety devices (e.g., anti-two block devices). Post certifications on the crane.

1.11 HOT WORK

Submit and obtain a written permit prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, from the Fire Division Marshal's Office, Bldg. M158, Room 202. A permit is required from the Explosives Safety Office for work in and around where explosives are processed, stored, or handled. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. The Contractor will provide at least two (2) twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO NASA AMES DISPATCH. Dial 9-1-1 from a land line. Dial 650-604-5555 from a cell phone.

When starting work in the facility, require personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO NASA Ames Dispatch. Dial 9-1-1 from a land line. Dial 650-604-5555 from a cell phone.

1.12 RADIATION SAFETY REQUIREMENTS

License Certificates for radiation materials and equipment shall be submitted to the COR and Radiation Safety Office (RSO) for all specialized and licensed material and equipment that could cause fatal harm to construction personnel or to the construction project.

Workers shall be protected from radiation exposure in accordance with 10 CFR 20. Standards for Protection Against Radiation.

Loss of radioactive material shall be reported immediately to the COR.

Actual exposure of the radiographic film or unshielding the source shall not be initiated until after 5 p.m. on weekdays.

In instances where radiography is scheduled near or adjacent to buildings or areas having limited access or one-way doors, no assumptions shall be made as to building occupancy. Where necessary, the COR will direct the Contractor to conduct an actual building entry, search, and alert. Where removal of personnel from such a building cannot be accomplished and it is otherwise safe to proceed with the radiography, a fully instructed employee shall be positioned inside such building or area to prevent exiting while external radiographic operations are in process. Transportation of Regulated Amounts of Radioactive Material will comply with 49 CFR, Subchapter C, Hazardous Material Regulations. Local Fire authorities and the site Radiation Safety officer (RSO) shall be notified of any Radioactive Material use.

Transmitter Requirements: The base policy concerning the use of transmitters such as radios, cell phones, etc., must be adhered to by all contractor personnel. They must also obey Emissions control (EMCON) restrictions.

1.13 FACILITY OCCUPANCY CLOSURE

Streets, walks, and other facilities occupied and used by the Government shall not be closed or obstructed without written permission from the COR.

1.14 GAS PROTECTION

Contractor shall have one or more employees properly trained and experienced in operation and calibration of gas testing equipment and formally qualified as gas inspectors who shall be on duty during times workers are in confined spaces. Their primary functions shall be to test for gas and operate testing equipment. Unless equipment of constant supervisory type with automatic alarm is employed, gas tests shall be made at least every 2 hours or more often when character of ground or experience indicates gas may be encountered. A gas test shall be made before workmen are permitted to enter the excavation after an idle period exceeding one-half hour.

Readings shall be permanently recorded daily, indicating the concentration of gas, point of test, and time of test. Submit copies of the gas test readings to the COR at the end of each work day.

Special requirements, coordination, and precautions will apply to areas that contain a hazardous atmosphere or, by virtue of their use or physical character, may be oxygen deficient. A check by Government is required prior to entering confined space. Surveillance and monitoring shall be

required in these types of work spaces by both Contractor and Government personnel.

1.15 HIGH NOISE LEVEL PROTECTION

Operations performed by the Contractor that involve the use of equipment with output of high noise levels (jackhammers, air compressors, and explosive-actuated devices) shall be scheduled for during the hours 8 a.m. to 5 p.m. unless otherwise approved in writing by the COR. The government may further restrict the hours of operation of high noise level equipment at the COR's discretion. Use of any such equipment shall be approved in writing by the COR prior to commencement of work.

1.16 SEVERE STORM PLAN

In the event of a severe storm warning, the Contractor must:

a. Secure outside equipment and materials and place materials that could be damaged in protected areas.

b. Check surrounding area, including roof, for loose material, equipment, debris, and other objects that could be blown away or against existing facilities.

c. Ensure that temporary erosion controls are adequate.

1.17 CONFINED SPACE ENTRY REQUIREMENTS.

Contractors entering and working in confined spaces performing general industry work are required to follow the requirements of OSHA 29 CFR Part 1926.

PART 2 PRODUCTS

2.1 CONFINED SPACE SIGNAGE

Provide permanent signs integral to or securely attached to access covers for new permit-required confined spaces. Signs wording: "DANGER--PERMIT-REQUIRED CONFINED SPACE - DO NOT ENTER -" in bold letters a minimum of one inch in height and constructed to be clearly legible with all paint removed. The signal word "DANGER" shall be red and readable from 5 feet.

2.2 FALL PROTECTION ANCHORAGE

Leave in place fall protection anchorage, conforming to ASSE/SAFE Z359.1, installed under the supervision of a qualified person in fall protection, for continued customer use and so identified by signage stating the capacity of the anchorage (strength and number of persons who may be tied-off to it at any one time).

PART 3 EXECUTION

3.1 CONSTRUCTION AND/OR OTHER WORK

Comply with USACE EM 385-1-1, NFPA 241, the APP, the AHA, Federal and/or State OSHA regulations, and other related submittals and activity fire and safety regulations. The most stringent standard prevails.

3.1.1 Hazardous Material Exclusions

Notwithstanding any other hazardous material used in this contract, radioactive materials or instruments capable of producing ionizing/non-ionizing radiation (with the exception of radioactive material and devices used in accordance with USACE EM 385-1-1 such as nuclear density meters for compaction testing and laboratory equipment with radioactive sources) as well as materials which contain asbestos, mercury or polychlorinated biphenyls, di-isocynates, lead-based paint are prohibited. The COR, upon written request by the Contractor, may consider exceptions to the use of any of the above excluded materials. The Radiation Safety Officer (RSO) must be notified prior to excepted items of radioactive material and devices being brought on base.

3.1.2 Unforeseen Hazardous Material

The design should have identified materials such as PCB, lead paint, and friable and non-friable asbestos and other OSHA regulated chemicals (i.e. 29 CFR Part 1910.1000). If additional material, not indicated, that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the COR immediately. Within 10 working days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions."

3.2 PRE-OUTAGE COORDINATION MEETING

Contractors are required to apply for utility outages at least 3 business days in advance. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, attend a pre-outage coordination meeting with the COR to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.3 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Contractor shall ensure that each employee is familiar with and complies with these procedures and USACE EM 385-1-1, Section 12, Control of Hazardous Energy.

COR will, at the Contractor's request, apply lockout/tagout tags and take other actions that, because of experience and knowledge, are known to be necessary to make the particular equipment safe to work on for government owned and operated systems.

No person, regardless of position or authority, shall operate any switch, valve, or equipment that has an official lockout/tagout tag attached to it, nor shall such tag be removed except as provided in this section. No person shall work on any energized equipment including, but not limited to activities such as erecting, installing, constructing, repairing, adjusting, inspecting, un-jamming, setting up, trouble shooting, testing, cleaning, dismantling, servicing and maintaining machines equipment of

processes until an evaluation has been conducted identifying the energy source and the procedures which will be taken to ensure the safety of personnel.

When work is to be performed on electrical circuits, only qualified personnel shall perform work on electrical circuits.

A supervisor who is required to enter an area protected by a lockout/tagout tag will be considered a member of the protected group provided he notifies the holder of the tag stub each time he enters and departs from the protected area.

Identification markings on building light and power distribution circuits shall not be relied on for established safe work conditions.

Before clearance will be given on any equipment other than electrical (generally referred to as mechanical apparatus), the apparatus, valves, or systems shall be secured in a passive condition with the appropriate vents, pins, and locks.

Pressurized or vacuum systems shall be vented to relieve differential pressure completely.

Vent valves shall be tagged open during the course of the work.

Where dangerous gas or fluid systems are involved, or in areas where the environment may be oxygen deficient, system or areas shall be purged, ventilated, or otherwise made safe prior to entry.

3.3.1 Tag Placement

Lockout/tagout tags shall be completed in accordance with the regulations printed on the back thereof and attached to any device which, if operated, could cause an unsafe condition to exist.

If more than one group is to work on any circuit or equipment, the employee in charge of each group shall have a separate set of lockout/tagout tags completed and properly attached.

When it is required that certain equipment be tagged, the Government will review the characteristics of the various systems involved that affect the safety of the operations and the work to be done; take the necessary actions, including voltage and pressure checks, grounding, and venting, to make the system and equipment safe to work on; and apply such lockout/tagout tags to those switches, valves, vents, or other mechanical devices needed to preserve the safety provided. This operation is referred to as "Providing Safety Clearance."

3.3.2 Tag Removal

When any individual or group has completed its part of the work and is clear of the circuits or equipment, the supervisor, project leader, or individual for whom the equipment was tagged shall turn in his signed lockout/tagout tag stub to the COR. That group's or individual's lockout/tagout tags on equipment may then be removed on authorization by the COR.

3.4 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

Establish a fall protection and prevention program, for the protection of all employees exposed to fall hazards. Within the program include company policy, identify responsibilities, education and training requirements, fall hazard identification, prevention and control measures, inspection, storage, care and maintenance of fall protection equipment and rescue and evacuation procedures.

3.4.1 Training

Institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, provide training for each employee who might be exposed to fall hazards. Provide training by a competent person for fall protection in accordance with USACE EM 385-1-1, Section 21.B.

3.4.2 Fall Protection Equipment and Systems

Enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is exposed to a fall hazard. Protect employees from fall hazards as specified in EM 385-1-1, Section 21. In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with USACE EM 385-1-1, Paragraphs 21.N through 21.N.04. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel. Fall protection must comply with 29 CFR 1926.500, Subpart M, USACE EM 385-1-1 and ASSE/SAFE A10.32.

3.4.2.1 Personal Fall Arrest Equipment

Personal fall arrest equipment, systems, subsystems, and components shall meet ASSE/SAFE Z359.1. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabiners shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 6 feet. The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.

3.4.3 Fall Protection for Roofing Work

Implement fall protection controls based on the type of roof being constructed and work being performed. Evaluate the roof area to be accessed for its structural integrity including weight-bearing capabilities for the projected loading.

a. Low Sloped Roofs:

1. For work within 6 feet of an edge, on low-slope roofs, Protect personnel from falling by use of personal fall arrest systems, guardrails, or safety nets. A safety monitoring system is not adequate fall protection and is not authorized.

2. For work greater than 6 feet from an edge, erect and install warning lines in accordance with 29 CFR 1926.500 and USACE EM 385-1-1.

b. Steep-Sloped Roofs: Work on steep-sloped roofs requires a personal fall arrest system, guardrails with toe-boards, or safety nets. This requirement also includes residential or housing type construction.

3.4.4 Existing Anchorage

Certified (or re-certified) by a qualified person for fall protection existing anchorages, to be used for attachment of personal fall arrest equipment in accordance with ASSE/SAFE Z359.1. Exiting horizontal lifeline anchorages must be certified (or re-certified) by a registered professional engineer with experience in designing horizontal lifeline systems.

3.4.5 Horizontal Lifelines

Design, install, certify and use under the supervision of a qualified person horizontal lifelines for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500).

3.4.6 Guardrails and Safety Nets

Design, install and use guardrails and safety nets in accordance with EM 385-1-1 and 29 CFR 1926 Subpart M.

3.4.7 Rescue and Evacuation Procedures

When personal fall arrest systems are used, the contractor must ensure that the mishap victim can self-rescue or can be rescued promptly should a fall occur. Prepare a Rescue and Evacuation Plan and include a detailed discussion of the following: methods of rescue; methods of self-rescue; equipment used; training requirement; specialized training for the rescuers; procedures for requesting rescue and medical assistance; and transportation routes to a medical facility. Include the Rescue and Evacuation Plan within the Activity Hazard Analysis (AHA) for the phase of work, in the Fall Protection and Prevention (FP&P) Plan, and the Accident Prevention Plan (APP).

3.5 SCAFFOLDING

Each scaffold shall be installed, relocated, and dismantled in accordance with designs and instructions of a registered Professional Engineer, and supervised by a competent design person. Provide employees with a safe means of access to the work area on the scaffold. Climbing of any scaffold braces or supports not specifically designed for access is prohibited. Access scaffold platforms greater than 20 feet maximum in height by use of a scaffold stair system. Do not use vertical ladders commonly provided by scaffold system manufacturers for accessing scaffold platforms greater than 20 feet maximum in height. The use of an adequate gate is required. Ensure that employees are qualified to perform scaffold erection and dismantling. Do not use scaffold without the capability of supporting at

least four times the maximum intended load or without appropriate fall protection as delineated in the accepted fall protection and prevention plan. Stationary scaffolds must be attached to structural building components to safeguard against tipping forward or backward. Give special care to ensure scaffold systems are not overloaded. Side brackets used to extend scaffold platforms on self-supported scaffold systems for the storage of material is prohibited. The first tie-in shall be at the height equal to 4 times the width of the smallest dimension of the scaffold base. Place work platforms on mud sills. Scaffold or work platform erectors shall have fall protection during the erection and dismantling of scaffolding or work platforms that are more than six feet. Delineate fall protection requirements when working above six feet or above dangerous operations in the Fall Protection and Prevention (FP&P) Plan and Activity Hazard Analysis (AHA) for the phase of work.

3.6 EQUIPMENT

3.6.1 Material Handling Equipment

a. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.

b. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.

c. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

3.6.2 Weight Handling Equipment

a. Equip cranes and derricks as specified in EM 385-1-1, section 16.

b. Notify the COR 15 days in advance of any cranes entering the activity so that necessary quality assurance spot checks can be coordinated. Prior to cranes entering federal activities, a Crane Access Permit must be obtained from the COR. A copy of the permitting process will be provided at the Preconstruction Conference. Contractor's operator shall remain with the crane during the spot check.

c. Comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, and ASME B30.8 for floating cranes and floating derricks.

d. Under no circumstance shall a Contractor make a lift at or above 90 percent of the cranes rated capacity in any configuration.

e. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and follow the requirements of USACE EM 385-1-1 Section 11 and ASME B30.5 or ASME B30.22 as applicable.

f. Do not crane suspended personnel work platforms (baskets) unless the Contractor proves that using any other access to the work location would provide a greater hazard to the workers or is impossible. Do not lift personnel with a line hoist or friction crane.

g. Inspect, maintain, and recharge portable fire extinguishers as

specified in NFPA 10, Standard for Portable Fire Extinguishers.

h. All employees must keep clear of loads about to be lifted and of suspended loads.

i. Use cribbing when performing lifts on outriggers.

j. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.

k. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.

l. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by COR personnel.

m. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by COR personnel.

n. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).

3.6.3 Equipment and Mechanized Equipment

a. Proof of qualifications for operator shall be kept on the project site for review.

b. Manufacture specifications or owner's manual for the equipment shall be on-site and reviewed for additional safety precautions or requirements that are sometimes not identified by OSHA or USACE EM 385-1-1. Incorporate such additional safety precautions or requirements into the AHAs.

3.6.4 USE OF EXPLOSIVES

Explosives shall not be used or brought to the project site without prior written approval from the COR. Such approval shall not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

Storage of explosives, when permitted on Government property, shall be only where directed and in approved storage facilities. These facilities shall be kept locked at all times except for inspection, delivery, and withdrawal of explosives.

Explosive work shall be performed in accordance with NASA-STD 8719.12. This document is available at:

http://www.hq.nasa.gov/office/codeq/doctree/871912.htm

3.7 EXCAVATIONS

Perform soil classification by a competent person in accordance with 29 CFR 1926.

3.7.1 Utility Locations

Prior to digging, the appropriate digging permit must be obtained. All underground utilities in the work area must be positively identified by a private utility locating service in addition to any station locating service and coordinated with the station utility department. Any markings made during the utility investigation must be maintained throughout the contract.

3.7.2 Utility Location Verification

The Contractor must physically verify underground utility locations by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system. Digging within 2 feet of a known utility must not be performed by means of mechanical equipment; hand digging shall be used. If construction is parallel to an existing utility expose the utility by hand digging every 100 feet if parallel within 5 feet of the excavation.

3.7.3 Shoring Systems

Trench and shoring systems must be identified in the accepted safety plan and AHA. Manufacture tabulated data and specifications or California registered engineer tabulated data for shoring or benching systems shall be readily available on-site for review. Job-made shoring or shielding must have the registered professional engineer stamp, specifications, and tabulated data. Extreme care must be used when excavating near direct burial electric underground cables.

3.7.4 Trenching Machinery

Operate trenching machines with digging chain drives only when the spotters/laborers are in plain view of the operator. Provide operator and spotters/laborers training on the hazards of the digging chain drives with emphasis on the distance that needs to be maintained when the digging chain is operating. Keep documentation of the training on file at the project site.

3.8 UTILITIES WITHIN CONCRETE SLABS

Utilities located within concrete slabs or pier structures, bridges, and the like, are extremely difficult to identify due to the reinforcing steel used in the construction of these structures. Whenever contract work involves concrete chipping, saw cutting, or core drilling, the existing utility location must be coordinated with station utility departments in addition to a private locating service. Outages to isolate utility systems must be used in circumstances where utilities are unable to be positively identified. The use of historical drawings does not alleviate the contractor from meeting this requirement.

3.9 ELECTRICAL

3.9.1 Conduct of Electrical Work

Underground electrical spaces must be certified safe for entry before entering to conduct work. Cables that will be cut must be positively identified and de-energized prior to performing each cut. Positive cable identification must be made prior to submitting any outage request for electrical systems. Arrangements are to be coordinated with the COR and

Station Utilities for identification. The COR will not accept an outage request until the Contractor satisfactorily documents that the circuits have been clearly identified. Perform all high voltage cable cutting remotely using hydraulic cutting tool. When racking in or live switching of circuit breakers, no additional person other than the switch operator will be allowed in the space during the actual operation. Plan so that work near energized parts is minimized to the fullest extent possible. Use of electrical outages clear of any energized electrical sources is the preferred method. When working in energized substations, only qualified electrical workers will be permitted to enter. When work requires Contractor to work near energized circuits as defined by the CEC and NFPA 70, high voltage personnel must use personal protective equipment that includes, as a minimum, electrical hard hat, safety shoes, insulating gloves with leather protective sleeves, fire retarding shirts, coveralls, face shields, and safety glasses. In addition, provide electrical arc flash protection for personnel as required by NFPA 70E. Insulating blankets, hearing protection, and switching suits may also be required, depending on the specific job and as delineated in the Contractor's AHA.

3.9.2 Portable Extension Cords

Size portable extension cords in accordance with manufacturer ratings for the tool to be powered and protected from damage. Immediately removed from service all damaged extension cords. Portable extension cords shall meet the requirements of NFPA 70E and OSHA electrical standards.

3.10 WORK IN CONFINED SPACES

Comply with the requirements in Section 34 of USACE EM 385-1-1, OSHA 29 CFR 1910.146 and OSHA 29 CFR 1926.21(b)(6). Any potential for a hazard in the confined space requires a permit system to be used.

a. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Section 34 of USACE EM 385-1-1 for entry procedures.) All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.

b. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.

c. Sewer wet wells require continuous atmosphere monitoring with audible alarm for toxic gas detection.

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HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for safety and health documents and procedures for hazardous waste site cleanup projects.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN PETROLEUM INSTITUTE (API)

API RP 1604	Closure of Underground Petroleum Storage Tanks
API RP 2219	Safe Operation of Vacuum Trucks in Petroleum Service
API Std 2015	Safe Entry and Cleaning of Petroleum Storage Tanks

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z358.1	American National Standard for Emergency Eyewash and Shower Equipment

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

NIOSH 85-115	Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	Safety and Health Requirements Manual
ER 385-1-95	Safety -- Safety and Health Requirements for Munitions and Explosives of Concern (MEC) Operations

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 20	Standards for Protection Against Radiation

29 CFR 1904	Recording and Reporting Occupational Injuries and Illnesses
29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR 1926	Safety and Health Regulations for Construction
29 CFR 1926.65	Hazardous Waste Operations and Emergency Response
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

1.3 DESCRIPTION OF WORK

This section requires Contractors to implement practices and procedures for working safely and in compliance with OSHA and USACE regulation while performing cleanup activities on uncontrolled hazardous waste sites.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Work Zones

Decontamination Facilities

Drawings showing the layout of the personnel and equipment decontamination.

SD-03 Product Data

Exposure Monitoring/Air Sampling Program

Personnel exposure monitoring/sampling results.

Site Control Log

Record of each entry and exit into the site, as specified.

Employee Certificates

1.5 REGULATORY REQUIREMENTS

Comply with EM 385-1-1, OSHA requirements in 29 CFR 1910 and 29 CFR 1926 with work performed under this contract, especially OSHA's Standards

29 CFR 1926.65 and 29 CFR 1910.120 and state specific OSHA requirements where applicable. Submit to the COR for resolution matters of interpretation of standards before starting work. The most stringent requirements apply where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary.

1.6 PRECONSTRUCTION SAFETY CONFERENCE

Conduct a preconstruction safety conference prior to the start of site activities and after submission of the Contractor's APP/SSHP. The objective of the meeting will be to discuss health and safety concerns related to the impending work, discuss project health and safety organization and expectations, review and answer comments and concerns regarding the APP/SSHP or other health and safety concerns the Contractor may have. Ensure that those individuals responsible for health and safety at the project level are available and attend this meeting.

1.7 ACCIDENT PREVENTION PLAN/SITE SAFETY AND HEALTH PLAN (APP/SSHP)

Develop and implement a Site Safety and Health Plan and attach to the Accident Prevention Plan (APP) as an appendix (APP/SSHP). Address all occupational safety and health hazards (traditional construction as well as contaminant-related hazards) associated with cleanup operations within the APP/SSHP. Cover each SSHP element in section 28.A.01 of EM 385-1-1 and each APP element in Appendix A of EM 385-1-1. There are overlapping elements in Section 28.A.01 and Appendix A of EM 385-1-1. SSHP appendix elements that overlap with APP elements need not be duplicated in the APP/SSHP provided each SOH issue receives adequate attention and is documented in the APP/SSHP. The APP/SSHP is a dynamic document, subject to change as project operations/execution change. The APP/SSHP will require modification to address changing and previously unidentified health and safety conditions. It is the Contractor's responsibility to ensure that the APP/SSHP is updated accordingly. Submit amendments to the APP/SSHP to the COR as the APP/SSHP is updated. For long duration projects resubmit the APP/SSHP to the COR annually for review. The APP/SSHP must contain all updates.

1.7.1 Acceptance and Modifications

Prior to submittal, the APP/SSHP must be signed and dated by the Safety and Health Manager and the Site Superintendent. Submit for review 5 days prior to the Preconstruction Safety Conference. Deficiencies in the APP/SSHP will be discussed at the preconstruction safety conference, and be revised to correct the deficiencies and resubmitted for acceptance. Onsite work must not begin until the plan has been accepted. Maintain a copy of the written APP/SSHP onsite. Changes and modifications to must be made with the knowledge and concurrence of the Safety and Health Manager, the Site Superintendent, and the COR. Bring to the attention of the Safety and Health Manager, the Site Superintendent, and the COR any unforeseen hazard that becomes evident during the performance of the work, through the Site Safety and Health Officer (SSHO) for resolution as soon as possible. In the interim, take necessary action to re-establish and maintain safe working conditions in order to safeguard onsite personnel, visitors, the public, and the environment. Disregard for the provisions of this specification or the accepted APP/SSHP will be cause for stopping work until the matter has been rectified.

1.7.2 Availability

Make available the APP/SSHP in accordance with 29 CFR 1910.120, (b)(1)(v) and 29 CFR 1926.65, (b)(1)(v).

1.8 SITE DESCRIPTION AND CONTAMINATION CHARACTERIZATION

1.8.1 Project/Site Conditions

Refer to the following reports and information for the site description and contamination characterization. Contact the COR for the location of the reports and other documents.

1.8.1.1 CERCLA Documents

See drawings for list of documents.

1.8.1.2 RCRA Documents

See drawings for list of documents.

1.8.1.3 UST Documents

See drawings for list of documents.

1.8.2 Ordnance and Explosives (OE)

Stop work and contact the COR (CO) if ordnance and explosives (OE), explosive media or chemical agent contaminated media (CACM) are discovered during hazardous waste site cleanup activities. Proceed with work after the CO gives permission and, according to ER 385-1-95 requirements.

1.9 TASK SPECIFIC HAZARDS, INITIAL PPE, HAZWOPER MEDICAL SURVEILLANCE AND TRAINING APPLICABILITY

Task specific occupational hazards, task specific HAZWOPER medical surveillance and training applicability and task specific initial PPE requirements for the project are listed on the Task Hazard and Control Sheets at the end of this section. It is the Contractor's responsibility to reevaluate occupational safety and health hazards as the work progresses and to adjust the PPE and onsite operations, if necessary, so that the work is performed safely and in compliance with occupational safety and health regulations.

1.10 STAFF ORGANIZATION, QUALIFICATION AND RESPONSIBILITIES

1.10.1 Safety and Health Manager

Safety and Health Manager must be an Industrial Hygienist certified by the American Board of Industrial Hygiene.

1.10.1.1 Additional Qualifications

The Safety and Health Manager must have the following additional qualifications:

a. A minimum of 3 years experience in developing and implementing safety and health programs at hazardous waste sites, in the hazardous waste disposal industry, in the chemical industry, in the petroleum

processing industry and/or at underground storage tank removal projects.

b. Documented experience in supervising professional and technician level personnel.

c. Documented experience in developing worker exposure assessment programs and air monitoring programs and techniques.

d. Documented experience in managing personal protective equipment programs and conducting PPE hazard evaluations for the types of activities and hazards likely to be encountered on the project.

e. Working knowledge of state and Federal occupational safety and health regulations.

1.10.1.2 Responsibilities and Duties

The Safety and Health Manager shall:

a. Be responsible for the development, implementation, oversight, and enforcement of the APP/SSHP.

b. Sign and date the APP/SSHP prior to submittal.

c. Conduct initial site-specific training.

d. Be present onsite during the first 3 days of remedial activities and at the startup of each new major phase of work.

e. Visit the site as needed and at least once per week for the duration of activities, to audit the effectiveness of the APP/SSHP.

f. Be available for emergencies.

g. Provide onsite consultation as needed to ensure the APP/SSHP is fully implemented.

h. Coordinate any modifications to the APP/SSHP with the Site Superintendent, the SSHO, and the COR.

i. Provide continued support for upgrading/downgrading of the level of personal protection.

j. Be responsible for evaluating air monitoring data and recommending changes to engineering controls, work practices, and PPE.

k. Review accident reports and results of daily inspections.

l. Serve as a member of the Contractor's quality control staff.

1.10.2 Additional Certified Health and Safety Support Personnel

Retain health physics support from a health physicist certified by the American Board of Health Physics to develop radiation protection requirements of the APP/SSHP and, when necessary, visit the site to help implement ionizing radiation protection requirements of the APP/SSHP.

1.10.3 Site Safety and Health Officer

Designate an individual and one alternate as the Site Safety and Health Officer (SSHO). The name, qualifications (education and training summary and documentation), and include work experience of the Site Safety and Health Officer and alternate in the APP/SSHP.

1.10.3.1 Qualifications

The SSHO shall meet the following qualifications:

a. A minimum of 2 years experience in implementing safety and health programs at hazardous waste sites, in the hazardous waste disposal industry, at underground storage tank removal projects, and/or in the chemical or petroleum processing industry, and/or radioactive waste cleanup projects where Level B personal protective equipment was required.

b. Documented experience in construction techniques and construction safety procedures.

c. Working knowledge of Federal and state occupational safety and health regulations.

d. Specific training in personal and respiratory protective equipment, confined space entry and in the proper use of air monitoring instruments and air sampling methods including monitoring for ionizing radiation.

1.10.3.2 Responsibilities and Duties

The Site Safety and Health Officer shall:

a. Assist and represent the Safety and Health Manager in onsite training and the day to day onsite implementation and enforcement of the accepted APP/SSHP.

b. Be assigned to the site on a full time basis for the duration of field activities. The SSHO can have collateral duties in addition to Safety and Health related duties. If operations are performed during more than 1 work shift per day, a site Safety and Health Officer must be present for each shift and when applicable, act as the radiation safety officer (RSO) as defined in paragraph 06.E.02 of EM 385-1-1 on radioactive waste cleanup projects.

c. Have authority to ensure site compliance with specified safety and health requirements, Federal, state and OSHA regulations and all aspects of the APP/SSHP including, but not limited to, activity hazard analyses, air monitoring, monitoring for ionizing radiation, use of PPE, decontamination, site control, standard operating procedures used to minimize hazards, safe use of engineering controls, the emergency response plan, confined space entry procedures, spill containment program, and preparation of records by performing a daily safety and health inspection and documenting results on the Daily Safety Inspection Log in accordance with 29 CFR 1904.

d. Have authority to stop work if unacceptable health or safety conditions exist, and take necessary action to re-establish and maintain safe working conditions.

e. Consult with and coordinate any modifications to the APP/SSHP with the Safety and Health Manager, the Site Superintendent, and the COR.

f. Serve as a member of the Contractor's quality control staff on matters relating to safety and health.

g. Conduct accident investigations and prepare accident reports.

h. Conduct daily safety inspection and document safety and health findings into the Daily Safety Inspection Log. Track noted safety and health deficiencies to ensure that they are corrected.

i. In coordination with site management and the Safety and Health Manager, recommend corrective actions for identified deficiencies and oversee the corrective actions.

1.10.4 Occupational Physician

Utilize the services of a licensed physician, who is certified in occupational medicine by the American Board of Preventative Medicine, or who, by necessary training and experience is Board eligible. The physician must be familiar with this site's hazards and the scope of this project. Include the medical consultant's name, qualifications, and knowledge of the site's conditions and proposed activities in the APP/SSHP. The physician will be responsible for the determination of medical surveillance protocols and for review of examination/test results performed in compliance with 29 CFR 1910.120, (f) and 29 CFR 1926.65, (f) and paragraph MEDICAL SURVEILLANCE.

1.10.5 Persons Certified in First Aid and CPR

At least two persons who are currently certified in first aid and CPR by the American Red Cross or other approved agency must be onsite at all times during site operations. They must be trained in universal precautions and the use of PPE as described in the Bloodborne Pathogens Standard of 29 CFR 1910, Section .1030. These persons may perform other duties but will be immediately available to render first aid when needed.

1.10.6 Safety and Health Technicians

For each work crew in the exclusion zone, one person, designated as a Safety and Health technician, must perform activities such as air monitoring, decontamination, and safety oversight on behalf of the SSHO. They must have appropriate training equivalent to the SSHO in each specific area for which they have responsibility and report to and be under the supervision of the SSHO.

1.11 TRAINING

Meet the following requirements in the Contractor's training program for workers performing cleanup operations and who will be exposed to contaminants.

1.11.1 General Hazardous Waste Operations Training

All Personnel performing duties with potential for exposure to onsite contaminants must meet and maintain the following 29 CFR 1910.120/ 29 CFR 1926.65 (e) training requirements:

a. 40 hours of off site hazardous waste instruction.

b. 3 days actual field experience under the direct supervision of a trained, experienced supervisor.

c. 8 hours refresher training annually.

Onsite supervisors must have an additional 8 hours management and supervisor training specified in 29 CFR 1910.120/29 CFR 1926.65 (e) (4).

1.11.2 Pre-entry Briefing

Prior to commencement of onsite field activities, all site employees, including those assigned only to the Support Zone, must attend a site-specific safety and health training session. This session will be conducted by the Safety and Health Manager and the Site Safety and Health Officer to ensure that all personnel are familiar with requirements and responsibilities for maintaining a safe and healthful work environment. Thoroughly discuss procedures and contents of the accepted APP/SSHP and Sections 01.B.02 and 28.D.03 of EM 385-1-1. Each employee must sign a training log to acknowledge attendance and understanding of the training. Notify the COR at least 5 days prior to the initial site-specific training session so government personnel involved in the project may attend.

1.11.3 Periodic Sessions

Conduct periodic onsite training by the SSHO at least weekly for personnel assigned to work at the site during the following week. Address safety and health procedures, work practices, any changes in the APP/SSHP, activity hazard analyses, work tasks, or schedule; results of previous week's air monitoring, review of safety discrepancies and accidents. Convene a meeting prior to implementation of the change must be convened should an operational change affecting onsite field work be made, to explain safety and health procedures. Conduct a site-specific training sessions for new personnel, visitors, and suppliers by the SSHO using the training curriculum outlines developed by the Safety and Health Manager. Each employee must sign a training log to acknowledge attendance and understanding of the training.

1.11.4 Other Training

Site specific training for sites where radioactive wastes are to be cleaned up include:

a. Site specific procedures for handling and storing radioactive materials;

b. Health and safety hazards associated with exposure to the radioactive material that will be cleaned up or otherwise handled and the purpose and function of protective devices and precautions used to minimize exposures;

c. Elements of the APP/SSHP and company specific procedures intended to provide protection from radiation exposure;

d. Worker responsibility to report any unsafe acts which might result in exposure to ionizing radiation;

e. Appropriate worker response procedures to events that may result in

worker exposure to ionizing radiation;

f. Worker rights and responsibilities with respect to ionizing radiation exposure. Provide training as specified by 29 CFR 1910 Section .146, by the Safety and Health Manager shall for employees who are required to supervise, standby, or enter permit-required confined spaces. Train in accordance with 49 CFR 172 Subpart, Persons involved in any aspect of the transportation of hazardous materials.

1.12 PERSONAL PROTECTIVE EQUIPMENT

1.12.1 Site Specific PPE Program

Provide onsite personnel exposed to contaminants with appropriate personal protective equipment. Components of levels of protection (B, C, D and modifications) must be relevant to site-specific conditions, including heat and cold stress potential and safety hazards. Use only respirators approved by NIOSH. Keep protective equipment and clothing clean and well maintained. Include site-specific procedures to determine PPE program effectiveness and for onsite fit-testing of respirators, cleaning, maintenance, inspection, and storage of PPE within the PPE section of the APP/SSHP.

1.12.2 Levels of Protection

The Safety and Health Manager must establish and evaluate as the work progresses the levels of protection for each work activity. Also establish action levels for upgrade or downgrade in levels of PPE. Describe in the SSHP the protocols and the communication network for changing the level of protection. Address air monitoring results, potential for exposure, changes in site conditions, work phases, job tasks, weather, temperature extremes, individual medical considerations, etc. within the PPE evaluation protocol.

1.12.2.1 Initial PPE Components

The following items constitute initial minimum protective clothing and equipment ensembles.

a. Level D. Work shirt, safety boots, safety glasses, hard hat, and no respiratory protection required. Dust mask may be optional.

b. Modified Level D. Same as level D for respirator but increase to level C for skin protection.

c. Level C. Full-face or half-face air purifying respirator (NIOSH approved) with appropriate cartridges, hooded chemical-resistant clothing such as tyvek, inner and outer chemical resistant gloves, and steel shank chemical resistant boots.

d. Level B. Level C skin protection plus positive-pressure, full-face self-contained breathing apparatus or positive-pressure supplied air respirator with escape self-contained breathing apparatus (SCBA).

1.12.3 PPE for Government Personnel

Three clean sets of personal protective equipment and personal dosimeters for work on radioactive waste cleanup sites and clothing (excluding air-purifying negative-pressure respirators and safety shoes, which will be

provided by individual visitors), as required for entry into the Exclusion Zone and/or Contamination Reduction Zone, must be available for use by the COR or official visitors. The items must be cleaned and maintained by the Contractor and stored in the clean room of the decontamination facility and clearly marked: "FOR USE BY GOVERNMENT ONLY." Provide basic training in the use and limitations of the PPE provided.

1.13 MEDICAL SURVEILLANCE PROGRAM

Meet 29 CFR 1910.120/29 CFR 1926.65 (f) and the following requirements for medical surveillance program for workers performing cleanup operations and who will be exposed to contaminants. Assure the Occupational Physician or the physician's designee performs the physical examinations and reviews examination results. Participation in the medical surveillance program will be without cost to the employee, without loss of pay and at a reasonable time and place.

1.13.1 Frequency of Examinations

Medical surveillance program participants must receive medical examinations and consultations on the following schedule:

a. Every 12 months

b. If and when the participant develops signs and symptoms indicating a possible overexposure due to an uncontrolled release of a hazardous substance on the project.

c. Upon termination or reassignment to a job where medical surveillance program participation is not required, unless his/her previous annual examination/consultation was less than 6 months prior to reassignment or termination.

d. On a schedule specified by the occupational physician.

1.13.2 Content of Physical Examinations/Consultation

Verify the following information about medical surveillance program participants:

a. Baseline health conditions and exposure history.

b. Allergies/sensitivity/susceptibility to hazardous substances exposure.

c. Ability to wear personal protective equipment inclusive of NIOSH certified respirators under extreme temperature conditions.

d. Fitness to perform assigned duties.

Provide the occupational physician with the following information for each medical surveillance program participant:

a. Information on the employee's anticipated or measured exposure.

b. A description of any PPE used or to be used.

c. A description of the employee's duties as they relate to the employee's exposures (including physical demands on the employee and heat/cold stress).

d. A copy of 29 CFR 1910.120, or 29 CFR 1926.65.

e. Information from previous examinations not readily available to the examining physician.

f. A copy of Section 5.0 of NIOSH 85-115.

g. Information required by 29 CFR 1910 Section .134.

1.13.3 Physician's Written Opinion

Obtain and furnish to the Safety and Health Manager; and the employee before work begins, a copy of the physician's written opinion for each employee. Address the employee's ability to perform hazardous waste site remediation work and containing the following:

a. The physician's verification of the employee's fitness to perform duties as well as recommended limitations upon the employee's assigned work and/or PPE usage.

b. The physician's opinion about increased risk to the employee's health resulting from work; and

c. A statement that the employee has been informed and advised about the results of the examination.

1.13.4 Employee Certificates

Provided on employee certificates for each worker performing cleanup operations with potential for contaminant-related occupational exposure signed by the safety and health manager and the occupational physician indicating the workers meet the training and medical surveillance requirements of this contract.

1.13.5 Site Specific Medical Surveillance

Prior to onsite work, medical surveillance program participants must undergo medical testing. Provide an explanation of the site specific medical surveillance testing in the APP/SSHP.

1.14 EXPOSURE MONITORING/AIR SAMPLING PROGRAM

Prepare and implement by the Safety and Health Manager an exposure monitoring/air sampling program to identify and quantify safety and health hazards and airborne levels of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment for affected site personnel. Include action levels for upgrading/downgrading PPE in the program. Monitor for the following gasses and vapors as provided on the project drawings. Monitor for the following aerosolized contaminants.

1.14.1 Ionizing Radiation Sampling and Dosimetry

1.14.1.1 Air Sampling and Dosimetry

Use instrument sampling methods and dosimeters to evaluate occupational exposure to radioactive isotopes and ionizing radiation fields.

1.14.1.2 Evaluation

Radiation dosimetry must be evaluated by an individual or company holding current personnel dosimetry accreditation from the National Voluntary Laboratory Accreditation Program (NVLAP). Electronic dosimetry may be used to assign external dose if approved by the COR.

1.14.1.3 Documentation

Document employee exposure to external radiation. Include reviewing each employee's radiation exposure history in accordance with 10 CFR 20 Section .2104, for compliance with exposure standards prior to allowing the employee access to a restricted area. If the employee has no exposure history, the employee must provide a signed written statement to that effect.

1.14.1.4 Reporting

Furnish reports of exposure to ionizing radiation to the COR as soon as available and to each employee annually, upon termination, and within 30 days of any personal request.

1.15 HEAT STRESS MONITORING AND MANAGEMENT

Document in the APP/SSHP and implement the procedures and practices in section 06.J. in EM 385-1-1 to monitor and manage heat stress.

1.16 SPILL AND DISCHARGE CONTROL

Develop and implement written spill and discharge containment/control procedures. Address radioactive wastes, shock sensitive wastes, laboratory waste packs, material handling equipment, as well as drum and container handling, opening, sampling, shipping and transport. Describe prevention measures, such as building berms or dikes; spill control measures and material to be used (e.g. booms, vermiculite); location of the spill control material; personal protective equipment required to cleanup spills; disposal of contaminated material; and who is responsible to report the spill. Storage of contaminated material or hazardous materials must be appropriately bermed, diked and/or contained to prevent any spillage of material on uncontaminated soil. If the spill or discharge is reportable, and/or human health or the environment are threatened, the National Response Center, the state, and the COR must be notified as soon as possible. Reporting requirements will be provided through the COR.

1.17 MATERIALS TRANSFER SAFETY

Remove liquids and residues from the tanks using explosion-proof or air-driven pumps. Bond to the tank and ground pump motors and suction hoses to prevent electrostatic ignition hazards. Use of a hand pump will be permitted to remove the last of the liquid from the bottom of the tanks. If a vacuum truck is used for removal of liquids or residues, the area of operation for the vacuum truck must be vapor free. locate the truck upwind from the tank and outside the path of probable vapor travel. Discharge the vacuum pump exhaust gases through a hose of adequate size and length downwind of the truck and tank area. Vacuum truck operating and safety practices must conform to API RP 2219. Collect tank residues in drums, tanks, or tank trucks labeled according to 49 CFR 171 and 49 CFR 172 and disposed of as specified. Disconnect and drain fittings and lines of their contents after the materials have been transferred and the tanks have been exposed. Do not spill contents into the environment during cutting or

disconnecting of tank fittings. Transfer materials drained into DOT-approved drums for storage and/or transportation. Only non-sparking or non-heat producing tools shall be used to disconnect and drain or to cut through tank fittings. Electrical equipment (e.g., pumps, portable hand tools, etc.) used for tank preparation must be explosion-proof. Following cutting or disconnecting of the fittings, plug openings leading to the tanks.

1.18 DRUM AND CONTAINER HANDLING

Procedures and Precautions will be provided through the COR.

1.19 HOT WORK

Hot work will not be permitted on or within the tanks or anywhere else not previously specified as a hot work area, except as outlined herein. Prior to conducting hot work, a hot work permit must be prepared by the person to be conducting the hot work and reviewed and signed off by the Contractor's qualified person. An additional hot work permit may need to be obtained from local authorities or in the case of military or other federal installations, the fire marshal. An example format for a hot work permit must be included in the AAPP/SSHP. Describe compliance with the following procedures. After tank interiors have been decontaminated, hot work may be conducted only when the tank is inerted, and to the extent necessary to begin dismantling the tanks. After decontamination of tank interiors, hot work must not be performed unless monitoring indicates atmospheres within and immediately surrounding the tanks are less than 8% oxygen inside the tank and less than 10% of the LFL outside the tank; continuous monitoring must continue until the hot work is completed. The hot work prohibition includes welding, cutting, grinding, sawing, or other similar operations which could be expected to potentially generate combustion-producing temperatures or sparks, or which could produce potentially hazardous fumes or vapors. Designate an individual at each hot work site as a fire watch. This person's sole responsibility is to monitor the hot work and have immediate access to the fire extinguisher located at each hot work site. A new permit must be obtained at the start of each work shift during which hot work will be conducted.

1.20 WASTE DISPOSAL

Waste disposal will be coordinated through the COR.

1.21 TANK PURGING FOR PERMIT-REQUIRED CONFINED SPACE ENTRIES

Purge tanks for confined space entry. Reduce the flammable vapors to less than 10% of the LFL and the oxygen content be between 19.5% and 23.5%. Do not attempt confined space entry into the tanks unless absolutely necessary, as for example, to remove sludge from the tank. Flammable vapors may be exhausted from the tank by any of the methods from API RP 1604 listed below, or any method approved by the COR. Specify the purging method to be used within the APP/SSHP.

a. Ventilation by Eductor-Type Air Movers: Properly bond and ground the eductor-type air mover to prevent the generation and discharge of static electricity. When using this method, the fill (drop) tube must remain in place to ensure ventilation at the bottom of the tank. Tanks equipped with fill (drop) tubes that are not removable must be purged by this method. Use an eductor extension to discharge vapors a minimum of 12 feet above grade or 3 feet above adjacent roof lines, whichever

is greater. If this is not possible, propose and get approved alternative methods prior to purging. Noise levels generated by these devices as a result of high airflow may exceed OSHA PELs. Evaluate noise levels and provide appropriate hearing protection.

b. Ventilation by Diffused Air Blowers: When using this purging method, the air-diffusing pipe is properly bonded and grounded to prevent the discharge of a spark. Fill (drop) tubes must be removed to allow proper diffusion of the air in the tank. Air supply must be from a compressor that has been checked to ensure that Grade D breathing air is being supplied. Air pressure in the tank must not exceed 5 psi gauge to avoid tank failure.

c. Commercial Emulsifiers and Volatile Fuel Encapsulators: These products are completely miscible in water, aid in the elimination of flammable vapors, and are biodegradable. Determine prior to using this method, regulatory requirements for treatment and disposal of the water. Standing outside the tank, rinse the tank with a 3-to-6 percent solution of the product using a pressure sprayer through a tank opening. Measure explosive concentrations at several levels (top, middle, and bottom) within the tank. If readings are greater than 10% of the LFL, rinse the tank again. When LFL readings are acceptable, pump the water in the tank for disposal.

1.22 TANK INERTING (NO ENTRY)

Following the removal of tank contents but prior to removal of the tank(s) and tank preparation activities, inert the tank(s) only by introducing an inert gas, carbon dioxide (CO_2) or liquid nitrogen (N_2), to remove flammable vapors. Before inerting, plug all openings in the tanks with threaded or expansion type plugs except the vent tube and the opening to be used for introducing the inert gas. Within 30 minutes prior to initiating any activities (e.g., excavating, preparation, removal, opening, demolition, transportation, or other similar activities) involving a tank which has been inerted, the inerted nature of the tank (oxygen levels less than 8%) must be verified.

a. Do not use CO_2 fire extinguishers for inerting the tank interiors. If a compressed gas (e.g., CO_2 or N_2) is introduced into the tank the following requirements must be met to prevent the buildup of static electricity:

   1. Bond together and ground the UST and the compressed gas supply tank.

   2. Supply the compressed gas only at low flows.

   3. Release the liquid or gas at the tank bottom so that static electricity is not generated by liquid falling to the bottom of the tank. Slowly fill the tank from the bottom up.

b. If used, introduce dry ice, which evolves CO_2 gas as it evaporates, in the amount of at least 3 lbs per 100 gallons of tank capacity. Prevent skin contact with dry ice by wearing heavy cloth gloves.

c. Introduce sufficient quantities of inert gas (CO_2 or N_2) into the tanks to lower the oxygen content to less than 8%. Do not exceed 5 psi pressure inside the tank. Prior to proceeding with additional activities on the tank (e.g., excavating), the oxygen content of the

tanks must be monitored to confirm that it is less than 8%. Conduct additional oxygen level monitoring at least hourly while activities involving the tanks are underway but prior to decontamination of tank interiors; at least daily during periods in which the tanks are not being disturbed but prior to decontamination of their interiors; or as directed by the COR. If monitoring of tank interiors indicates that oxygen levels are not remaining below 8%, introduce additional inert gas and initiate more frequent oxygen monitoring.

d. During inerting procedures, use an extension vent tube a minimum of 12 feet above grade or 3 feet above any adjacent (within 75 feet) roof lines, whichever is greater to discharge tank vapors. If this is not possible, propose and get approved alternative methods prior to inerting. Continuous combustible gas/oxygen monitoring shall be conducted at the vent and inert gas introduction holes.

1.23 TANK ATMOSPHERE TESTING

Monitor the air within the storage tanks to ensure the space is either adequately purged and safe for personnel entry, or to ensure the tank has been adequately inerted and the oxygen content is less than 8%. In both instances, perform monitoring at the top, bottom, and middle areas of the tanks to ensure stratification has not occurred. Report monitoring results to project personnel to ensure safe operations. Record data as specified in paragraph EXPOSURE MONITORING/AIR SAMPLING PROGRAM.

1.23.1 Monitoring to Ensure Purging

When monitoring to ensure purging, both oxygen content and LFL readings are required. Prior to obtaining LFL readings, monitor the oxygen content of the space and verify that the combustible gas indicators are operating within the oxygen limits identified by the CGI manufacturer. Do not permit personnel to enter spaces with oxygen levels are less than 19.5%, except in emergencies, and then only when equipped with the proper PPE and when following permit-required confined space entry procedures. Monitor toxic air contaminants as specified in paragraph EXPOSURE MONITORING/AIR SAMPLING PROGRAM.

1.23.2 Monitoring to Ensure Inerting

Monitor inerted tanks to ensure oxygen readings remain below a maximum allowable percentage of 8% by volume.

1.24 TANK LIFTING

Lift tanks using equipment with a rated capacity greater than the load to be lifted. Lift tanks by lifting eyes or by straps under the ends of the tanks. Do not lift by the manhole flange or by removing the bungs. Direct personnel to remain away from the ends of the tanks and position tanks , whenever possible, with the ends oriented away from occupied or traveled areas, due to potential for rupture. During transportation, secure the tanks to prevent movement.

1.25 TANK DISPOSAL

Excavated tanks will be transported directly to a state-certified tank destruction facility. Tanks are generally treated as hazardous waste and require a hazardous waste manifest. All hazardous waste manifests must be submitted to the COR for signature and date from authorized Government

official. Exceptions to all demolition on-site must be obtained from the COR in consultation with the Environmental Management Division and local regulatory agencies. If demolition is allowed, demolition will not be permitted until a decontamination of the interiors and exteriors is complete. Demolition must involve opening the tanks sufficiently to permanently prohibit further use as containers of liquids. Tanks must be inerted and tested before they are opened. Submit plans and procedures in the APP/SSHP, including a list of materials and supplies, for safely and effectively demolishing the tanks.

1.26 TANK CLEANING

Conform to API Std 2015 for safety practices and procedures for the cleaning of the storage tanks. Conduct opening of the tanks to permit decontamination utilizing only methods approved in the APP/SSHP. Decontaminate the interior and exterior of the tank prior to removing it from the work site unless the tank is being transported directly to a state-certified tank destruction facility. Submit plans and procedures in the SSHP, including materials and supplies, for safely and effectively opening the tanks, cleaning surfaces of the interior and exterior of the tanks, and disposing of the decontamination fluids. Volatile organic solvents are not permitted to be utilized for decontamination procedures. Personnel must not enter any of the storage tanks as a part of this project, except when following permit-required confined space entry procedures. Collect and dispose of decontamination fluids. Upon completion of this project, written certification must be made that the tank was properly decontaminated prior to being removed from the site.

1.27 SITE CONTROL MEASURES

1.27.1 Work Zones

Initial anticipated work zone boundaries (exclusion zone, contamination reduction zone, support zone, all access points and decontamination areas) are to be clearly delineated on the site drawings. Base delineation of work zone boundaries on the contamination characterization data and the hazard/risk analysis to be performed as described in paragraph: HAZARD/RISK ANALYSIS. As work progresses and field conditions are monitored, work zone boundaries may be modified (and site drawings modified) with approval of the COR. Clearly identify work zones with appropriate marking in the field (using fences, tape, signs, etc.). Submit and post a site map, showing work zone boundaries and locations of decontamination facilities in the onsite office. Work zones must consist of the following:

a. Exclusion Zone (EZ): The exclusion zone is the area where hazardous contamination is either known or expected to occur and the greatest potential for exposure exists. Control entry into this area and exit may only be made through the CRZ.

b. Contamination Reduction Zone (CRZ): The CRZ is the transition area between the Exclusion Zone and the Support Zone. The personnel and equipment decontamination areas must be separate and unique areas located in the CRZ.

c. Support Zone (SZ): The Support Zone is defined as areas of the site, other than exclusion zones and contamination reduction zones, where workers do not have the potential to be exposed to hazardous substances or dangerous conditions resulting from hazardous waste operations. Secure the Support Zone against active or passive contamination. Site

offices, parking areas, and other support facilities must be located in the Support Zone.

1.27.2 Site Control Log

A log of personnel visiting, entering, or working on the site must be maintained. Include the following: date, name, agency or company, time entering and exiting site, time entering and exiting the exclusion zone (if applicable). Before visitors are allowed to enter the Contamination Reduction Zone or Exclusion Zone, they must show proof of current training, medical surveillance and respirator fit testing (if respirators are required for the tasks to be performed) and fill out a Certificate of Worker or Visitor Acknowledgment. Record this visitor information, including date, in the log.

1.27.3 Communication

Provide and install an employee alarm system that has adequate means of on and off site communication in accordance with 29 CFR 1910 Section .165. The means of communication must be able to be perceived above ambient noise or light levels by employees in the affected portions of the workplace. The signals must be distinctive and recognizable as messages to evacuate or to perform critical operations.

1.27.4 Site Security

Provide the following site security: controlled and manned entry points, locked gates during non-work hours, and appropriate signs. Print signs in bold large letters on contrasting backgrounds. Signs must be visible from all points where entry might occur and at such distances from the restricted area that employees may read the signs and take necessary protective steps before entering.

1.28 PERSONAL HYGIENE AND DECONTAMINATION

Personnel entering the Exclusion or Contamination Reduction Zones or otherwise exposed to hazardous chemical vapors, gases, liquids, or contaminated solids must decontaminate themselves and their equipment prior to exiting the contamination reduction zone (CRZ) and entering the support zone. Consult Chapter 10.0 of NIOSH 85-115 when preparing decontamination procedures. Submit a detailed discussion of personal hygiene and decontamination facilities and procedures to be followed by site workers as part of the APP/SSHP. Train employees in the procedures and enforce the procedures throughout site operations.

1.28.1 Decontamination Facilities

Initially set up a decontamination line in the CRZ. Employees must exit the exclusion zone through the CRZ and implement the following decontamination procedures and techniques: Scrub and rinse water proof outer garments, remove all outer garments, hand and face wash, shower. Showers, if needed, must comply with 29 CFR 1910, Section.141 and EM 385-1-1, 02 C, Washing Facilities. Additional decontamination procedures Contractor personnel are to follow will be provided on the drawings. It is the Site Safety and Health Officer's responsibility to recommend techniques to improve personnel decontamination procedures, if necessary.

1.28.2 Equipment Decontamination

The vehicles and equipment used in the EZ shall be decontaminated in the CRZ prior to leaving the site.

1.28.2.1 Facilities for Equipment and Personnel

Provide a vehicle/equipment decontamination station within the CRZ for decontaminating vehicles and equipment leaving the EZ. The Contractor will provide the procedures and details for the vehicle/equipment decontamination facility to the COR.

1.28.2.2 Procedures

Procedures for equipment decontamination must be developed and utilized to prevent the spread of contamination into the SZ and offsite areas. These procedures must address disposal of contaminated products and spent materials used on the site, including containers, fluids, oils, etc. Assume any item taken into the EZ to be contaminated and perform an inspection and decontaminate. Vehicles, equipment, and materials must be cleaned and decontaminated prior to leaving the site. Handle construction material in such a way as to minimize the potential for contaminants being spread and/or carried offsite. Prior to exiting the site, vehicles and equipment must be monitored to ensure the adequacy of decontamination.

1.29 EMERGENCY EQUIPMENT AND FIRST AID REQUIREMENTS

Maintain, as a minimum, the following items onsite and available for immediate use:

a. First aid equipment and supplies approved by the consulting physician.

b. Emergency eyewashes and showers that comply with ANSI/ISEA Z358.1.

c. Emergency-use respirators. For escape purposes, supply 5- to 15-minute emergency escape masks. For rescue purposes, Supply 2 positive pressure self-contained breathing apparatus (SCBA). Dedicate these for emergency use only and are to be maintained onsite in the Contamination Reduction Zone.

d. Provide fire extinguishers of sufficient size and type at site facilities and in all vehicles and at any other site locations where flammable or combustible materials present a fire risk.

1.30 EMERGENCY RESPONSE AND CONTINGENCY PROCEDURES

An Emergency Response Plan, that meets the requirements of 29 CFR 1910.120 (l) and 29 CFR 1926.65 (l), must be developed and implemented as a section of the APP/SSHP. In the event of any emergency associated with remedial action, without delay, alert all onsite employees and as necessary offsite emergency responders that there is an emergency situation; take action to remove or otherwise minimize the cause of the emergency; alert the COR; and institute measures necessary to prevent repetition of the conditions or actions leading to, or resulting in, the emergency. Train employees that are required to respond to hazardous emergency situations to their level of responsibility according to 29 CFR 1910.120 (q) and 29 CFR 1926.65 (q) requirements. Rehearse the plan regularly as part of the overall training program for site operations. Review the plan periodically and revised as necessary to reflect new or changing site conditions or information.

Provide copies of the Emergency Response Portion of the accepted APP/SSHP to the affected local emergency response agencies. Address, as a minimum, the following elements in the plan:

a. Pre-emergency planning. Coordinate with local emergency response providers during preparation of the Emergency Response Plan. At a minimum, coordinate with local fire, rescue, hazardous materials response teams, police and emergency medical providers to assure all organizations are capable and willing to respond to and provide services for on-site emergencies. Ensure the Emergency Response Plan for the site is compatible and integrated with the local fire, rescue, medical and police security services available from local emergency response planning agencies.

b. Personnel roles, lines of authority, communications for emergencies.

c. Emergency recognition and prevention.

d. Site topography, layout, and prevailing weather conditions.

e. Criteria and procedures for site evacuation (emergency alerting procedures, employee alarm system, emergency PPE and equipment, safe distances, places of refuge, evacuation routes, site security and control).

f. Specific procedures for decontamination and medical treatment of injured personnel.

g. Route maps to nearest prenotified medical facility. Site-support vehicles must be equipped with maps. At the beginning of project operations, drivers of the support vehicles must become familiar with the emergency route and the travel time required.

h. Emergency alerting and response procedures including posted instructions and a list of names and telephone numbers of emergency contacts (physician, nearby medical facility, fire and police departments, ambulance service, Federal, state, and local environmental agencies; as well as Safety and Health Manager, the Site Superintendent, the COR and/or their alternates).

i. Criteria for initiating community alert program, contacts, and responsibilities.

j. Procedures for reporting incidents to appropriate government agencies. In the event that an incident such as an explosion or fire, or a spill or release of toxic materials occurs during the course of the project, the appropriate government agencies must be immediately notified. In addition, verbally notify the COR and the local district safety office immediately and receive a written notification within 24 hours. Include within the report the following items:

    1. Name, organization, telephone number, and location of the Contractor.

    2. Name and title of the person(s) reporting.

    3. Date and time of the incident.

    4. Location of the incident, i.e., site location, facility name.

5. Brief summary of the incident giving pertinent details including type of operation ongoing at the time of the incident.

6. Cause of the incident, if known.

7. Casualties (fatalities, disabling injuries).

8. Details of any existing chemical hazard or contamination.

9. Estimated property damage, if applicable.

10. Nature of damage, effect on contract schedule.

11. Action taken to ensure safety and security.

12. Other damage or injuries sustained, public or private.

k. Procedures for critique of emergency responses and follow-up.

1.31 CERTIFICATE OF WORKER/VISITOR ACKNOWLEDGEMENT

A copy of a Contractor-generated certificate of worker/visitor acknowledgement must be completed and submitted for each visitor allowed to enter contamination reduction or exclusion zones, and for each employee, following the example certificate at the end of this section.

1.32 INSPECTIONS

Attach to and submit with the Daily Quality Control reports the SSHO's Daily Inspection Logs. Include with each entry the following: date, work area checked, employees present in work area, PPE and work equipment being used in each area, special safety and health issues and notes, and signature of preparer.

1.33 SAFETY AND HEALTH PHASE-OUT REPORT

Submit a Safety and Health Phase-Out Report in conjunction with the project close out report and will be received prior to final acceptance of the work. Include the following minimum information:

a. Summary of the overall performance of safety and health (accidents or incidents including near misses, unusual events, lessons learned, etc.).

b. Final decontamination documentation including procedures and techniques used to decontaminate equipment, vehicles, and on site facilities.

c. Summary of exposure monitoring and air sampling accomplished during the project.

d. Signatures of Safety and Health Manager and SSHO.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

Task Hazard and Control Requirements Sheet	
Task	
Initial Anticipated Hazards	
Initial PPE	
Initial Controls	
Initial Exposure Monitoring	
Yes or No	HAZWOPER Medical Surveillance Required
Yes or No	HAZWOPER Training Required

-- End of Section --

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ENVIRONMENTAL MANAGEMENT

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for responsibilities and requirements regarding environmental management.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z400.1/Z129.1	Hazardous Industrial Chemicals - Material Safety Data Sheets - Preparation

ASTM INTERNATIONAL (ASTM)

ASTM D 4840	Sampling Chain-Of-Custody Procedures
ASTM D 5663	Validating Recycled Content in Packaging Paper and Paperboard
ASTM E 1991	Environmental Life Cycle Assessment of Building Materials/Products
ASTM E 2114	Standard Terminology for Sustainability Relative to the Performance of Buildings
ASTM E 2129	Standard Practices for Data Collection for Sustainability Assessment of Building Products
ASTM E 2432	Standard Guide for General Principles of Sustainability Relative to Buildings

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 14040	Environmental Management - Life Cycle Assessment - Principles and Framework

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

APR 8553.1	Ames Environmental Management System

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST BEES 4.0	Building for Environmental and Economic Sustainability

U.S. DEPARTMENT OF AGRICULTURE (USDA)

Biomass R&D Act	Biomass Research and Development Act, as amended by 39001 of the Food Conservation and Energy Act of 2008 (2008 Farm Bill or FCEA)
U.S. Farm Bill	Farm Security and Rural Investment Act (2002 Farm Bill) U.S. Farm Bill of May 2002

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

NPDES	National Pollutant Discharge Elimination System

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR	Protection of Environment
40 CFR 261	Identification and Listing of Hazardous Waste

INTERNATIONAL CODE COUNCIL (ICC)

ICC CFC	California Fire Code

1.3 DEFINITIONS

Definitions pertaining to sustainable development are as defined in ASTM E 2114 and as specified.

a. "Biobased content" is calculated as the weight of the biobased material divided by the total weight of the product, and is expressed as a percentage by weight.

b. "Biobased materials" include fuels, chemicals, building materials, or electric power or heat produced from biomass as defined by the Biomass R&D Act. Minimum biobased content shall be as defined in the U.S. Farm Bill.

c. "Chain-of-custody" is a process whereby a product or material is maintained under the physical possession or control during its entire life cycle.

d. "Pollution and environmental damage" is caused by the presence of chemical, physical, or biological elements or agents. Human health or welfare is adversely affected; ecological balances are unfavorably altered; the utility of the environment for aesthetic, cultural, or historical purposes degrades.

e. "Hazardous material" as defined by Chapter 6.95 of the State of California Health and Safety Code, is any material that poses a significant present or potential hazard to human health and safety or

to the environment if released into the workplace or the environment. Common examples are oil, fuel, caustic and acid cleaners, mineral spirits, petroleum distillate based solvents, oil based paints, aerosol spray paints, coolants and antifreeze, and solvents/cleaners containing chlorinated compounds.

"High-GWP refrigerant" means a compound used as a heat transfer or gas that is: (a) a chlorofluorocarbon, a hydrochlorofluorocarbon, a hydrofluorocarbon, a perfluorocarbon, or any compound or blend of compounds, with a GWP (global warming potential) value equal to or greater than 150, or (b) any ozone depleting substance as defined in Title 4 of Code of Federal Regulations, Part 82, Paragraph 82.3.

f. "High-GWP refrigerant" means a compound used as a heat transfer or gas that is: (a) a chlorofluorocarbon, a hydrochlorofluorocarbon, a hydrofluorocarbon, a perfluorocarbon, or any compound or blend of compounds, with a GWP (global warming potential) value equal to or greater than 150, or (b) any ozone depleting substance as defined in Title 4 of Code of Federal Regulations, Part 82, Paragraph 82.3.

g. "Hazardous waste" as defined in California Code of Regulation Title 22, Section 66261.3. Hazardous Waste, includes extremely hazardous waste, acutely hazardous waste, RCRA hazardous waste, non-RCRA hazardous waste and special waste. Examples include waste paint, solvents, PCB transformers, contaminated soil, and oil.

h. "Non-sewerable" includes wastewater that contains at least one contaminant above the allowable discharge limit set by the Publicly Owned Treatment Works (POTWs) for discharge to the sanitary sewer.

i. "Reclamation" as defined by California Code of Regulations, Title 22, Section 66260.10, means that a material is processed to recover a usable product, or that it is regenerated. Examples are recovery of lead from spent batteries and regeneration of spent solvents.

j. "Recycle" is to take something that would otherwise be thrown away and make it into something that can be used again. Examples include fluorescent light tubes and cardboard boxes.

k. "Solid Waste" includes rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, construction, and agricultural operations, and from community activities.

l. "Sustainable" as defined in E.O. 13423, is to create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic, and other requirements of present and future generations of Americans.

1.4 PRECONSTRUCTION MEETING

After award of Contract and prior to commencement of the work, the Contractor shall schedule and conduct a meeting with the COR to discuss the proposed Environmental Protection Plan and to develop a mutual understanding relative to the details of environmental protection. The requirements for this meeting may be fulfilled during the coordination and mutual understanding meeting as specified in Section 01 45 00.00 10 01 45 00.00 20 01 45 00.00 40 QUALITY CONTROL.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Environmental Protection Plan

Instructor Qualifications

Submit reference data to demonstrate instructors' individual and firm's capabilities and experience.

For projects with a footprint greater than 1 acre:

-- Risk Assessment as defined in the Construction General Permit (CAS000002),

-- Site Map,

-- Storm Water Pollution Prevention Plan (SWPPP) prepared by Qualified SWPPP Developer, as defined in the Construction General Permit (CAS000002),

-- Post-Construction Water Balance Performance Standard Spreadsheet as specified in the Construction General Permit (CAS000002).

Request for Incidental Sewer Discharge form, at least 7 working days before commencement of discharge.

MSDSs of proposed coating and/or adhesive materials, before bringing these materials on-site.

Proposed type and quantity (in pounds) of coatings and/or adhesive materials to be used for the project. Ames tracks all coating usage in a facility wide air permit that limits the use of coatings that can be used in any consecutive 12-month period. If a project may cause Ames to exceed the permit limit, a special permit for coatings will be needed.

For projects that require installation of diesel engines (generators, water pumps, fire pumps, air compressors, etc.), provide specifications detailing engine rating (horsepower, HP), air emissions, engine EPA Tier, and other relevant data. Engines greater than 50 HP are subject to air permitting per BAAQMD Regulation 2-1-114.2.1.

For projects utilizing portable diesel engine powered equipment (diesel generators, air compressors, water pumps, etc.) with a rating of 50 HP or more, include the air permit from the BAAQMD or State registration from the California Air Resources Board (CARB). Note: diesel engine powered equipment that will be on-site for less than 72 consecutive hours does not need to include the air permit per BAAQMD Regulation 2-1-114.2.3.

For installation or retrofitting of boilers, provide specifications detailing boiler rating (units of million British thermal units per hour, MMBTU/hr), nitric oxide (NOx) and carbon monoxide (CO) air emissions, and other relevant data. Boilers rated >2 MMBTU/hr are

subject to permitting requirements per BAAQMD Regulation 2-1-114. Natural gas boilers with a rating of 10 MMBTU/hr or more need to obtain an air permit from the BAAQMD per BAAQMD Regulation 2-1-114.1. The boilers will need to go through a New Source Review and meet the requirements of BAAQMD Regulation 2, Rule 2 New Source Review. Boilers rated greater than 2 MMBTU/hr but less than 10 MMBTU/hr need to be registered with the BAAQMD per BAAQMD Regulation 9-7-404.

For projects that require the installation of abrasive blasting or sand/bead blasting equipment, include the equipment specifications detailing manufacturer and model and if the equipment has a particle collection system. Permanent abrasive blasting sources that have a confined volume of less than 100 cubic feet and are abated by a particulate filter are exempt from permitting per BAAQMD Regulation 2-1-118.1.

Hazardous Waste Disposal Subcontractors before proposed project commencement. For projects installing/modifying refrigeration systems, provide specifications detailing the refrigerant capacity of the equipment and leak detection capabilities. Refrigeration systems with a capacity or more than 50 pounds need to be registered with the State, CARB.

SD-03 Product Data

Life Cycle Assessments

Packaging

Submit documentation indicating percentage of post-industrial and post-consumer recycled content per unit of product. Indicate relative dollar value of recycled content products to total dollar value of products included in project.

SD-06 Test Reports

Field Quality Control Reports

SD-07 Certificates

Environmental Regulatory Requirements

For Government's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with environmental regulations bearing on performance of the work.

Records of wastewater discharges, including dates and quantities of water discharged, daily.

Spill Cleanup Records, as necessary.

For all projects utilizing temporary equipment with a fuel tank with fuel capacity of 10 gallons or greater:

-- Capacity of fuel tank,

-- Type of fuel tank to be used (e.g., sub-base tank, etc.),

-- Type of secondary containment (must comply with Santa Clara County Hazardous Materials Storage Ordinance),

-- Type of fill point spill protection,

-- Whether or not the system has plastic tanks (plastic tanks require additional submittal of approval of Ames Fire Marshall).

Records of solvents and coatings usage with MSDSs, upon completion of project.

-- Record type of coating/solvent use, date of use and quantity.

-- For any coatings or resins that are mixed before they are applied, record the type of components and mix ratio.

Type and quantity (in pounds) of Ozone Depleting Substances (ODS) used, recovered, disposed or otherwise handled.

Site Inspection Checklists, every week for projects handling hazardous materials.

Hazardous Waste Profiles and supporting analytical data before disposal.

SD-08 Manufacturer's Instructions

Material Safety Data Sheets

Hazardous Materials Inventories Statement (HMIS) and Material Safety Data Sheets (MSDS), at project commencement and as necessary to reflect changes in materials stored.

SD-11 Closeout Submittals

Training Program

Submit two copies of instructional program outline for demonstration and training, including a schedule of dates, times, length of instruction, instructors' names, learning objective, and teaching outline for each training module. At completion of training, submit one complete training manual for Government's use, and a list of participants with each participant's results of performance-based test for each training module. For Government's records, submit Contractor 40 CFR employee training records upon request of the COR.

Protection of Natural Resources

1.6 CONTRACTOR'S ENVIRONMENTAL MANAGER

Designate an on-site Environmental Manager responsible for overseeing the environmental goals for the project and implementing procedures for environmental protection.

1.6.1 Duties

The Environmental Manager shall be responsible for the following:

a. Compliance with applicable Federal, State, and local environmental regulations, including maintaining required documentation.

b. Implementation of the Waste Management Plan.

c. Implementation of the Indoor Air Quality (IAQ) Management Plan.

d. Implementation of the Environmental Protection Plan.

e. Environmental training for Contractor personnel in accordance with their position requirements.

f. Monitoring and documentation of environmental procedures.

1.6.2 Qualifications

Minimum 5 years construction experience on projects of similar size and scope; minimum 2 years experience with environmental procedures similar to those of this project; familiarity with Environmental Management Systems (EMSs); familiarity with environmental regulations applicable to construction operations.

1.7 ENVIRONMENTAL REGULATORY REQUIREMENTS

The Contractor shall be responsible for knowing Federal, State, and local regulatory requirements pertaining to legal disposal of all construction and demolition waste materials. Comply with all applicable regulations and maintain records of permits, licenses, certificates, and other environmental regulatory requirement correspondences. The following is a list of major laws, policies and procedures, and is subject to change.

CODE OF FEDERAL REGULATIONS (CFR)

10 CFR Part 435	Energy Conservation
14 CFR Part 1216	NASA Environmental Quality Regulations
29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR 1910.1200	Hazard Communication Training
36 CFR Part 800	National Historic Preservation Act Regulations
40 CFR 82	Protection of Stratospheric Ozone
40 CFR 112	Oil Pollution Prevention
40 CFR Chapter 1 Subchapters A, D, and N	Clean Water Act (Title 33, Chapter 26 of the USC)
40 CFR Part 122 and scattered sections	National Pollutant Discharge Elimination System (NPDES)

40 CFR 1500-1508	National Environmental Policy Act
40 CFR Part 247	Comprehensive Procurement Guidelines
40 CFR 260	Hazardous Waste Management System: General
40 CFR 265.16	Generator Training
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
43 CFR Part 10	Native American Graves Protection and Repatriation Act Regulations
43 CFR 7	Protection of Archaeological Resources Regulations
49 CFR Ch. 1 (parts 100-199)	Transportation
50 CFR Part 17	Endangered Species Act Regulations
50 CFR Part 21	Migratory Bird Treaty Act
50 CFR Part 22	Bald and Golden Eagle Protection Act
50 CFR Part 216	Marine Mammal Protection Act Regulations

CALIFORNIA CODE OF REGULATIONS (CCR)

CCR Title 13, Division 3	Motor Vehicles, Air Resources
CCR Title 14	Natural Resources
CCR Title 17, Division 3	Public Health, Air Resources
CCR Title 19	Public Safety
CCR Title 22 Section 66260, et.al.	Hazardous Waste Management
CCR Title 19, Division 1	State Fire Marshal
CCR Title 19, Division 2	Office of Emergency Services
CCR Title 19, Division 3	Seismic Safety Commission
CCR Title 19, Division 5	Earthquake Emergency and Seismic Permit Review Pane 1
CCR Title 22, Division 4.5	Environmental Health Standards for the Management of Hazardous Waste
CCR Title 23	Waters
CCR Title 24, Part 6	California's Energy Efficiency Standard
CCR Title 26	Toxics
CCR Title 27	Environmental Protection

CCR Title 22, 66265.16	Generator Training
EO 13423	Strengthening Federal Environmental, Energy, and Transportation Management
EO 13514	Federal Leadership in Environmental, Energy, and Economic Performance

UNITED STATES CODES (USC)

16 USC 469	National Historic Preservation Action Amendments of 1980
16 USC 470	National Historic Preservation Act of 1966, as amended
16 USC 470aa-470mm	Archaeological Resources Protection Act
16 USC Chapt. 31, 1361 et seq.	Marine Mammal Protection Act
16 USC 668-668d	Bald and Golden Eagle Protection Act
16 USC 703-712	Migratory Bird Treaty Act
16 USC 1531-1544	Endangered Species Act
25 USC 3001-3013	Native American Graves - Protection
33 USC 1251 et seq.	Clean Water Act
33 USC 2701 et seq.	Oil Pollution Act
42 USC 4371 et seq.	National Environmental Policy Act
42 USC 6901-6992	Resource Conservation and Recovery Act
42 USC 7401 et seq.	Clean Air Act
42 USC 8251 et seq.	National Energy Conservation Policy Act, Part B/Federal Energy Management
42 USC 9601 et seq.	Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
42 USC 13101- 13109	Pollution Prevention Act of 1990

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD, GENERAL NPDES PERMITS

CAS000001	Industrial Storm Water Discharges
CAS000002	Construction Storm Water Discharges
CAS000004	Small Municipal Separate Storm Sewer Systems
CAG912003	Discharge or Reuse of Extracted and Treated Groundwater

BAY AREA AIR QUALITY MANAGEMENT DISTRICT RULES AND REGULATIONS, AIR QUALITY (BAAQMD)

BAAQMD Regulations 1-12	General
BAAQMD Regulation 2, Rule 1	General Requirements
BAAQMD Regulation 8, Rule 3	Architectural Coatings
BAAQMD Regulation 8, Rule 49	Aerosol Paint Products
BAAQMD Regulation 8, Rule 51	Adhesive and Sealant Products
BAAQMD Regulation 9, Rule, 6	Natural Gas-Fired Boilers and Water heaters (Boilers rated 0-2 MMBTU/hr)
BAAQMD Regulation 9, Rule 7	Boilers (Boilers rated >2 MMBTU/hr
BAAQMD Regulation 11, Rules 1 & 2	Asbestos
BAAQMD Regulation 12, Rule 3	Asphalt Air Blowing
BAAQMD Regulation 12, Rule 4	Sandblasting

SANTA CLARA COUNTY

Sunnyvale Municipal Code 12	City of Sunnyvale Waters and Sewer Ordinance
Palo Alto Chapter 16	City of Palo Alto Sewer Use Ordinance
SCC ordinance Code B11	Santa Clara County Hazardous Materials and Toxic Gas Storage and Permitting

NASA POLICY AND PLANS AND EXECUTIVE ORDERS

APD 8500.1	Ames Environmental Policy
APR 8500.1	Ames Environmental Procedural Requirements
APR 8553.1	Ames Environmental Management System (incorporating by reference Environmental Work Instructions (http://environmentalmanagement.arc.nasa.gov/ems/index.h
NPD 8500.1	NASA Environmental Management
NPR 8553.1	NASA Environmental Management Systems
NPR 8580.1	NASA Procedural Requirements for Implementing the National Environmental Policy Act and Executive Order 12114
SWPPP and BMPs	Storm Water Pollution Prevention Plan and Best Management Practices
SPCC	Spill Prevention, Control and Countermeasures Plan

ESL	(2008) California Regional Water Quality Control Board, Region IX, Environmental Screening Levels
EPA RSL	(2011) U.S. Environmental Protection Agency, Region IX, Regional Screening Levels Table
SSPP	NASA Strategic Sustainability Performance Plan
Records of Decision	(2002) NASA Ames Development Plan Programmatic Environmental Impact Statement and Record of Decision
	(1989) USEPA Record of Decision for the MEW Study Area (Ground Water Contamination)
	(2010) USEPA Record of Decision Amendment for the Vapor Intrusion Pathway

1.8 ENVIRONMENTAL REQUIREMENTS FOR PRODUCTS

1.8.1 Material Safety Data Sheets (MSDS)

Submit an MSDS for each product specified in other sections or required by OSHA to have an MSDS. MSDS shall be prepared within the previous five years. Include information for MSDS Sections 1 through 16 in accordance with ANSI Z400.1/Z129.1 and 29 CFR 1910.1200 Appendix D.

In addition to the MSDS, provide the additional information:

a. Include data used to determine the hazards cited in Section 3. Identify acute data, carcinogenicity, reproductive effects, and target organ effects. Provide written description of the process used in evaluating chemical hazards relative to preparation of the MSDS.

b. Include data regarding the proper disposal of the chemical, including the disposal of any contaminated packaging. Include information regarding recycling and reuse. Indicate whether or not the product is considered to be "hazardous waste" according to 40 CFR 261.

c. Identify Federal, State, and local regulations applicable to the material.

d. Include additional information relative to recycled content, biobased content, and other information regarding environmental and health impacts. Identify the date MSDS was prepared.

1.8.2 Life Cycle Assessments (LCAs)

For the following products, submit LCA data developed in accordance with ISO 14040; and where BEES data exists, submit NIST BEES 4.0 analysis using 100 percent Environmental Performance Weighting and the EPA Scientific Advisory Board Environmental Impact Category Weights.

a. Masonry

b. Finish Carpentry

c. Plastic Fabrications

d. Building Insulation

e. Roofing

f. Joint Sealers

g. Wood & Plastic Doors

h. Windows

i. Skylights

j. Glazed Curtain Wall

k. Gypsum Board

l. Tile

m. Acoustical Ceilings

n. Resilient Flooring

o. Carpet

p. Toilet Compartments

q. Loading Dock Equipment

r. Office Equipment

s. Furnishings & Accessories

t. Renewable Energy Equipment

u. Elevators

v. HVAC equipment

x. Lighting equipment

1.9 ENVIRONMENTAL PROTECTION PLAN

Prepare and submit an Environmental Protection Plan not less than 10 days before the preconstruction meeting. At a minimum, address the following elements in accordance with this section:

a. Identification and contact information for Environmental Manager.

b. General site information, including preconstruction description and photographs.

c. Summary of training program.

d. Procedures to address water resources.

e. Procedures to address land resources.

f. Procedures to address air resources.

g. Procedures to address fish, wildlife and plant (and their habitats) resources.

h. Procedures to address cultural resources.

i. Monitoring and quality control procedures.

Procedures to avoid interfering with remediation activities or creating new pathways.

Revise and resubmit Plan as required by the COR. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations.

1.10 ENVIRONMENTAL DEMONSTRATION AND TRAINING

Contractor shall provide environmental training for workers performing work on the project site.

1.10.1 Instructor Qualifications

Training shall be given by a firm or individual experienced in providing training or education similar in content and extent to that indicated for this project.

1.10.2 Coordination

Coordinate instruction schedule with Government operations. Adjust schedule as required to minimize disruption of Government operations. Coordinate instruction with demonstration and training of general building systems.

1.10.3 Training Program

Develop a training program for all site workers that includes the following topics:

a. Overview of environmental and sustainability issues related to the building industry.

b. Overview of environmental and sustainability issues related to the project.

c. Compliance with applicable Federal, State, and local environmental regulations.

d. Review of site specific procedures and management plans implemented during construction, including the Waste Management Plan, Indoor Air Quality (IAQ) Management Plan, Environmental Protection Plan, and procedures for noise and acoustics management.

e. All personnel shall be trained in the hazards and safe work practices for their tasks.

f. Personnel performing hazardous operations shall receive training as specified in applicable regulations.

1. Personnel handling hazardous materials shall have received Hazard Communication Training per 29 CFR 1910.1200 and CCR Title 8 Section 5194 and Emergency Response Awareness Level training per 29 CFR 1910.120. Employee training documents shall be kept at the jobsite.

2. Personnel containing spills or conducting cleanup of small spills shall have received First Responder Operations level training per 29 CFR 1910.120.

3. Personnel generating hazardous waste shall receive training on the proper management of hazardous waste per 40 CFR 265.16 and CFR Title 22 Section 265.16.

4. Personnel using personal protective equipment (PPE) shall receive training on its proper use per 29 CFR 1910.132.

5. Personnel involved with hazardous materials and hazardous waste preparation for shipment shall receive training as hazmat employees per 49 CFR 172.704(c)(2).

g. Personnel handling hazardous materials shall have received Hazard Communication Training per 29 CFR 1910.1200 and CCR Title 8 Section 5194 and Emergency Response Awareness Level training per 29 CFR 1910.120. Employee training documents shall be kept at the jobsite.

h. Personnel containing spills or conducting cleanup of small spills shall have received First Responder Operators level training per 29 CFR 1910.120.

i. Personnel generating hazardous waste shall have received training on the proper management of hazardous waste per 40 CFR 66265.16 and CFR Title 22 Section 66265.16.

j. All Contractor personnel involved in operations with potential to impact storm water quality or the storm drain system shall have awareness training regarding the project specific SWPPP and the applicable BMPs. Documentation of this training shall be provided to the Government.

k. Personnel operating in wildlife habitats, where operations may be affected by wildlife, or who may come in contact with wildlife shall have wildlife awareness training relevant to this project.

l. Personnel operating in or whose operations may affect cultural resources shall have awareness training relevant to the project.

m. Personnel shall have awareness training of the NASA Ames Environmental Management System, including high priority risks (air, hazmat, energy, water).

1.10.3.1 Scheduling

Provide instruction at mutually agreeable times.

1.10.3.2 Training Modules

Develop a learning objective and teaching outline for each topic in the

Training Program. Include a description of specific skills and knowledge that each participant is expected to acquire. Instructors shall be well-versed in the particular topics that they are presenting.

1.10.3.3 Evaluation

At the conclusion of each training module, assess and document each participant's understanding of the module by use of a written performance-based test.

PART 2 PRODUCTS

2.1 ENVIRONMENTALLY PREFERABLE PRODUCTS

Consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, and disposal of products, and provide products and materials with the least effect on the environment, determined by LCA analysis, released toxins, and other methods.

a. All products purchased for Federal projects with Federal funds, including contractors, are required by EO 13423 and Part 23 of the Federal Acquisition Regulations (FAR) to assess and give preference to those products and services that are environmentally preferable. Environmentally preferable products are of recycled content, recyclable, of low toxicity, reusable, locally produced, low-polluting, have long life cycles, are harvested on a sustained yield basis, and are biobased.

b. In addition, EO 13423 and RCRA 6002 require the U.S. EPA and USDA to maintain the Comprehensive Procurement Guidelines (CPG) and BioPreferred Program, which are lists of products and materials that MUST be purchased at the maximum recycled-content level specified. CPG items include: building insulation, carpet, carpet cushion, cement, concrete, latex paint, floor tiles, flowable fill, laminated paperboard, modular threshold ramps, non-pressure pipe, patio blocks, roofing materials, shower and restroom dividers/partitions, plastic lumber landscaping timbers and posts, plastic fencing, playground equipment, playground surfaces, blasting grit, industrial drums, manual grade strapping, mats, pallets, signage, bike racks, and structural fiberboard. BioPreferred product categories include: roof coatings, composite panels, fluid- filled transformers, plastic insulating foam, carpets, greases, hydraulic fluids, metal working fluids, wood and concrete sealers, concrete and asphalt release fluids, erosion control materials, and interior paints and coatings.

c. If using Federal funds, including contractors, and purchasing one of these products, the product must be purchased at the highest recycled content level practicable.

d. The complete up-to-date list of CPG products and required recycled content levels is available at http://www.epa.gov/cpg/. The list of USDA BioPreferred program product categories and the minimum biobased content standards established for each category is at http://www.biopreferred.gov/ProposedAndFinalItemDesignations.aspx.

e. If this product is unacceptable based on quality, availability, or cost, a waiver must be submitted to and approved by the Environmental Management Division. The COR will provide form ARC 813 to the contractor when required. More information is available at http://

environmentalmanagement.arc.nasa.gov/forms/.

f. For guidance on finding specific products that meet these requirements, please contact the Environmental Management Division.

2.1.1 Prohibited Materials

The use of the following materials is prohibited:

a. Products containing asbestos.

b. Products containing urea formaldehyde.

c. Products containing polychlorinated biphenyls.

d. Products containing chlorinated fluorocarbons.

e. Solder or flux containing more than 0.2 percent lead and domestic water pipe or pipe fittings containing more than 8 percent lead.

f. Paint containing more than 0.06 percent lead.

2.1.2 Packaging

Where Contractor has the option to provide one of the listed products or equal, preference shall be given to products with minimal packaging and easily recyclable packaging, and to manufacturers with policies that take back product packaging.

2.1.2.1 Industrial Paperboard

Minimum 100 percent post-consumer recycled content in accordance with ASTM D 5663.

2.1.2.2 Carrier Board

Minimum 100 percent recycled content with a minimum of 15 percent post-consumer recycled content in accordance with ASTM D 5663.

2.1.2.3 Brown Papers

Minimum 40 percent recycled content with a minimum of 20 percent post-consumer recycled content in accordance with ASTM D 5663.

2.1.3 Substitutions

Notify the COR when Contractor is aware of materials, equipment, or products that meet the aesthetic and programmatic intent of Contract Documents, but which are more environmentally responsible than materials, equipment, or products specified or indicated in the Contract Documents. Submit the following for initial review by the COR:

a. Product data including manufacturer's name, address, and phone number.

b. Description of environmental advantages of proposed substitution over specified product.

PART 3 EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Comply with applicable regulations and these specifications. Preserve the natural resources within the project boundaries and outside the limits of permanent work performed under this Contract in their existing condition or restore to an equivalent or improved condition as approved by the COR. Where violation of environmental procedures requirements will irreversibly damage the site, the Contractor shall immediately contact the COR and CO to coordinate with the NASA Ames Environmental Management Division to develop a mitigation strategy and, if necessary, report to regulatory agencies.

3.1.1 General Disturbance

Confine demolition and construction activities to work area limits indicated on the Drawings. Remove debris, rubbish, and other waste materials resulting from demolition and construction operations from site. Transport materials with appropriate vehicles and dispose of them off site to areas that are approved for disposal by governing authorities having jurisdiction. Avoid spillage by covering and securing loads when hauling on or adjacent to public streets or highways. Remove spillage and sweep, wash, or otherwise clean project site, streets, or highways. Burning is prohibited.

3.1.2 Water Resources

Comply with requirements of the NPDES and the applicable State Pollutant Discharge Elimination System (SPDES). Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water. Store and service construction equipment at areas designated for collection of oil wastes. Prevent ponding of stagnant water conducive to mosquito breeding habitat. Prevent run-off from site during demolition and construction operations. Equipment will be permitted to ford live streams if temporary culverts or bridges are constructed for the purpose and the CO and COR have obtained approval from the NASA Ames Environmental Management Division that the action will not violate wetlands or wildlife laws, regulations and policies, such as those covering steelhead salmon, western pond turtle, salt marsh harvest mouse, and protected birds. Remove temporary culverts and bridges upon completion of work and repair the area to its original condition, unless otherwise accepted in writing by the COR.

3.1.2.1 Wastewater Discharge Permits

a. In accordance with the Clean Water Act, the City of Sunnyvale Water and Sewers Ordinance, and the City of Palo Alto Sewer Use Ordinance, a specific written Incidental Sewer Discharge permit is required before discharging wastewaters to the sanitary sewer system from project activities such as excavation dewatering, saw cutting coolant water, cleaning operations, and decontamination water.

b. The Contractor shall complete and submit a Request for Incidental Sewer Discharge form to the COR at least 7 work days before the planned discharge of groundwater or other wastewater. The request shall include the estimated discharge volume, discharge rate, source of the wastewater and the duration of discharge. The Government will sample the wastewater and obtain the discharge approval.

c. Wastewater Discharge

1. With the exception of groundwater from excavation, wastewater from Contractor operations shall be containerized by the Contractor until the Contractor is notified a discharge permit has been obtained.

2. The Contractor shall record and submit information specified in the discharge permit issued to the project including, but not limited to, the dates of discharge, quantity of water discharged, source of the wastewater, dates wastewater was sampled and analyzed (if required), and filtering method (if required).

3. Non-sewerable wastewater shall be disposed of by the Government in accordance with subsection 3.1.8.1, Government Disposal.

4. Non-sewerable wastewater shall be treated, managed, and disposed of properly by the Contractor in accordance with subsection 3.1.8.2, Contractor Disposal.

d. In the event that the POTW requires a Groundwater Discharge Permit, the Contractor will coordinate with the Environmental Management Division to complete the application. This may take 2-4 weeks. The Environmental Management Division must submit the completed application, along with all fees, and receive the approved permit prior to any discharge of any groundwater.

3.1.2.2 Storm Water Management

a. All development or redevelopment with a footprint that exceeds 5,000 square feet shall be in accord with the Technical Guidance on Implementing the Stormwater Runoff Requirements for Federal Projects under Section 438 of the Energy Independence and Security Act, which states that "the sponsor . . . shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."

b. Site Inspections - In accordance with Santa Clara County Hazardous Materials Storage Ordinance No. NS-517.31 the project site and all hazardous materials storage areas shall be inspected weekly by the Government to ensure compliance. In accordance with the project specific Storm Water Pollution Prevention Plan (SWPPP), the Government shall conduct inspections prior to any forecasted storm event, every 24 hour period during extended rain events and after every storm event to ensure required Best Management Practices (BMPs) were implemented and remained effective.

c. Hazardous Materials Storage

1. Hazardous materials storage shall be in accordance with Santa Clara County Hazardous Materials Storage Ordinance No. NS-517.31, and the General Storm Water Permit. Hazardous materials shall be handled in manner that minimizes the potential for releases. All liquid hazardous materials must be secondarily contained. Adequate spill response equipment shall be readily available.

2. Hazardous materials and hazardous wastes shall be labeled, handled properly, and stored in watertight containers with appropriate

secondary containment. Secondary containment shall be of adequate size and compatible with the materials stored. Storage areas shall be properly labeled and secured.

d. Staging Area - In accordance with the Clean Water Act and Ames SWPPP, to the maximum extent practicable, the staging area must be located away from storm drain inlets, gutters, drainage ditches, storm drain inlets, and creeks.

e. Granular Material Storage - In accordance with the Clean Water Act and Ames SWPPP, granular material shall be stored at least 10 ft from drainage ditches, catch basins, and curbs.

f. Refuse Bins - Refuse bins shall not be overloaded. Liquid materials shall not be placed in dumpsters or bins. Leaking dumpsters shall be replaced. Dumpsters and bins shall not be cleaned on-site. Dumpsters and bins shall be kept closed except when loading or emptying. Waste disposal containers shall be covered at the end of every business day and during a rain event. Dumpsters shall be wildlife resistant (per NADRPEIS and ROD 2002)

g. Landscaping - The Contractor shall control soil erosion and storm run-off to protect natural habitat from the project site to the satisfaction of the COR.

h. Stockpiles - All loose stockpiled construction materials that are not actively being used (soil, spoils, aggregate, fly-ash, stucco, hydrated lime, etc.) shall be covered and bermed.

i. Site Operations - shall be conducted in accordance with the Clean Water Act and Ames SWPPP.

j. Equipment Fueling and Maintenance - In accordance with the applicable BMP, equipment fluid changes and fueling shall be conducted over drip pans to prevent spilled materials from contacting the ground surface. The operator of leaking equipment shall contain and control the leak. All other maintenance and repairs of Contractor equipment is prohibited on-site.

k. Paint Clean-up

1. Painting operations must be conducted in accordance with Ames SWPPP and applicable BAAQMD requirements.

2. Water Based Paints

a) The Contractor shall paint out as much excess paint as possible from brushes, rollers, and equipment before starting clean up. Rinse brushes, rollers, and other tools over a sink that drains to the sanitary sewer using water only. Tools and equipment shall not be cleaned into streets, gutters, storm drains, or creeks. Dispose of dry brushes, rollers, rags, and drop cloths as solid waste.

b) Disposal of containers with any liquids as a solid waste is prohibited. These materials must be used elsewhere or handled as a hazardous waste and disposed of in accordance with subsection 3.1.8.2, Contractor Disposal.

3. Oil Based Paints

a) The Contractor shall paint out as much excess paint as possible from brushes, rollers, and equipment before starting clean up. Cleaning wash water shall be containerized and disposed of as hazardous waste. Reuse thinners and solvents by pouring back into original container through a filter.

b) Dispose of waste thinners, solvents, paint sludge, and wash water from cleaning of equipment and tools as hazardous waste. Containers with residual product shall be managed as a hazardous waste and disposed of in accordance with subsection 3.1.8.2, Contractor Disposal.

l. Paving Operations

1. Catch basins and manholes shall be protected when paving or applying seal coat, tack coat, slurry seal, or fog seal. Sweeping or washing down excess sand (from applying sand seals or covering excess oil) into gutters, storm drains, or creeks is prohibited. Excess materials shall either be collected and returned to the stockpile or disposed of properly.

2. Paving operations shall not obscure existing utility boxes, ground water monitoring wells, manholes, valve boxes or similar features. Notify the COR of any features potentially impacted.

m. Concrete/Asphalt Cutting and Core Drilling - In accordance with the applicable BMP, the Contractor shall not allow slurry run-off from saw cutting or core drilling to enter the storm or sanitary sewer collection systems. Catch basins and drains shall be protected. The Contractor shall sweep/shovel up slurry cutting waste from work areas before leaving an area or at the end of each work day, whichever is sooner. If saw-cut slurry enters a drain, the Contractor shall remove the slurry and notify the COR immediately.

n. Concrete Truck/Wash Out - In accordance with the applicable BMP, washing out concrete trucks or equipment into streets, gutters, storm drains, or creeks is prohibited. Trucks may be washed out on the ground surface in a location approved by the COR.

o. Sweeping - Roadways and on-site paved areas impacted by the project shall be cleaned as necessary to the satisfaction of the COR and swept at the end of each workday, prior to forecasted rain, at the end of each phase and at project completion. Hosing down paved areas and streets is prohibited.

p. Reclaimed Water - The Contractor shall use reclaimed water for dust control and other construction site operations unless an exception is granted by the COR. Reclaimed water is available at no cost from a hydrant located on Moffett Federal Airfield approximately 328 ft south of the intersection of Macon Road and Fifth Avenue.

q. Storm Drain Management

1. In accordance with the applicable BMP, catch basins near the project shall be protected to prevent debris, pollutants, sediments and releases from entering the storm drain system. Catch basins shall be inspected and cleaned out to the satisfaction of

the COR at the end of each phase or at project completion.

2. In accordance with the applicable BMP, the Contractor shall control soil erosion and storm runoff from the Contractor's site to the satisfaction of the COR.

r. Broken/Ruptured Pipes - If the Contractor breaks a utility pipe, or observes any broken or leaking pipes, it shall immediately notify the COR. The Contractor shall immediately notify Ames Environmental Management Division if the pipe contained any liquid except potable water. The Contractor shall berm the area to prevent run-off from releases of non-potable water from entering the storm drain.

s. Draining, Tanks, Piping, and Equipment

1. Tanks, piping, and equipment shall be drained as required. Devices to properly contain the product shall be provided by the Contractor. Storm drains in the vicinity shall be covered during drainage operations.

2. The Government will conduct the sampling of drained fluid in order to determine disposal options unless there is sufficient generator knowledge to determine disposal options.

3. The Government will obtain the necessary sanitary sewer discharge permits if the discharge is sewerable. Non-sewerable water shall be treated to a level to allow discharge to the sanitary sewer or managed and disposed of properly.

4. Disposal of drained fluid and associated costs shall be by the Government in accordance with subsection 3.1.8.1, Government Disposal.

t. Authorized Non-Storm Water Discharges

1. Following is a list of authorized non-storm water discharges:

a) Atmospheric condensate including refrigeration, air conditioning and compressor condensate.

b) Irrigation drainage and landscape watering.

c) Uncontaminated ground water provided that the water does not become contaminated with soil or sediment (muddy).

d) Water from fire hydrant flushing or testing.

e) Water from fire fighting activities.

2. To the extent practicable, authorized non-storm water discharges shall be minimized. Additionally, the Environmental Management Division shall be notified of all authorized non-storm water discharges so that they may be observed and/or documented as required by the General Storm Water Permits.

3.1.2.3 Spill Prevention, Control, and Reporting

a. All liquid petroleum products must be secondarily contained in accordance with Ames Spill Prevention Control and Countermeasures Plan

and 40 CFR 112, spill clean-up materials (such as rags, absorbent booms/pads), and tools (such as shovels and brooms) shall be maintained at the project site and be readily accessible. Releases of hazardous materials to the environment shall be contained and measures implemented to prevent leaks and spills from entering storm drains. Spills of hazardous materials to unpaved surfaces in excess of 1 ounce shall immediately be reported to Environmental Management Division.

b. All Contractors are responsible for preventing release of environmental hazards into the environment. In the event Contractors introduce environmental hazards into the environment during the course of their work (e.g., puncture a drum of hazardous waste, asbestos containing run-off, accidentally spilling chemicals), they are responsible for cleaning up the environmental hazards within 24 hours of occurrence.

b. cial 911 from any NASA phone or 650-604-5555 from an outside phone to request assistance of any spill by the Contractor.

3.1.2.4 Drinking Water Resources

Any proposed drinking water well must be coordinated with the Ames Remediation Program Manager, who is the only person authorized to sign well permit applications on behalf of NASA as the landowner before applications are submitted to the Santa Clara County Water District. Under no circumstances may a drinking water well be placed in a location that has not been cleaned up to residential standards, e.g., capped landfills, petroleum sites, or in a location that would otherwise interfere with on-going remediation activities.

3.1.3 Land Resources

Prior to construction, identify land resources to be preserved within the work area. Do not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and landforms without permission from the COR. Coordinate protection practices with work specified in Division 2 EXISTING CONDITIONS.

a. Construction Over Or In MEW Study Area

1. Any construction over or in the area of shallow groundwater contamination known as the MEW Study Area must implement the remedy prescribed in the Record of Decision for the Middlefield/Ellis/Whisman (MEW) Study Area and Record of Decision Amendment for the Vapor Intrusion Pathway and be coordinated with the Ames Environmental Management Division Remediation Program Manager.

2. Soil boring and well data shall be transmitted to the Ames Remediation Program Manager.

3. The Contractor shall follow procedures outlined in Section 02 61 13. This section can be detained from the COR, if needed.

b. Contaminated Soil Management

1. The Contractor shall notify the COR immediately if soil appears discolored or has an odor. The Contractor shall place suspect soil on plastic sheeting and cover with a plastic tarpaulin. The suspect soil will be tested by the Government for contamination.

2. Contaminated soil shall be transferred to a designated on-site location for disposal by the Government in accordance with subsection 3.1.8.1, Government Disposal or properly disposed of by the contractor in accordance with subsection 3.1.8.2, Contractor Disposal.

c. Construction Over or In Landfill Sites and Petroleum Contaminated Sites

Any construction over or in the vicinity of former landfill sites, petroleum contaminated sites, treatment systems and other remediation activities, must be coordinated with the Ames Environmental Management Division Remediation Program Manager for consistency with CERCLA, RCRA, and TSCA decision documents issued by the U.S. Environmental Protection Agency, Regional Water Quality Control Board, and California Department of Toxic Substances Control. In no case shall residential construction be authorized where the sites have not been cleaned up to residential standards.

d. Construction, Removal, or Modification of Wells

Any request to construct, remove, or modify a well, including, e.g., drinking water wells, geothermal wells, monitoring wells, must be coordinated with the Ames Environmental Management Division Remediation Program Manager for consistency with CERCLA, RCRA, and TSCA decision documents issued by the U.S. Environmental Protection Agency, Regional Water Quality Control Board, and California Department of Toxic Substances Control. Only the Ames RPM is authorized to sign well permit applications on behalf of NASA as the landowner prior to submittal to the Santa Clara County Water District for approval. In no case shall drinking water well permit applications be authorized by NASA where the sites have not been cleaned up to residential standards.

3.1.3.1 Erodible Soils

Plan and conduct earthwork to minimize the duration of exposure of unprotected soils, except where the constructed feature obscures borrow areas, quarries, and waste material areas. Clear areas in reasonably sized increments only as needed to use the areas developed. Form earthwork to final grade as shown. Immediately protect side slopes and back slopes upon completion of rough grading.

3.1.3.2 Erosion and Sedimentation Control Devices

Construct or install temporary and permanent erosion and sedimentation control features as required.

3.1.3.3 Tree and Plant Protection

Protect as specified in Division 2 EXISTING CONDITIONS and as specified. Prior to start of construction, tag each tree and plant scheduled to remain. In the event of damage to tree or plant, the Government may, at the COR's discretion, deduct the indicated value of the damaged tree or plant from the Contract Sum.

3.1.3.4 Drinking Water Sources

Any proposed drinking water well must be coordinated with Ames Remediation Program Manager, who is the only person authorized to sign well permit

applications on behalf of NASA as the landowner before applications are submitted to the Santa Clara County Water District. Under no circumstances may a drinking water well be placed in a location that has not been cleaned up to residential standards, e.g., capped landfills, petroleum sties, or in a location that would otherwise interfere with on-going remediation activities.

3.1.4 Air Resources

Comply with Indoor Air Quality (IAQ) Management Plan and as follows:

a. Prevent creation of dust, air pollution, and odors.

b. Sequence construction to avoid unnecessary disturbance to site.

c. Use mulch, water sprinkling, temporary enclosures, and other appropriate methods as needed to limit dust and dirt rising and scattering in air. Do not use water when it may create hazardous or other adverse conditions such as flooding and pollution.

d. Store volatile liquids, including fuels and solvents, in closed containers. Do not store with materials that have a high capacity to adsorb VOC emissions or in occupied spaces.

e. Properly maintain equipment to reduce gaseous pollutant emissions.

f. Construction operations and materials used on the project shall be in compliance with the Rules and Regulations for Air Quality of the Bay Area Air Quality Management District (BAAQMD).

g. If coatings are used, the coatings need to meet the VOC requirements of the BAAQMD Regulations. The VOC requirements vary depending on the coating operation. For architectural coatings, follow the requirements of BAAQMD Regulation 8, Rule 3. For surface coating of miscellaneous metal parts and products, follow the requirements of BBAQMD Regulation 8, Rule 49. For adhesive and sealant products, follow the requirements of BAAQMD Regulation 8, Rule 51. the VOC content can be found on the coating's MSDS. The VOC normally is listed in the section listing the physical and chemical properties of the coating. General assistance is always available from the Environmental Management Division to ensure compliance with BAAQMD coating regulations.

h. Aerospace Coatings - Aerospace coatings shall conform to BAAQMD Regulation 8, Rule 29 for VOC content limits.

i. Architectural Coatings - Architectural coatings and paints shall conform to BAAQMD Regulation 8, Rule 3 for VOC content - Architectural Coating Limits.

j. Spray Paints - Spray paints shall conform to BAAQMD Regulation 8, Rule 49 for VOC content - Aerosol Coatings.

k. Chlorofluorocarbons (CFCs) and Other Class I Ozone Depleting Substances.

   1. Class I Ozone Depleting Substances (ODS) as defined and identified herein shall not be used in the performance of this contract, nor be provided as part of the equipment. This prohibition shall prevail over any other provision, specification, drawing, or

referenced documents.

2. Class I ODS is defined in Section 602(a) of the Clean Air Act and includes the following chemicals:

   a) Chlorofluorocarbon-11 (CFC-11)
   b) Chlorofluorocarbon-12 (CFC-12)
   c) Chlorofluorocarbon-13 (CFC-13)
   d) Chlorofluorocarbon-111 (CFC-111)
   e) Chlorofluorocarbon-112 (CFC-112)
   f) Chlorofluorocarbon-113 (CFC-113)
   g) Chlorofluorocarbon-114 (CFC-114)
   h) Chlorofluorocarbon-115 (CFC-115)
   i) Chlorofluorocarbon-211 (CFC-211)
   j) Chlorofluorocarbon-212 (CFC-212)
   k) Chlorofluorocarbon-213 (CFC-213)
   l) Chlorofluorocarbon-214 (CFC-214)
   m) Chlorofluorocarbon-215 (CFC-215)
   n) Chlorofluorocarbon-216 (CFC-216)
   o) Chlorofluorocarbon-217 (CFC-217)
   p) Halon-1211
   q) Halon-1301
   r) Halon-2402
   s) Carbon tetrachloride
   t) Methyl chloroform

3. Service, maintain, renovate, and demolish ODS containing equipment in accordance with 40 CFR 82. Prevent a discharge of ODS to the atmosphere. ODS recovery equipment shall be certified by an EPA-approved equipment testing organization. Place recovered ODS in cylinders suitable for the type of ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. For new ODS added to existing equipment, provide the following data to the Environmental Management Division, Mail Stop 237-14, within 48 hours of adding the new ODS: equipment manufacturer and model number, location, type of ODS, quantity added, and date the work was performed.

4. The Contractor shall ensure that CFC refrigerants are recovered by a certified technician in accordance with the Final Rule of the Clean Air Act of 1990, Section 608, before the equipment is removed from Government property. Keep copies of technician certification at the technician's place of business.

5. In accordance with §82.3 of Section 608 of the CAA, recovered ODS for destruction must be shipped to a destruction facility which uses one of the following destruction technologies: liquid injection incineration, reactor cracking, gaseous/fume oxidation, rotary kiln incineration, cement kiln, or radio frequency plasma; recovered ODS for reclamation must be sent to an EPA-certified refrigerant reclaimer. A list can be viewed at: http://www.epa.gov/ozone/ partnerships/rad/radpartners.html.

l. Hydrochlorofluorocarbons (HCFCs) and Other Class II Ozone Depleting Substances.

1. Class II Ozone Depleting Substances (ODS) as defined and identified herein shall not be used in the performance of this contract, nor be provided as part of the equipment. This

prohibition shall prevail over any other provision, specification, drawing, or referenced documents. Refer to the EPA Significant New Alternatives Policy (SNAP) Program for a listing of acceptable ODS substitutes by sector found at http://www.epa.gov/ozone/snap/lists/index.html.

2. Class II ODS is defined in Section 602(b) of the Clean Air Act and includes the following chemicals:

   a) hydrochlorofluorocarbon-21 (HCFC-21)
   b) hydrochlorofluorocarbon-22 (HCFC-22)
   c) hydrochlorofluorocarbon-31 (HCFC-31)
   d) hydrochlorofluorocarbon-121 (HCFC-121)
   e) hydrochlorofluorocarbon-122 (HCFC-122)
   f) hydrochlorofluorocarbon-123 (HCFC-123)
   g) hydrochlorofluorocarbon-124 (HCFC-124)
   h) hydrochlorofluorocarbon-131 (HCFC-131)
   i) hydrochlorofluorocarbon-132 (HCFC-132)
   j) hydrochlorofluorocarbon-133 (HCFC-133)
   k) hydrochlorofluorocarbon-141 (HCFC-141)
   l) hydrochlorofluorocarbon-142 (HCFC-142)
   m) hydrochlorofluorocarbon-221 (HCFC-221)
   n) hydrochlorofluorocarbon-222 (HCFC-222)
   o) hydrochlorofluorocarbon-223 (HCFC-223)
   p) hydrochlorofluorocarbon-224 (HCFC-224)
   q) hydrochlorofluorocarbon-225 (HCFC-225)
   r) hydrochlorofluorocarbon-226 (HCFC-226)
   s) hydrochlorofluorocarbon-231 (HCFC-231)
   t) hydrochlorofluorocarbon-232 (HCFC-232)
   u) hydrochlorofluorocarbon-233 (HCFC-233)
   v) hydrochlorofluorocarbon-234 (HCFC-234)
   w) hydrochlorofluorocarbon-235 (HCFC-235)
   x) hydrochlorofluorocarbon-241 (HCFC-241)
   y) hydrochlorofluorocarbon-242 (HCFC-242)
   z) hydrochlorofluorocarbon-243 (HCFC-243)
   aa) hydrochlorofluorocarbon-244 (HCFC-244)
   bb) hydrochlorofluorocarbon-251 (HCFC-251)
   cc) hydrochlorofluorocarbon-252 (HCFC-252)
   dd) hydrochlorofluorocarbon-253 (HCFC-253)
   ee) hydrochlorofluorocarbon-261 (HCFC-261)
   ff) hydrochlorofluorocarbon-262 (HCFC-262)
   gg) hydrochlorofluorocarbon-271 (HCFC-271)

3. Service, maintain, renovate, and demolish ODS containing equipment in accordance with 40 CFR 82. Prevent a discharge of ODS to the atmosphere. ODS recovery equipment must be certified by an EPA-approved equipment testing organization. Place recovered ODS in cylinders suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. For new ODS added to existing equipment, provide the following data to the Environmental Management Division, Mail Stop 237-14, within 48 hours of adding the new ODS: equipment manufacturer and model number, location, type of ODS, quantity added, and date the work was performed.

4. The Contractor shall ensure that HCFC refrigerants are recovered by a certified technician in accordance with the Final Rule of the Clean Air Act of 1990, Section 608, before the equipment is removed from Government property. Keep copies of technician

certification at the technician's place of business.

5. In accordance with §82.3 of Section 608 of the CAA, recovered ODS for destruction must be shipped to a destruction facility which uses one of the following destruction technologies: liquid injection incineration, reactor cracking, gaseous/fume oxidation, rotary kiln incineration, cement kiln, or radio frequency plasma; recovered ODS for reclamation must be sent to an EPA-certified refrigerant reclaimer. A list can be viewed at http://www.epa.gov/ozone/ partnerships/rad/radpartners.html.

m. Reduce indoor levels of radon gas and formaldehyde emissions by following industry and U.S. EPA guidelines on indoor environmental quality (see http://www.epa.gov/iaq for more information).

The Contractor is responsible for meeting the State and CARB requirements for both the off-road and on-road vehicle regulations.

Use of sulfur hexafluoride (SF6) is restricted to gas insulated switchgear equipment and some research and development activities. Contact the Environmental Management Division, Code JQ, before bringing any SF6 containing equipment on-site.

Refrigeration systems with a full charge greater than 50 pounds of high-GWP refrigerant, must meet the requirements of the CARB regulation for the management of high global warming potential refrigerants for stationary sources (California Code of Regulations Title 17 Subarticle 5.1 Sections 95380 to 95398.

The Contractor shall provide information (construction schedule, construction equipment fleet emissions information, etc.) to the Environmental Management Division to calculate construction related emissions. The COR and the Contractor shall coordinate construction activities to ensure that the NASA Ames overall emission of ozone precursor compounds associated with project construction and operation do not exceed a cumulative total of 100 tones per year.

The Contractor shall use mitigation measures to reduce nitrogen oxides (NOx) emission from construction activities. The Contractor shall reduce unnecessary idling of construction equipment and follow NASA Ames idling guidelines for diesel power equipment. All construction equipment is prohibited from idling more than 5 minutes. The Contractor shall properly maintain construction equipment.

The staging of three or more pieces of construction equipment near or just upwind from sensitive receptors, such as residences or daycare uses, is prohibited.

3.1.5 Fish, Wildlife, Plant Resources, and Habitat

Manage and control construction activities to minimize interference with and damage to fish and wildlife and plants and habitat. Do not disturb fish and wildlife. Do not alter water flows or otherwise significantly disturb the native habitat related to the project and critical to the survival of fish and wildlife, and protected plants except as indicated or specified. Do not introduce non-native species. Contact Ames Facilities Maintenance for assistance in control of common pests, such as rats, bees, fleas, and the EMD for assistance in managing wildlife concerns.

3.1.5.1 Burrowing Owl Habitat

a. The Contractor shall conduct its activities in a manner that does not negatively impact fauna or flora, in accordance with 40 CFR 1500, 50 CFR 402, and Ames Environmental Procedural Requirement, APR 8500.1.

b. The Contractor shall comply with the "Burrowing Owl Management Policy for Ames Research Center."

3.1.6 Cultural Resources, Plant Resources, and Habitat

Manage and control construction activities to minimize interference with and damage to cultural resources and plants and habitat. Do not disturb cultural resources. Do not alter water flows or otherwise significantly disturb the native habitat related to the project and critical to the preservation of cultural resources, and protected plants except as indicated or specified. Do not introduce non-native species.

3.1.7 Resource Conservation/Sustainability

The Contractor shall conduct its activities in a manner that conserves resources and minimizes pollution in accordance with NASA Ames EMS, NASA Strategic Sustainability Performance Plan, Executive Order 13423 "Strengthening Federal Environmental, Energy, and Transportation Management" and Executive Order 13514 "Federal Leadership in Environmental, Energy, and Economic Performance." All new construction, major renovation or repair and alteration of NASA buildings will comply with "Guiding Principles for Federal Leadership in High Performance and Sustainable Buildings" (Guiding Principles) at http://www.wbdg.org/references/mou.php.

a. Minimize the amount of energy required during construction and operation by using resource efficient construction techniques, building systems (including HVAC, heating, electrical, water, lighting, heat-pumps and boilers), insulation, fixtures, appliances, and controls.

b. Whenever possible, utilize energy efficient office equipment through the Environmental Protection Agency's Energy Star labeling program (http://www.energystar.gov).

c. Use automated monitors and controls for energy, water, waste, temperature, moisture, and ventilation.

d. Conserve water with systems that reduce consumption and recycle water through reclamation and treatment systems.

e. Maximize the reduction, reuse, recycling or composting of waste and scrap materials.

f. Minimize waste, spillage, pilferage, spoil, and misuse of building materials.

g. Consider adaptive reuse, rather than demolition whenever possible.

h. Follow Federal Comprehensive Procurement Guidelines (http://www.epa.gov/epawaster/conserve/tools/cpg/index.htm) for building materials and products. Select materials that have a long-life cycle; select least toxic materials; select recyclable materials; select materials that are resource-efficient; select materials with the maximum recycled content; select materials harvested on a sustained yield basis; and select

products causing the least pollution during their manufacture, use and reuse.

i. Reduce, reuse, and recycle to minimize consumption and waste in business operations.

j. Utilize environmental life cycle cost analysis in the development process.

3.1.8 Hazardous Waste Management

3.1.8.1 Government Disposal

a. The Contractor shall label, package, and secondarily contain liquid hazardous wastes before submitting the hazardous wastes to the Government for subsequent disposal.

b. Hazardous Waste Manifest

1. NASA Ames Research Center shall be designated as the generator on the manifest and only approved Environmental Management Division personnel shall sign the Uniform Hazardous Waste Manifests. Contractors shall not sign hazardous waste manifests.

2. If the waste is generated from a tenant's site, where the tenant holds the generator permit, the tenant with requisite training must sign the manifest.

3. NASA Ames Research Center Ames Dispatch (650)604-5416 shall be designated as the emergency contact on the manifest.

3.1.8.2 Contractor Disposal

a. Hazardous wastes generated by materials brought on site by the Contractor shall be properly handled, shipped, and disposed of as required by Federal, State, and local regulations. No hazardous materials shall remain at the worksite upon completion of the project unless specified otherwise. The Government shall sample waste streams for purposes of waste characterization. Waste Profiles shall be submitted to the COR. Hazardous wastes shall be disposed of at a permitted Treatment, Storage, and Disposal Facility (TSDF) authorized to accept the specific waste to be shipped. Use of deep well injection as a treatment or disposal method is prohibited.

b. Hazardous Waste Manifest

1. NASA Ames Research Center shall be designated as the generator on the manifest and only approved Ames Environmental Management Division personnel shall sign the Uniform Hazardous Waste Manifests. Contractors shall not sign hazardous waste manifests.

2. If the waste is generated from a tenant's site, where the tenant holds the generator permit, the tenant with requisite training must sign the manifest.

3. NASA Ames Research Center (650)604-5416 (Ames Dispatch) shall be designated as the emergency contact on the manifest.

4. The Contractor shall prepare shipments in compliance with 49 CFR.

The Contractor shall meet the removal and disposal time frames established by law.

5. The Contractor shall use only disposal facilities that have a valid permit to manage hazardous waste, and shall be responsible for determining that permit allows for the type of management and disposal intended for that waste. The Contractor shall be responsible for ensuring that any party handling hazardous waste, including subcontractors, transporters, and TSDFs are in compliance with applicable Federal, State, and local regulations.

c. Treatment, Storage, And Disposal Facility List - The Contractor shall provide a list of storage and disposal facilities (TSDF) that perform treatment, storage, or disposal services under this contract. Each facility shall have, as a minimum, EPA RCRA interim status or state approval as a treatment or disposal facility and be in good standing with the regulatory community. Recycling facilities shall meet applicable Federal, State, and local regulations. The Contractor agrees that no facility other than those initially approved for use under this contract will be used, without first obtaining the written approval of the COR.

d. Hazardous Waste Liability - For the purpose of this contract, the Contractor shall be responsible for any release or threatened release of the materials or substances handled under this contract, as well as any liabilities resulting or arising from or related to this contract, and shall bear all costs pertaining to such releases including, but not limited to, responses, remediation, testing, or disposal costs, and further shall defend and indemnify the Government for any costs including, but not limited to, any judgments, penalties, assessments, litigation, or attorney fees.

e. Hazardous Waste Transportation - Certified Waste Haulers shall be utilized. Government directed waste shall be transported to the disposal facility or interim storage facility without delay, in accordance with Department of Transportation (DOT) manifest regulations. The Contractor shall notify the Government if 30 days or more have elapsed during shipment.

f. Containerized Hazardous Waste - Hazardous wastes and other materials picked up by the Contractor from other facilities may not be added to any container of Government hazardous waste.

g. Bulk Hazardous Waste - Bulk hazardous waste shipments shall be weighed to confirm shipping weight.

h. Fluorescent Light Tubes - Fluorescent light tubes removed by the Contractor shall be turned over to the Government for recycling.

3.1.9 Chemical Usage and Handling

a. Hazardous material shall be used only as described on the Material Safety Data Sheet. The Contractor shall wear the protective equipment recommended by the manufacturer. Containers of hazardous materials and hazardous wastes shall be kept closed except when in use. Containers of liquid hazardous materials shall be stored in secondary containment at the end of each work shift.

b. Reclamation of Equipment Containing Hazardous Material Residues - The

Contractor shall disclose to COR the facility to which equipment containing hazardous material residues are shipped for reclamation, such as electrical wire wrapped with asbestos and electrical panels containing asbestos. The disclosure shall be documented on the Bill of Lading or by other written means.

c. Disposal of Non-Hazardous Waste Containing Hazardous Material Residue - The Contractor shall disclose to COR the facility to which equipment containing hazardous material residues are shipped for disposal, such as steel coated with lead paint. The disclosure shall be documented on the Bill of Lading or by other written means. Supporting analytical data shall be included to document the equipment is not hazardous waste.

d. Labeling

1. Containers, drums, vessels, tanks, and associated piping containing hazardous materials shall be labeled in accordance with California Code of Regulations Title 8 Section 5194 and the most recent edition of the California Fire Code.

2. Label containers with description of contents, percentages of components (if not pure), hazardous properties, name of contact person or waste generator, phone number, and date. If material is a waste, container shall have a hazardous waste accumulation label.

3. Report such chemicals to NASA Ames Environmental Management Division if chemicals to be on-site for more than 20 working days. Division will enter chemicals into NASA Ames chemical inventory system and affix a label.

4. Report when chemicals labeled under d.3 are used up or removed from the Center so that the Division can remove from Ames chemical inventory.

3.2 FIELD QUALITY CONTROL

Comply with requirements of agencies having jurisdiction and as specified herein. Provide field practices, shipping, and handling of samples in accordance with ASTM D 4840. Provide Field Quality Control Reports in accordance with approved Environmental Protection Plan.

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QUALITY CONTROL

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for inspections, test reports, and contractor obligations for establishing effective quality assurance procedures.

The requirements of this Section apply to, and are a component part of, each section of the specifications.

1.2 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Submit the following items in accordance with paragraph entitled, "Records," of this section.

Quality Control Data

Quality Control Coordinating Actions

Quality Control Training

Inspection Records

Letters of Authority or Delegation

Field Tests
Factory Tests

SD-07 Certificates

Submit a detailed written statement describing procedures that will be implemented to achieve quality on the project according to the paragraph entitled, "Quality Assurance (QA) Plan," of this section.

Submit the following in accordance with paragraph entitled, "Qualifications," of this section.

Contractor's Quality Representative Qualifications

Special Certifications

1.2.1 Quality Assurance (QA) Plan

Address the following within the QA Plan:

Description of the authority, responsibilities and coordinating procedures, of on-site/off-site quality assurance personnel, including those QA personnel not under direct control of the Contractor.

List personnel designated by the Contractor to accomplish the work required by the contract.

Provide an appendix with a copy of each form, report format, or similar record to be used in the QA program.

Contractor's organization that handles construction contract activities.

Contractor's operational plan for accomplishing and reviewing work controls, fabrication controls, certifications, and documentation of quality control operations, inspections, and test records, including those for subcontractors.

Include within these provisions the methods to be used during the procurement cycle (order to delivery) for those materials or equipment that require source inspections, shop fabrications, or similar operations located separately from the work site.

Description of on-site personnel training.

Certification(s) of personnel, procedures, processes, and equipment.

Nondestructive testing requirements.

Identification of independent certifying and testing laboratories.

1.2.2 Records

Include all quality control data; factory tests or manufacturer's certifications, quality control coordinating actions; records of quality control training/certifications as well as routine hydrostatic, electrical continuity, grounding, welding, line cleaning, field tests and similar tests. Quality records must be available for examination by the COR.

Furnish legible copies of the test and inspection records to the COR. Cover work placement traceable to the contract schedule, specifications and drawings, and must be verified by the Contractor.

Submit for approval, the narrative description of an inspection system which provides for compliance with the quality requirements and technical criteria of the contract within 5 working days after notice to proceed.

Submit Letters of Authority or Delegation outlining the authority and responsibilities of quality control personnel along with a copy of the letter of delegation to the COR that defines delegated duties and responsibilities.

In-process inspection records and control away from the job site may be used as evidence of quality of materials/work and may reduce further inspection or testing after delivery to the job site.

Records of waste and recycling shall be maintained as described in Section 01 74 19 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT.

1.3 QUALITY ASSURANCE

1.3.1 Qualifications

When approval or certification of special processes, operating personnel, and special equipment or procedures is required by the specifications, obtain necessary approvals or special certifications prior to starting the work.

1.3.2 Quality Control Requirements

Provide a quality control program encompassing: selection of construction materials and sources; suppliers; subcontractors; on-site and off-site fabrication of Contractor-furnished assemblies; on-site and off-site assembly; erection; work procedures; workmanship; inspection; and testing.

Provide document systems ensuring that quality provisions of contract schedule, specifications, and drawings have been performed.

1.3.2.1 Management and Organization

Designate an individual within the on-site organization whose responsibility is the day-to-day on-site management and direction of the Quality Program including quality control of any work performed by subcontractors.

The Quality Program Manager will report to the Contractor's management and have the necessary authority to discharge contractual responsibilities.

1.3.2.2 Identification and Data Retrieval

Provide an identification and data retrieval system.

Records, drawings, submittals, and equipment must be identified by referencing the Contract Number; Contract Specification Number; Contract Drawing Number; Submittal Document Number; Contract Change Number; and the Contractor's Drawing Number System.

1.3.2.3 Procurement

Contractor is responsible for controlling procurement sources and those of his subcontractors to ensure that each purchase meets quality requirements.

1.3.2.4 Receiving Inspection System

Maintain a site receiving inspection system that ensures procured materials and equipment are inspected and tested.

Receiving inspection records must accompany each procurement delivery to the construction site. Maintain records of site receiving inspections.

Show defects, discrepancies, dispositions, and waivers, including evidence of Government source inspection within the records. When waivers are required the COR shall provide form ARC 762.

1.3.2.5 Nonconforming Articles and Material Control

Control nonconformances discovered by the Contractor, subcontractors, suppliers or Government quality representatives to prevent their use and to

correct deficient operations.

a. Prepare a "nonconformance" report for each instance comprising:

1. A unique and traceable number.

2. Identification of the nonconforming article or material.

3. A description of the nonconformance and the applicable requirement.

4. Cause or reason for the nonconformance.

5. Remedial actions taken or recommended.

6. Disposition of the nonconforming article or material.

b. Identify and mark each nonconforming article for removal from the work area.

c. Monitor and correct deficient operations.

1.3.2.6 Fabrication, Process, and Work Control

Ensure compliance of requirements in contract specifications and drawings with procedures and controls.

Establish in-process inspections, to ensure compliance with quality requirements.

1.3.2.7 Quality Control Records

Maintain Quality Control records at a central on-site location.

Maintenance of quality control records do not relieve the Contractor from submitting samples, test data, detail drawings, material certificates, or other information required by each section in the specification.

Ensure each record is identified and traceable to specific requirements in the specifications and drawings.

1.3.2.8 Drawings and Change Control

Maintain drawing-control system to provide revised drawings and ensure continuous removal of obsolete drawings from work areas. Control changes involving interface with other work areas, or affecting materials controlled by others. Integrate this system with the document requirements of the contract.

Clearly annotate and identify drawing changes and associated drawings for implementation that are to be revised accordingly. Use for fabrication and inspection drawings that have been approved, or approved as noted, by the COR.

1.3.3 Quality Inspections

1.3.3.1 Government Inspections

Work performed under this contract will be subject to verification and/or inspection by the COR. Changes to the specifications or drawings will not

be allowed without written authorization of the COR.

When the COR determines that inspected work needs to be corrected, the COR will be allowed 24 hours to complete reinspection of the corrected work.

Notify COR in writing before backfilling or encasing any underground utility so that work may be inspected. Failure to notify the COR before backfill or encasement occurs will require the work be uncovered at no additional cost to the Government.

Contractor's program is subject to continuous evaluation, review, and verification by the COR. Contractor will be notified in writing of any noncompliance and will be given 3 working days to correct identified deficiencies.

1.3.3.2 Contractor's Quality Inspections

Implement an inspection system that Documents and indicates quality control through records of inspections, tests, and procedures.

Include the following within the Contractor's Quality Assurance System:

a. Single Contractor's representative responsible for on-site communication and operation of the inspection program.

b. Purchasing control system documenting project procurement to drawings, specifications, and approved submittals.

c. Receiving inspection system documenting inspections for each procurement.

d. Documentation for handling and disposing of nonconforming components and materials.

e. Inspection records for each specific section of the specification and drawings.

f. Identification of test(s) to be performed, test procedures, records, and independent organizations used.

g. Documenting and maintaining certification or re-certification of procedures.

h. Management of government-furnished equipment, components, and materials.

i. Calibration of gages, tools, measuring instruments, and independent laboratories used.

Establish a system of scheduled or random audits to ensure task completion.

1.3.4 Field Services

1.3.4.1 Responsibility for Inspection and Testing

Contractor is responsible for all inspections and tests, and the accompanying documentation for each inspection and test. The Contractor shall utilize independent inspection and testing laboratories or services as approved by the COR.

Contractor is also be responsible for tests of construction materials utilizing the services of an approved independent testing laboratory.

1.3.4.2 Inspection and Test Records

Provide on-site records of each inspection and test performed throughout the life of the contract including, but not be limited to, factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved, identification of operators and inspectors, result of inspections or tests, nature of defects, causes for rejection, proposed remedial action, and corrective actions taken.

Inspection records, test procedures, test results, and associated forms be verified by and provided to the COR. Final test data must have a cover letter/sheet clearly marked with the system name, date, and the words "Final Test Data".

1.4 HANDLING AND STORAGE

Provide controls, procedures and documentation with each shipment, that meet requirements of each section of the specifications.

Include documentation with each shipment that consist of documentation required by the contract along with specifications required to identify, store, preserve, operate, and maintain the items shipped.

1.5 SEQUENCING AND SCHEDULING

Notify the Government at least 3 working days prior to scheduled inspections and tests.

Provide 10 working days notice to the Government of the date when the contract work will begin at the site.

When Contractor suspends work for 3 working days or longer prior to completion notify the COR. Do not resume work without notification of the COR.

Notify the COR at least 1 working day in advance of backfilling or encasing any underground utility.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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SECTION 01 50 00

TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for temporary construction facilities, safety systems, construction traffic provisions, construction signage and controls over contractor operations required for use in all projects.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C511	Standard for Reduced-Pressure Principle Backflow Prevention Assembly

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR List	List of Approved Backflow Prevention Assemblies
FCCCHR Manual	Manual of Cross-Connection Control

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 241	Standard for Safeguarding Construction,Alteration, and Demolition Operations

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	ational Electrical Code

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	Obstruction Marking and Lighting

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Construction site plan
Traffic control plan

1.4 CONSTRUCTION SITE PLAN

Prior to the start of work, submit a site plan showing the locations and dimensions of temporary facilities (including layouts and details, equipment and material storage area (onsite and offsite), and access and haul routes, avenues of ingress/egress to the fenced area and details of the fence installation. Identify any areas which may have to be graveled to prevent the tracking of mud. Indicate if the use of a supplemental or other staging area is desited. Show locations of safety and construction fences, site trailers, construction entrances, trash dumpsters, temporary sanitary facilities, and worker parking areas.

PART 2 PRODUCTS

2.1 TEMPORARY SIGNAGE

2.1.1 Bulletin Board

Immediately upon beginning of work, provide a weatherproof glass-covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the contract, Wage Rate Information poster, and other information approved by the COR. Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, as approved by the COR.

2.1.2 Advertising Signage

Advertisement signage shall not be erected.

2.2 TEMPORARY TRAFFIC CONTROL

2.2.1 Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic barricades will be required. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

2.2.2 Fencing

a. Provide fencing along the construction site at all open excavations and tunnels to control access by unauthorized people. Fencing must be installed to be able to restrain a force of at least 250 pounds against it.

b. Enclose the outdoor project work area and Contractor lay-down area with

an 8 ft high chain link fence and gates. Remove the fence upon completion and acceptance of the work.

2.2.3 Temporary Wiring

Provide temporary wiring in accordance with NFPA 241 and CEC and NFPA 70, Article 305-6(b), Assured Equipment Grounding Conductor Program. Include frequent inspection of all equipment and apparatus.

PART 3 EXECUTION

3.1 EMPLOYEE PARKING

Contractor employees will park privately owned vehicles in an area designated by the COR. This area will be within reasonable walking distance of the construction site. Contractor employee parking must not interfere with existing and established parking requirements of the government installation.

3.2 AVAILABILITY AND USE OF UTILITY SERVICES

3.2.1 Temporary Utilities

Provide temporary utilities required for construction. Materials may be new or used, must be adequate for the required usage, not create unsafe conditions, and not violate applicable codes and standards.

3.2.2 Electricity

Provide connections, sized to provide service required for power and lighting. Locate feeder and branch wiring with area distribution boxes so that power is available throughout the project site by use of power cords. Provide lighting as required for safe and secure operations. Electricity used will be furnished by the Government. Maximum power supplied by the Government will be 120V/1PH.

3.2.3 Water

Make connections to existing facilities to provide water for construction purposes. Water used will be furnished by the Government. Any water provided by the Government will be protected by an air gap.

3.2.4 Sanitation

a. Provide and maintain within the construction area minimum field-type sanitary facilities approved by the COR and periodically empty wastes into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Obtain approval from the system owner prior to discharge into any municipal, district, or commercial sanitary sewer system. Any penalties and/or fines associated with improper discharge will be the responsibility of the Contractor. Coordinate with the COR and follow station regulations and procedures when discharging into the station sanitary sewer system. Maintain these conveniences at all times without nuisance. Include provisions for pest control and elimination of odors. Government toilet facilities will not be available to Contractor's personnel.

b. Provide temporary sewer and sanitation facilities that are self-contained units with both urinals and stool capabilities.

Ventilate the units to control odors and fumes and empty and clean them at least once a week or more often if required by the COR. The doors shall be self-closing. The exterior of the unit shall match the base standard color. Locate the facility behind the construction fence or out of the public view.

3.2.5 Telephone

Make arrangements and pay all costs for telephone facilities desited.

3.2.6 Obstruction Lighting of Cranes

Provide a minimum of 2 aviation red or high intensity white obstruction lights on temporary structures (including cranes) over 100 feet above ground level. Light construction and installation must comply with FAA AC 70/7460-1. Lights must be operational during periods of reduced visibility, darkness, and as directed by the COR.

3.2.7 Fire Protection

Provide temporary fire protection equipment for the protection of personnel and property during construction. Remove debris and flammable materials daily to minimize potential hazards.

3.3 TRAFFIC PROVISIONS

3.3.1 Maintenance of Traffic

a. Conduct operations in a manner that will not close any thoroughfare or interfere in any way with traffic on railways or highways except with written permission of the COR at least 10 working days prior to the proposed modification date, and provide a Traffic Control Plan detailing the proposed controls to traffic movement for approval. The plan must be in accordance with State and local regulations. Make all notifications and obtain any permits required for modification to traffic movements outside NASA's jurisdiction. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.

b. Conduct work so as to minimize obstruction of traffic, and maintain traffic on at least half of the roadway width at all times. Obtain approval from the COR prior to starting any activity that will obstruct traffic.

c. Provide, erect, and maintain, at contractors expense, lights, barriers, signals, passageways, detours, and other items, that may be required by the Life Safety Signage, overhead protection authority having jurisdiction.

3.3.2 Protection of Traffic

Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the COR. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment the work, and the erection and maintenance of adequate warning, danger, and direction signs, will be as required by the State and local authorities having jurisdiction. Protect the traveling public from damage to person and property. Minimize the interference with

public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit. Contractor is responsible for the repair of any damage to roads caused by construction operations.

3.3.3 Rush Hour Restrictions

Do not interfere with the peak traffic flows preceding and during normal operations for Bush Circle and the Main Gate without notification to and approval by the COR.

3.3.4 Dust Control

Dust control methods and procedures must be approved by the COR. Treat dust abatement on access roads with applications of calcium chloride, water sprinklers, or similar methods or treatment.

3.4 CONTRACTOR'S TEMPORARY FACILITIES

3.4.1 Safety

Protect the integrity of any installed safety systems or personnel safety devices. If entrance into systems serving safety devices is required, the Contractor must obtain prior approval from the COR. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and obtain approval from the COR.

3.4.2 Administrative Field Offices

The Contractor may, at its option and the COR's discretion, furnish and maintain a trailer-type mobile office acceptable to the and providing as a minimum the facilities specified above. The trailer must be at least 20 feet from existing buildings.

3.4.3 Trailers or Storage Buildings

Trailers or storage buildings will be permitted, where space is available, subject to the approval of the COR. The trailers or buildings shall be in good condition, free from visible damage rust and deterioration, and meet all applicable safety requirements. Trailers shall be roadworthy and comply with all appropriate state and local vehicle requirements. Failure to maintain storage trailers or buildings to these standards shall result in the removal of non-complying units at the Contractor's expense. A sign not smaller than 24 by 24 inches shall be conspicuously placed on the trailer depicting the company name, business phone number, and emergency phone number. Trailers shall be anchored to resist high winds and must meet applicable state of local standards for anchoring mobile trailers.

3.4.4 Storage Area

Construct a temporary 6 foot high chain link fence around materials. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Do not place or store Trailers, materials, or equipment outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the COR away from the vicinity of the construction site but within the installation boundaries. Trailers, equipment, or materials must not be open to public view with the exception

of those items which are in support of ongoing work on any given day. Do not stockpile materials outside the fence in preparation for the next day's work. Park mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment within the fenced area at the end of each work day.

3.4.5 Supplemental Storage Area

Upon Contractor's request, the COR will designate another or supplemental area for the Contractor's use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but will be within the installation boundaries. Fencing of materials or equipment will not be required at this site; however, the Contractor is responsible for cleanliness and orderliness of the area used and for the security of any material or equipment stored in this area. Utilities will not be provided to this area by the Government.

3.4.6 Appearance of Trailers

a. Trailers utilized by the Contractor for administrative or material storage purposes must present a clean and neat exterior appearance and be in a state of good repair. Trailers which, in the opinion of the COR, require exterior painting or maintenance will not be allowed on installation property.

3.4.7 Maintenance of Storage Area

a. Keep fencing in a state of good repair and proper alignment. Grassed or unpaved areas, which are not established roadways, will be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways, should the Contractor elect to traverse them with construction equipment or other vehicles; gravel gradation will be at the Contractor's discretion. Mow and maintain grass located within the boundaries of the construction site for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers will be edged or trimmed neatly.

b. Cut grass (or annual weeds) within the construction and storage sites to a maximum 4 inch height at least once a week during the growing season unless the grass area is not visible to the public. Trim the grass around fences at time of grass cutting. Maintain grass or weeds on stockpiled earth as descried above.

3.4.8 Security Provisions

Provide adequate outside security lighting at the Contractor's temporary facilities. The Contractor will be responsible for the security of its own equipment; in addition, the Contractor will notify the appropriate law enforcement agency requesting periodic security checks of the temporary project field office.

3.4.9 Weather Protection of Temporary Facilities and Stored Materials

Take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday. Ensure that the openings are

completely sealed off to protect materials and equipment in the building from damage.

3.5 TEMPORARY PROJECT SAFETY FENCING

At the COR's discretion, but not later than 10 working days after the date established for commencement of work, furnish and erect temporary project safety fencing at the work site. The safety fencing must be a high visibility orange colored, high density polyethylene grid or approved equal, a minimum of 42 inches high, supported and tightly secured to steel posts located on maximum 10 foot centers, constructed at the approved location. Maintain the safety fencing during the life of the contract and, upon completion and acceptance of the work, will become the property of the Contractor and be removed from the work site.

3.6 CLEANUP

Remove construction debris, waste materials, packaging material and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store within the fenced area described above or at the supplemental storage area any materials resulting from demolition activities which are salvageable. Neatly stacked stored materials not in trailers, whether new or salvaged.

3.7 RESTORATION OF STORAGE AREA

Upon completion of the project remove the bulletin board, signs, barricades, haulroads, and any other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence that will become the property of the Contractor. Restore to the original or better condition, areas used by the Contractor for the storage of equipment or material, or other use. Gravel used to traverse grassed areas must be removed and the area restored to its original condition, including top soil and seeding as necessary.

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SECTION 01 57 19.00 20

TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for environmental protection and other environmental temporary controls.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 530/F-93/004	Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
EPA 833-R-060-04	Developing Your Storm Water Pollution Prevention Plan, a Guide for Construction Sites

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
40 CFR 112	Oil Pollution Prevention
40 CFR 122.26	Storm Water Discharges (Applicable to State NPDES Programs, see section 123.25)
40 CFR 241	Guidelines for Disposal of Solid Waste
40 CFR 243	Guidelines for the Storage and Collection of Residential, Commercial, and Institutional Solid Waste
40 CFR 258	Subtitle D Landfill Requirements
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous

	Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Permit Program
40 CFR 271	Requirements for Authorization of State Hazardous Waste Programs
40 CFR 272	Approved State Hazardous Waste Management Programs
40 CFR 273	Standards For Universal Waste Management
40 CFR 279	Standards for the Management of Used Oil
40 CFR 280	Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks (UST)
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 355	Emergency Planning and Notification
40 CFR 372-SUBPART D	Specific Toxic Chemical Listings
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
40 CFR 82	Protection of Stratospheric Ozone
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements

49 CFR 173	Shippers - General Requirements for Shipments and Packagings
49 CFR 178	Specifications for Packagings

BAY AREA AIR QUALITY MANAGEMENT DISTRICT (Bay Area AQMD)

Regulation 2, Rule 1	General Requirements
Regulation 2, Rule 2	New Source Review
Regulation 3	Fees
Regulation 8, Rule 3	Architectural Coatings
Regulation 8, Rule 19	Surface Preparation of Miscellaneous Metal Parts and Products
Regulation 8, Rule 49	Aerosol Paint Products
Regulation 8, Rule 51	Adhesive and Sealant Products
Regulation 9, Rule 6	NOx Emissions from Natural Gas-Fired Boilers and Water Heaters
Regulation 9, Rule 7	NOx and CO from Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters
Regulation 11, Rule 1	Lead
Regulation 12, Rule 4	Sandblasting

CALIFORNIA CODE OF REGULATIONS (CCR)

CCR Title 22, Division 4.5	Hazardous Waste Management
CCR title 66265.16	Generator Training

SANTA CLARA COUNTY (SCC)

NS-517.31	Santa ClaraCounty Hazardous Materials Storage Ordinance
Sunnyvale Municipal Code 12	City of Sunnyvale Waters and Sewer Ordinance
Palo Alto Chapter 16	City of Palo Alto Sewer Use Ordinance
NS-517.44	Santa Clara County Toxic Gas Ordinance

1.3 DEFINITIONS

1.3.1 Sediment

Soil and other debris that have eroded and have been transported by runoff water or wind.

1.3.2 Solid Waste

Garbage, refuse, debris, sludge, or other discharged material, including solid, liquid, semisolid, or contained gaseous materials resulting from domestic, industrial, commercial, mining, or agricultural operations. Types of solid waste typically generated at construction sites may include:

a. Green waste: The vegetative matter from landscaping, land clearing and grubbing, including, but not limited to, grass, bushes, scrubs, small trees and saplings, tree stumps and plant roots. Marketable trees, grasses and plants that are indicated to remain, be re-located, or be re-used are not included.

b. Surplus soil: Existing soil that is in excess of what is required for this work, including aggregates intended, but not used, for on-site mixing of concrete, mortars and paving. Contaminated soil meeting the definition of hazardous material or hazardous waste is not included.

c. Debris: Non-hazardous solid material generated during the construction, demolition, or renovation of a structure which exceeds 2.5 inch particle size that is: a manufactured object; plant or animal matter; or natural geologic material (e.g. cobbles and boulders), broken or removed concrete, masonry, and rock asphalt paving; ceramics; roofing paper and shingles. Inert materials may be reinforced with or contain ferrous wire, rods, accessories and weldments. A mixture of debris and other material such as soil or sludge is also subject to regulation as debris if the mixture is comprised primarily of debris by volume, based on visual inspection.

d. Wood: Dimension and non-dimension lumber, plywood, chipboard, hardboard. Treated and/or painted wood that meets the definition of lead contaminated or lead based contaminated paint is not included.

e. Scrap metal: Scrap and excess ferrous and non-ferrous metals such as reinforcing steel, structural shapes, pipe and wire that are recovered or collected and disposed of as scrap. Scrap metal meeting the definition of hazardous material or hazardous waste is not included.

f. Paint cans: Metal cans that are empty of paints, solvents, thinners and adhesives. If permitted by the paint can label, a thin dry film may remain in the can.

g. Recyclables: Materials, equipment and assemblies such as doors, windows, door and window frames, plumbing fixtures, glazing and mirrors that are recovered and sold as recyclable. Metal meeting the definition of lead contaminated or lead based paint contaminated may not be included as recyclable if sold to a scrap metal company. Paint cans may not be included as recyclable if sold to a scrap metal company.

h. Hazardous Waste: By definition, to be a hazardous waste a material must first meet the definition of a solid waste. Hazardous waste and hazardous debris are special cases of solid waste. They have additional regulatory controls and must be handled separately. They are thus defined separately in this document.

Material not regulated as solid waste are: nuclear source or byproduct materials regulated under the Federal Atomic Energy Act of 1954 as amended; suspended or dissolved materials in domestic sewage effluent or irrigation return flows, or other regulated point source discharges;

regulated air emissions; and fluids or wastes associated with natural gas or crude oil exploration or production.

1.3.3 Hazardous Debris

As defined in Solid Waste paragraph, debris that contains listed hazardous waste (either on the debris surface, or in its interstices, such as pore structure) per 40 CFR 261; or debris that exhibits a characteristic of hazardous waste per 40 CFR 261.

1.3.4 Chemical Wastes

This includes salts, acids, alkalizes, herbicides, pesticides, and organic chemicals.

1.3.5 Garbage

Refuse and scraps resulting from preparation, cooking, dispensing, and consumption of food.

1.3.6 Hazardous Waste

Any discarded material, liquid, solid, or gas, which meets the definition of hazardous material or is designated hazardous waste by the Environmental Protection Agency or State Hazardous Control Authority as defined in 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, 40 CFR 268, 40 CFR 270, 40 CFR 271, 40 CFR 272, 40 CFR 273, 40 CFR 279, and 40 CFR 280.

1.3.7 Hazardous Materials

Hazardous materials as defined in 49 CFR 171 and listed in 49 CFR 172 and State and Local regulations.

Hazardous material is any material that:

a. Is regulated as a hazardous material per 49 CFR 173, or

b. Requires a Material Safety Data Sheet (MSDS) per 29 CFR 1910.120, or

c. During end use, treatment, handling, packaging, storage, transpiration, or disposal meets or has components that meet or have potential to meet the definition of a hazardous waste as defined by 40 CFR 261 Subparts A, B, C, or D.

Designation of a material by this definition, when separately regulated or controlled by other instructions or directives, does not eliminate the need for adherence to that hazard-specific guidance which takes precedence over this instruction for "control" purposes. Such material include ammunition, weapons, explosive actuated devices, propellants, pyrotechnics, chemical and biological warfare materials, medical and pharmaceutical supplies, medical waste and infectious materials, bulk fuels, radioactive materials, and other materials such as asbestos, mercury, and polychlorinated biphenyls (PCBs). Nonetheless, the exposure may occur incident to manufacture, storage, use and demilitarization of these items.

1.3.8 Waste Hazardous Material (WHM)

Any waste material which because of its quantity, concentration, or

physical, chemical, or infectious characteristics may pose a substantial hazard to human health or the environment and which has been so designated. Used oil not containing any hazardous waste, as defined above, falls under this definition.

1.3.9 Oily Waste

Those materials which are, or were, mixed with used oil and have become separated from that used oil. Oily wastes also means materials, including wastewaters, centrifuge solids, filter residues or sludges, bottom sediments, tank bottoms, and sorbents which have come into contact with and have been contaminated by, used oil and may be appropriately tested and discarded in a manner which is in compliance with other State and local requirements.

Large quantities of this material, generated as a result of a major spill or in lieu of proper maintenance of the processing equipment, are a solid waste. As a solid waste, a hazardous waste determination must be performed prior to disposal. As this can be an expensive process, it is recommended that this type of waste be minimized through good housekeeping practices and employee education.

1.3.10 Regulated Waste

Those solid waste that have specific additional Federal, state, or local controls for handling, storage, or disposal.

1.3.11 Class I Ozone Depleting Substance (ODS)

Class I ODS is defined in Section 602(a) of The Clean Air Act and includes the following chemicals:

chlorofluorocarbon-11 (CFC-11)
chlorofluorocarbon-12 (CFC-12)
chlorofluorocarbon-13 (CFC-13)
chlorofluorocarbon-111 (CFC-111)
chlorofluorocarbon-112 (CFC-112)
chlorofluorocarbon-113 (CFC-113)
chlorofluorocarbon-114 (CFC-114)
chlorofluorocarbon-115 (CFC-115)
chlorofluorocarbon-211 (CFC-211)
chlorofluorocarbon-212 (CFC-212)
chlorofluorocarbon-213 (CFC-213)
chlorofluorocarbon-214 (CFC-214)
chlorofluorocarbon-215 (CFC-215)
chlorofluorocarbon-216 (CFC-216)
chlorofluorocarbon-217 (CFC-217)
chlorofluorocarbon-500 (CFC-500)
chlorofluorocarbon-502 (CFC-502)
chlorofluorocarbon-503 (CFC-503)
halon-1211
halon-1301
halon-2402
carbon tetrachloride
methyl bromide
methyl chloroform

Class II ODS is defined in Section 602(s) of The Clean Air Act and includes the following chemicals:

hydrochlorofluorocarbon-21 (HCFC-21)
hydrochlorofluorocarbon-22 (HCFC-22)
hydrochlorofluorocarbon-31 (HCFC-31)
hydrochlorofluorocarbon-121 (HCFC-121)
hydrochlorofluorocarbon-122 (HCFC-122)
hydrochlorofluorocarbon-123 (HCFC-123)
hydrochlorofluorocarbon-124 (HCFC-124)
hydrochlorofluorocarbon-131 (HCFC-131)
hydrochlorofluorocarbon-132 (HCFC-132)
hydrochlorofluorocarbon-133 (HCFC-133)
hydrochlorofluorocarbon-141 (HCFC-141)
hydrochlorofluorocarbon-142 (HCFC-142)
hydrochlorofluorocarbon-221 (HCFC-221)
hydrochlorofluorocarbon-222 (HCFC-222)
hydrochlorofluorocarbon-223 (HCFC-223)
hydrochlorofluorocarbon-224 (HCFC-224)
hydrochlorofluorocarbon-225 (HCFC-225)
hydrochlorofluorocarbon-226 (HCFC-226)
hydrochlorofluorocarbon-231 (HCFC-231)
hydrochlorofluorocarbon-232 (HCFC-232)
hydrochlorofluorocarbon-233 (HCFC-233)
hydrochlorofluorocarbon-234 (HCFC-234)
hydrochlorofluorocarbon-235 (HCFC-235)
hydrochlorofluorocarbon-241 (HCFC-241)
hydrochlorofluorocarbon-242 (HCFC-242)
hydrochlorofluorocarbon-243 (HCFC-243)
hydrochlorofluorocarbon-244 (HCFC-244)
hydrochlorofluorocarbon-251 (HCFC-251)
hydrochlorofluorocarbon-252 (HCFC-252)
hydrochlorofluorocarbon-253 (HCFC-253)
hydrochlorofluorocarbon-261 (HCFC-261)
hydrochlorofluorocarbon-262 (HCFC-262)
hydrochlorofluorocarbon-271 (HCFC-271)

1.3.11.1 Universal Waste

The universal waste regulations streamline collection requirements for certain hazardous wastes in the following categories: batteries, pesticides, mercury-containing equipment (e.g., thermostats) and lamps (e.g., fluorescent bulbs). The rule is designed to reduce hazardous waste in the municipal solid waste (MSW) stream by making it easier for universal waste handlers to collect these items and send them for recycling or proper disposal. These regulations can be found at 40 CFR 273.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Preconstruction Survey

Solid Waste Management Plan and Permit

Regulatory Notifications

Environmental Management Plan

Storm Water Pollution Prevention Plan

Storm Water Notice of Intent (for NPDES coverage under the general permit for construction activities)

Dirt and Dust Control Plan

Contractor Hazardous Material Inventory Log

SD-06 Test Reports

Laboratory Analysis

Disposal Requirements

Erosion and Sediment Control Inspection Reports

Storm Water Inspection Reports for General Permit

Contractor 40 CFR employee training records

Solid Waste Management Report; G

SD-11 Closeout Submittals

Some of the records listed below are also required as part of other submittals. For the "Records" submittal, maintain on-site a separate three-ring Environmental Records binder and submit at the completion of the project. Make separate parts to the binder corresponding to each of the applicable sub items listed below.

Storm Water Pollution Prevention Plan compliance notebook

Waste Determination Documentation

Disposal Documentation for Hazardous and Regulated Waste

Contractor 40 CFR Employee Training Records

Solid Waste Management Permit

Solid Waste Management Report

Contractor Hazardous Material Inventory Log

Hazardous Waste/Debris Management

Regulatory Notifications

1.5 ENVIRONMENTAL PROTECTION REQUIREMENTS

Provide and maintain, during the life of the contract, environmental protection as defined. Plan for and provide environmental protective measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with Federal, State, and local regulations pertaining to the environment,

including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.

The Contractor may be required to promptly conduct tests and procedures for the purpose of assessing whether construction operations are in compliance with Applicable Environmental Laws. Analytical work shall be done by qualified laboratories; and where required by law, the laboratories shall be certified.

1.5.1 Conformance with the Environmental Management System

The Contractor shall perform work under this contract consistent with the policy and objectives identified in the installation's Environmental Management System (EMS). The Contractor shall perform work in a manner that conforms to objectives and targets, environmental programs and operational controls identified by the EMS. The Contractor will provide monitoring and measurement information as necessary to address environmental performance relative to environmental, energy, and transportation management goals. In the event an EMS nonconformance or environmental noncompliance associated with the contracted services, tasks, or actions occurs, the Contractor shall take corrective and/or preventative actions. In addition, the Contractor shall ensure that its employees are aware of their roles and responsibilities under the EMS and how these EMS roles and responsibilities affect work performed under the contract.

The Contractor is responsible for ensuring that their employees receive applicable environmental and occupational health and safety training, and keep up to date on regulatory required specific training for the type of work to be conducted onsite. All on-site Contractor personnel, and their subcontractor personnel, performing tasks that have the potential to cause a significant environmental impact shall be competent on the basis of appropriate education, training or experience. Upon contract award, the COR's Representative will notify the installation's EMS coordinator to arrange EMS training. The installation's EMS coordinator shall identify training needs associated with environmental aspects and the EMS, and arrange training or take other action to meet these needs. The Contractor shall provide training documentation to the COR. The EMS coordinator shall retain associated records.

1.6 QUALITY ASSURANCE

1.6.1 Preconstruction Survey

Perform a Preconstruction Survey of the project site with the COR, and take photographs showing existing environmental conditions in and adjacent to the site. Submit a report for the record.

1.6.2 Regulatory Notifications

The Contractor is responsible for all regulatory notification requirements in accordance with Federal, State and local regulations. In cases where must also provide public notification (such as stormwater permitting), the Contractor must coordinate with the COR. The Contractor shall submit copies of all regulatory notifications to the COR prior to commencement of work activities. Typically, regulatory notifications must be provided for the following (this listing is not all inclusive): demolition, renovation, NPDES defined site work, remediation of controlled substances (asbestos, hazardous waste, lead paint).

1.6.3 Environmental Brief

Attend an environmental brief to be included in the preconstruction meeting. Provide the following information: types, quantities, and use of hazardous materials that will be brought onto the activity; types and quantities of wastes/wastewater that may be generated during the contract. Discuss the results of the Preconstruction Survey at this time.

Prior to initiating any work on site, meet with the COR and activity environmental staff to discuss the proposed Environmental Management Plan. Develop a mutual understanding relative to the details of environmental protection, including measures for protecting natural resources, required reports, required permits, permit requirements, and other measures to be taken.

1.6.4 Environmental Manager

Appoint in writing an Environmental Manager for the project site. The Environmental Manager will be directly responsible for coordinating contractor compliance with Federal, State, local, and station requirements. The Environmental Manager will ensure compliance with Hazardous Waste Program requirements (including hazardous waste handling, storage, manifesting, and disposal); implement the Environmental Management Plan; ensure that all environmental permits are obtained, maintained, and closed out; ensure compliance with Storm Water Program Management requirements; ensure compliance with Hazardous Materials (storage, handling, and reporting) requirements; and coordinate any remediation of regulated substances (lead, asbestos, PCB transformers). This can be a collateral position; however the person in this position must be trained to adequately accomplish the following duties: ensure waste segregation and storage compatibility requirements are met; inspect and manage Satellite Accumulation areas; ensure only authorized personnel add wastes to containers; ensure all Contractor personnel are trained in 40 CFR requirements in accordance with their position requirements; coordinate removal of waste containers; and maintain the Environmental Records binder and required documentation, including environmental permits compliance and close-out.

1.6.5 Contractor 40 CFR Employee Training Records

Prepare and maintain employee training records throughout the term of the contract meeting applicable 40 CFR requirements. The Contractor will ensure every employee completes a program of classroom instruction or on-the-job training that teaches them to perform their duties in a way that ensures compliance with Federal, State and local regulatory requirements for RCRA Large Quantity Generator. The Contractor will provide a Position Description for each employee, by subcontractor, based on the Davis-Bacon Wage Rate designation or other equivalent method, evaluating the employee's association with hazardous and regulated wastes. This Position Description will include training requirements as defined in 40 CFR 265 for a Large Quantity Generator facility. Submit these training records to the COR at the conclusion of the project, unless otherwise directed.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 ENVIRONMENTAL MANAGEMENT PLAN

Prior to initiating any work on site, the Contractor will meet with the COR to discuss the proposed Environmental Protection Plan and develop a mutual understanding relative to the details of environmental protection, including measures for protecting natural resources, required reports, and other measures to be taken. The Contractor's Environmental Plan shall incorporate construction related objectives and targets from the installation's Environmental Management System. The Environmental Management Plan will be submitted in the following format and shall include the elements specified below.

a. Description of the Environmental Management Plan

1. General overview and purpose

(a) A brief description of each specific plan required by environmental permit or elsewhere in this contract.

(b) The duties and level of authority assigned to the person(s) on the job site that oversee environmental compliance.

(c) A copy of any standard or project specific operating procedures that will be used to effectively manage and protect the environment on the project site.

(d) Communication and training procedures that will be used to convey environmental management requirements to contractor employees and subcontractors.

(e) Emergency contact information contact information (office phone number, cell phone number, and e-mail address).

2. General site information

b. Management of Natural Resources

1. Land resources

2. Tree protection

3. Replacement of damaged landscape features

4. Temporary construction

5. Stream crossings

6. Fish and wildlife resources

7. Wetland areas

c. Protection of Historical and Archaeological Resources

1. Objectives

2. Methods

d. Storm Water Management and Control

1. Ground cover

2. Erodible soils

3. Temporary measures

(a) Mechanical retardation and control of runoff

(b) Vegetation and mulch

(4) Effective selection, implementation and maintenance of Best Management Practices (BMPs).

e. Protection of the Environment from Waste Derived from Contractor Operations

1. Control and disposal of solid and sanitary waste. If Section 01 74 19.05 20 is included in the contract, submit the plan required by that section as part of the Environmental Management Plan.

2. Control and disposal of hazardous waste (Hazardous Waste Management Section)

This item will consist of the management procedures for all hazardous waste to be generated. The elements of those procedures will coincide with the Activity Hazardous Waste Management Plan. As a minimum, include the following:

(a) Procedures to be employed to ensure a written waste determination is made for appropriate wastes which are to be generated;

(b) Sampling/analysis plan;

(c) Methods of hazardous waste accumulation/storage (i.e., in tanks and/or containers);

(d) Management procedures for storage, labeling, transportation, and disposal of waste (treatment of waste is not allowed unless specifically noted);

(e) Management procedures and regulatory documentation ensuring disposal of hazardous waste complies with Land Disposal Restrictions (40 CFR 268);

(f) Management procedures for recyclable hazardous materials such as lead-acid batteries, used oil, and the like;

(g) Used oil management procedures in accordance with 40 CFR 279;

(h) Pollution prevention\hazardous waste minimization procedures;

(i) Plans for the disposal of hazardous waste by permitted facilities;

(j) Procedures to be employed to ensure all required employee training records are maintained.

f. Prevention of Releases to the Environment

(1) Procedures to prevent releases to the environment

(2) Notifications in the event of a release to the environment

g. Regulatory Notification and Permits

List what notifications and permit applications must be made. Demonstrate that those permits have been obtained by including copies of all applicable, environmental permits.

3.1.1 Environmental Protection Plan Review

Within thirty days after the Contract award date, submit the proposed Environmental Management Plan for further discussion, review, and approval. Commencement of work will not begin until the environmental management plan has been approved.

3.1.2 Licenses and Permits

The following permits will be obtained by the COR:

a. Air permits

b. Santa Clara County Permits (closures, installation, storage of hazardous materials, temporary fuel tanks for generators, air compressors, etc.)

c. Storm water permits (Notice of Intent, Notice of Termination).

d. Water discharge permits (discharges to the local publicly owned treatment works, POTW)

e. Migratory bird permit (if required)

The Contractor must provide all necessary documentation for acquiring the necessary permits. For permits obtained by the COR, whether or not required by the permit, the Contractor is responsible for conforming to all permit requirements and performing all quality control inspections of the work in progress, and to submit notifications and certifications to the applicable regulatory agency via the COR. The Contractor is responsible for obtaining their own permits for their equipment used during construction.

3.2 PROTECTION OF NATURAL RESOURCES

Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work. Confine construction activities to within the limits of the work indicated or specified. If the work is near streams, lakes, or other waterways, conform to the national permitting requirements of the Clean Water Act.

Do not disturb fish and wildlife. Do not alter water flows or otherwise significantly disturb the native habitat adjacent to the project and critical to the survival of fish and wildlife, except as indicated or specified.

Except in areas to be cleared, do not remove, cut, deface, injure, or destroy trees or shrubs without the COR's permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages unless authorized by the COR. Where such use of attached ropes, cables, or guys is authorized, the Contractor will be responsible for any resultant damage.

Protect existing trees which are to remain and which may be injured, bruised, defaced, or otherwise damaged by construction operations. Remove displaced rocks from uncleared areas. By approved excavation, remove trees with 30 percent or more of their root systems destroyed. Remove trees and other landscape features scarred or damaged by equipment operations, and replace with equivalent, undamaged trees and landscape features. Obtain COR's approval before replacement.

The COR's approval is required before any equipment will be permitted to ford live streams. In areas where frequent crossings are required, install temporary culverts or bridges. Obtain COR's approval prior to installation. Remove temporary culverts or bridges upon completion of work, and repair the area to its original condition unless otherwise required by the COR.

3.2.1 Erosion and Sediment Control Measures

3.2.1.1 Burnoff

Burnoff of the ground cover is not permitted.

3.2.1.2 Protection of Erodible Soils

Immediately finish the earthwork brought to a final grade, as indicated or specified. Immediately protect the side slopes and back slopes upon completion of rough grading. Plan and conduct earthwork to minimize the duration of exposure of unprotected soils.

3.2.1.3 Temporary Protection of Erodible Soils

Use the following methods to prevent erosion and control sedimentation:

a. Mechanical Retardation and Control of Runoff

Mechanically retard and control the rate of runoff from the construction site. This includes construction of diversion ditches, benches, berms, and use of silt fences and straw bales to retard and divert runoff to protected drainage courses.

3.2.2 Erosion and Sediment Control Inspection Reports

Note erosion control inspection reports may be compiled as part of a stormwater pollution prevention plan inspection reports if applicable.

3.2.2.1 Storm Water Notice of Intent for Construction Activities and Storm Water Pollution Prevention Plan

The Contractor shall submit a Storm Water Notice of Intent (for NPDES coverage under the general permit for construction activities) and a Storm Water Pollution Prevention Plan (SWPPP) for the project to the COR prior and gain approval prior to the commencement of work. The SWPPP shall meet

the requirements of the California State Water Resources Control Board's Construction General Permit (CAS000002). Submit the SWPPP along with any required Notice of Intents, Notice of Termination, and appropriate permit fees, via the COR, to the appropriate Federal or State agency (Notice of Intent and all applicable Permit Regulation Documents must be sent to California State Water Resources Control Board, along with appropriate fees) for approval, a minimum of 20 working days prior to the start of any land disturbing activities. The Contractor shall maintain an approved copy of the SWPPP at the construction on-site office, and continually update as regulations require, reflecting current site conditions. California now requires an Annual Report to be submitted by September 1st; an annual fee is also required.

Coverage under this permit requires the contractor prepare a Storm Water Pollution Prevention Plan (SWPPP), prepare and submit a Registration Statement as a co-permittee with the Construction Officer, and provide the permit fee to the responsible state agency before any land disturbing activities begin. The Environmental Management Division shall file the Notice of Intent for permit coverage and shall file the Notice of Termination once construction is complete. The contractor shall provide all documentation required to complete these Notices.

Under the terms and conditions of the permit, the Contractor may be required to install, inspect, maintain best management practices (BMPs), and submit stormwater BMP inspection reports and stormwater pollution prevention plan inspection reports. The Contractor shall ensure construction operations and management are constantly in compliance with the terms and conditions of the general permit for storm water discharges from construction activities.

a. The SWPPP shall:

1. Identify potential sources of pollution which may be reasonably expected to affect the quality of storm water discharge from the site.

2. Describe and ensure implementation of practices which will be used to reduce the pollutants in storm water discharge from the site.

3. Ensure compliance with terms of the EPA or State general permit for storm water discharge.

4. Select applicable best management practices from EPA 833-R-060-04.

5. Include a completed copy of the Registration Statement, BMP Inspection Report Template and Notice of Termination except for the effective date.

6. Storm Water Pollution Prevention Measures and Notice of Intent 40 CFR 122.26, EPA 833-R-060-04, and California Construction General Permit. Provide a "Storm Water Pollution Prevention Plan" (SWPPP) for the project. The SWPPP will meet the requirements of the California State Water Resources Control Board Construction General Permit. Submit the SWPPP along with any required Notice of Intents, Notice of Termination, and appropriate permit fees, via the COR, to the appropriate Federal or State agency for approval, a minimum of 10 working days prior to the start of construction. A copy of the approved SWPPP will be kept at the construction on-site office, and continually updated as

regulations require reflecting current site conditions.

3.2.2.2 Storm Water Pollution Prevention Plan Compliance Notebook

The contractor shall create and maintain a three binder of documents that demonstrate compliance with the Stormwater Construction Activity permit. The binder shall include a copy of the permit Registration Statement, proof of permit fee payment, SWPPP and SWPPP update amendments, inspection reports, copies of correspondence with the State Water Resources Control Board and a copy of the permit Notice of Termination. At the completion of the project the folder shall become the property of the Government. The compliance notebook shall be provided to COR. An advance copy of the Registration Statement shall be provided to the COR immediately after the form is presented to the permitting agency.

3.2.3 Stormwater Drainage and Construction Dewatering

There will be no discharge of excavation ground water to the sanitary sewer, storm drains, or to the river without prior specific authorization of the Environmental Division in writing. Discharge of hazardous substances will not be permitted under any circumstances.

Construction site runoff will be prevented from entering any storm drain or the river directly by the use of straw bales or other method suitable to the Environmental Division. Contractor will provide erosion protection of the surrounding soils.

Construction Dewatering shall not be discharged to the sanitary sewer. If the construction dewatering is noted or suspected of being contaminated, it may only be released to the storm drain system if the discharge is specifically permitted. Authorization for any contaminated groundwater release shall be obtained in advance from the base Environmental Officer. Discharge of hazardous substances will not be permitted under any circumstances.

3.3 HISTORICAL AND ARCHAEOLOGICAL RESOURCES

Carefully protect in-place and report immediately to the COR historical and archaeological items or human skeletal remains discovered in the course of work. Upon discovery, notify the COR. Stop work in the immediate area of the discovery until directed by the COR to resume work. The Government retains ownership and control over historical and archaeological resources.

3.4 SOLID WASTE MANAGEMENT PLAN and PERMIT

Provide to the COR written notification of the quantity of solid waste/debris that is anticipated to be generated by construction. Include in the report the locations where various types of waste will be disposed or recycled. Include letters of acceptance or as applicable, submit one copy of a State and local Solid Waste Management Permit or license showing such agency's approval of the disposal plan before transporting wastes off Government property.

3.4.1 Solid Waste Management Report

Monthly, submit a solid waste disposal report to the COR. For each waste, the report will state the classification (using the definitions provided in this section), amount, location, and name of the business receiving the solid waste.

The Contractor will include copies of the waste handling facilities' weight tickets, receipts, bills of sale, and other sales documentation. In lieu of sales documentation, the Contractor may submit a statement indicating the disposal location for the solid waste which is signed by an officer of the Contractor firm authorized to legally obligate or bind the firm. The sales documentation or Contractor certification will include the receiver's tax identification number and business, EPA or State registration number, along with the receiver's delivery and business addresses and telephone numbers. For each solid waste retained by the Contractor for his own use, the Contractor will submit on the solid waste disposal report the information previously described in this paragraph. Prices paid or received will not be reported to the COR unless required by other provisions or specifications of this Contract or public law.

3.4.2 Control and Management of Solid Wastes

Pick up solid wastes, and place in covered containers which are regularly emptied. Do not prepare or cook food on the project site. Prevent contamination of the site or other areas when handling and disposing of wastes. At project completion, leave the areas clean. Recycling is encouraged and can be coordinated with the COR and the activity recycling coordinator. Remove all solid waste (including non-hazardous debris) from Government property and dispose off-site at an approved landfill. Solid waste disposal off-site must comply with most stringent local, State, and Federal requirements including 40 CFR 241, 40 CFR 243, and 40 CFR 258.

Manage spent hazardous material used in construction, including but not limited to, aerosol cans, waste paint, cleaning solvents, contaminated brushes, and used rags, as per environmental law.

3.4.2.1 Dumpsters

Equip dumpsters with a secure cover and paint the standard base color. Keep cover closed at all times, except when being loaded with trash and debris. Locate dumpsters behind the construction fence or out of the public view. Empty site dumpsters at least once a week. or as needed to keep the site free of debris and trash. If necessary, provide 55 gallon trash containers painted the darker base color to collect debris in the construction site area. Locate the trash containers behind the construction fence or out of the public view. Empty trash containers at least once a day. For large demolitions, large dumpsters without lids are acceptable but should not have debris higher than the sides before emptying.

3.5 WASTE DETERMINATION DOCUMENTATION

Complete a Waste Determination form (provided at the pre-construction conference) for all contractor derived wastes to be generated. Base the waste determination upon either a constituent listing from the manufacturer used in conjunction with consideration of the process by which the waste was generated, EPA approved analytical data, or laboratory analysis (Material Safety Data Sheets (MSDS) by themselves are not adequate). Attach all support documentation to the Waste Determination form. As a minimum, a Waste Determination form must be provided for the following wastes (this listing is not all inclusive): oil and latex based painting and caulking products, solvents, adhesives, aerosols, petroleum products, and all containers of the original materials.

3.6 CONTRACTOR HAZARDOUS MATERIAL INVENTORY LOG

Submit the "Contractor Hazardous Material Inventory Log"(found at: http://www.wbdg.org/ccb/NAVGRAPH/graphtoc.pdf), which provides information required by (EPCRA Sections 312 and 313) along with corresponding Material Safety Data Sheets (MSDS) to the COR at the start and at the end of construction (30 days from final acceptance), and update no later than January 31 of each calendar year during the life of the contract. Documentation for any spills/releases, environmental reports or off-site transfers may be requested by the COR.

3.6.1 Disposal Documentation for Hazardous and Regulated Waste

Manifest, pack, ship and dispose of hazardous or toxic waste and universal waste that is generated as a result of construction in accordance with the generating facilities generator status under the Recourse Conservation and Recovery Act. Contact the COR for the facility RCRA identification number that is to be used on each manifest.

Submit a copy of the applicable EPA and or State permit(s), manifest(s), or license(s) for transportation, treatment, storage, and disposal of hazardous and regulated waste by permitted facilities. Hazardous or toxic waste manifest must be reviewed, signed, and approved by the Environmental Management Division's authorized personnel before the Contractor may ship waste. To obtain specific disposal instructions the Contractor must coordinate with the Activity environmental office.

3.7 POLLUTION PREVENTION/HAZARDOUS WASTE MINIMIZATION

Minimize the use of hazardous materials and the generation of hazardous waste. Include procedures for pollution prevention/ hazardous waste minimization in the Hazardous Waste Management Section of the Environmental Management Plan. Consult with the activity Environmental Management Division for suggestions and to obtain a copy of the installation's pollution prevention/hazardous waste minimization plan for reference material when preparing this part of the plan. If no written plan exists, obtain information by contacting the COR. Describe the types of the hazardous materials expected to be used in the construction when requesting information.

3.8 WHM/HW MATERIALS PROHIBITION

No waste hazardous material or hazardous waste shall be disposed of on government property. No hazardous material shall be brought onto government property that does not directly relate to requirements for the performance of this contract. The government is not responsible for disposal of Contractor's waste material brought on the job site and not required in the performance of this contract. The intent of this provision is to dispose of that waste identified as waste hazardous material/hazardous waste as defined herein that was generated as part of this contract and existed within the boundary of the Contract limits and not brought in from offsite by the Contractor. Incidental materials used to support the contract including, but not limited to aerosol cans, waste paint, cleaning solvents, contaminated brushes, rags, clothing, etc. are the responsibility of the Contractor. The list is illustrative rather than inclusive. The Contractor is not authorized to discharge any materials to sanitary sewer, storm drain, or to the river or conduct waste treatment or disposal on government property without written approval of the COR.

3.9 HAZARDOUS MATERIAL MANAGEMENT

No hazardous material shall be brought onto government property that does not directly relate to requirements for the performance of this contract.

Include hazardous material control procedures in the Safety Plan. Address procedures and proper handling of hazardous materials, including the appropriate transportation requirements. Submit a MSDS and estimated quantities to be used for each hazardous material to the COR prior to bringing the material on base. Typical materials requiring MSDS and quantity reporting include, but are not limited to, oil and latex based painting and caulking products, solvents, adhesives, aerosol, and petroleum products. At the end of the project, provide the COR with the maximum quantity of each material that was present at the site at any one time, the dates the material was present, the amount of each material that was used during the project, and how the material was used. Ensure that hazardous materials are utilized in a manner that will minimize the amount of hazardous waste that is generated. Ensure that all containers of hazardous materials have NFPA labels or their equivalent. Keep copies of the MSDS for hazardous materials on site at all times and provide them to the COR at the end of the project. Certify that all hazardous materials removed from the site are hazardous materials and do not meet the definition of hazardous waste per 40 CFR 261.

3.10 PETROLEUM PRODUCTS AND REFUELING

Conduct the fueling and lubricating of equipment and motor vehicles in a manner that protects against spills and evaporation. Manage all used oil generated on site in accordance with 40 CFR 279, State and Local regulations. Determine if any used oil generated while on-site exhibits a characteristic of hazardous waste. Used oil containing 1000 parts per million of solvents will be considered a hazardous waste and disposed of at Contractor's expense. Used oil mixed with a hazardous waste will also be considered a hazardous waste.

3.10.1 Oily and Hazardous Substances

Prevent oil or hazardous substances from entering the ground, drainage areas, or navigable waters. In accordance with 40 CFR 112, surround all temporary fuel oil or petroleum storage tanks with a temporary berm or containment of sufficient size and strength to contain the contents of the tanks, plus 10 percent freeboard for precipitation. The berm will be impervious to oil for 72 hours and be constructed so that any discharge will not permeate, drain, infiltrate, or otherwise escape before cleanup occurs.

3.10.2 Inadvertent Discovery of Petroleum Contaminated Soil or Hazardous Wastes

If petroleum contaminated soil or suspected hazardous waste is found during construction that was not identified in the contract documents, the contractor shall immediately notify the COR. The contractor shall not disturb this material until authorized by the COR.

3.11 FUEL TANKS

Petroleum products and lubricants required to sustain up to 30 days of construction activity may be kept on site. Storage and refilling practices shall comply with 40 CFR Part 112. Secondary containment shall be provided

and be no less than 110 percent of the tank volume plus five inches of free-board. All fuel tanks with a fuel tank capacity of 10 or more gallons which will be on site for 72 hours or more must have a Temporary Fuel Tank Permit from Santa Clara County Department of Environmental Health Hazardous Materials Division. If a secondary berm is used for containment then the berm shall be impervious to oil for 72 hours and be constructed so that any discharge will not permeate, drain, infiltrate, or otherwise escape before cleanup occurs. Drips pans are required and the tanks must be covered during inclement weather.

3.12 RELEASES/SPILLS OF OIL AND HAZARDOUS SUBSTANCES

Exercise due diligence to prevent, contain, and respond to spills of hazardous material, hazardous substances, hazardous waste, sewage, regulated gas, petroleum, lubrication oil, and other substances regulated by environmental law. Maintain spill cleanup equipment and materials at the work site. In the event of a spill, take prompt, effective action to stop, contain, curtail, or otherwise limit the amount, duration, and severity of the spill/release. In the event of any releases of oil and hazardous substances, chemicals, or gases; immediately (within 15 minutes) notify the NASA Ames Research Center Dispatch and the COR. Call 911 from any NASA desk phone or (650)604-5555 from a mobile phone to reach NASA Ames Dispatch If the contractor's response is inadequate, the NASA Ames Research Center may respond. If this should occur, the contractor will be required to reimburse the government for spill response assistance and analysis.

Contain and clean up these spills without cost to the Government. If Government assistance is requested or required, the Contractor will reimburse the Government for such assistance. Provide copies of the written notification and documentation that a verbal notification was made within 20 days.

Maintain spill cleanup equipment and materials at the work site. Clean up all hazardous and non-hazardous waste spills. The Contractor shall reimburse the government for all material, equipment, and clothing generated during any spill cleanup. The Contractor shall reimburse the government for all costs incurred including sample analysis materials, equipment, and labor if the government must initiate its own spill cleanup procedures, for Contractor responsible spills, when:

a. The Contractor has not begun spill cleanup procedure within one hour of spill discovery/occurrence, or

b. If, in the government's judgment, the Contractor's spill cleanup is not adequately abating life threatening situation and/or is a threat to any body of water or environmentally sensitive areas.

3.13 CONTROL AND MANAGEMENT OF HAZARDOUS WASTES

3.13.1 Facility Hazardous Waste Generator Status

NASA Ames Research Center is designated as a Large Quantity Generator. All work conducted within the boundaries of this activity must meet the regulatory requirements of this generator designation. The Contractor will comply with all provisions of Federal, State and local regulatory requirements applicable to this generator status regarding training and storage, handling, and disposal of all construction derived wastes.

3.13.2 Hazardous Waste/Debris Management

Identify all construction activities which will generate hazardous waste/debris. Provide a documented waste determination for all resultant waste streams. Hazardous waste/debris will be identified, labeled, handled, stored, and disposed of in accordance with all Federal, State, and local regulations including 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, and 40 CFR 268.

Hazardous waste will also be managed in accordance with the approved Hazardous Waste Management Section of the Environmental Protection Plan. Store hazardous wastes in approved containers in accordance with 49 CFR 173 and 49 CFR 178. Hazardous waste generated within the confines of Government facilities will be identified as being generated by the Government.

Prior to removal of any hazardous waste from Government property, all hazardous waste manifests must be signed by Environmental Management Division's authorized personnel. No hazardous waste will be brought onto Government property. Provide to the COR a copy of waste determination documentation for any solid waste streams that have any potential to be hazardous waste or contain any chemical constituents listed in 40 CFR 372-SUBPART D. For hazardous wastes spills, verbally notify the COR immediately.

3.13.2.1 Regulated Waste Storage/Satellite Accumulation/90 Day Storage Areas

If the work requires the temporary storage/collection of regulated or hazardous wastes, the Contractor will request the establishment of a Regulated Waste Storage Area, a Satellite Accumulation Area, or a 90 Day Storage Area at the point of generation. The Contractor must submit a request in writing to the COR providing the following information:

Contract Number	_____	Contractor	_____
Haz/Waste or Regulated Waste POC	_____	Phone Number	_____
Type of Waste	_____	Source of Waste	_____
Emergency POC	_____	Phone Number	_____

Location of the Site: _____
(Attach Site Plan to the Request)

Attach a waste determination form. Allow ten working days for processing this request. The designated area where waste is being stored shall be barricaded and a sign identifying as follows:

"DANGER OR CAUTION - UNAUTHORIZED PERSONNEL KEEP OUT"

3.13.2.2 Sampling and Analysis of HW

NASA Ames Research Center Environmental Management Division Hazardous Waster Program.

3.13.2.3 Hazardous Waste Disposal

No hazardous, toxic, or universal waste shall be disposed or hazardous

material abandoned on government property. And unless otherwise other wise noted in this contract, the government is not responsible for disposal of Contractor generated waste material. The disposal of incidental materials used to accomplish the work including, but not limited to aerosol cans, waste paint, cleaning solvents, contaminated brushes, rags, clothing, etc. are the responsibility of the Contractor. The list is illustrative rather than inclusive.

The Contractor is not authorized to discharge any materials to sanitary sewer, storm drain, or water way or conduct waste treatment or disposal on government property without written approval of the COR.

Control of stored waste, packaging, sampling, analysis, and disposal will be determined by the details in the contract. The requirements for jobs in the following paragraphs will be used as the guidelines for disposal of any hazardous waste generated.

a. Responsibilities for Contractor's Disposal

Contractor responsibilities include any generation of WHM/HW requiring Contractor disposal of solid waste or liquid.

1. The Contractor agrees to provide all service necessary for the final treatment/disposal of the hazardous material/waste in accordance with all local, State and Federal laws and regulations, and the terms and conditions of the contract within sixty (60) days after the materials have been generated. These services will include all necessary personnel, labor, transportation, packaging, detailed analysis (if required for disposal, and/or transportation, including manifesting or completing waste profile sheets, equipment, and the compilation of all documentation is required).

2. Contain all waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, 40 CFR 265, 40 CFR 266, 40 CFR 268, 40 CFR 270, 40 CFR 272, 40 CFR 273, 40 CFR 279, 40 CFR 280, and 40 CFR 761.

3. Obtaining a representative sample of the material generated for each job done to provide waste stream determination.

4. Analyzing for each sample taken and providing analytical results to the COR. Provide two copies of the results.

5. Determine the DOT proper shipping names for all waste (each container requiring disposal) and will demonstrate how this determination is developed and supported by the sampling and analysis requirements contained herein to the COR.

Contractor Disposal Turn-In Requirements

For any waste hazardous materials or hazardous waste generated which requires the Contractor to dispose of, the following conditions must be complied with in order to be acceptable for disposal:

a. Drums compatible with waste contents and drums meet DOT requirements for 49 CFR 173 for transportation of materials.

b. Drums banded to wooden pallets. No more than three (3) 55 gallon drums

to a pallet, or two (2) 85 gallon over packs.

c. Band using 1-1/4 inch minimum band on upper third of drum.

d. Recovery materials label (provided by Code 106.321) located in middle of drum, filled out to indicate actual volume of material, name of material manufacturer, other vendor information as available.

e. Always have three (3) to five (5) inches of empty space above volume of material. This space is called 'outage'.

3.13.3 Class I and II ODS Prohibition

Class I and II ODS as defined and identified herein will not be used in the performance of this contract, nor be provided as part of the equipment. This prohibition will be considered to prevail over any other provision, specification, drawing, or referenced documents. Regulations related to the protection of stratosphere ozone may be found in 40 CFR 82.

Heating and air conditioning technicians must be certified through an EPA-approved program. Copies of certifications shall be maintained at the employees' place of business and be carried as a wallet card by the technician, as provided by environmental law. Accidental venting of a refrigerant is a release and shall be reported to the COR.

3.13.3.1 Universal Waste/e-Waste Management

Universal waste including but not limited to some mercury containing building products such florescent lamps, mercury vapor lamps, high pressure sodium lamps, CRTs, batteries, aerosol paint containers, electrical equipment containing PCBs, and consumed electronic devices, shall be managed in accordance with applicable environmental law and installation instructions.

3.14 DUST CONTROL

Keep dust down at all times, including during nonworking periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming will not be permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing will be permitted only for cleaning nonparticulate debris such as steel reinforcing bars. Only wet cutting will be permitted for cutting concrete blocks, concrete, and bituminous concrete. Do not unnecessarily shake bags of cement, concrete mortar, or plaster.

3.14.1 Dirt and Dust Control Plan

Submit truck and material haul routes along with a plan for controlling dirt, debris, and dust on base roadways. As a minimum, identify in the plan the subcontractor and equipment for cleaning along the haul route and measures to reduce dirt, dust, and debris from roadways.

3.15 ABRASIVE BLASTING

3.15.1 Blasting Operations

The use of silica sand is prohibited in sandblasting.

Blasting operations must follow the requirements of the Bay Area Air

Quality Management District Regulation for Sandblasting, Regulation 12, Rule 4.

3.15.2 Disposal Requirements

Submit analytical results of the debris generated from abrasive blasting operations per paragraph entitled Laboratory Analysis of this section. Hazardous waste generated from blasting operations will be managed in accordance with paragraph entitled "Hazardous Waste\Debris Management" of this section and with the approved HWMP.

3.16 NOISE

Make the maximum use of low-noise emission products, as certified by the EPA. Blasting or use of explosives will not be permitted without written permission from the COR, and then only during the designated times. Confine pile-driving operations to the period between 8 a.m. and 4 p.m., Monday through Friday, exclusive of holidays, unless otherwise specified.

3.17 MERCURY MATERIALS

Mercury is prohibited in the construction of this facility, unless specified otherwise, and with the exception of mercury vapor lamps and fluorescent lamps. Dumping of mercury-containing materials and devices such as mercury vapor lamps, fluorescent lamps, and mercury switches, in rubbish containers is prohibited. Remove without breaking, pack to prevent breakage, and transport out of the activity in an unbroken condition for disposal as directed. Immediately report to the Environmental Office and the COR instances of breakage or mercury spillage. Clean mercury spill area to the satisfaction of the COR.

Cleanup of a mercury spill shall not be recycled and shall be managed as a hazardous waste for disposal.

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SECTION 01 62 35

RECYCLED / RECOVERED MATERIALS

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SECTION 01 62 35

RECYCLED / RECOVERED MATERIALS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for use of products containing recycled or recovered materials. Include a properly edited version of this guide specification in every design-bid-build and design-build project. EPA recycled content requirements must be addressed in all projects regardless of optional LEED/other recycled content goals.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.3 OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. EPA designated products specified in this contract comply with the stated policy and with the EPA guidelines. Make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

1.4 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Various sections of the specifications contain requirements for materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials. These items, when incorporated into the work under this contract, shall contain at least the specified percentage of recycled or recovered materials unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the

designated item requirements apply only if the designated item is used in the work.

1.5 EPA PROPOSED ITEMS INCORPORATED IN THE WORK

Products other than those designated by EPA are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

1.6 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

There are many products listed in 40 CFR 247 which have been designated or proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials and that these products be recycled when no longer needed.

PART 2 TITLE

Not Used

PART 3 TITLE

Not Used

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SECTION 01 74 19

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for the management of non-hazardous construction and demolition waste materials.

1.2 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy: (1) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse. A minimum of 50 percent by weight of total project solid waste shall be diverted from the landfill.

1.3 MANAGEMENT

Develop and implement a waste management program. Take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. The Environmental Manager, as specified in Section 01 35 40.00 20 Environmental Management, shall be responsible for instructing workers and overseeing and documenting results of the Waste Management Plan for the project. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor is responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained from salvage or recycling accrue to the Contractor. Appropriately permit firms and facilities used for recycling, reuse, and disposal for the intended use to the extent required by Federal, State, and local regulations. Also, provide on-site instruction of appropriate separation, handling, recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Waste Management Plan

SD-11 Closeout Submittals

Records

1.5 WASTE MANAGEMENT PLAN

A Waste Management Plan shall be submitted within 15 days after notice to proceed and not less than 10 days before the pre-construction meeting. The plan shall demonstrate how the project waste diversion goal shall be met and shall include the following:

a. Name of individuals on the Contractor's staff responsible for waste prevention and management.

b. Actions that will be taken to reduce solid waste generation, including coordination with subcontractors to ensure awareness and participation.

c. Description of the regular meetings to be held to address waste management.

d. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas on site and equipment to be used for processing, sorting, and temporary storage of wastes.

e. Characterization, including estimated types and quantities, of the waste to be generated.

f. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.

g. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity. Include the name, location, and phone number for each reuse facility to be used, and provide a copy of the permit or license for each facility.

h. List of specific waste materials that will be salvaged for resale, salvaged and reused on the current project, salvaged and stored for reuse on a future project, or recycled. Recycling facilities that will be used shall be identified by name, location, and phone number, including a copy of the permit or license for each facility.

i. Identification of materials that cannot be recycled/reused with an explanation or justification, to be approved by the COR.

j. Description of the means by which any waste materials identified in item (h) above will be protected from contamination.

k. Description of the means of transportation of the recyclable materials (whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler and removed from the site).

l. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill

cost avoidance.

Revise and resubmit Plan as required by the COR. Approval of Contractor's Plan will not relieve the Contractor of responsibility for compliance with applicable environmental regulations or meeting project cumulative waste diversion requirement. Distribute copies of the Waste Management Plan to each subcontractor, the Quality Control Manager, and the COR.

1.6 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. Quantities may be measured by weight or by volume, but must be consistent throughout. List each type of waste separately noting the disposal or diversion date. Identify the landfill, recycling center, waste processor, or other organization used to process or receive the solid waste. Provide explanations for any waste not recycled or reused. With each application for payment, submit updated documentation for solid waste disposal and diversion, and submit manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material. The records shall be made available to the COR during construction, and a copy of the records shall be delivered to the COR upon completion of the construction.

1.7 REPORTS

Provide quarterly reports and a final report to COR for review by Ames Environmental Management Division. Quarterly and final reports shall include project name, information for waste generated this quarter, and cumulative totals for the project. Each report shall include supporting documentation to include manifests, weight tickets, receipts, and invoices specifically identifying the project and waste material. Include timber harvest and demolition information, if any.

1.8 COLLECTION

Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in a manner that maximizes recyclability and salvagability of identified materials. Provide the necessary containers, bins and storage areas to facilitate effective waste management and clearly and appropriately identify them. Provide materials for barriers and enclosures around recyclable material storage areas which are nonhazardous and recyclable or reusable. Locate out of the way of construction traffic. Provide adequate space for pick-up and delivery and convenience to subcontractors. Recycling and waste bin areas are to be kept neat and clean, and recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials. Clean contaminated materials prior to placing in collection containers. Use cleaning materials that are nonhazardous and biodegradable. Handle hazardous waste and hazardous materials in accordance with applicable regulations and coordinate with Section 01 35 40.00 20 ENVIRONMENTAL MANAGEMENT. Separate materials by one of the following methods:

1.8.1 Source Separated Method.

Waste products and materials that are recyclable shall be separated from trash and sorted as described below into appropriately marked separate containers and then transported to the respective recycling facility for further processing. Deliver materials in accordance with recycling or

reuse facility requirements (e.g., free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process). Separate materials into the following category types as appropriate to the project waste and to the available recycling and reuse programs in the project area:

a. Land clearing debris.

b. Asphalt.

c. Concrete and masonry.

d. Metal (e.g. banding, stud trim, ductwork, piping, rebar, roofing, other trim, steel, iron, galvanized, stainless steel, aluminum, copper, zinc, lead brass, bronze).

    1. Ferrous.

    2. Non-ferrous.

e. Wood (nails and staples allowed).

f. Debris.

g. Glass (colored glass allowed).

h. Paper.

    1. Bond.

    2. Newsprint.

    3. Cardboard and paper packaging materials.

i. Plastic.

    1. Type 1: Polyethylene Terephthalate (PET, PETE).

    2. Type 2: High Density Polyethylene (HDPE).

    3. Type 3: Vinyl (Polyvinyl Chloride or PVC).

    4. Type 4: Low Density Polyethylene (LDPE).

    5. Type 5: Polypropylene (PP).

    6. Type 6: Polystyrene (PS).

    7. Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

j. Gypsum.

k. Non-hazardous paint and paint cans.

l. Carpet.

m. Ceiling tiles.

n. Insulation.

o. Beverage containers.

1.8.2 Co-Mingled Method.

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

1.8.3 Other Methods.

Other methods proposed by the Contractor may be used when approved by the COR.

1.9 DISPOSAL

Control accumulation of waste materials and trash. Recycle or dispose of collected materials off-site at intervals approved by the COR and in compliance with waste management procedures. Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.9.1 Reuse

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Sale or donation of waste suitable for reuse shall be considered.

1.9.2 Recycle

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling. All fluorescent lamps, HID lamps, and mercury-containing thermostats removed from the site shall be recycled. Arrange for timely pickups from the site or deliveries to recycling facilities in order to prevent contamination of recyclable materials.

1.9.3 Compost

Consider composting on site if a reasonable amount of compostable material will be available. Compostable materials include plant material and sawdust. COR shall be contacted to discuss compositing options with Plant Engineering before composting.

1.9.4 Waste

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

1.9.5 Return

Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used. -- End of Section --

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SECTION 01 75 00

STARTING AND ADJUSTING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for system testing and acceptance.

1.2 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Plan
including testing and start-up schedule

Operation and Maintenance Data

SD-02 Shop Drawings

Drawings, Diagrams and Schedules

Diagrams and Instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project

Drawings prepared by the Contractor to show how multiple systems and interdisciplinary work will be coordinated

SD-03 Product Data

Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work

SD-05 Design Data

Design Calculations, mix designs, analyses or other data.

SD-06 Test Reports

Submit test reports in accordance with the paragraphs entitled, " Factory Tests, "Functional Field Test" and "Final Acceptance Test" of this section.

Submit test procedures and the recording forms according to paragraph entitled, "Test Procedures."

SD-08 Manufacturer's Instructions

Demonstration and Training Information

Submit Manufacturer's Procedural Requirements for initial checkout, startup, and adjusting to ensure safe operation during acceptance testing and commissioning.

SD-09 Manufacturer's Field Reports

Documentation of the Testing and Verification Actions taken by manufacturer's representative at the job site, on a portion of the work, after installation, to confirm compliance with manufacturer's standards or instructions

SD-10 Operation and Maintenance Data

Refer to Section 01 78 23 OPERATION AND MAINTENANCE DATA for detailed requirements and procedures.

Operation and Maintenance Data provided by the manufacturer to ensure the safe and efficient operation, maintenance and repair of the system or equipment provided.

Safety and Security Data or Posters provided by the manufacturer

1.2.1 Preconstruction and Pre-Testing Requirements

The Contractor is responsible to deliver equipment and services to meet the requirements and specifications of their respective contract. All equipment must be free of latent manufacturing and installation defects. Acceptance criteria must be clearly defined to establish required baselines for future maintenance and life-cycle evaluations. The Government reserves the option to elect performance of acceptance testing by internal personnel, or a designated third party. Regardless of who performs the acceptance testing, the requirements of acceptance must be met by the Contractor.

Submit the following for review and approval prior to the commencement of work and any testing, whether such testing is on site or elsewhere:

a. Quality control plan

b. Operation and Maintenance Data, with details regarding start-up procedures

c. Manufacturer's procedural requirements

d. Demonstration and Training Information

1.2.2 Shop Drawings and Diagrams

Submit the following shop drawings, record drawings, and diagrams as required to correctly execute the installation of the work:

a. Drawings, diagrams and schedules

b. Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project

c. Drawings prepared by or for the Contractor to show how multiple systems

and interdisciplinary work will be coordinated

1.2.3 Product and Design Data

Contractor must submit all product data and any design calculations, mix designs, analyses or other data pertaining to a complete functional installation; including, but not limited to:

a. Catalog cuts, illustrations, schedules, diagrams, performance charts, instructions and brochures illustrating size, physical appearance and other characteristics of materials, systems or equipment for some portion of the work

b. Operation and Maintenance Data provided by the manufacturer to ensure the safe and efficient operation, maintenance and repair of the system or equipment provided.

c. Safety and Security Data or posters provided by the manufacturer to be posted in a conspicuous visible location for operational and maintenance personnel.

1.2.4 Tests Required

Perform tests to verify proper functioning of fire protection, fire suppression, HVAC, compressed air, electrical switchgear, protective relaying, fluid and gas systems, pump/motor combinations, boiler systems, hydraulic and pneumatic control, condition/performance monitoring systems, energy control and monitoring systems, and other assemblies and components that need to be tested as an interrelated whole.

1.2.4.1 Factory Tests

Submit certified copies of required tests performed at the factory to verify proper build. These test results will be used in the "Final Acceptance Test" section to verify no shipping damage and proper installation.

1.2.4.2 Functional Field Test

Contractor must perform functional field tests test to verify that the system and components have been properly installed and are functioning properly. Perform test(s) in the presence of the COR. Acceptance will be issued when system has performed per other sections and referenced industry standards.

Coordinate and submit documentation of the testing and verification actions taken by manufacturer's representative at the job siteafter installation, to confirm compliance with manufacturer's standards or instructions.

1.2.4.3 Final Acceptance Test

Perform a formal test with full documentation using the approved recording form. COR will witness this test and issue a written final acceptance. Provide final test data to the COR with a cover letter clearly marked with the system name, date, and the words " Final Test Data - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

1.2.4.4 Test Procedures

Submit test procedure and recording forms that document the test steps for approval to the COR 15 working days prior to the proposed test date. Procedure must clearly state step by step instruction to verify system parameters, components, and functions.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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SECTION 01 78 00

CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for closeout submittals including: revised project documents, warranty management, testing, adjusting and balancing, O & M manuals, and final cleaning.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM E 1971	Stewardship for the Cleaning of Commercial and Institutional Buildings

GREEN SEAL (GS)

GS-37	Industrial and Institutional Cleaners

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

As-Built Record of Equipment and Materials
Warranty Management Plan
Warranty Tags
Final Cleaning
Spare Parts Data

SD-08 Manufacturer's Instructions

Preventative Maintenance
Condition Monitoring (Predictive Testing)
Inspection
Posted Instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

SD-11 Closeout Submittals

Record Drawings
Certification of EPA Designated Items
List of Warranties

1.4 PROJECT RECORD DOCUMENTS

1.4.1 Record Drawings

Drawings showing final as-built conditions of the project. This paragraph covers record drawings complete, as a requirement of the contract. The terms "drawings," "contract drawings," "drawing files," "working record drawings" and "final record drawings" refer to contract drawings which are revised to be used for final record drawings showing as-built conditions.

1.4.1.1 Government Furnished Plans

The Government will supply 2 full size sets of the contract drawings to the Contractor for use in the record drawings.

In cases where shop drawings are to be approved prior to construction a full-sized set of the approved shop drawings are to be maintained on site. This set will be considered to be part of the "Working Record" and "Final Record Drawings".

1.4.1.2 Working Record and Final Record Drawings

Revise 1 set of paper drawings by red-line process to show the as-built conditions during the prosecution of the project. Keep these working as-built marked drawings current on a weekly basis and at least one set available on the jobsite at all times. Changes from the contract plans which are made in the work or additional information which might be uncovered in the course of construction must be accurately and neatly recorded as they occur by means of details and notes. Prepare final record (as-built) drawings after the completion of each definable feature of work as listed in the Contractor Quality Control Plan (Foundations, Utilities, Structural Steel, etc., as appropriate for the project). The working as-built marked prints and final record (as-built) drawings will be jointly reviewed for accuracy and completeness by the COR and the Contractor prior to submission of each monthly pay estimate. If the Contractor fails to maintain the working and final record drawings as specified herein, the COR will deduct from the monthly progress payment an amount representing the estimated cost of maintaining the record drawings. This monthly deduction will continue until an agreement can be reached between the COR and the Contractor regarding the accuracy and completeness of updated drawings. Show on the working and final record drawings, but not limited to, the following information:

a. The actual location, kinds and sizes of all sub-surface utility lines. In order that the location of these lines and appurtenances may be determined in the event the surface openings or indicators become covered over or obscured, show by offset dimensions to two permanently fixed surface features the end of each run including each change in direction on the record drawings. Locate valves, splice boxes and similar appurtenances by dimensioning along the utility run from a reference point. Also record the average depth below the surface of each run.

b. The location and dimensions of any changes within the building structure.

c. Correct grade, elevations, cross section, or alignment of roads, earthwork, structures or utilities if any changes were made from contract plans.

d. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor; including but not limited to fabrication, erection, installation plans and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.

e. The topography, invert elevations and grades of drainage installed or affected as part of the project construction.

f. Changes or modifications which result from the final inspection.

g. Where contract drawings or specifications present options, show only the option selected for construction on the final as-built prints.

h. If borrow material for this project is from sources on Government property, or if Government property is used as a spoil area, furnish a contour map of the final borrow pit/spoil area elevations.

i. Systems designed or enhanced by the Contractor, such as HVAC controls, fire alarm, fire sprinkler, and irrigation systems.

j. Modifications (include within change order price the cost to change working and final record drawings to reflect modifications) and compliance with the following procedures.

   1. Follow directions in the modification for posting descriptive changes.

   2. Place a Modification Delta at the location of each deletion.

   3. For new details or sections which are added to a drawing, place a Modification Delta by the detail or section title.

   4. For minor changes, place a Modification Delta by the area changed on the drawing (each location).

   5. For major changes to a drawing, place a Modification Delta by the title of the affected plan, section, or detail at each location.

   6. For changes to schedules or drawings, place a Modification Delta either by the schedule heading or by the change in the schedule.

   7. The Modification Delta size shall be 1/2 inch across unless the area where the circle is to be placed is crowded. Smaller size deltas shall be used for crowded areas.

1.4.1.3 Drawing Preparation

Modify the record drawings as may be necessary to correctly show the features of the project as it has been constructed by bringing the contract set into agreement with approved working as-built prints, and adding such

additional drawings as may be necessary. These working as-built marked prints must be neat, legible and accurate. These drawings are part of the permanent records of this project and the original hardcopy must be returned to the COR after approval by the Government. Any drawings damaged or lost by the Contractor must be satisfactorily replaced by the Contractor at no expense to the Government.

1.4.1.4 Payment

No separate payment will be made for record drawings required under this contract, and all costs accrued in connection with such drawings are considered a subsidiary obligation of the Contractor.

1.4.2 As-Built Record of Equipment and Materials

Submit the preliminary record of equipment and materials used on the project 10 working days prior to final inspection. Submit the final record of equipment and materials within 10 working days after final inspection. Key the designations to the related area depicted on the contract drawings. List the following data:

RECORD OF DESIGNATED EQUIPMENT AND MATERIALS DATA				
Description	Specification Section	Manufacturer and Catalog, Model, and Serial Number	Composition and Size	Where Used

1.4.3 Final Approved Shop Drawings

Furnish final approved project shop drawings that show the as-built conditions 20 working days after transfer of the completed facility.

1.4.4 Construction Contract Specifications

Furnish final record (as-built) construction contract specifications, including modifications thereto, 20 working days after transfer of the completed facility.

1.4.5 Real Property Equipment

Furnish a list of installed equipment furnished under this contract. Include all information usually listed on manufacturer's name plate. In the "EQUIPMENT-IN-PLACE LIST" include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. Furnish a draft list at time of transfer. Furnish the final list 20 working days after transfer of the completed facility.

1.5 SPARE PARTS DATA

Submit the Spare Parts Data list.

a. Indicate manufacturer's name, part number, nomenclature, and stock

level required for maintenance and repair. List those items that may be standard to the normal maintenance of the system.

b. Supply 2 of each part for spare parts inventory. Provision of spare parts does not relieve the Contractor of responsibilities listed under the contract guarantee provisions.

1.6 PREVENTATIVE MAINTENANCE

Submit Preventative Maintenance, Condition Monitoring (Predictive Testing) and Inspection schedules with instructions that state when systems should be retested.

a. Define the anticipated length of each test, test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements within the schedule. Provide a signoff blank for the Contractor and COR for each test feature; e.g., gpm, rpm, psi. Include a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventative maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize corrective maintenance and repair.

b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

1.7 CERTIFICATION OF EPA DESIGNATED ITEMS

Submit the Certification of EPA Designated Items as required by FAR 52.223-9, "Certification and Estimate of Percentage of Recovered Material Content for EPA Designated Items". Include on the certification form the following information: project name, project number, Contractor name, license number, Contractor address, and certification. The certification will read as follows and be signed and dated by the Contractor. "I hereby certify the information provided herein is accurate and that the requisition/procurement of all materials listed on this form comply with current EPA standards for recycled/recovered materials content. The following exemptions may apply to the non-procurement of recycled/recovered content materials: 1) The product does not meet appropriate performance standards; 2) The product is not available within a reasonable time frame; 3) The product is not available competitively (from two or more sources); 4) The product is only available at an unreasonable price (compared with a comparable non-recycled content product)." Record each product used in the project that has a requirement or option of containing recycled or biobased content in accordance with Section 01 62 35 RECYCLED/RECOVERED MATERIALS, noting total price, total value of post-industrial recycled content, total value of post-consumer recycled content, total value of biobased content, exemptions (1, 2, 3, or 4, as indicated), and comments. Recycled and biobased content values may be determined by weight or volume percent, but must be consistent throughout.

1.8 WARRANTIES

At least 20 working days before the contract completion date submit a List

of Warranties that includes the following information:

a. Item Warranted

b. Length of Warranty

c. Point of contact for each warranty

1.8.1 Warranty Response Time

For each warranty there is a 24 hour response time. If the warrantor does not respond within 24 hours for an issue covered by a warranty the Government has the right to fix the problem and charge the warrantor for the resources spent to fix the problem.

1.9 MECHANICAL TESTING AND BALANCING

All contract requirements of Section 23 05 93 TESTING, ADJUSTING AND BALANCING must be fully completed, including testing and inspection, prior to contract completion date, except as noted otherwise in Section 23 05 93. The time required to complete all work and testing as prescribed by Section 23 05 93 and is included in the allotted days for completion.

1.10 OPERATION AND MAINTENANCE MANUALS

Submit three hardcopies and one electronic copy ofthe project operation and maintenance manuals 20 working days prior to testing the system involved. Update and resubmit data for final approval no later than 20 working days prior to contract completion.

1.10.1 Configuration

Operation and Maintenance Manuals must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions. information shall be grouped by technical sections. Test data must be legible and of good quality. Organize data by separate index. Caution and warning indications must be clearly labeled.

1.10.2 Training and Instruction

Submit classroom and field instructions in the operation and maintenance of systems equipment where required by the technical provisions. These services must be directed by the Contractor, using the manufacturer's factory-trained personnel or qualified representatives. COR will be given 5 working days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor, such as lists, static exhibits, and visual aids, must be made available to the COR.

1.11 CLEANUP

Provide final cleaning in accordance with ASTM E 1971 and submit the listing of completed final clean-up items. Leave premises "broom clean." Use only nonhazardous cleaning materials, including natural cleaning materials, in the final cleanup. Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces; vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. Clean filters of operating equipment and comply with the Indoor Air Quality

(IAQ) Management Plan. Clean debris from roofs, gutters, downspouts and drainage systems. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus materials, rubbish and construction facilities from the site. Recycle, salvage, and return construction and demolition waste from project in accordance with the Waste Management Plan. Promptly and legally transport and dispose of any trash. Do not burn, bury, or otherwise dispose of trash on the project site.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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SECTION 01 78 23

OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for operation and maintenance (O&M) data normally shipped by a manufacturer at the same time as his associated piece of equipment is shipped. The requirements specified herein are intended to require those items of O&M data normally expected from the manufacturer of the associated equipment.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM E 1971	Stewardship for the Cleaning of Commercial and Institutional Buildings

1.3 SUBMISSION OF OPERATION AND MAINTENANCE DATA

Submit two hard copies and one electronic copy of the Operation and Maintenance (O&M) Data specifically applicable to this contract and a complete and concise depiction of the provided equipment, product, or system, stressing and enhancing the importance of system interactions, troubleshooting, and long-term preventative maintenance and operation. The subcontractors shall compile and prepare data and deliver to the Contractor prior to the training of Government personnel. The Contractor shall compile and prepare aggregate O&M data including clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 SUBMITTAL PROCEDURES.

1.3.1 Package Quality

Documents must be fully legible. Poor quality copies and material with hole punches obliterating the text or drawings will not be accepted.

1.3.2 Package Content

Data package content shall be as shown in the paragraph titled "Schedule of Operation and Maintenance Data Packages." Comply with the data package

requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Commissioned items without a specified data package requirement in the individual technical sections shall use Data Package 4. Commissioned items with a Data Package 1 or 2 requirement shall use instead Data Package 3.

1.3.3 Changes to Submittals

Manufacturer-originated changes or revisions to submitted data shall be furnished by the Contractor if a component of an item is so affected subsequent to acceptance of the O&M Data. Changes, additions, or revisions required by the COR for final acceptance of submitted data, shall be submitted by the Contractor within 20 working days of the notification of this change requirement.

1.3.4 Review and Approval

The Government shall review the commissioned systems and equipment submittals for completeness and applicability. The Government shall verify that the systems and equipment provided meet the requirements of the Contract documents and design intent, particularly as they relate to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts. This work shall be in addition to the normal review procedures for O&M data.

1.4 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

1.4.1 Operating Instructions

Include specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.4.1.1 Safety Precautions

List personnel hazards and equipment or product safety precautions for all operating conditions.

1.4.1.2 Operator Prestart

Include procedures required to install, set up, and prepare each system for use.

1.4.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.4.1.4 Normal Operations

Provide narrative description of Normal Operating Procedures. Include Control Diagrams with data to explain operation and control of systems and specific equipment.

1.4.1.5 Emergency Operations

Include Emergency Procedures for equipment malfunctions to permit a short

period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Include Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of all utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.4.1.6 Operator Service Requirements

Include instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gage readings.

1.4.1.7 Environmental Conditions

Include a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.4.2 Preventive Maintenance

Include the following information for preventive and scheduled maintenance to minimize corrective maintenance and repair for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.4.2.1 Lubrication Data

Include preventative maintenance lubrication data, in addition to instructions for lubrication provided under paragraph titled "Operator Service Requirements":

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

1.4.2.2 Preventive Maintenance Plan and Schedule

Include manufacturer's schedule for routine preventive maintenance, inspections, tests and adjustments required to ensure proper and economical operation and to minimize corrective maintenance. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

1.4.2.3 Cleaning Recommendations

Provide environmentally preferable cleaning recommendations in accordance with ASTM E 1971.

1.4.3 Corrective Maintenance (Repair)

Include manufacturer's recommended procedures and instructions for correcting problems and making repairs for the installed model and features

of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.4.3.1 Troubleshooting Guides and Diagnostic Techniques

Include step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.4.3.2 Wiring Diagrams and Control Diagrams

Wiring diagrams and control diagrams shall be point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.4.3.3 Maintenance and Repair Procedures

Include instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.4.3.4 Removal and Replacement Instructions

Include step-by-step procedures and a list required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Instructions shall include a combination of text and illustrations.

1.4.3.5 Spare Parts and Supply Lists

Include lists of spare parts and supplies required for maintenance and repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.4.4 Corrective Maintenance Work-Hours

Include manufacturer's projection of corrective maintenance work-hours including requirements by type of craft. Corrective maintenance that requires completion or participation of the equipment manufacturer shall be identified and tabulated separately.

1.4.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.4.5.1 Product Submittal Data

Provide a copy of all SD-03 Product Data submittals required in the applicable technical sections.

1.4.5.2 Manufacturer's Instructions

Provide a copy of all SD-08 Manufacturer's Instructions submittals required in the applicable technical sections.

1.4.5.3 O&M Submittal Data

Provide a copy of all SD-10 Operation and Maintenance Data submittals required in the applicable technical sections.

1.4.5.4 Parts Identification

Provide identification and coverage for all parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing shall show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Parts shown in the listings shall be grouped by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog

1.4.5.5 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or contract documents in order to keep warranties in force. Include warranty information for primary components such as the compressor of air conditioning system.

1.4.5.6 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.4.5.7 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components.

1.4.5.8 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms.

1.4.5.9 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each Subcontractor who installed the product or equipment, or system. For each item, also provide the name address and

telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.5 TYPES OF INFORMATION REQUIRED IN CONTROLS O&M DATA PACKAGES

Include Data Package 5 and the following for control systems:

a. Narrative description on how to perform and apply all functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.

b. Full as-built sequence of operations.

c. Copies of all checkout tests and calibrations performed by the Contractor (not Cx tests).

d. Full points list. A listing of rooms shall be provided with the following information for each room:

1. Floor

2. Room number

3. Room name

4. Air handler unit ID

5. Reference drawing number

6. Air terminal unit tag ID

7. Heating and/or cooling valve tag ID

8. Minimum cfm

9. Maximum cfm

e. Full print out of all schedules and set points after testing and acceptance of the system.

f. Electronic copy of the entire as-built program for this facility.

g. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

1.6 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Furnish the O&M data packages specified in individual technical sections. The required information for each O&M data package is as follows:

1.6.1 Data Package 1

a. Safety precautions

b. Cleaning recommendations

c. Maintenance and repair procedures

d. Warranty information

e. Contractor information

f. Spare parts and supply list

1.6.2 Data Package 2

a. Safety precautions

b. Normal operations

c. Environmental conditions

d. Lubrication data

e. Preventive maintenance plan and schedule

f. Cleaning recommendations

g. Maintenance and repair procedures

h. Removal and replacement instructions

i. Spare parts and supply list

j. Parts identification

k. Warranty information

l. Contractor information

1.6.3 Data Package 3

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Environmental conditions

g. Lubrication data

h. Preventive maintenance plan and schedule

i. Cleaning recommendations

j. Troubleshooting guides and diagnostic techniques

k. Wiring diagrams and control diagrams

l. Maintenance and repair procedures

m. Removal and replacement instructions

n. Spare parts and supply list

o. Product submittal data

p. O&M submittal data

q. Parts identification

r. Warranty information

s. Testing equipment and special tool information

t. Testing and performance data

u. Contractor information

1.6.4 Data Package 4

a. Safety precautions

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Operator service requirements

g. Environmental conditions

h. Lubrication data

i. Preventive maintenance plan and schedule

j. Cleaning recommendations

k. Troubleshooting guides and diagnostic techniques

l. Wiring diagrams and control diagrams

m. Maintenance and repair procedures

n. Removal and replacement instructions

o. Spare parts and supply list

p. Corrective maintenance man-hours

q. Product submittal data

r. O&M submittal data

s. Parts identification

t. Warranty information

u. Personnel training requirements

v. Testing equipment and special tool information

w. Testing and performance data

x. Contractor information

1.6.5 Data Package 5

a. Safety precautions

b. Operator prestart

c. Start-up, shutdown, and post-shutdown procedures

d. Normal operations

e. Environmental conditions

f. Preventive maintenance plan and schedule

g. Troubleshooting guides and diagnostic techniques

h. Wiring and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Product submittal data

m. Manufacturer's instructions

n. O&M submittal data

o. Parts identification

p. Testing equipment and special tool information

q. Warranty information

r. Testing and performance data

s. Contractor information

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

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SECTION 01 86 12.07 40

RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for Reliability Centered Building and Equipment Acceptance for Mechanical systems.

1.2 SYSTEM DESCRIPTION

This specification establishes acceptance requirements to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that will shorten the design life of the equipment. These requirements utilize Predictive Testing & Inspection (PT&I) technologies and are essential elements in the Government's Reliability Centered Building and Equipment Acceptance Program.

This specification is not intended to limit the inspection and acceptance process to the use of PT&I techniques. This guide is intended to supplement comprehensive and detailed commissioning and quality control specifications.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Plan

Material, Equipment, and Fixture Lists

SD-02 Shop Drawings

Fabrication Drawings

Installation Drawings

SD-03 Product Data

Manufacturer's Catalog Data

Warranty

SD-05 Design Data

Design Analysis and Calculations

SD-06 Test Reports

Ductwork Leakage Test

Hydrostatic Test

Performance Test

Visual Inspection

SD-07 Certificates

Certificates

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

SD-10 Operation and Maintenance Data

Operations and Maintenance Manuals

SD-11 Closeout Submittals

Record Drawings

Acceptance Documentation

1.5 DESIGN DATA

Submit applicable design analysis and calculations for the equipment as instructed by the project specification.

1.6 QUALITY ASSURANCE

Submit a Quality Control plan outlining the intended methods of receiving, testing, and installing equipment. The RCBEA GUIDE specifies minimum test equipment requirements. Use trained and adequately certified personnel in the appropriate acceptance testing PT&I technologies to ensure that the results are accurate and consistent. Submit the following as part of the quality control plan for all required acceptance testing:

a. List of all test equipment used, including its manufacturer, model number, calibration date, certificate of calibration, and serial number.

b. Certificates of test personnel qualifications and certifications.

1.7 WARRANTY

Furnish workmanship and performance warranty for the work performed for a period not less than 1 year from the date of Government acceptance of the work; issued directly to the Government. Perform corrective action that becomes necessary because of defective materials and workmanship while system is under warranty 7 days after notification, unless additional time is approved by the COR. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the Contractor. Provide a 1 year minimum contractor installation warranty.

PART 2 PRODUCTS

2.1 PRODUCT DATA

Submit material, equipment, and fixture lists for all equipment, materials, and fixtures planned for use to complete the job before commencing work. Include at a minimum, the item's description, quantity, manufacturer's style or catalog numbers, and specification and drawing reference numbers. Provide a complete list of construction equipment to be used.

2.1.1 Manufacturer Product Data

Submit fabrication drawings for equipment and specialties consisting of fabrication and assembly details to be performed in the factory.

Submit data for all equipment listed in the paragraph entitled, "Product Data," of this section. Include manufacturer's standard catalog data, at least 10 working days prior to the purchase or installation of a particular component, highlighted to show material, size, options, equipment performance data charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit for each specified component.

Submit for all equipment listed in the paragraph entitled, "Product Data," of this section. Include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

Submit manufacturer's catalog data and equipment foundation data for all new equipment as specified.

2.1.2 Certification Data

Submit applicable certificates for all new equipment showing conformance with test requirements, laboratory certifications, etc,. as instructed by the project specification.

PART 3 EXECUTION

3.1 INSTALLATION

Submit installation drawings for all installed equipment consisting of equipment layouts including assembly, applicable manufacturer's instructions, installation details and electrical connection diagrams; layout and installation details including support structures, piping and related system components. Include on the drawings any information required to demonstrate that the system has been coordinated and will properly function within the system, and show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

Submit connection diagrams for equipment, pipes, valves and specialties indicating the relations and connections of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit record drawings, at least 14 days after completion of equipment installation and acceptance testing. Update mechanical system drawings to reflect final record as-built conditions after all related work is completed.

3.2 EXAMINATION

Perform visual inspection on all new equipment installed. Correct all abnormalities or defects as directed by the COR.

3.3 FIELD QUALITY CONTROL AND ACCEPTANCE TESTING

Deliver equipment and services that meet the contract requirements and specifications. The Government desites that all such equipment be free of latent manufacturing and installation defects, and acceptance criteria is defined to ensure, to the maximum extent possible within economic reason, that these criteria are met. Perform acceptance testing as defined in this specification and the RCBEA GUIDE, using both traditional and PT&I technologies. The Government will observe and monitor the acceptance testing, analysis and documentation as part of the Government's Quality Assurance Program. Not until the requirements of acceptance are met will the equipment or facility be accepted by the Government.

3.3.1 Predictive Testing and Inspection

Perform the following PT&I Tests in accordance with the requirements and criteria established in the RCBEA GUIDE. Include test point locations in all submitted reports.

Provide final test reports to the COR. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words " Final Test Report Data - Forward to the COR for inclusion in the Maintenance Information Database.

a. Perform alignment test for:

    1. Pumps (laser preferred)

    2. Fans

b. Perform balancing test for:

1. Motors

2. Pumps

3. Fans

c. Perform cold starting test for:

1. Diesel Engine

2. Diesel Generator

3. Motors

d. Perform cooling system evaluation test for:

1. Diesel Engine

2. Diesel Generator

e. Perform ductwork leakage test for:

1. HVAC Ducts

f. Perform exhaust emissions test for:

1. Diesel Engine

2. Diesel Generator

g. Perform high voltage test for:

1. Motors

h. Perform hydrostatic test for:

1. Fluid Piping

i. Perform operational fire damper test for:

1. HVAC Ducts

j. Perform vibration analysis test for:

1. Pumps

2. Fans

3. Other rotating equipment

3.4 OPERATIONS AND MAINTENANCE

Submit manufacturer's operations and maintenance manuals for all new equipment installed.

Submit complete copies of operations and maintenance manuals in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system

startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown. Include the manufacturer's name, model number, parts list, routine maintenance procedures, possible breakdowns and repairs, trouble shooting guide, and a brief description of all equipment and their basic operating features. Include piping and equipment layouts and simplified wiring and control diagrams of the system as installed. Where available, provide technical manuals in electronic format with Standard Graphics Markup Language. Submit operations and maintenance manuals 20 working days prior to testing any equipment.

3.5 ACCEPTANCE DOCUMENTATION

Upon completion of the project and acceptance testing the COR will provide acceptance documentation to the Contractor. Complete, sign and date this documentation and submit back to the COR for processing and approval.

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RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for Reliability Centered Building and Equipment Acceptance for Electrical Systems.

1.2 SYSTEM DESCRIPTION

This specification establishes acceptance requirements to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that will shorten the design life of the equipment. These requirements utilize Predictive Testing & Inspection (PT&I) technologies and are essential elements in the Government's Reliability Centered Building and Equipment Acceptance Program.

This specification is not intended to limit the inspection and acceptance process to the use of PT&I techniques. This guide is intended to supplement comprehensive and detailed commissioning and quality control specifications.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Quality Control Plan

Material, Equipment, and Fixture Lists

SD-02 Shop Drawings

Connection Diagrams

Fabrication Drawings

Installation Drawings

SD-03 Product Data

Manufacturer's Catalog Data

Equipment Foundation Data

Specific Equipment Data

Spare Parts List

Warranty

SD-05 Design Data

Design Analysis and Calculations

SD-06 Test Reports

Automatic Transfer Test

Battery Impedance Test

Breaker Timing Test

Contact Resistance Test

Continuity Test

Fall of Potential Test

General Battery Test

General Charger Test

High Voltage Test

Infrared Thermography Test

Insulation Oil Test

Insulation Resistance Test

Overpotential Test

Point to Point Test

Power Factor Test

Turns Ratio Test

Ultrasonic (Airborne)Test

Visual Inspection

SD-07 Certificates

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SD-08 Manufacturer's Instructions

Manufacturer's Instructions

SD-10 Operation and Maintenance Data

Operations and Maintenance Manuals

SD-11 Closeout Submittals

Acceptance Documentation

Record Drawings

Baseline Data Report

1.5 DESIGN DATA

Submit applicable design analysis and calculations for the equipment listed below as instructed by the project specification.

a. Batteries (General)

b. Batteries (Lead-Acid)

c. Battery Chargers

d. Breakers

e. Cables

f. Electrical Automatic Transfer Switches

g. Electric Buss

h. Electrical Control Panels

i. Electrical Distribution Panels

j. Electrical Grounding Grid

k. Electrical Lightning Protection

l. Electrical Power Centers

m. Electrical Power Supplies

n. Electrical Rectifiers

o. Electrical Relays

p. Electrical Starters

q. Electric Switches

r. Motor Control Centers

s. Switchgear

t. Transformers

1.6 QUALITY ASSURANCE

Submit a Quality Control plan outlining the intended methods of receiving, testing, and installing equipment. The RCBEA GUIDE specifies minimum test equipment requirements. Use trained and adequately certified personnel in the appropriate acceptance testing PT&I technologies to ensure that the results are accurate and consistent. Submit the following as part of the quality control plan for all required acceptance testing:

a. List of all test equipment used, including its manufacturer, model number, calibration date, certificate of calibration, and serial number.

b. Certificates of test personnel qualifications and certifications.

1.7 WARRANTY

Furnish workmanship and performance warranty for the work performed for a period not less than 1 year from the date of Government acceptance of the work; issued directly to the Government. Perform corrective action that becomes necessary because of defective materials and workmanship while system is under warranty 7 days after notification, unless additional time is approved by the COR. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the Contractor. Provide a 1 year minimum contractor installation warranty.

PART 2 PRODUCTS

2.1 PRODUCT DATA

Submit material, equipment, and fixture lists for all equipment, materials, and fixtures planned for use to complete the job before commencing work. Include at a minimum, the item's description, quantity, manufacturer's style or catalog numbers, and specification and drawing reference numbers. Provide a complete list of construction equipment to be used.

2.1.1 Manufacturer Product Data

Submit fabrication drawings for equipment and specialties consisting of fabrication and assembly details to be performed in the factory. Show connection diagrams and assemblies in switchgear fabrication drawings

Submit for all equipment listed. Include manufacturer's standard catalog data, at least 25 working days prior to the purchase or installation of a particular component, highlighted to show material, size, options, equipment performance data charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Include manufacturer's recommended installation instructions and procedures. If vibration isolation is specified for a unit, include vibration isolator literature containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations. Submit for each specified component.

Submit manufacturer's catalog data and equipment foundation data (as applicable) for the following equipment:

Include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

a. Batteries (General)

b. Batteries (Lead-Acid)

c. Battery Chargers

d. Breakers

e. Cables

f. Electrical Automatic Transfer Switches

g. Electric Buss

h. Electrical Control Panels

i. Electrical Distribution Panels

j. Electrical Grounding Grid

k. Electrical Lightning Protection

l. Electrical Power Centers

m. Electrical Power Supplies

n. Electrical Rectifiers

o. Electrical Relays

p. Electrical Starters

q. Electric Switches

r. Motor Control Centers

s. Switchgear

t. Transformers

2.1.2 Certification Data

Submit applicable certificates for the equipment listed below showing conformance with test requirements, laboratory certifications, etc. as instructed by the project specification.

a. Batteries (General)

b. Batteries (Lead-Acid)

c. Battery Chargers

d. Breakers

e. Cables

f. Electrical Automatic Transfer Switches

g. Electric Buss

h. Electrical Control Panels

i. Electrical Distribution Panels

j. Electrical Grounding Grid

k. Electrical Lightning Protection

l. Electrical Power Centers

m. Electrical Power Supplies

n. Electrical Rectifiers

o. Electrical Relays

p. Electrical Starters

q. Electric Switches

r. Motor Control Centers

s. Switchgear

t. Transformers

2.1.3 Specific Equipment Data

Submit the following information for all equipment listed below: location of installation, NASA Identification number, date of installation (required or actual acceptance date), and applicable NASA reference drawing number. Unless explicitly stated in submitted manufacturer's literature, provide and submit for the following equipment:

a. Batteries (General)

    1. Battery identification (Type)

b. Battery (Lead-Acid)

    1. Battery identification (Type)

    2. Battery specifications

c. Battery Chargers

    1. Battery charger type

    2. Battery charger specifications

d. Breakers - General

1. Breaker type

2. Breaker Specifications (including current transformer ratios)

e. Cables - Low

1. Power cable type

f. Electrical Automatic Transfer Switch (ATS)

1. ATS Identification (Type)

g. Electric Buss

1. Buss Type

2. Buss Specifications (including current and load capacity)

h. Electrical Control Panel

1. Electrical Control Panel Type (NEMA enclosure type)

2. Voltage configuration (120/240 VAC, 12/24 VDC, etc.)

3. Amperage

4. Dimensions

5. Weight

6. UL certification

7. EMI levels (if applicable)

i. Electrical Distribution Panel

1. Electrical Control Panel Type (NEMA enclosure type)

2. Voltage configuration (120/240 VAC, 12/24 VDC, etc.)

3. Amperage (panel main bus maximum)

4. Dimensions

5. Weight

6. UL certification

7. EMI levels (if applicable)

8. Number of circuit breaker positions (outputs)

9. Electrical Distribution Panel impedance

j. Electrical Grounding Grid

1. Grid Identification (Type)

k. Electrical Lightning Protection

1. Electrical Lightning Protection for Type I or II building structures

2. Class I Type Structures (Buildings below 75 feet in height)

3. Class II Type Structures (Buildings at or above 75 feet in height)

4. Class I & Class II Type Structures where the structural steel will be used in lieu of downlead or vertical cables

5. Electrical Lightning Protection Specifications: UL certification – "Master Label" rating by a UL inspector

6. Installation configuration

l. Electrical Power Centers

1. Electrical power center type (NEMA enclosure type)

2. Voltage configuration (120/240 VAC, 12/24 VDC, etc.)

3. Amperage (panel main bus maximum)

4. Dimensions

5. Weight

6. UL certification

7. EMI levels (if applicable)

8. Number of circuit breaker positions (outputs)

9. Electrical power center impedance

m. Electrical Power Supplies

1. Electrical power supply type

2. DC Output ratings

3. Dimensions, Weight

4. UL certification, EMI levels (if applicable)

5. Electrical Power Supply impedance

n. Electrical Rectifiers

1. Electrical rectifier type (enclosure type)

2. DC Voltage range (and DC current supply, kA)

3. Thyristor configurations (bridge, double-star, parallel)

4. Pulse number per unit

5. Dimensions, Weight

6. UL certification

o. Electrical Relays

1. Electrical relay type (NEMA enclosure type)

2. Voltage configuration

3. Time over current curves (time delay curves)

4. Phase and ground operating curves (shapes)

5. Dimensions, Weight

6. UL certification, EMI levels (if applicable)

7. Number and types of output relays

8. Current loading

p. Electrical Starters

1. Electrical Starter Type (NEMA enclosure type)

2. Amperage and voltage configuration (25A-60A, <600V and ¼-50HP, etc.)

3. Overload settings

4. Dimensions, Weight

5. UL certification, EMI levels (if applicable)

q. Electric Switch, All Types

1. Switch type

2. Switch specifications

r. Motor Control Center

1. Motor control center type

2. Motor control center specifications

s. Switchgear

1. Switchgear type

2. Switchgear specification data (voltage rating)

t. Transformers

1. Transformer Type

2. Winding resistance

3. Current transformer ratios

4. Transformer impedance

5. Load loss at rated voltage and current

6. Current loading

2.1.4 Extra Materials

Submit spare parts list data for each different item of material and equipment specified, after approval of detail drawings and not later than 1 month prior to the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and source of supply, a recommended spare parts list for 12 months operation, and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

PART 3 EXECUTION

3.1 INSTALLATION

Submit installation drawings for all installed equipment consisting of equipment layouts including assembly, applicable manufacturer's instructions, installation details and electrical connection diagrams; layout and installation details including support structures, conduit and related system components. Include on the drawings any information required to demonstrate that the system has been coordinated and will properly function within the electrical system, and show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

Submit connection diagrams for electrical equipment, panels, conduit, and specialties indicating the relations and connections of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit record drawings, at least 14 days after completion of equipment installation and acceptance testing. Update electrical system drawings to reflect final record as-built conditions after all related work is completed.

3.2 EXAMINATION

Perform visual inspection on the equipment listed below. Correct all abnormalities or defects as directed by the COR.

a. Batteries (General)

b. Batteries (Lead-Acid)

c. Battery Chargers

d. Breakers

e. Cables

f. Electrical Automatic Transfer Switches

g. Electric Buss

h. Electrical Control Panels

i. Electrical Distribution Panels

j. Electrical Grounding Grid

k. Electrical Lightning Protection

l. Electrical Power Centers

m. Electrical Power Supplies

n. Electrical Rectifiers

o. Electrical Relays

p. Electrical Starters

q. Electric Switches

r. Motor Control Centers

s. Switchgear

t. Transformers

3.3 FIELD QUALITY CONTROL AND ACCEPTANCE TESTING

Deliver equipment and services that meet the contract requirements and specifications. Ensure all equipment is free of latent manufacturing and installation defects, and acceptance criteria are met. Perform acceptance testing as defined in this specification and the RCBEA GUIDE, using both traditional and PT&I technologies. The Government will observe and monitor the acceptance testing, analysis and documentation as part of the Government's Quality Assurance Program. Not until the requirements of acceptance are met will the equipment or facility be accepted by the Government.

3.3.1 Predictive Testing and Inspection Tests

Perform the following PT&I Tests in accordance with the requirements and criteria established in the RCBEA GUIDE. Include test point locations in all submitted reports.

Provide final test reports to the COR. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Report Data".

a. Perform Automatic Transfer Test for:

    1. Electrical Automatic Transfer Switch

b. Perform Battery Impedance Test for:

    1. Batteries (General)

f. Perform Breaker Timing Test for:

    1. Breakers- General

g. Perform Contact Resistance Test for:

    1. Battery (Lead-Acid)

    2. Battery Chargers

    3. Breakers- General

    4. Electrical Automatic Transfer Switch

    5. Electric Buss

    6. Electrical Control Panel

    7. Electrical Distribution Panel

    8. Electrical Power Centers

    9. Electrical Power Supplies

    10. Electrical Rectifiers

    11. Electric Switch, Low Voltage Air

    12. Electrical Relays

    13. Electrical Starters

    14. Switchgear

    15. Transformers

h. Perform Continuity Test for:

    1. Electrical Lightning Protection

i. Perform Fall of Potential Test for:

    1. Electrical Grounding Grid

j. Perform General Battery Test for:

    1. Battery (Lead-Acid)

k. Perform General Charger Test for:

    1. Battery Chargers

l. Perform High Voltage Test for:

    1. Breakers - General

    2. Cables - Low Voltage (600V Maximum)

3. Electrical Distribution Panel
4. Electrical Power Centers
5. Electrical Rectifiers
6. Switchgear
7. Transformers

m. Perform Infrared Thermography Test for:

1. Electrical Control Panels
2. Electrical Distribution Panel
3. Electrical Power Centers
4. Electrical Power Supplies
5. Electrical Starters
6. Motor Control Center
7. Switchgear
8. Transformers
9. Batteries (General)
10. Battery Chargers
11. Breakers- General
12. Electrical Automatic Transfer Switch
13. Electric Buss
14. Electrical Rectifiers
15. Electric Switch, Low Voltage Air

n. Perform Insulation Oil Test for:

1. Transformers

o. Perform Insulation Resistance Test for:

1. Breakers - General
2. Cables- Low Voltage (600V Maximum)
3. Electrical Automatic Transfer Switch
4. Electric Buss
5. Electrical Rectifiers
6. Electrical Relays

7. Electric Switch, Low Voltage Air
8. Switchgear
9. Electrical Control Pane
10. Electrical Distribution Panel
11. Electrical Lightning Protection
12. Electrical Power Centers
13. Electrical Power Supplies
14. Electrical Starters
15. Motor Control Centers
16. Transformers

p. Perform Overpotential Test for:

1. Electric Buss

q. Perform Point to Point Test for:

1. Electrical Grounding Grid

r. Perform Power Factor Test for:

1. Electrical Rectifiers
2. Transformers
3. Breakers - General
4. Cables (General)
5. Electrical Automatic Transfer Switch
6. Electrical Control Panel
7. Electrical Distribution Panel
8. Electrical Power Centers
9. Electrical Power Supplies
10. Switchgear

s. Perform Turns Ratio Test for:

1. Electrical Rectifiers
2. Transformers

t. Perform Ultrasonic (Airborne) Test for:

1. Electrical Control Panel
2. Electrical Distribution Panel
3. Electrical Power Centers
4. Electrical Starters
5. Motor Control Centers
6. Switchgear
7. Transformers
8. Batteries (Lead-Acid)
9. Battery Chargers
10. Breakers- General
11. Cables (General)
12. Cables- Low Voltage (600V Maximum)
13. Electrical Automatic Transfer Switch
14. Electric Buss
15. Electrical Rectifiers
16. Electric Switch, Low Voltage Air

3.3.2 Baseline Data from Verification Testing

Upon completion of all PT&I tests submit baseline data report to the COR. Include a summary of all performance data, set points, operating parameters and PT&I test results obtained for equipment and building systems.

3.4 OPERATIONS AND MAINTENANCE

Submit manufacturer's operations and maintenance manuals for the following equipment:

a. Batteries (General)

b. Battery Chargers

c. Breakers

d. Cables

   1. Low Voltage (600V Maximum)

e. Electrical Automatic Transfer Switches

f. Electric Buss

g. Electrical Control Panels

h. Electrical Distribution Panels

i. Electrical Grounding Grid

j. Electrical Lightning Protection

k. Electrical Power Centers

l. Electrical Power Supplies

m. Electrical Rectifiers

n. Electrical Relays

o. Electrical Starters

p. Electric Switches

    1. Low Voltage Air

q. Motor Control Centers

r. Switchgear

s. Transformers

Submit one electronic copy and three hard of operations and maintenance manuals in bound 8-1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown. Include the manufacturer's name, model number, parts list, routine maintenance procedures, possible breakdowns and repairs, trouble shooting guide, and a brief description of all equipment and their basic operating features. Include piping and equipment layouts and simplified wiring and control diagrams of the system as installed. Where available, provide technical manuals in electronic format with Standard Graphics Markup Language. When electronic format publications are provided, only two copies of the document are required. Submit operations and maintenance manuals 20 working days prior to testing any equipment.

3.5 ACCEPTANCE DOCUMENTATION

Provide the following acceptance testing/commissioning documentation as part of the project closeout reports;

a. Schedule of Equipment Pre-Start Up and Commissioning

b. Equipment Matrix and Deficiencies Report

c. Pre-Function Checklist

d. Functional Performance Tests

Upon completion of the project and acceptance testing the COR will provide acceptance documentation to the Contractor. Complete, sign and date this documentation and submit back to the COR for processing and approval.

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SECTION 02 32 00

SUBSURFACE DRILLING, SAMPLING, AND TESTING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for determining the type, nature, and characteristics of subsurface materials as they exist to the depths and at the locations specified.

1.2 SUBSURFACE EXPLORATION PROGRAMS

NASA Ames Research Center is entirely located within a State of California Seismic Hazard Zone or "zone of required investigation" for liquefaction. Seismic Hazard Zone Maps, Seismic Hazard Zone Reports and additional information on seismic hazard zone mapping in California are available on the California Geological Survey's (CGS) Internet page: http://www.consrv.ca.gov/cgs/shzp/Pages/Index.aspx.

Subsurface exploration programs shall be conducted in accordance with CGS Special Publication 117A "Guidelines for Evaluating and Mitigating Seismic Hazards in California;" available at: http://gmw.consrv.ca.gov/shmp/webdocs/sp117.pdf.

The scope of subsurface exploration programs, including the number and types of explorations, the equipment used to drill and sample, the in-situ testing equipment, and the laboratory testing program, shall be developed by a registered design professional in conjunction with the COR. Although no minimum number of explorations is required, one exploration per 5,000 square feet of structure footprint with a minimum of two explorations per structure may be considered good guidance. Borings shall be of sufficient depth to adequately characterize the subsurface conditions, including liquefaction potential. At a minimum, explorations should extend beyond the anticipated foundation depth.

1.3 PAYMENT

Payment will be made on a lump sum basis as determined in Contract documents. Lump sum contract cost shall include: mobilization and demobilization of all equipment and personnel, exploration, sampling, backfill, site restoration, and disposal of drilling fluid.

1.4 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. The latest edition of each test method shall be used.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM D 1452	Soil Investigation and Sampling by Auger Borings
ASTM D 1586	Penetration Test and Split-Barrel Sampling of Soils
ASTM D 1587	Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
ASTM D 2487	Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2488	Description and Identification of Soils (Visual-Manual Procedure)
ASTM D 2573	Standard Test Method for Field Vane Shear Test in Cohesive Soil
ASTM D 3550	Standard Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils
ASTM D 4220	Standard Practices for Preserving and Transporting Soil Samples
ASTM D 5434	Standard Guide for Field Logging of Subsurface Explorations of Soil and Rock
ASTM D 5778	Standard Test Method for Electronic Friction Cone and Piezocone Penetration Testing of Soils
ASTM D 5783	Standard Guide for Use of Direct Rotary Drilling with Water Based Drilling Fluid for Geoenvironmental Exploration and the Installation of Subsurface Water Quality Monitoring Devices
ASTM D 6066	Standard Practice for Determining the Normalized Penetration Resistance of Sands for Evaluation of Liquefaction Potential
ASTM D 6151	Standard Practice for Using Hollow Stem Augers for Geotechnical Exploration and Soil Sampling
ASTM D 6169	Standard Guide for Selection of Soil and Rock Sampling Devices Used With Drill Rigs for Environmental Investigations
ASTM D 6519	Standard Practice for Sampling of Soil Using the Hydraulically Operated Stationary Piston Sampler

1.5 SYSTEM DESCRIPTION

Provide the data to determine the type, nature, and characteristics of subsurface materials and the extent and conditions of the various materials as they exist to the depths and at the locations specified. This is to be accomplished by means of conventional borings and sampling, cone penetration tests, and/or test pits.

1.5.1 Conventional Borings and Sampling

Conventional boring and sampling shall be performed in accordance with ASTM D 1452, ASTM D 5783, ASTM D 6151, and/or ASTM D 6169. Conventional borings include: mud rotary borings, hollow-stem auger borings, and solid-stem auger borings. Soil samples shall be obtained using either driven samplers or thin-walled tube samplers.

1.5.1.1 Drive Sampling

Drive sampling shall be performed in accordance with ASTM D 3550. Standard Penetration Tests (SPT) shall be performed in accordance with ASTM D 1586 and ASTM D 6066.

1.5.1.2 Undisturbed Sampling

All undisturbed sampling shall be accomplished in accordance with ASTM D 1587 or ASTM D 6519.

1.5.2 Cone Penetration Tests

Cone Penetration Tests (CPTs) shall be performed in accordance with ASTM D 5778. The CPT rig shall be fully maintained, in good condition, complete with competent and qualified personnel. At least one pore pressure dissipation test shall be performed per CPT.

1.5.3 Test Pit Excavation and Sampling

A test pit is any excavation in soil, hardpan, decomposed rock, or other unconsolidated or partially consolidated overburden materials which has an open cross-sectional area large enough to permit efficient excavation and shoring/lining, engineering and geological inspection and photographing of the subsurface soils and manual undisturbed sampling from within the test pit. All test pits shall be excavated, dewatered (if necessary), shored/lined and protected from surface water drainage in accordance with all applicable Federal, State, local, Corps of Engineers, and OSHA safety regulations.

1.5.4 Sequencing and Scheduling

1.5.4.1 Schedule of Drilling, Sampling, and Testing

Prior to starting work, submit a work plan for drilling, sampling, testing, and safety. The plan shall include, but shall not be limited to, the proposed method of drilling and sampling including a description of the equipment and sampling tools that will be used, a listing of any subcontractors to include a description of how the subcontractors will be used and a description of all methods and procedures that will be utilized to insure a safe operation and to protect the environment. No work shall be performed until this plan has been approved and no deviation from the approved plan will be permitted without prior approval by the COR. The

schedule of Drilling, Sampling, and Testing is to be provided using the following schedule format:

SCHEDULE OF DRILLING, SAMPLING AND TESTING

EXPLORATION NO.	METHOD	DEPTH FEET	VERTICAL OR INCLINED	SPECIAL INSTRUCTIONS

1.5.4.2 Order of Work

The order in which work is to be accomplished should be agreed upon by the Contractor and COR prior to the commencement of field work.

1.5.5 Oversight of Subsurface Exploration

a. Provide a qualified, Geologist or engineer, experienced in subsurface exploration for each drill unit to oversee all drilling, sampling, and field testing operations. This individual shall be responsible for the preparation of a separate log and/or report for each boring, or test pit. This individual shall also be responsible for the preparation of all soil samples.

b. The presence of a Government representative or the keeping of separate drilling records by the COR shall not relieve the Contractor of the responsibility for the work specified in this specification.

1.6 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Pre-Construction Submittals

Work Plan

Health and Safety Plan

SD-06 Test Reports

Contractor shall provide a report documenting all subsurface exploration activities, including permitting, if applicable, backfill, boring logs, and laboratory testing. Specific reporting requirements for conventional borings, CPTs, and test pits, are discussed in Section 3.8.

1.7 QUALITY ASSURANCE

Comply with all Federal, State and local laws, regulations and ordinances relating to the performance of this work. Procure all required permits, certifications and licenses required by Federal, State, and local law for the execution of this work. Submit copies of all permits, certifications,

and licenses prior to starting work. This submittal shall also include a statement of the prior experience, in the type of work described in these specifications, of the person or persons designated to perform the work specified herein.

1.8 DELIVERY, STORAGE, AND HANDLING

1.8.1 General

The Contractor is solely responsible for retaining samples for a period of one year from the date of drilling. Samples shall be kept from freezing and from undue exposure to the weather. The Contractor shall keep all descriptive labels and designations on sample jars, tubes, and boxes clean and legible.

1.8.2 Undisturbed Samples

Undisturbed samples should be handled and transported in accordance with ASTM D 4224. Take every precaution to avoid damage to samples as a result of careless handling and undue delay in shipping. Samples shall be shipped in containers of sufficient durability to protect the samples from any damage during shipment. Avoid exposing sealed and crated samples to precipitation, direct sunlight, freezing and temperatures in excess of 100 degrees F. Samples permitted to freeze, even partially, shall be replaced by the Contractor. In general, no undisturbed samples shall remain on the site of sampling for more than one week before shipment. Samples shall be stored and shipped with the tube in a vertical position in order to prevent consolidation and segregation or change of water content.

1.9 PROJECT/SITE CONDITIONS

1.9.1 Environmental Requirements

Comply with Section 01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS. In order to prevent and to provide for abatement and control of any environmental pollution arising from Contractor activities in the performance of this contract, the Contractor and its subcontractors shall comply with all applicable Federal, State, and local laws, regulations, and ordinances concerning environmental pollution control and abatement.

a. The Contractor is responsible for keeping informed of all updates and changes in all applicable laws, regulations, and ordinances.

b. Do not pollute lakes, ditches, rivers, springs, canals, waterways, groundwaters, or reservoirs with drill fluids, fuels, oils, bitumens, calcium chloride, insecticides, herbicides, or other materials that may be harmful to the environment or a detriment to outdoor recreation.

1.9.2 Field Measurements

The actual locations of drill holes, test pits, etc., will be established in the field by the Contractor, in conjunction with the COR prior to the start of work. The elevations of the established locations will also be provided by the COR prior to the start of work. The Contractor will be provided access to the locations as necessary for the prosecution of the work. Since no separate payment will be made for access construction, all costs associated with this shall be included in the cost of exploration.

1.9.3 Disposal of Excess Drill Cuttings and Drilling Fluids

Excess drill cuttings and drilling fluids, if any, shall be placed in 55-gallon drums or other suitable container approved by the COR for subsequent offsite disposal by the Contractor, unless the material is allowed by the COR to be spread out on site. Collected material, if required by the COR, shall also be tested for potential environmental contaminants (e.g., gasoline or diesel fuel, motor oil, heavy metals, insecticides or herbicides) as specified by the COR.

PART 2 PRODUCTS

The Contractor shall provide all drilling and sampling materials and equipment, including materials for transportation and storage of samples.

PART 3 EXECUTION

3.1 MOBILIZATION AND DEMOBILIZATION

3.1.1 Mobilization

Mobilization consists of the delivery to the site of all plant, equipment, materials and supplies to be furnished by the Contractor, the complete assembly in satisfactory working order of all such plant and equipment at the jobsite and the satisfactory storage at the site of all such materials and supplies.

3.1.2 Demobilization

Demobilization consists of the removal from the site of all plant, equipment, materials and supplies after completion of the work and also includes, at the direction of the COR, the cleanup and removal of all scrap, waste backfill material, waste drilling fluid, soil contaminated with engine/hydraulic oil, backfilling all sumps or excavations resulting from the operations and, in general, returning the site as close to its original condition as possible.

3.2 IDENTIFYING SAMPLES

A moisture proof label containing the project name, hole number and sample number shall be placed on the sample shipping container or this information can be written using a waterproof pen or scribed on the container. Take all precautions required to insure that the shipping boxes are not subjected to rough handling or damaging environmental conditions.

3.3 CONVENTIONAL BORING AND SAMPLING

Samples shall be labeled in accordance with paragraph IDENTIFYING SAMPLES. Samples shall be obtained at 2-1/2-foot intervals for the top 20 feet of the soil profile and at 5-foot intervals at depths of greater than 20 feet below the ground surface. In order to retain the natural moisture content, samples should be sealed in air-tight containers immediately after sampling.

3.3.1 Drive Sampling

Coarse-grained soils should be sampled using a Standard Penetration Test (2-inch outside diameter) sampler in accordance with ASTM D 1586 and ASTM D 6066.

Stiff fine-grained soils should be sampled with either a 2-inch O.D. SPT sampler, a 3-inch O.D. Modified California sampler, or thin-walled samples (discussed in next section). Perform pocket penetrometer and torvane tests on samples of fine-grained soils. If samples will be used for laboratory strength, permeability, or consolidation testing, the thin-walled sampler should be used.

3.3.2 Undisturbed Sample Boring and Sampling

In general, labeling of undisturbed samples shall conform to paragraph IDENTIFYING SAMPLES. Particular care shall be taken to indicate the top and bottom of each sample tube and the length of retained soil. Tubes and crates for undisturbed samples shall be labeled "DO NOT JAR OR VIBRATE" and "HANDLE, HAUL, AND SHIP IN A VERTICAL POSITION".

3.3.3 Procedure

Undisturbed samples should be obtained using thin-walled tubes with a minimum diameter of 2 inches in accordance with ASTM D 1587 or ASTM D 6519. Samplers shall be advanced downward by one continuous, smooth drive using the drill rig's hydraulic feed system. The hydraulic down pressure shall be read and recorded at 6 inch intervals during each sample drive. The sampling device for stiff and dense soils shall be advanced by continuous rotation of the outer cutting barrel in conjunction with use of drill fluid circulation. Driving of any undisturbed sampling device by means such as a drop hammer will not be permitted.

Drilling fluid and disturbed soil shall be removed from both ends of the soil sample. Small samples should be collected from either end of the sample for visual classification. Perform pocket penetrometer and torvane tests on samples of fine-grained soils.

3.3.4 Sealing

The soil sample obtained in a thin wall Shelby tube shall be retained in the tube and sealed on both ends with a mechanically expandable O-ring sealing disk of the appropriate size, plastic cap and duct tape, or with a mixture of paraffin and microcrystalline wax.

If wax is used, approximately 2 inches of soils should be trimmed from each end, and a metal or wooden disk, having a slightly smaller diameter than the inside diameter of the sample tube. Wax seal should be at least 1/4-inch thick.

3.4 CONE PENETRATION TESTING

Cone Penetration Tests (CPTs) shall be performed in accordance with ASTM D 5778. The CPT rig shall be fully maintained, in good condition, complete with competent and qualified personnel. At least one pore pressure dissipation test shall be performed per CPT.

CPT data report should include CPT logs and equipment specifications, including truck weight, cone dimensions, and CPT net area ratio. At a minimum, CPT logs should include: depth, tip resistance, sleeve friction, pore pressure, friction ratio, differential pore pressure, and Soil Behavior Type.

3.5 TEST PIT EXCAVATION AND SAMPLING

3.5.1 Excavation

The test pits shall be excavated to depths and dimensions indicated in paragraph SCHEDULE OF DRILLING, SAMPLING, AND TESTING. Become thoroughly familiar with work site and with all available subsurface data, particularly groundwater conditions, before excavating pits. Regardless of the method of excavation employed, the pits shall be excavated, dewatered and shored/lined in conformance with all applicable safety regulations.

3.5.2 Sampling

A minimum of one sample should be obtained of each material type encountered in each test pit. In order to retain the natural moisture content, samples should be sealed in air-tight containers immediately after sampling. The method of sampling should be consistent with the intended use of the samples (i.e., if only visual classification and index testing will be performed, disturbed samples would be sufficient).

The Contractor's representative should measure the test pit excavation and provide a sketch indicating the subsurface profile and sample locations.

3.6 SUPPLEMENTAL EXPLORATIONS

Explorations that are abandoned or from which unsatisfactory samples or cores are obtained will be supplemented by other explorations adjacent to the original in order that satisfactory samples or the required information will be obtained. Actual locations of any supplemental explorations will be established by the COR. Penetration to the depth where the original was abandoned or to the depths where unsatisfactory samples were obtained may be made by any method selected by the Contractor that in the opinion of the COR will permit satisfactory completion and sampling below the elevation where the last satisfactory sample was obtained in the abandoned or satisfactory sampling in the reaches where satisfactory samples were not obtained in the original explorations. No payment will be made for supplemental explorations that are required to be to replace explorations that were abandoned or from which satisfactory samples were not obtained because of mechanical failure of drilling and sampling equipment, negligence on the part of the Contractor, or other preventable cause for which the Contractor is responsible except that payment will be made for acceptable portions of these supplementary explorations below the depths or outside the reaches for which payment was made for the original.

3.7 BACKFILLING

3.7.1 Drill Holes

Unless otherwise noted in these specifications or directed by the COR, all drill holes shall be backfilled and abandoned in accordance with all Federal, State, and local laws, regulations and ordinances. Preserve all holes in good condition until final measurement and until the records and samples have been accepted. As a minimum, all holes shall be grouted from the bottom of the hole to within 2 feet of the ground surface using a grout mixture of six to eight gallons of water per sack (94 pounds) of portland cement. All grout shall be pumped through a tremie pipe that is inserted to the bottom of the boring to insure that the grout fills the full extent of the hole. The remaining ungrouted top 2 feet of the hole shall be backfilled with local soil and tamped. All backfilling operations shall be

performed in the presence of the COR and, if required by regulation, Federal, State, and local officials. No separate payment will be made for backfilling drill holes. The cost of this work shall be included in the drilling costs.

3.7.2 Test Pits

Backfill all test pits with local soil compacted to original densities as directed by the COR. No separate payment will be made for backfilling test pits. The cost of this work shall be included in the test pit excavation costs.

3.8 RECORDS

Submit complete, legible copies of DRILLING LOG, ENG FORM 1836 and 1836A, and records to the COR upon completion of the work. Keep accurate driller's logs and records of all work accomplished under this contract and deliver complete, legible copies of these logs and records to the COR upon completion of the work. All such records shall be recorded during the actual performance of the work and shall be preserved in good condition and order until they are delivered and accepted. The following information shall be included on the logs or in the records for each exploration:

a. Exploration number or designation and elevation ground surface.

b. Driller's name and Geologist's name.

c. Make, size, and manufacturer's model designation of drilling, sampling, and test-pit excavating equipment.

d. Type of exploration operation by depth.

e. Hole diameter.

f. Dates and time explorations were performed.

g. Drill action, rotation speed, hydraulic pressure, water pressure, tool drops, and any other unusual and non-ordinary experience which could indicate the subsurface conditions encountered.

h. Depths at which samples or cores were recovered or attempts made to sample or core including top and bottom depth of each run.

i. Classification or description by depths of the materials obtained using the Unified Soil Classification System (ASTM D 2487) and including a description of moisture conditions, consistency and other appropriate descriptive information described in ASTM D 2488. This classification or description shall be made immediately after the samples or cores are retrieved.j. Indication of penetration resistance such as drive-hammer blows given in blows per foot for driving samples and the pressure in psi applied to push thin-wall or piston-type samplers.

k. Weight of drive hammer. Hammer drop height, hammer release system, and hammer manufacturer/model number.

l. Depth at which groundwater is encountered initially and when stabilized.

m. Depths at which drill water is lost and regained and amounts.

n. Depths at which the color of the drill water return changes.

o. Type of drill fluid.

p. Depth of bottom of hole.

r. CPT data report should include CPT logs and equipment specifications, including truck weight, cone dimensions, and CPT net area ratio. At a minimum, CPT logs should include: depth, tip resistance, sleeve friction, pore pressure, friction ratio, differential pore pressure, and soil behavior type.

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SECTION 02 41 00

DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for demolition, deconstructon, dismantling, reconditioning and disposal of existing building materials, equipment and utilities as a part of new construction or renovation work

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI Guideline K	Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants

AMERICAN SOCIETY FOR TESTING MATERIALS (ASTM)

ASTMD 2487	Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.6	Safety Requirements for Demolition Operations

CARPET AND RUG INSTITUTE (CRI)

CRI 104	Standard for Installation Specification of Commercial Carpet

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	Safety and Health Requirements Manual

U.S. DEFENSE LOGISTICS AGENCY (DLA)

DLA 4145.25	Storage and Handling of Liquefied and

	Gaseous Compressed Gases and Their Full and Empty Cylinders

U.S. DEPARTMENT OF DEFENSE (DOD)

DOD 4000.25-1-M	MILSTRIP - Military Standard Requisitioning and Issue Procedures
MIL-STD-129	Military Marking for Shipment and Storage

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	Obstruction Marking and Lighting

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 82	Protection of Stratospheric Ozone
49 CFR 173.301	Shipment of Compressed Gases in Cylinders and Spherical Pressure Vessels

1.3 PROJECT DESCRIPTION

1.3.1 Demolition

Prepare a Demolition Plan and submit proposed salvage, demolition, and removal procedures for approval before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of utility services, and airfield lighting, if requireda detailed description of methods and equipment to be used for each operation and of the sequence of operations. Identify components and materials to be salvaged for reuse or recycling with reference to paragraph Existing Facilities to be Removed. Append tracking forms for all removed materials indicating type, quantities, condition, destination, and end use. Coordinate with Waste Management Plan. Include statements affirming Contractor inspection of the existing roof deck and its suitability to perform as a safe working platform or if inspection reveals a safety hazard to workers, state provisions for securing the safety of the workers throughout the performance of the work. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by COR prior to work beginning.

1.3.2 General Requirements

Do not begin demolition or until authorization is received from the COR. The work of this section is to be performed in a manner that maximizes salvage and recycling of materials. Remove rubbish and debris from the project site daily; do not allow accumulations inside or outside the buildings on airfield pavements. The work includes demolition, , salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily, unless otherwise directed. Store materials that cannot be removed daily in areas specified by the COR. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.4 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the COR. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract. Do not overload structural elements to remain. Provide new supports and reinforcement for existing construction weakened by demolition, or removal work. Repairs, reinforcement, or structural replacement require approval by the COR prior to performing such work.

1.4.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide temporary shoring and bracing for support of building components to prevent settlement or other movement. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

1.4.2 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times. Where removal of existing roofing is necessary to accomplish work, have materials and workmen ready to provide adequate and temporary covering of exposed roof areas.

1.4.3 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition and operations. Prior to start of work, utilities serving each area of alteration or removal will be shut off by the Government and disconnected and sealed by the Contractor .

1.4.4 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished or deconstructed, unless directed otherwise by the COR. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted. Where burning is permitted, adhere to

federal, state, and local regulations.

1.6 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available in accordance with a schedule to be provided by the COR.

1.7 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions

SD-07 Certificates

Demolition Plan
Notification
Notification of Demolition and Renovation form

SD-11 Closeout Submittals

Receipts

1.8 QUALITY ASSURANCE

Submit timely notification of demolition and renovation projects to the COR and local authorities as neccary in accordance with 40 CFR 61, Subpart M. Notify the Regional Office of the United States Environmental Protection Agency (USEPA) State's environmental protection agency local air pollution control district/agency and the COR in writing 10 working days prior to the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSE/SAFE A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

1.8.1 Dust and Debris Control

Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Vacuum and dust the work area daily.

1.9 PROTECTION

1.9.1 Traffic Control Signs

a. Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Anchor barricades in a manner to prevent displacement by wind. Notify the COR 10 days prior to beginning such work.

1.9.2 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the project site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.10 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair or replace items to be relocated which are damaged by the Contractor with new undamaged items as approved by the COR.

1.11 EXISTING CONDITIONS

Before beginning any demolition or work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the COR showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document. Submit survey results.

PART 2 PRODUCTS

2.1 FILL MATERIAL

a. Comply with excavating, backfilling, and compacting procedures for soils used as backfill material to fill basements, voids, depressions or excavations resulting from demolition or of structures. Fill material shall be waste products from demolition or until all waste appropriate for this purpose is consumed.

b. Fill material shall conform to the definition of satisfactory soil material as defined by ASTM D 2487 in accordance with Section 31 00 00 Earthwork. In addition, fill material shall be free from roots and other organic matter, trash, debris, frozen materials, and stones larger than 2 inches in any dimension.

c. Proposed fill material must be sampled and tested by an approved soil testing laboratory in accordance with Section 31 00 00 Earthwork

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

Inspect and evaluate existing structures onsite for reuse. Existing construction scheduled to be removed for reuse shall be disassembled. Dismantled and removed materials are to be separated, set aside, and

prepared as specified, and stored or delivered to a collection point for reuse, remanufacture, recycling, or other disposal, as specified. Materials shall be designated for reuse onsite whenever possible.

3.1.1 Structures

a. Remove existing structures indicated to be removed to the level indicated on the Drawings. Interior walls, other than retaining walls and partitions, shall be removed to the level shown on the Drawings. Break up basement slabs to permit drainage. Remove sidewalks, curbs, gutters and street light bases as indicated.

b. Demolish structures in a systematic manner from the top of the structure to the ground. Complete demolition work above each tier or floor before the supporting members on the lower level are disturbed. Demolish concrete and masonry walls in small sections. Remove structural framing members and lower to ground by means of derricks, platforms hoists, or other suitable methods as approved by the COR.

c. Locate demolition and equipment throughout the structure and remove materials so as to not impose excessive loads to supporting walls, floors, or framing.

3.1.2 3.1.2 Utilities and Related Equipment

3.1.2.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the COR. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition or work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.2.2 Disconnecting Existing Utilities

Remove existing utilities , as indicated and uncovered by work and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the COR. When utility lines are encountered but are not indicated on the drawings, notify the COR prior to further work in that area. Remove meters and related equipment and deliver to a location in accordance with instructions of the COR.

3.1.3 Chain Link Fencing

Remove chain link fencing, gates and other related salvaged items scheduled for removal and transport to designated areas. Remove gates as whole units. Cut chain link fabric to 25 foot lengths and store in rolls off the ground. Maintain security when required by the COR.

3.1.4 Paving and Slabs

Remove concrete and asphaltic concrete paving and slabs including aggregate base as indicated on the Drawings as indicated . Provide neat sawcuts at limits of pavement removal as indicated. Pavement and slabs designated to be recycled and utilized in this project shall be moved, ground and stored as directed by the COR. Pavement and slabs not to be used in this project shall be removed from the Installation at Contractor's expense.

3.1.5 Roofing

Remove existing roof system and associated components in their entirety down to existing roof deck. Remove built-up or single-ply roofing to effect the connections with new flashing or roofing. Remove gravel surfacing from existing roofing felts for a minimum distance of 18 inches back from the cut. Remove gravel without damaging felts. Salvage asphalt roofing materials. Cut existing felts or membrane and insulation along straight lines. Remove roofing system and insulation without damaging the roof deck. Sequence work to minimize building exposure between demolition or and new roof materials installation as approved by the COR.

3.1.5.1 Temporary Roofing

Install temporary roofing and flashing as necessary to maintain a watertight condition throughout the course of the work. Remove temporary work prior to installation of permanent roof system materials unless approved otherwise by the COR. Make provisions for worker safety during demolition, and installation of new materials as described in paragraphs entitled "Statements" and "Regulatory and Safety Requirements."

3.1.5.2 Reroofing

When removing the existing roofing system from the roof deck, remove only as much roofing as can be recovered by the end of the work day, unless approved otherwise by the COR. Do not attempt to open the roof covering system in threatening weather. Reseal all openings prior to suspension of work the same day.

3.1.6 Masonry

Sawcut and remove masonry so as to prevent damage to surfaces to remain and to facilitate the installation of new work. Where new masonry adjoins existing, the new work shall abut or tie into the existing construction as indicated . Provide square, straight edges and corners where existing masonry adjoins new work and other locations. .

3.1.7 Concrete

Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete. Salvage removed concrete.

3.1.8 Structural Steel

Dismantle structural steel at field connections and in a manner that will prevent bending or damage. Salvage for structural steel, steel joists, girders, angles, plates, columns and shapes. Do not use flame-cutting torches Flame-cutting torches are permitted only when other methods of dismantling are not practical. Transport steel joists and girders as whole units and not dismantled if practicle. Transport structural steel shapes to a designated recycling facility , stacked according to size, type of member and length, and stored off the ground, protected from the weather.

3.1.9 Miscellaneous Metal

Salvage shop-fabricated items such as access doors and frames, steel gratings, metal ladders, wire mesh partitions, metal railings, metal windows and similar items as whole units. Salvage light-gage and cold-formed metal framing, such as steel studs, steel trusses, metal gutters, roofing and siding, metal toilet partitions, toilet accessories and similar items. Scrap metal shall become the Contractor's property. Recycle scrap metal as part of demolition and operations. Provide separate containers to collect scrap metal and transport to a scrap metal collection or recycling facility, in accordance with the Waste Management Plan.

3.1.10 Carpentry

Salvage for lumber, millwork items, and finished boards, and sort by type and size.

3.1.11 Carpet

Remove existing carpet for reclamation in accordance with manufacturer recommendations and as follows. Remove used carpet in large pieces, roll tightly, and pack neatly in a container. Remove adhesive according to recommendations of the Carpet and Rug Institute (CRI). Adhesive removal solvents shall comply with CRI 104. Recycle removed carpet cushion.

3.1.12 Acoustic Ceiling Tile

Remove, neatly stack, and recycle acoustic ceiling tiles. Recycling may be available with manufacturer. Otherwise, priority shall be given to a local recycling organization.

3.1.13 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces, using on-site materials when available. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish. Patching shall be as specified and indicated, and shall include:

a. Concrete and Masonry: Completely fill holes and depressions, caused by previous physical damage or left as a result of removals in existing masonry walls to remain, with an approved masonry patching material, applied in accordance with the manufacturer's printed instructions.

b. Where existing partitions have been removed leaving damaged or missing resilient tile flooring, patch to match the existing floor tile.

c. Patch acoustic lay-in ceiling where partitions have been removed. The transition between the different ceiling heights shall be effected by continuing the higher ceiling level over to the first runner on the lower ceiling and closing the vertical opening with a painted sheet metal strip.

3.1.14 Air Conditioning Equipment

Recover all refrigerants prior to removing air conditioning, refrigeration, and other equipment containing refrigerants and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS) unless otherwise indicated by the COR."

3.1.15 Cylinders and Canisters

Remove all fire suppression system cylinders and canisters and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)."

3.1.16 Locksets on Swinging Doors

Remove all locksets from all swinging doors indicated to be removed and disposed of. Deliver the locksets and related items to a designated location for receipt by the COR after removal as directed.

3.1.17 Mechanical Equipment and Fixtures

Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Disconnect mechanical equipment and fixtures at fittings. Remove service valves attached to the unit. Salvage each item of equipment and fixtures as a whole unit; listed, indexed, tagged, and stored. Salvage each unit with its normal operating auxiliary equipment. Transport salvaged equipment and fixtures, including motors and machines, to a designated storage area as directed by the COR. Do not remove equipment until approved. Transport mechanical equipment and fixtures to recycling service for disassembly and recycling of parts.

3.1.17.1 Preparation for Storage

Remove water, dirt, dust, and foreign matter from units; tanks, piping and fixtures shall be drained; interiors, if previously used to store flammable, explosive, or other dangerous liquids, shall be steam cleaned. Seal openings with caps, plates, or plugs. Secure motors attached by flexible connections to the unit. Change lubricating systems with the proper oil or grease.

3.1.17.2 Piping

Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage as directed by the COR. Store salvaged piping according to size and type. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property. Store piping outdoors until all fumes and residues are removed. Box prefabricated supports, hangers, plates, valves, and specialty items according to size and type. Wrap sprinkler heads individually in plastic bags before boxing. Classify piping not designated for salvage, or not reusable as scrap metal and remove from the site.

3.1.17.3 Ducts

Classify removed duct work as scrap metal and remove from the site.

3.1.17.4 Fixtures, Motors and Machines

Remove and salvage fixtures, motors and machines associated with plumbing, heating, air conditioning, refrigeration, and other mechanical system installations. Salvage, box and store auxiliary units and accessories with the main motor and machines. Tag salvaged items for identification, storage, and protection from damage. Classify broken, damaged, or otherwise unserviceable units and not caused to be broken, damaged, or otherwise unserviceable as debris to be disposed of by the Contractor.

3.1.18 Electrical Equipment and Fixtures

Salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment. Salvage wiring systems and components. Box loose items and tag for identification. Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

3.1.18.1 Fixtures

Remove and salvage electrical fixtures. Salvage unprotected glassware from the fixture and salvage separately. Salvage incandescent, mercury-vapor, and fluorescent lamps and fluorescent ballasts manufactured prior to 1978, boxed and tagged for identification, and protected from breakage.

3.1.18.2 Electrical Devices

Remove and salvage switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items. Box and tag these items for identification according to type and size.

3.1.18.3 Wiring Ducts or Troughs

Remove and salvage wiring ducts or troughs. Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices from the busway and store separately.

3.1.18.4 Conduit and Miscellaneous Items

Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

3.1.19 Elevators and Hoists

Remove elevators, hoists, and similar conveying equipment and salvage as whole units, to the most practical extent. Remove and prepare items for salvage without damage to any of the various parts. Salvage and store rails for structural steel with the equipment as an integral part of the unit.

3.1.20 Items With Unique/Regulated Disposal Requirements

Remove and dispose of items with unique or regulated disposal requirements in the manner dictated by law or in the most environmentally responsible manner.

3.2 CONCURRENT EARTH-MOVING OPERATIONS

Do not begin excavation, filling, and other earth-moving operations that are sequential to demolition or work in areas occupied by structures to be demolished or deconstructed until all demolition and in the area has been completed and debris removed. Fill holes, open basements and other hazardous openings.

3.3 DISPOSITION OF MATERIAL

3.3.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor and shall be removed from Government property. Title to materials resulting from demolition and , and materials and equipment to be removed, is vested in the Contractor upon approval by the COR of the Contractor's demolition, , and removal procedures, and authorization by the COR to begin demolition and . The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.3.2 Reuse of Materials and Equipment

Remove and store materials and equipment listed in the Demolition Plan to be reused or relocated to prevent damage, and reinstall as the work progresses.

3.3.3 Salvaged Materials and Equipment

Remove materials and equipment that are listed in the Demolition Plan and specified to be removed by the Contractor and that are to remain the property of the Government, and deliver to a storage site as directed by the COR.

a. Salvage items and material to the maximum extent possible.

b. Store all materials salvaged for the Contractor as approved by the COR and remove from Government property before completion of the contract. On site sales of salvaged material is prohibited.

c. Remove salvaged items to remain the property of the Government in a manner to prevent damage, and packed or crated to protect the items from damage while in storage or during shipment. Items damaged during removal or storage must be repaired or replaced to match existing items. Properly identify the contents of containers. Deliver the items reserved as property of the Government to the areas designated:

f. Remove and capture all Class I ODS refrigerants in accordance with the Clean Air Act Amendment of 1990, and turn in to the NASA as directed by the COR.

3.3.4 Disposal of Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting AHRI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be turned over to the Contracting Officer or removed from Government property and disposed of in accordance with 40 CFR 82as directed. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82.

3.3.4.1 Special Instructions

No more than one type of ODS is permitted in each container. A warning/ hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

a. Activity name and unit identification code

b. Activity point of contact and phone number

c. Type of ODS and pounds of ODS contained

d. Date of placement in container

3.3.4.2 Fire Suppression Containers

Deactivate fire suppression system cylinders and canisters with electrical charges or initiators prior to shipment. Also, safety caps must be used to cover exposed actuation mechanisms and discharge ports on these special cylinders.

3.3.5 Transportation Guidance

Ship all ODS containers in accordance with MIL-STD-129, DLA 4145.25 (also referenced one of the following: Army Regulation 700-68, Naval Supply Instruction 4440.128C, Marine Corps Order 10330.2C, and Air Force Regulation 67-12), 49 CFR 173.301, and DOD 4000.25-1-M.

3.3.6 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable noncombustible material in the disposal area located off site.

3.4 CLEANUP

Remove debris and rubbish from basement and similar excavations. Remove and transport the debris in a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.5 DISPOSAL OF REMOVED MATERIALS

3.5.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified off the center in the Waste Management Plan.

3.5.2 Burning on Government Property

Burning of materials removed from demolished and deconstructed structures will not be permitted.

3.5.3 Removal to Spoil Areas on Government Property

Transport noncombustible materials removed from demolition and structures to designated spoil areas on Government property when directed by the COR.

3.5.4 Removal from Government Property

Transport waste materials removed from demolished and deconstructed structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

3.6 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

-- End of Section --

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DIVISION 02 - EXISTING CONDITIONS

SECTION 02 42 91

REMOVAL AND SALVAGE OF HISTORIC BUILDING MATERIALS

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SECTION 02 42 91

REMOVAL AND SALVAGE OF HISTORIC BUILDING MATERIALS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for removal and salvage of historic building materials of historic buildings and structures.

1.2 PROJECT DESCRIPTION

The work includes removal and salvage of identified historic items and materials, and removal of resulting rubbish and debris. General demolition of non-historic materials and removal of resulting rubbish and debris shall comply with the requirements of Section 02 41 00 DEMOLITION . Materials to be salvaged or recycled shall be stored daily in areas and manner specified by the COR. In the interest of conservation, salvage and recycling shall be pursued to the maximum extent possible. Submit a Work Plan. The "Plan" shall include the procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, careful removal and disposition of materials specified to be salvaged or recycled, dust control, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations.

1.2.1 Dust Control

The amount of dust resulting from removal, salvage and demolition operations shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water to control dust will not be permitted when it will result in, or create, damage to existing building materials and hazardous or objectionable conditions such as ice, flooding and pollution.

1.2.2 Protection

1.2.2.1 Protection of Existing Historic Property

Before beginning any removal, salvage or demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Take necessary precautions to avoid damage to existing historic items that are to remain in place, to be reused, or to remain the property of the Government. Repair or restore items damaged by the Contractor to original condition, or replaced, as approved by the COR. Coordinate the work of this section with all other work. Construct and maintain shoring, bracing and supports, as required. Ensure that structural elements are not overloaded. Provide additional supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.2.2.2 Protection From the Weather

The interior of buildings to remain and salvageable materials shall be protected from the weather at all times. Salvaged historic materials shall be stored out of contact with the ground and under weathertight covering.

1.2.2.3 Environmental Protection

The work shall comply with the requirements of Section 02 82 14.00 10 ASBESTOS ABATEMENT.

1.3 QUALIFICATIONS

Provide qualified workers trained and experienced in whole-building recycling, including removal and salvage of historic materials. Submit documentation of five consecutive years of work of this type with a list of similar projects identifying when, where, and for whom the work was done. A current point-of-contact for identified references shall be provided.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 SALVAGED ITEMS

Salvage items to the maximum extent possible. Prior to any demolition work, historic items to be salvaged shall be removed from the structure. Removal of salvageable items shall be accomplished by hand labor to the maximum extent possible. Care shall be taken to not damage historic portions of the structure to remain or items identified for salvage. Furnishings, equipment, and materials not scheduled for salvage or recycling shall be removed prior to any salvaging procedures. Keep a complete recording of all salvaged materials including the condition of such materials before, and after, salvage operations. Such records are to be submitted to the COR.

3.1.1 Site Work

The following site items shall be removed intact and salvaged: fences and gates, site furnishings, fountains, sculpture, site ornaments, and site lighting fixtures.

3.1.2 Concrete

The following concrete items shall be removed intact and salvaged: precast architectural elements such as ornamental logos, i.e., NACA Bldg. XX).

3.1.3 Masonry

The following masonry items shall be removed intact and salvaged: brick, stone, terra cotta, cast stone, clay tile trim elements, cornerstones and moldings.

3.1.4 Metals

The following metal items shall be removed intact and salvaged: ladders, stairs and handrails, cast architectural ornament, architectural metalwork,

ornamental ironwork, gratings and metal walkways, door knobs (antique).

3.1.5 Wood

The following materials shall be removed intact and salvaged: wood decking, millwork, custom paneling, wood stairs and handrails, ladders, architectural woodwork, custom casework, wood timbers (5 x 5 inch or larger).

3.1.6 Thermal and Moisture Protection

The following materials shall be removed intact and salvaged: slate tiles, clay tiles, gutters, leaders, and downspouts, skylights, roof accessories and exterior siding.

3.1.7 Doors and Windows

Doors and windows with associated hardware and operating mechanisms shall be removed intact (including glass) and salvaged per schedule.

3.1.8 Finishes

The following special or historic finishes shall be protected, removed and remain intact: stenciling, decorative tile, molded ornament, decorative ceiling materials, wood flooring, textured wall coverings, and murals.

3.1.9 Equipment and Specialty Items

The following equipment and specialty items shall be removed intact and salvaged: louvers and vents, stoves, plaques, lockers, bath accessories partitions, contents of cornerstones, document boxes and miscellaneous distinctive metal work..

3.1.10 Mechanical Equipment

The following mechanical equipment shall be removed intact and salvaged: bathroom fixtures, radiators, registers and grilles, ladders and metal stairs, fans, cranes and lifting equipment.

3.1.11 Electrical Equipment

The following electrical fixtures and equipment shall be removed intact and salvaged: light fixtures, switches,clocks, and electric motors and generators.

3.2 RECYCLED MATERIALS

Recycle materials to the maximum extent possible. Removal of recyclable materials shall be accomplished by hand labor wherever possible. Historic portions of the structure to remain and items identified for salvage shall not be damaged while removing materials for recycling. The following materials shall be recycled: dimension lumber, marble and granite stone slabs, glass, metals, redwood planks and douglas fir planks: high quality interior finish wood.

3.3 DISPOSITION OF MATERIALS

Title to materials and equipment to be demolished, except Government and using service salvage and historical items, is vested in the Contractor

upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

3.3.1 Material Salvaged for the Contractor

Temporarily store salvaged material as approved by the COR and remove from Government property before completion of the contract. Sale of salvaged material on the site is prohibited.

3.3.2 Items Salvaged for the Government

Salvaged items to remain the property of the Government shall be removed in a manner to prevent damage, packed or crated to protect the items from damage, or as directed by the COR. Items damaged during removal or storage shall be reported to the COR. The COR will determine the appropriate action for damaged items.. Containers shall be properly identified as to contents.

3.4 CLEAN-UP

Upon completion of the work, portions of structure to remain and adjacent areas and structures shall be cleaned of dust, dirt, and debris caused by salvage and demolition operations. Debris and rubbish shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

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SECTION 02 61 13

EXCAVATION AND HANDLING OF CONTAMINATED MATERIAL

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for excavation, handling, and temporary storage of contaminated material.

1.2 MEASUREMENT AND PAYMENT

1.2.1 Measurement

Measurement for excavation and onsite transportation shall be based on the actual number of cubic yards of contaminated material in-place prior to excavation. Determination of the volume of contaminated material excavated shall be based on cross-sectional volume determination reflecting the differential between the original elevations of the top of the contaminated material and the final elevations after removal of the contaminated material. Measurement for backfilling of excavated areas shall be based on in-place cubic yards of compacted fill. Measurement for construction of stockpile areas shall be based on the number of square yards of stockpile liner constructed.

1.2.2 Payment

1.2.2.1 Excavation and Transportation

Compensation for excavation and onsite transportation of contaminated material will be paid as a unit cost. This unit cost shall include any other items incidental to excavation and handling not defined as having a specific unit cost.

1.2.2.2 Backfilling

Compensation for backfill soil, transportation of backfill, backfill soil conditioning, backfilling, compaction, and geotechnical testing will be paid as a single unit cost.

1.2.2.3 Stockpiling

Compensation for construction of stockpile areas will be paid for as a unit cost. This unit cost shall include all aspects of grading, preparation, handling, placement, maintenance, removal, treatment, and disposal of stockpile cover materials and liner materials and all other items incidental to construction of stockpiles.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol

or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM D1556	Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2167	Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2487	Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D422	Particle-Size Analysis of Soils
ASTM D5434	Field Logging of Subsurface Explorations of Soil and Rock
ASTM D6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D698	Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft.)

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	Safety and Health Requirements Manual

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926	Safety and Health Regulations for Construction
40 CFR 302	Designation, Reportable Quantities, and Notification

1.4 DESCRIPTION OF WORK

Approximate locations of contaminated material are shown on the drawings. Submit a Work Plan as specified below. Notify the COR within 48 hours, and before excavation, if contaminated material is discovered that has not been previously identified or if other discrepancies between data provided and actual field conditions are discovered. Ground water is approximately 4 to 9 feet below pre-excavation ground surface.

1.4.1 Scheduling

Notify the COR 7 calendar days prior to the start of excavation of

contaminated material. The COR will beresponsible for contacting regulatory agencies in accordance with the applicable reporting requirements as well as coordinating with the ARC Environmental Management Division.

1.4.2 Work Plan

Submit a Work Plan within 30 calendar days after notice to proceed. No work at the site, with the exception of site inspections and surveys, shall be performed until the Work Plan is approved. Allow 30 calendar days in the schedule for the Government's review. No adjustment for time or money will be made if resubmittals of the Work Plan are required due to deficiencies in the plan. At a minimum, the Work Plan shall include:

a. Schedule of activities.

b. Method of excavation and equipment to be used.

c. Shoring or side-wall slopes proposed.

d. Dewatering plan.

e. Storage methods and locations for liquid and solid contaminated material.

f. Borrow sources and haul routes.

g. Decontamination procedures.

h. Spill contingency plan.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Work Plan

SD-06 Test Reports

Backfill
Confirmation Sampling and Analysis
Sampling of Stored Material, Material Not used for onsite backfill to be tested to determine proper disposal.

1.6 REGULATORY REQUIREMENTS

1.6.1 Permits and Licenses

Obtain required federal, state, and local permits for excavation and storage of contaminated material. Permits shall be obtained at no additional cost to the Government.

PART 2 PRODUCTS

2.1 SPILL RESPONSE MATERIALS

Provide appropriate spill response materials including, but not limited to the following: containers, adsorbents, shovels, and personal protective equipment. Spill response materials shall be available at all times when contaminated materials/wastes are being handled or transported. Spill response materials shall be compatible with the type of materials and contaminants being handled.

2.2 BACKFILL

Backfill shall be classified in accordance with ASTM D2487 as GW, GP, GM, GC, SW, SP, SM, SC, ML, MH, CL, or CH and shall be free from roots and other organic matter, trash, debris, snow, ice or frozen materials. Backfill material shall be tested for the parameters listed below at a frequency of once per 500 cubic yards. A minimum of one set of classification tests shall be performed per borrow source.

PART 3 EXECUTION

3.1 EXISTING STRUCTURES AND UTILITIES

No excavation shall be performed until site utilities have been field located. Take the necessary precautions to ensure no damage occurs to existing structures and utilities. Damage to existing structures and utilities resulting from the Contractor's operations shall be repaired at no additional cost to the Government. Utilities encountered that were not previously shown or otherwise located shall not be disturbed without approval from the COR.

3.2 CONTAMINATED MATERIAL REMOVAL

3.2.1 Excavation

Areas shall be excavated to the depth and extent shown on the drawings unless directed by the COR. Excavation shall be performed in a manner that will limit spills and the potential for contaminated material to be mixed with uncontaminated material. An excavation log describing visible signs of contamination encountered shall be maintained for each area of excavation. Excavation logs shall be prepared in accordance with ASTM D5434.

3.3 CONFIRMATION SAMPLING AND ANALYSIS

The COR shall be present to inspect the removal of contaminated material from each site. After all material suspected of being contaminated has been removed, the excavation shall be examined for evidence of contamination.

3.4 CONTAMINATED MATERIAL STORAGE

Material shall be placed in temporary storage immediately after excavation. The following paragraphs describe acceptable methods of material storage. Storage units shall be in good condition and constructed of materials that are compatible with the material or liquid to be stored. If multiple storage units are required, each unit shall be clearly labeled with an identification number and a written log shall be kept to track the source of contaminated material in each temporary storage unit.

3.4.1 Stockpiles

Stockpiles shall be constructed to isolate stored contaminated material from the environment. The maximum stockpile size shall be 200 cubic yards. Stockpiles shall be constructed to include:

a. A chemically resistant geomembrane liner free of holes and other damage. Non-reinforced geomembrane liners shall have a minimum thickness of 20 mils. Scrim reinforced geomembrane liners shall have a minimum weight of 40 lbs/1000 square feet. The ground surface on which the geomembrane is to be placed shall be free of rocks greater than 0.5 inches in diameter and any other object which could damage the membrane.

b. Geomembrane cover free of holes or other damage to prevent precipitation from entering the stockpile. Non-reinforced geomembrane covers shall have a minimum thickness of 10 mils. Scrim reinforced geomembrane covers shall have a minimum weight of 26 lbs/1000 square feet. The cover material shall be extended over the berms and anchored or ballasted to prevent it from being removed or damaged by wind.

c. Berms surrounding the stockpile, a minimum of 12 inches in height. Vehicle access points shall also be bermed.

d. The liner system shall be sloped to allow collection of leachate. Storage and removal of liquid which collects in the stockpile, in accordance with paragraph Liquid Storage.

3.4.2 Liquid Storage

Liquid collected from excavations and stockpiles shall be temporarily stored in 55 gallon barrels or other appropriate storage, such as a Baker Tank, depending on volume of liquid generated. Liquid storage containers shall be water-tight and shall be located as shown on the drawings .

3.5 SAMPLING

3.5.1 Sampling of Stored Material

Samples of stored material shall be collected at a frequency of once per 100 cubic yards. Samples shall be tested for the following:

Chemical Parameter	Action Level
PCB and Metals and/or other suspected contaminant	TO BE DETERMINED IN FIELD by Environmental Management Division

Stored material with contaminant levels that exceed the action levels shall be treated offsite. Analyses for contaminated material to be taken to an

offsite treatment facility shall conform to local, state, and federal criteria as well as to the requirements of the treatment facility. Documentation of all analyses performed shall be furnished to the COR. Additional sampling and analyses to the extent required by the approved offsite treatment, storage or disposal (TSD) facility shall be the responsibility of the Contractor and shall be subject to approval by the COR.

3.5.2 Sampling Liquid

Liquid collected from excavations and stockpiles shall be temporarily stored in 55 gallon barrels or other appropriate storage, such as a Baker Tank, depending on volume of liquid generated. Samples shall be tested for the following:

Chemical Parameter	Action Level
PCB and Metals and/or other suspected contaminant	TO BE DETERMINED IN FIELD by Environmental Management Division

Liquid with contaminant levels that exceed action levels shall be treated offsite. Analyses for contaminated liquid to be taken to an offsite treatment facility shall conform to local, state, and federal criteria as well as to the requirements of the treatment facility. Documentation of all analyses performed shall be furnished to the COR. Additional sampling and analysis to the extent required by the approved offsite treatment, storage or disposal (TSD) facility receiving the material shall be the responsibility of the Contractor and shall be subject to approval by the COR.

3.6 SPILLS

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), pollutant, contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), notify the COR immediately. If the spill exceeds the reporting threshold, follow the pre-established procedures as described in the Base Wide Contingency Plan for immediate reporting and containment. Immediate containment actions shall be taken to minimize the effect of any spill or leak. Cleanup shall be in accordance with applicable federal, state, and local regulations. As directed by the COR, additional sampling and testing shall be performed to verify spills have been cleaned up. Spill cleanup and testing shall be done at no additional cost to the Government.

3.7 BACKFILLING

3.7.1 Confirmation Test Results

Excavations shall be backfilled immediately after all contaminated materials have been removed and confirmation test results have been approved. Backfill shall be placed and compacted to the lines and grades shown on the drawings.

3.7.2 Compaction

Engineered fill consisting of imported material or on-site soil which is not expansive should be compacted to at least 90 percent relative compaction as determined by ASTM D1557 at a moisture content slightly above laboratory optimum. Engineered fill consisting of native expansive soils should be compacted to 87 to 92 percent relative compaction at a moisture

content of at least 3 percent laboratory optimum. The upper six inches of soil beneath asphalt concrete pavements should be compacted to at least 92 percent relative compaction. Fill material should be spread and compacted in lifts not exceeding 8 inches in pre-compacted thickness. Density tests shall be performed at a frequency of once per 2,500 square feet per lift. A minimum of 4 density tests shall be performed on each lift of backfill placed. Field in-place dry density shall be determined in accordance with ASTM D1556, ASTM D2167, or ASTM D6938. If ASTM D6938 is used, a minimum of one in ten tests shall be checked using ASTM D1556 or ASTM D2167. Test results from ASTM D1556 or ASTM D2167 shall govern if there is a discrepancy with the ASTM D6938 test results.

3.8 DISPOSAL REQUIREMENTS

Offsite disposal of contaminated material shall be in accordance with Section 02 81 00 TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS.

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SECTION 02 61 23

REMOVAL AND DISPOSAL OF PCB CONTAMINATED SOILS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for the removal and disposal of polychlorinated biphenyls (PCBs) contaminated soils.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM D 4397	Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 530/F-93/004	Test Methods for Evaluating Solid Waste (Vol IA, IB, IC, and II) (SW-846)
EPA 560/5-86-017	Field Manual for Grid Sampling of PCB Spill Sites to Verify Cleanup

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants
29 CFR 1910.120	Hazardous Waste Operations and Emergency Response
29 CFR 1910.145	Accident Prevention Signs and Tags
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
40 CFR 761.75	Chemical Waste Landfills
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special

	Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packagings
49 CFR 174	Carriage by Rail
49 CFR 176	Carriage by Vessel
49 CFR 177	Carriage by Public Highway
49 CFR 178	Specifications for Packagings
49 CFR 179	Specifications for Tank Cars

1.3 DEFINITIONS

1.3.1 PCBs (Polychlorinated Biphenyls)

40 CFR 761. PCB and PCBs means any chemical substance that is limited to the biphenyl molecule that has been chlorinated to varying degrees or any combination of substances which contain such substance.

1.3.2 PCB-Contaminated Soil

Soils containing concentrations greater than 0.74 mg/kg (parts per million (ppm)) PCBs when tested as specified herein.

1.3.3 PCB-Contaminated Water

Water containing greater than 0.5 ug/L (parts per billion (ppb)) when tested as specified herein.

1.3.4 PCB-Contaminated Non Porous Surfaces

Non-porous surfaces containing concentrations greater than 10 micrograms PCB per 100 cm^2 measured by a standard wipe test as defined in 40 CFR 761.123.

1.3.5 Permissible Exposure Limits (PEL)

PEL for PCBs is 0.50 milligrams per cubic meter on an 8-hour time weighted average basis.

1.3.6 PCB Remediation Waste

Waste containing PCBs as a result of a spill, release, or other unauthorized disposal. PCB remediation waste includes, but is not limited to, soil, rags, and other debris generated as a result of any PCB spill cleanup.

1.3.7 TSCA

Toxic Substances Control Act (15 U.S.C. 2601, *et seq.*).

1.4 DESCRIPTION OF WORK

The work includes removal and disposal of PCB contaminated soils. Perform work in accordance with 40 CFR 761, 29 CFR 1910.120, and the requirements specified herein. Excavate to the horizontal and vertical limits of the identified contaminated soil as indicated. After removing contaminated soil as indicated, sample, test, and excavate as specified until clean soil is encountered. All work done in the excavation and disposal of PCB-contaminated soils will be coordinated with the Environmental Management Division through the COR.

1.4.1 Existing Conditions

PCB contaminant levels range from will be provided on project drawings.

1.5 METHOD OF MEASUREMENT

For the PCB contaminated soil material, which the COR directs to be removed from site, the unit of measurement for excavation will be the ton. Tonnage to be paid for will be the number of tons removed from the site. Quantities will be verified from the State-certified weigh station. The requirements of Contract Clause entitled "Variation in Estimated Quantity" do not apply to payment for removal of PCB contaminated soil.

1.6 QUALITY ASSURANCE

1.6.1 Training

Instruct employees on the dangers of PCB exposure, on respirator use, decontamination, and applicable OSHA and EPA regulations.

1.6.2 Certified Industrial Hygienist (CIH)

Obtain the services of an industrial hygienist certified by the American Board of Industrial Hygiene to certify training, and review and approve the PCB removal plan, including determination of the need for personnel protective equipment (PPE) in performing PCB removal work.

1.6.3 Regulation Documents

Maintain at the job site one readily available copy each of 29 CFR 1910.1000, 40 CFR 761, and all contractor prepared plans required under "Submittals" paragraphs.

1.6.4 Protection Plan

Prepare and submit a protection plan, prepared by the CIH, covering protection of workers and the environment from PCB hazards. Specific protection requirements shall be determined by the CIH and, as a minimum, as specified herein.

1.6.5 PCB-Contaminated Soil Removal Plan

Prepare and submit, 10 working days prior to initiating work, a soil removal plan describing methods, techniques, and phases of dealing with the contaminated soil, including: a schedule to be employed in the excavation, a sequence of operations, the method of excavation, hauling, and handling of the contaminated materials, and the proposed equipment. Define the Contractor's source for fill and method for importing the fill material.

Ensure that work operations or processes involving PCB-contaminated materials are conducted in accordance with 40 CFR 761 and the applicable requirements of this section, including but not limited to:

a. Obtaining advance approval of PCB storage sites.

b. Notifying COR prior to commencing the operation.

c. Reporting leaks and spills to the COR.

d. Cleaning up spills.

e. Maintaining an access log of employees working in a PCB control area and providing a copy to the COR upon completion of the operation.

f. Inspecting PCB and PCB-contaminated items and waste containers for leaks and forwarding copies of inspection reports to the COR.

g. Maintaining a spill kit.

h. Maintaining inspection, inventory, and spill records.

1.6.6 PCB-Contaminated Water Handling Plan

Prepare and submit plan detailing methods and techniques for collection of PCB contaminated water.

1.6.7 Sampling and Testing Plan

Prepare and submit a sampling and testing plan. Include the names of testing laboratories to be used to accomplish analysis of contaminated soil and water. Describe field and laboratory sampling procedures, testing methods, and quality control procedures. For sample reports, show sample identification for location, date, time, sample method, contamination level, name of individual sampler, identification of laboratory, and quality control procedures. Maximum turnaround time of five (5) working days is required for laboratory sample analyses in accordance with the standard work week of the contract.

1.6.8 Training Certification

Submit certificates signed and dated by the CIH and by each employee stating that the employee has received training.

1.6.9 CIH Qualifications

Submit the name, address, and telephone number of the industrial hygienist selected to perform the duties in paragraph entitled "Certified Industrial Hygienist." Submit proper documentation that the industrial hygienist is certified, including certification number and date of certification and recertification.

1.6.10 PCB Disposal Plan

Submit a PCB Disposal Plan within 45 calendar days after award of contract for COR's approval. Comply with applicable requirements of Federal, State, and local PCB waste regulations and address:

a. Identification of PCB wastes associated with the work.

b. Estimated quantities of wastes to be generated and disposed of.

c. Names and qualifications of each Contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and a 24-hour point of contact. Furnish two copies of EPA and State PCB waste permits and EPA identification numbers.

d. Names and qualifications (experience and training) of personnel who will be working on-site with PCB wastes.

e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.

f. Spill prevention, containment, and cleanup contingency measures to be implemented.

g. Location of state-certified weigh station.

h. Work plan and schedule for PCB waste containment, removal, and disposal. Clean up and containerize wastes daily.

1.6.11 Vehicle Decontamination Verification

Provide documentation verifying that vehicles and containers were decontaminated prior to leaving the disposal site, were properly operating, and were covered, within 24 hours after removal of waste from the site.

1.6.12 Closeout Report

Prepare closeout report containing following items: test results including readings and locations, a diagram of the limits of the excavated area with sample locations indicated (indicate reference benchmark used), chain of custody forms, certificates of disposal, truck manifests, and description of the work completed.

1.7 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Field Screening Test

SD-07 Certificates

Protection Plan

PCB-Contaminated Soil Removal Plan

PCB-Contaminated Water Handling Plan

Sampling and Testing Plan

Confirmatory Grid Sampling Plan

Training certification

CIH qualifications

PCB Disposal Plan

Shipping documentation

Vehicle decontamination verification

Borrow site testing

Certificate of Disposal

SD-11 Closeout Submittals

Closeout Report

PART 2 PRODUCTS

2.1 PLASTIC SHEETING

ASTM D 4397.

2.2 FIELD SCREENING TEST

Field test capable of detecting PCBs down to at least 1 ppm, with less than 5 percent false negatives, and providing on site results within 2 hours of taking sample.

PART 3 EXECUTION

3.1 PROTECTION OF WORKERS AND THE ENVIRONMENT

Protect workers and the environment from PCB hazards in accordance with the PCB protection plan and, as a minimum, as specified herein.

3.1.1 Worker Safety

Provide portable decontamination and shower rooms. Workers shall wear and use PPE, as recommended by the industrial hygienist, upon entering a PCB control area. If PPE is not required by the CIH, specify in the PCB removal work plan. Keep work footwear inside work area until completion of the job. Have available one set of PPE required for use by COR for inspection of work. Do not carry out PCB handling operations in confined spaces. Do not delay aid to a seriously injured worker for reasons of decontamination.

3.1.2 PCB Control Area

Establish a PCB control area to prevent unauthorized entry of personnel. Rope off area and provide 29 CFR 1910.145 signs at approaches and around perimeter. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Allow only personnel briefed on the elements and trained as specified herein into the area. Do not permit food, drink, or smoking materials in the control area. Smoking is not permitted within 50 feet of the PCB control area. Provide "No Smoking" signs as directed by the COR.

3.1.3 Air Quality

Include provisions to ensure that airborne PCB concentrations below the PEL of air defined herein are not exceeded outside of the PCB control area or by workers inside the PCB control area. Provide air monitoring, personnel monitoring, and sampling to ensure workers safety as determined by the CIH and as specified herein. As a minimum, sample the air daily at the following locations: at locations being disturbed, within the breathing zone of workers, and at the downwind border of the control area. Measure using instrument capable of detecting airborne PCBs at concentrations below OSHA PEL, or use a direct reading total particulate meter correlated to a worst case amount of PCBs attached to the particulate. When airborne concentrations exceed PEL at the breathing zone of workers, provide respirators and additional worker protection as dictated in the Site Health and Safety Plan. If airborne concentration exceeds PEL at boundary of control area, immediately stop work and notify the COR.

3.1.4 Special Hazards

a. Do not expose PCBs to open flames or other high temperature sources since toxic decomposition by-products may be produced.

b. Do not heat PCBs to temperatures of 135 degrees F or higher without COR's concurrence.

3.2 PCB SPILL PREVENTION

Use appropriate vehicles and operating practices to prevent spillage or leakage of contaminated materials from occurring during operations. Inspect vehicles leaving the contaminated soil removal site to ensure that no contaminated soil adheres to the wheels or undercarriage. Immediately report any spills to the COR and provide cleanup in accordance with 40 CFR 761, Subpart G.

3.3 EXCAVATION PROCEDURES

Notify the COR at least 48 hours prior to the start of excavation of contaminated soils. Use methods and equipment that result in minimal disturbance to remaining soil beyond the excavation limits. Remove and dispose of any material that becomes contaminated as a result of the Contractor's operation at no additional cost to the Government. Stage operations to minimize the time the contaminated soil is exposed to the weather. Provide protection measures around the area of contaminated soils to divert runoff of water from within the excavation boundaries.

3.3.1 Underground Utilities

Location of the existing utilities indicated is approximate and other underground utilities may be present. Scan the construction site with electromagnetic and sonic equipment and mark the surface of the ground where existing underground utilities are discovered. Physically verify the location and elevation of the existing utilities indicated prior to starting construction. If utilities other than those indicated are found, stop work and contact the COR. Protect existing utilities from damage and intrusion of PCBs.

3.3.2 Dust Control

Maintain strict dust control at all times to prevent dust particles with

PCB attached from becoming airborne. Sprinkle or treat the soil at the site and other areas disturbed by operations with dust suppressants or water.

3.3.3 Washdown of Solid Material

Remove asphalt pavement, concrete slabs, and structures encountered above or below the ground surface within the excavation limits. Brush to remove soil materials and clean to limit defined herein for PCB surface contaminated solids by double rinsing, and place in the adjacent rubble pile. Collect and dispose of washdown water as contaminated water. Sample each type of solid material using either wipe samples or destructive samples at locations as directed by the COR. Analyze samples for PCBs in accordance with EPA 530/F-93/004, Method 8080. Collect and test field blanks and replicates in accordance with EPA protocol. Repeat cleaning process and testing until PCBs are below the limits specified herein.

3.3.3.1 Wipe Samples

40 CFR 761. A 10 cm by 10 cm template gauze pad or glass wool of known size which has been saturated in the laboratory with hexane and stored in sealed glass vials. Wipe immediately after exposing medium to air. Place sample in pre-cleaned glass bottle, cap, label, and place in ice chest until analyzed.

3.3.3.2 Destructive Samples

EPA 560/5-86-017. Remove sufficient sample for analysis using chisel, hole saw, drills, etc. Take samples less than 3/8 inch deep and place in glass pre-cleaned sample bottle, cap, label, and place in ice chest.

3.3.4 Excavation Limits

Remove contaminated soil to the horizontal and vertical limits as indicated. Verify the limits of clean soils by testing and sampling. Handle and dispose of material within this area as PCB contaminated. After excavation to the indicated limits, conduct an analysis of the excavation to determine if any remaining PCB contaminated soils exist. Collect samples and test by field screening. When field screening results show PCB concentrations below the contamination level, test using confirmation sampling and testing. If groundwater is encountered prior to reaching the vertical limits, notify the COR.

3.3.4.1 Field Screening

Collect soil samples at the same interval as determined for the confirmatory grid sampling plan along the bottom and along the sidewalls of the excavation, and test using field screening test.

3.3.4.2 Confirmation Sampling and Testing

When field screening results show PCB concentrations below the contaminated level, test using confirmation sampling and testing. For each PCB remediation waste excavation, take a minimum of three (3) samples for each type of bulk PCB remediation waste or porous surface in accordance with 40 CFR 261.283. Sample along the bottom and sidewalls of excavation. Use sampling grid scheme and number of samples as defined in EPA 560/5-86-017 and 40 CFR 761.283. Compositing of samples for analysis shall not be allowed. Submit and receive approval of Confirmatory Grid Sampling Plan

scheme prior to starting work. Analyze samples in accordance with EPA 530/F-93/004, Method 8080 for PCBs. Determine moisture content of the sample in accordance with EPA Method 160.3. Provide quality control in accordance with EPA guidelines, and as a minimum as follows:

a. Duplicate samples - collect and analyze duplicate soil samples at the rate of 10 percent of the total number of samples (rounded to the next highest number).

b. Matrix spike and matrix spike duplicate - collect one matrix spike sample for every 20 samples collected (rounded to the next highest number). Split the matrix spike sample, and analyze both the matrix spike and the matrix spike duplicate.

3.3.5 Additional Excavations

If field screening results indicate the PCB-contaminated soils remain, notify the COR. Where directed, continue excavation horizontal and vertical limits as directed by the COR. Collect and analyze additional confirmation samples in the new excavation areas. Screen and analyze after each excavation episode as required. Payment for additional excavation and testing will be made in accordance with the Changes Clause of the contract.

3.3.6 Stockpiled Material

Place soil removed from the excavation in a temporary containment area near the excavation area. Divert water from the containment area. Cover containment area with 30 mil polyethylene sheeting. Place excavated soil on the impervious barrier and cover with 6 mil polyethylene sheeting. Provide berm around the outer limits of the containment area and cover with polyethylene sheets. Secure edges of sheets to keep the polyethylene sheeting in place. Cover excavated contaminated soil at all times when not being worked. Maintain sheeting and replace when worn or ripped. As an option, soil may be stockpiled in trucks suitable for carrying PCB contaminated soils as specified herein.

3.3.6.1 Composite Testing of Stockpiled Material

Take composite samples from stockpiled material prior to removing from site. Use a grid interval of 3 meters to sample PCB remediation waste that is not in a container. For bulk PCB remediation waste in a single container, collect a core sample for the entire depth of the waste container. For multiple containers, follow the procedure provided in 40 CFR 761.265(c). To develop a composite sample of the size necessary to run the required tests, take several samples from different areas along the surface and in the center of the stockpile. Combine these samples and thoroughly mix to develop the composite sample.

3.4 CONTAMINATED WATER

Collect washwater. Collect ground, surface, and rain water contaminated by operations including water collected in the open excavation pit or temporary containment. Soak up with absorbent material so that no free liquid is present. Containerize, sample, and analyze PCB absorbed material and dispose of as specified for contaminated soils.

3.5 COLLECTION, TREATMENT, AND DISCHARGE OF PCB-CONTAMINATED WATER

Furnish labor, materials, and equipment necessary for collecting, treating,

and discharging of PCB-contaminated surface and subsurface water in excavations at the site. Conduct excavation and backfilling operations at the site in a manner that minimizes the amount of surface and subsurface water which may collect in the open excavation. Collect standing surface water in contact with PCB-contaminated material.

3.5.1 Subsurface Drainage

Remove water by pumping or other methods to prevent softening of surfaces exposed by excavation. Provide water treatment necessary to treat water to levels specified herein. Operate dewatering system continuously until construction work below existing water levels is complete. After placement of initial backfill, water level may be allowed to rise, but never above one foot below the prevailing level of excavation or backfill. Submit performance records weekly. Measure and record performance or dewatering system at the same time each day by use of observation wells or piezometers installed in conjunction with the dewatering system.

3.5.2 Treatment System Requirements

The Contractor shall be responsible for all aspects of verifying design parameters designing, providing, installing, operating, maintaining, and removing collection, storage, and treatment facilities as required to discharge treated waters within the treatment limits required. The treatment system shall:

a. Be capable of removing PCB contaminants to below the limit defined herein for contaminated water.

b. Include effluent holding tanks designed to allow on-site testing of water quality prior to discharge.

c. Include recycle capability for retreatment of effluent not meeting the discharge requirements of this specification, as determined by on-site testing.

3.5.3 Treatment System Operations

Monitor, test, and adjust the treatment system in accordance with the work plan and Sampling and Analysis Plan, or as otherwise modified by special regulatory requirements. If there is a conflict between requirements, the more stringent requirement shall prevail. Test water in accordance with EPA Method 608.

3.5.4 Discharge of Treated Water

Do not discharge any water until tests results showing water is below PCB-contaminated water limits as specified herein. Provide erosion control at outlet of piping to minimize erosion. Discharge for treated water shall be to the location as directed by the COR..

3.5.5 Cleanup and Removal of Treatment System

Upon completion of work, close and remove from the site the surface water and groundwater treatment system. Restore the site to its original condition. Decontaminate equipment in accordance with the Contractor's Site Health and Safety Plan. Containerize, sample, test, and dispose of carbon, residues, cleaning aids, decontamination liquids, and waste as specified for the contaminated soils.

3.6 TRANSPORTATION AND DISPOSAL

Furnish labor, materials, and equipment necessary to store, transport, and dispose of PCB contaminated material in accordance with Federal, State, and local requirements. Prepare and maintain waste shipment records and manifests required by the Resource Conservation and Recovery Act (RCRA), U.S. Federal Department of Transportation (DOT), and State transportation department.

3.6.1 Transportation

49 CFR 171, 49 CFR 172, 49 CFR 173, 49 CFR 174, 49 CFR 176, 49 CFR 177, 49 CFR 178 49 CFR 179. Transport PCB contaminated soils in vehicles designed to carry PCB contaminated soils in accordance with Federal and State requirements. Transport PCB contaminated solid material, articles, or equipment in DOT Specification 5, 5B, or 17C containers with removable heads. Store liquid PCBs in DOT Specification 17E containers. In addition to those requirements:

a. Inspect and document vehicles and containers for proper operation and covering. Repair or replace damaged containers.

b. Inspect vehicles and containers for proper markings, manifest documents, and other requirements for waste shipment.

c. Perform and document decontamination procedures prior to leaving the worksite and again before leaving the disposal site.

3.6.1.1 Weight Certification

Weigh vehicles transporting PCB contaminated materials at a State-certified weigh scale.

3.6.1.2 Shipping Documentation

40 CFR 761. Before transporting the PCB waste, provide a completed hazardous waste manifest to the COR or designated individual to sign and date the manifest. After receiving the hazardous waste manifest signed and dated by the Government official, sign and date the manifest acknowledging acceptance of the PCB waste from the Government. Return a signed copy to the Government before leaving the job site. Ensure that the manifest accompanies the PCB waste at all times. Submit transporter certification of notification to EPA of their PCB waste activities and EPA identification numbers. Within 35 days from shipment date, the transporter shall provide a copy of the manifest signed and dated by the disposer.

3.6.1.3 Payment Upon Furnishing Certificate of Disposal of PCBs

Payment will not be made until the certificate of disposal has been furnished to the COR.

3.6.2 Disposal

Dispose of PCB contaminated soils in accordance with 40 CFR 761 at a TSCA regulated landfill meeting the requirements of 40 CFR 761.75. The disposer shall forward a copy of the manifest to the COR within 30 days of receipt of PCBs.

3.6.2.1 Certificate of Disposal

Submit certificate of disposal to the Government within 20 working days of the date that the disposal of the PCB waste identified on the manifest was completed. Include:

a. The identity of the disposal facility, by name, address, and EPA identification number.

b. The identity of the PCB waste affected by the Certificate of Disposal including reference to the manifest number for the shipment.

c. A statement certifying the fact of disposal of the identified PCB waste, including the date(s) of disposal, and identifying the disposal process used.

d. A certification as defined in 40 CFR 761, Section 3.

3.7 CLEANUP

Maintain surfaces of the PCB control area free of accumulations of PCBs. Restrict the spread of dust and debris; keep waste from being distributed over work area. Do not remove the PCB control area and warning signs prior to the COR's approval. Reclean areas showing residual PCBs.

3.7.1 Solvent Cleaning

Clean contaminated tools, containers, etc., after use by rinsing three times with an appropriate solvent or by wiping down three times with a solvent wetted rag. Suggested solvents are stoddard solvent or hexane. Used cleaning materials will be (solvents, rags, etc.) containerized and characterized to determine proper disposal.

3.8 REPORTS

Prepare and submit a remediation closeout report at the completion of the work.

3.9 BACKFILLING, GRADING, TOPSOILING, AND SEEDING

Commence backfilling of the excavation within 7 working days after receiving confirmatory test results that indicate no further PCB contamination is present. Soils brought in from off site for use as backfill shall contain less than one part per million (ppm) PCBs. Provide borrow site testing for PCBs from composite sample of material from borrow site, with at least one test from each borrow site. Material shall not be brought on site until tests have been approved by the COR. Provide backfill, compaction, grading, and seeding in accordance with Section 31 00 00 EARTHWORK.

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SECTION 02 81 00

TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIALS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for transportation and disposal of hazardous material.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

INTERNATIONAL AIR TRANSPORT ASSOCIATION (IATA)

IATA DGR	Dangerous Goods Regulations

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 266	Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Permit Program

40 CFR 279	Standards for the Management of Used Oil
40 CFR 300	National Oil and Hazardous Substances Pollution Contingency Plan
40 CFR 302	Designation, Reportable Quantities, and Notification
40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
49 CFR 107	Hazardous Materials Program Procedures
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packagings
49 CFR 178	Specifications for Packagings

1.3 DEFINITIONS

1.3.1 Hazardous Material

A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated pursuant to the Hazardous Materials Transportation Act, 49 U.S.C. Appendix Section 1801 et seq. The term includes materials designated as hazardous materials under the provisions of 49 CFR 172, Sections .101 and .102 and materials which meet the defining criteria for hazard classes and divisions in 49 CFR 173. EPA designated hazardous wastes are also hazardous materials.

1.3.2 Hazardous Waste

A waste which meets criteria established in RCRA or specified by the EPA in 40 CFR 261 or which has been designated as hazardous by a RCRA authorized state program.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Onsite Hazardous Waste Management
Notices of Non-Compliance and Notices of Violation
Packaging Notifications

SD-06 Test Reports

Recordkeeping
Spill Response
Exception Report

SD-07 Certificates

Certification
Security Plan
Transportation and Disposal Coordinator
Training
EPA Offsite Policy
Certificates of Disposal
Shipping Documents and Packagings Certification
Waste Minimization

1.5 QUALITY ASSURANCE

1.5.1 Transportation and Disposal Coordinator

Designate, by position and title, one person to act as the Transportation and Disposal Coordinator (TDC) for this contract. The TDC shall serve as the single point of contact for all environmental regulatory matters and shall have overall responsibility for total environmental compliance at the site including, but not limited to, accurate identification and classification of hazardous waste and hazardous materials; determination of proper shipping names; identification of marking, labeling, packaging and placarding requirements; completion of waste profiles, hazardous waste manifests, asbestos waste shipment records, PCB manifests, bill of ladings, exception and discrepancy reports; and all other environmental documentation. The TDC shall have, at a minimum, one year of specialized experience in the management and transportation of hazardous waste and have been Department of Transportation certified under 49 CFR 172, Subpart H.

1.5.2 Training

The Contractor's hazardous materials employees shall be trained, tested, and certified to safely and effectively carry out their assigned duties in accordance with Section 01 35 29.13 HEALTH, SAFETY, AND EMERGENCY RESPONSE PROCEDURES FOR CONTAMINATED SITES. The Contractor's employees transporting hazardous materials or preparing hazardous materials for transportation, including samples, shall be trained, tested, and certified in accordance with 49 CFR 172, Subpart H, including security awareness and any applicable security plans. Where shipment of hazardous materials by air may be occurring, such as for sample shipments, the Contractor's hazardous material employees shall also be trained on IATA DGR. Contractor employees making determinations that shipments do not constitute DOT regulated hazardous materials shall also be trained, tested, and certified in accordance with 49 CFR 172, Subpart H.

1.5.3 Certification

The Contractor and/or subcontractors transporting hazardous materials shall possess a current certificate of registration issued by the Research and Special Programs Administration (RSPA), U.S. Department of Transportation, when required by 49 CFR 107, Subpart G. Submit copies of the certificates or written statements certifying exemption from these requirements.

1.5.4 Laws and Regulations Requirements

Work shall meet or exceed the minimum requirements established by Federal, S tate, and local laws and regulations which are applicable. These requirements are amended frequently and compliance with amendments is required as they become effective. In the event that compliance exceeds the scope of work or conflicts with specific requirements of the contract, notify the COR immediately.

PART 2 PRODUCTS

2.1 MATERIALS

Provide all the materials required for the packaging, labeling, marking, placarding and transportation of hazardous wastes and hazardous materials in conformance with Department of Transportation standards or IATA DGR. Details in this specification shall not be construed as establishing the limits of the Contractor's responsibility.

2.1.1 Packagings

Provide bulk and non-bulk containers for packaging hazardous materials/wastes consistent with the authorizations referenced in the Hazardous Materials Table in 49 CFR 172, Section 101, Column 8. Bulk and non-bulk packaging shall meet the corresponding specifications in 49 CFR 173 referenced in the Hazardous Materials Table, 49 CFR 172, Section 101. Each packaging shall conform to the general packaging requirements of Subpart B of 49 CFR 173, to the requirements of 49 CFR 178 at the specified packing group performance level, to the requirements of special provisions of column 7 of the Hazardous Materials Table in 49 CFR 172, Section 101, and shall be compatible with the material to be packaged as required by 40 CFR 262. Also provide other packaging related materials such as materials used to cushion or fill voids in overpacked containers, etc. Sorbent materials shall not be capable of reacting dangerously with, being decomposed by, or being ignited by the hazardous materials being packaged. Additionally, sorbents used to treat free liquids to be disposed of in landfills shall be non-biodegradable as specified in 40 CFR 264, Section 314. In addition, packaging notifications will be provided to the Government in accordance with 49 CFR 172, Section .178.2(c) regarding type and dimensions of closures, including gaskets, needed to satisfy performance test requirements.

2.1.2 Markings

Provide markings for each hazardous material/waste package, freight container, and transport vehicle consistent with the requirements of 49 CFR 172, Subpart D and 40 CFR 262, Section .32 (for hazardous waste) 40 CFR 761, Section .45 (for PCBs) 40 CFR 61, Section .149(d) (for asbestos). Markings shall be capable of withstanding, without deterioration or substantial color change, a 180 day exposure to conditions reasonably expected to be encountered during container storage and transportation.

2.1.3 Labeling

Provide primary and subsidiary labels for hazardous materials/wastes consistent with the requirements in the Hazardous Materials Table in 49 CFR 172, Section .101, Column 6. Labels shall meet design specifications required by 49 CFR 172, Subpart E including size, shape, color, printing, and symbol requirements. Labels shall be durable and

weather resistant and capable of withstanding, without deterioration or substantial color change, a 180 day exposure to conditions reasonably expected to be encountered during container storage and transportation.

2.1.4 Placards

For each offsite shipment of hazardous material/waste, provide primary and subsidiary placards consistent with the requirements of 49 CFR 172, Subpart F. Placards shall be provided for each side and each end of bulk packaging, freight containers, transport vehicles, and rail cars requiring such placarding. Placards may be plastic, metal, or other material capable of withstanding, without deterioration, a 30 day exposure to open weather conditions and shall meet design requirements specified in 49 CFR 172, Subpart F.

2.1.5 Spill Response Materials

Provide spill response materials including, but not limited to, containers, adsorbent, shovels, and personal protective equipment. Spill response materials shall be available at all times in which hazardous materials/wastes are being handled or transported. Spill response materials shall be compatible with the type of material being handled.

2.2 EQUIPMENT AND TOOLS

Provide miscellaneous equipment and tools necessary to handle hazardous materials and hazardous wastes in a safe and environmentally sound manner.

PART 3 EXECUTION

3.1 ONSITE HAZARDOUS WASTE MANAGEMENT

These paragraphs apply to Government owned waste only. Contractors are prohibited by 10 U.S.C. 2692 from storing Contractor owned waste onsite for any length of time. The Contractor is responsible for ensuring compliance with all Federal, State, and local hazardous waste laws and regulations and shall verify those requirements when preparing reports, waste shipment records, hazardous waste manifests, or other documents. Identify hazardous wastes using criteria set forth in 40 CFR 261 or all applicable State and local laws, regulations, and ordinances. When accumulating hazardous waste onsite, comply with generator requirements in 40 CFR 262 and 22 CCR 66262 to 265 and Santa Clara CUPA Regulations. Onsite accumulation times shall be restricted to applicable time frames referenced in 40 CFR 262, Section .3 4 and 22 CCR 66262.34. Accumulation start dates shall commence when waste is first generated (i.e. containerized or otherwise collected for discard). Only use containers in good condition and compatible with the waste to be stored. Ensure containers are closed except when adding or removing waste, and immediately mark all hazardous waste containers with the words "hazardous waste" and other information required by 40 CFR 262, Section .32 and 22 CCR 66262.32 as soon as the waste is containerized. An additional marking shall be placed on containers of "unknowns" designating the date sampled, and the suspected hazard. Inspect containers for signs of deterioration and for responding to any spills or leaks. Inspect all hazardous waste areas weekly and provide written documentation of the inspection. Include date and time of inspection, name of individual conducting the inspection, problems noted, and corrective actions taken on the inspection logs.

3.1.1 Hazardous Waste Classification

Identify, in consultation with the waste generator, all waste codes applicable to each hazardous waste stream based on requirements in 40 CFR 261 or any applicable State or local law or regulation. Also identify all applicable treatment standards in 40 CFR 268 and State land disposal restrictions and make a determination as to whether or not the waste meets or exceeds the standards. Waste profiles, analyses, classification and treatment standards information shall be submitted to COR for review and approval.

3.1.2 Management Plan

Prepare a plan detailing the manner in which hazardous wastes will be managed and describing the types and volumes of hazardous wastes anticipated to be managed as well as the management practices to be utilized. The plan shall identify the method to be used to ensure accurate piece counts and/or weights of shipments; shall identify waste minimization methods; shall propose facilities to be utilized for treatment, storage, and/or disposal; shall identify areas onsite where hazardous wastes are to be handled; and shall identify whether transfer facilities are to be utilized; and if so, how the wastes will be tracked to ultimate disposal. Submit the plan prior to start of work. Written documentation of weekly hazardous waste inspections shall be submitted on a quarterly basis.

3.2 OFFSITE HAZARDOUS WASTE MANAGEMENT

Use RCRA Subtitle C permitted facilities which meet the requirements of 40 CFR 264 or facilities operating under interim status which meet the requirements of 40 CFR 265. Offsite treatment, storage, and/or disposal facilities with significant RCRA violations or compliance problems (such as facilities known to be releasing hazardous constituents into ground water, surface water, soil, or air) shall not be used. Submit Notices of Non-Compliance and Notices of Violation by a Federal, State, or local regulatory agency issued to the Contractor in relation to any work performed under this contract. Immediately provide copies of such notices to the COR. Also furnish all relevant documents regarding the incident and any information requested by the COR, and coordinate its response to the notice with the COR or the designated representative prior to submission to the notifying authority. Also furnish a copy to the COR of all documents submitted to the regulatory authority, including the final reply to the notice, and all other materials, until the matter is resolved.

3.2.1 Treatment, Storage, and/or Disposal Facility and Transporter

Provide the COR with EPA ID numbers, names, locations, and telephone numbers of TSD facilities and transporters. This information shall be contained in the Hazardous Waste Management Plan and shall be approved by the COR prior to waste disposal.

3.2.2 Status of the Facility

Facilities receiving hazardous waste shall be permitted in accordance with 40 CFR 270 or operating under interim status in accordance with 40 CFR 265 requirements, or permitted by a State authorized by the Environmental Protection Agency to administer the RCRA permit program. Additionally, prior to using a TSD Facility, contact the EPA Regional Offsite Coordinator specified in 40 CFR 300, Section .440, to determine the facility's status, and document all information necessary to satisfy the requirements of the

EPA Offsite policy and submit this information to the COR.

3.2.3 Shipping Documents and Packagings Certification

Prior to shipment of any hazardous material offsite and a minimum of 7 days prior to anticipated pickup, the Contractor's TDC shall provide for review written certification to the COR that hazardous materials have been properly packaged, labeled, and marked in accordance with Department of Transportation and EPA requirements. The original Designated Facility to Generator copy of the hazardous waste manifest shall be furnished by the designated disposal facility not later than 35 days after acceptance of the shipment. The Contractor's TDC shall also provide written certification regarding waste minimization efforts documenting that efforts have been taken to reduce the volume and toxicity of waste to the degree economically practicable and that the method of treatment, storage, or disposal selected minimizes threats to human health and the environment.

3.2.4 Transportation

Prior to conducting hazardous materials activities, the Contractor responsible for pre-transportation activities shall either certify to the Government that a HM Security Plan is in place which meets the requirements of 49 CFR 172, Subpart I or in the event that the types or amounts of hazardous materials are excluded from the security planning requirements, a written statement to that effect detailing the basis for the exception. Use manifests for transporting hazardous wastes as required by 40 CFR 263 or any applicable State or local law or regulation. Transportation shall comply with all requirements in the Department of Transportation referenced regulations in the 49 CFR series. Prepare hazardous waste manifests for each shipment of hazardous waste shipped offsite. Manifests shall be completed using instructions in 40 CFR 262, Subpart B and any applicable S tate or local law or regulation. Submit manifests and waste profiles to COR for review and approval. Prepare land disposal restriction notifications as required by 40 CFR 268 or any applicable State or local law or regulation for each shipment of hazardous waste. Submit notifications with the manifest to the Environmental Management Division for review and approval.

3.2.5 Treatment and Disposal of Hazardous Wastes

The hazardous waste shall be transported to an approved hazardous waste treatment, storage, or disposal facility within 90 days of the accumulation start date on each DOT container. Ship hazardous wastes only to facilities which are properly permitted to accept the hazardous waste or operating under interim status. Ensure wastes are treated to meet land disposal treatment standards in 40 CFR 268 prior to land disposal. Propose TSD facilities via submission of the Hazardous Waste Management Plan, subject to the approval of the COR. Submit Certificates of Disposal documenting the ultimate disposal, destruction or placement of polychlorinated biphenyls (PCBs) within 180 days of initial shipment. Receipt of these certificates will be required for final payment.

3.3 RADIOACTIVE MATERIALS MANAGEMENT

In consultation with the COR generator, evaluate, prior to shipment of any material offsite, whether the material is regulated as a hazardous waste in addition to being regulated as a radioactive material; this shall be done for the purpose of determining proper shipping descriptions, marking requirements, etc., as described below.

3.3.1 Identification of Proper Shipping Names

Use 49 CFR 172, Section .101 to identify proper shipping names for each hazardous material (including hazardous wastes) to be shipped offsite. Submit proper shipping names to the COR in the form of draft shipping documents for review and approval at least 3 days before shipment for review and approval.

3.3.2 Packaging, Labeling, and Marking

Package, label, and mark hazardous materials/wastes using the specified materials and in accordance with the referenced authorizations. Mark each container of hazardous waste of 110 gallons or less with the following:

"HAZARDOUS WASTE - Federal Law Prohibits Improper Disposal.
If found, contact the nearest police or public safety authority or the U.S. Environmental Protection Agency.
Generator's name _____
Manifest Document Number _____".

3.3.3 Shipping Documents

Ensure that each shipment of hazardous material sent offsite is accompanied by properly completed shipping documents. This includes shipments of samples that may potentially meet the definition of a Department of Transportation regulated hazardous material.

3.3.3.1 PCB Waste Shipment Documents

Prepare hazardous waste manifests for each shipment of PCB waste shipped offsite. Complete manifests using instructions in 40 CFR 761, Sections .207 and .208 and all other applicable requirements. Submit documents to Environmental Management Division for review and approval.

3.3.3.2 Asbestos Waste Shipment Documents

Prepare waste shipment records, as required by 40 CFR 61, for shipments of asbestos. Submit waste shipment records to the Environmental Management Division for review and approval. Waste shipment records shall be signed by the Contractor.

3.3.3.3 Other Hazardous Material Shipment Documents

Prepare a bill of lading for each shipment of hazardous material which is not accompanied by a hazardous waste manifest or asbestos waste shipment record which fulfills the shipping paper requirements. The bill of lading shall satisfy the requirements of 49 CFR 172, Subpart C, and any applicable State or local law or regulation, and shall be submitted to the Environmental Management Division for review and approval. For laboratory samples and treatability study samples, prepare bills of lading and other documentation as necessary to satisfy conditions of the sample exclusions in 40 CFR 261, Section .4(d) and (e) and any applicable State or local law or regulation. Bill of ladings requiring shipper's certifications shall be signed by the Government.

3.4 OBTAINING EPA ID NUMBERS

Complete EPA Form 8700-12, Notification of Hazardous Waste Activity, and

submit to the COR for review and approval. Allow a minimum of 30 days for processing the application and assigning the EPA ID number. Shipment shall be made not earlier than one week after receipt of the EPA ID number.

3.5 SPECIAL REQUIREMENTS FOR ASBESTOS WASTES

If work involves asbestos containing wastes, manage these wastes in accordance with Section 3.3.3.2 of this specification.

3.6 WASTE MINIMIZATION

Minimize the generation of hazardous waste to the maximum extent practicable and take all necessary precautions to avoid mixing clean and contaminated wastes. Identify and evaluate recycling and reclamation options as alternatives to land disposal. Requirements of 40 CFR 266 shall apply to: hazardous wastes recycled in a manner constituting disposal; hazardous waste burned for energy recovery; lead-acid battery recycling; and hazardous wastes with economically recoverable precious metals. Submit written certification that waste minimization efforts have been undertaken to reduce the volume and toxicity of waste to the degree economically practicable and that the method of treatment, storage, or disposal selected minimizes threats to human health and the environment.

3.7 RECORDKEEPING

The Contractor is responsible for maintaining adequate records to support information provided to the COR regarding exception reports, annual reports, and biennial reports; maintaining asbestos waste shipment records for a minimum of 3 years from the date of shipment or any longer period required by any applicable law or regulation or any other provision of this contract; and maintaining bill of ladings for a minimum of 375 days from the date of shipment or any longer period required by any applicable law or regulation or any other provision of this contract. Submit information necessary to file State annual or EPA biennial reports for all hazardous waste transported, treated, stored, or disposed of under this contract. Do not forward these data directly to the regulatory agency but to the COR at the specified time. The submittal shall contain all the information necessary for filing of the formal reports in the form and format required by the governing Federal or State regulatory agency. A cover letter shall accompany the data to include the contract number, Contractor name, and project location. In the event that a manifest copy documenting receipt of hazardous waste at the treatment storage and disposal facility is not received within 35 days of shipment initiation, or that a manifest copy documenting receipt of PCB waste at the designated facility is not received within 35 days of shipment initiation, prepare and submit an exception report to the COR within 37 days of shipment initiation.

3.8 SPILL RESPONSE

In the event of a spill or release of a hazardous substance (as designated in 40 CFR 302), or pollutant or contaminant, or oil (as governed by the Oil Pollution Act (OPA), 33 U.S.C. 2701 et seq.), notify the COR immediately. Any direction from the COR concerning a spill or release shall not be considered a change under the contract. If the spill exceeds a reporting threshold, follow the pre-established procedures for immediate reporting to the COR. Comply with all applicable requirements of Federal, State, or local laws or regulations regarding any spill incident.

3.9 EMERGENCY CONTACTS

The Contractor is responsible for complying with the emergency contact provisions in 49 CFR 172, Section .604. Whenever the Contractor ships hazardous materials, provide a 24 hr emergency response contact and phone number of a person knowledgeable about the hazardous materials being shipped and who has comprehensive emergency response and incident mitigation information for that material, or has immediate access to a person who possesses such knowledge and information. The phone shall be monitored on a 24 hour basis at all times when the hazardous materials are in transportation, including during storage incidental to transportation. Ensure that information regarding this emergency contact and phone number are placed on all hazardous material shipping documents. Designate an emergency coordinator and post the following information at areas in which hazardous wastes are managed:

a. The name of the emergency coordinator.

b. Phone number through which the emergency coordinator can be contacted on a 24 hour basis.

c. The telephone number of the local fire department.

d. The location of fire extinguishers and spill control materials.

Attachment A SAMPLE OFF-SITE POLICY CERTIFICATION MEMO	
Project/Contract #:	
Waste Stream:	
Primary TSD Facility, EPA ID #	
Alter. TSD Facility, EPA ID # and	
EPA Region	Contact
I	(617) 918-1752
II	(212) 637-4130
III	(214) 814-5267
IV	(404) 562-8591
V	(312) 353-8207
VI	(214) 665-2282
VII	(913) 551-7154
VIII	(303) 312-6419
IX	(415) 972-3304
X	(206) 553-2859
EPA representative contacted:	
EPA representative phone number:	
Date contacted:	
Comment:	
The above EPA representative was contacted on _____. As of that date the above sites were considered acceptable in accordance with the Off-Site	
Date:	Signature:
Phone number:	

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ASBESTOS HAZARD CONTROL ACTIVITIES

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for removal, encapsulation, enclosureencasement, or repair of friable and non-friable asbestos-containing material (ACM) which is encountered during the demolition, alteration, renovation, or maintenance of structures, substrates, equipment or portions thereof that contain asbestos; transportation, disposal, storage, containment of; and housekeeping activities on the site at which these activities are performed This specification is used in conjunction with Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS.

1.2 PAYMENT PROCEDURES

Submit copies of weight bills and delivery tickets for payment to the COR during the progress of the work. Furnish scale tickets for each load of ACM weighed and certified. These tickets shall include tare weight; identification mark for each vehicle weighed; and date, time and location of loading and unloading. Tickets shall be furnished at the point and time individual trucks arrive at the worksite. A master log of all vehicle loading shall be furnished for each day of loading operations. Before the final statement is allowed, file with the COR certified weigh bills and/or certified tickets and manifests of all ACM actually disposed by the Contractor for this contract.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA)

AIHA Z9.2	Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems

ASTM INTERNATIONAL (ASTM)

ASTM D 4397	Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 1368	Visual Inspection of Asbestos Abatement

	Projects
BAY AREA AIR QUALITY MANAGEMENT DISTRICT (BAAQMD)	
Regulation #11	Rule #2
COMPRESSED GAS ASSOCIATION (CGA)	
CGA G-7	Compressed Air for Human Respiration; 6th Edition
INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)	
ANSI/ISEA Z87.1	Occupational and Educational Personal Eye and Face Protection Devices
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 701	Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)	
NIOSH 94-113	NIOSH Manual of Analytical Methods
U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)	
EPA 340/1-90/018	Asbestos/NESHAP Regulated Asbestos Containing Materials Guidance
U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)	
29 CFR 1910.134	Respiratory Protection
29 CFR 1910.141	Sanitation
29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)
29 CFR 1926.1101	Asbestos
29 CFR 1926.32	Safety and Health Regulations for Construction - Definition
40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 763, Subpart E	Asbestos Emergency Response Act (AHERA)
42 CFR 84	Approval of Respiratory Protective Devices
49 CFR 107	Hazardous Materials Program Procedures
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response

	Information, and Training Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packagings

UNDERWRITERS LABORATORIES (UL)

UL 586	Standard for High-Efficiency Particulate, Air Filter Units

1.4 DEFINITIONS

1.4.1 Amended Water

Water containing a wetting agent or surfactant with a surface tension of at least 29 dynes per square centimeter.

1.4.2 Asbestos-Containing Material (ACM)

Any materials containing more than one percent asbestos.

1.4.3 Asbestos-Containing Construction Material (ACCM)

Any material containing more than one tenth of one percent asbestos.

1.4.4 Authorized Person

Any person authorized by the Contractor and required by work duties to be present in the regulated areas.

1.4.5 BAAQMD - Bay Area Air Quality Management District

Local EPA Region 9 enforcement.

1.4.6 Building Inspector

Individual who inspects buildings for asbestos and has EPA Model Accreditation Plan (MAP) "Building Inspector" training; accreditation required by 40 CFR 763, Subpart E, Appendix C, has EPA/State certification/license as a "Building Inspector".

1.4.7 CAC - Certified Asbestos Consultant

Certification administered by California's Division of Occupational Safety and Health for contracting asbestos consultant work.

1.4.8 Class I Asbestos Work

Activities defined by OSHA involving the removal of thermal system insulation (TSI) and surfacing ACM.

1.4.9 Class II Asbestos Work

Activities defined by OSHA involving the removal of ACM which is not thermal system insulation or surfacing material. This includes, but is not limited to, the removal of asbestos - containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastic. Certain "incidental" roofing materials such as mastic, flashing and cements when they are still intact are excluded from Class II asbestos work. Removal of

small amounts of these materials which would fit into a glovebag may be classified as a Class III job.

1.4.10 Class III Asbestos Work

Activities defined by OSHA that involve repair and maintenance operations, where ACM, including TSI and surfacing ACM, is likely to be disturbed. Operations may include drilling, abrading, cutting a hole, cable pulling, crawling through tunnels or attics and spaces above the ceiling, where asbestos is actively disturbed or asbestos-containing debris is actively disturbed.

1.4.11 Class IV Asbestos Work

Maintenance and custodial construction activities during which employees contact but do not disturb ACM and activities to clean-up dust, waste and debris resulting from Class I, II, and III activities. This may include dusting surfaces where ACM waste and debris and accompanying dust exists and cleaning up loose ACM debris from TSI or surfacing ACM following construction

1.4.12 Clean Room

An uncontaminated room having facilities for the storage of employees' street clothing and uncontaminated materials and equipment.

1.4.13 Competent Person

In addition to the definition in 29 CFR 1926.32(f), a person who is capable of identifying existing asbestos hazards as defined in 29 CFR 1926.1101, selecting the appropriate control strategy, has the authority to take prompt corrective measures to eliminate them and has EPA Model Accreditation Plan (MAP) "Contractor/Supervisor" training; has EPA/State certification/license as a "Contractor/Supervisor".

1.4.14 Contractor/Supervisor

Individual who supervises asbestos abatement work and has EPA Model Accreditation Plan "Contractor/Supervisor" training; has EPA/State certification as a "Contractor/Supervisor".

1.4.15 Critical Barrier

One or more layers of plastic sealed over all openings into a regulated area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in a regulated area from migrating to an adjacent area.

1.4.16 Decontamination Area

An enclosed area adjacent and connected to the regulated area and consisting of an equipment room, shower area, and clean room, which is used for the decontamination of workers, materials, and equipment that are contaminated with asbestos.

1.4.17 Demolition

The wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of asbestos products.

1.4.18 Disposal Bag

A 6 mil thick, leak-tight plastic bag, pre-labeled in accordance with 29 CFR 1926.1101, used for transporting asbestos waste from containment to disposal site.

1.4.19 Disturbance

Activities that disrupt the matrix of ACM, crumble or pulverize ACM, or generate visible debris from ACM. Disturbance includes cutting away small amounts of ACM, no greater than the amount which can be contained in 1 standard sized glovebag or waste bag, not larger than 60 inches in length and width in order to access a building component.

1.4.20 Equipment Room or Area

An area adjacent to the regulated area used for the decontamination of employees and their equipment.

1.4.21 Friable ACM

A term defined in 40 CFR 61, Subpart M and EPA 340/1-90/018 meaning any material which contains more than 1 percent asbestos, as determined using the method specified in 40 CFR 763, Polarized Light Microscopy (PLM), that when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

1.4.22 Glovebag

Not more than a 60 by 60 inch impervious plastic bag-like enclosure affixed around an asbestos-containing material, with glove-like appendages through which material and tools may be handled.

1.4.23 High-Efficiency Particulate Air (HEPA) Filter

A filter capable of trapping and retaining at least 99.97 percent of all mono-dispersed particles of 0.3 micrometers in diameter.

1.4.24 Intact

ACM which has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix. Removal of "intact" asphaltic, resinous, cementitious products does not render the ACM non-intact simply by being separated into smaller pieces.

1.4.25 Model Accreditation Plan (MAP)

USEPA training accreditation requirements for persons who work with asbestos as specified in 40 CFR 763.

1.4.26 NASA Consultant (NC)

Code QH Safety, Health and Medical Services personnel who have obtained a California Asbestos Consultant (CAC) credentials.

1.4.27 Negative Initial Exposure Assessment

A demonstration by the Contractor to show that employee exposure during an operation is expected to be consistently below the OSHA Permissible

Exposure Limits (PELs).

1.4.28 NESHAP

National Emission Standards for Hazardous Air Pollutants. The USEPA NESHAP regulation for asbestos is at 40 CFR 61, Subpart M.

1.4.29 Nonfriable ACM

A NESHAP term defined in 40 CFR 61, Subpart M and EPA 340/1-90/018 meaning any material containing more than 1 percent asbestos that, when dry, cannot be crumbled, pulverized or reduced to powder by hand pressure.

1.4.30 Nonfriable ACM (Category I)

A NESHAP term defined in 40 CFR 61, Subpart E and EPA 340/1-90/018 meaning asbestos-containing packings, gaskets, resilient floor covering, and asphalt roofing products containing more than 1 percent asbestos.

1.4.31 Nonfriable ACM (Category II)

A NESHAP term defined in 40 CFR 61, Subpart E and EPA 340/1-90/018 meaning any material, excluding Category I nonfriable ACM, containing more than 1 percent asbestos.

1.4.32 Permissible Exposure Limits (PELs)

1.4.32.1 PEL-Time Weighted Average(TWA)

Concentration of asbestos not in excess of 0.1 fibers per cubic centimeter of air (f/cc) as an 8 hour time weighted average (TWA).

1.4.32.2 PEL-Excursion Limit

An airborne concentration of asbestos not in excess of 1.0 f/cc of air as averaged over a sampling period of 30 minutes.

1.4.33 Regulated Area

An OSHA term defined in 29 CFR 1926.1101 meaning an area established by the Contractor to demarcate areas where Class I, II, and III asbestos work is conducted; also any adjoining area where debris and waste from such asbestos work accumulate; and an area within which airborne concentrations of asbestos exceed, or there is a reasonable possibility they may exceed, the permissible exposure limit.

1.4.34 Removal

All operations where ACM is taken out or stripped from structures or substrates, and includes demolition operations.

1.4.35 Repair

Overhauling, rebuilding, reconstructing, or reconditioning of structures or substrates, including encapsulation or other repair of ACM attached to structures or substrates.

1.4.36 Surfacing ACM

Asbestos-containing material which contains more than 1% asbestos and is sprayed-on, troweled-on, or otherwise applied to surfaces, such as acoustical plaster on ceilings and fireproofing materials on structural members, or other materials on surfaces for acoustical, fireproofing, or other purposes.

1.4.37 Thermal System Insulation (TSI) ACM

ACM which contains more than 1% asbestos and is applied to pipes, fittings, boilers, breeching, tanks, ducts, or other interior structural components to prevent heat loss or gain or water condensation.

1.4.38 Transite

A generic name for asbestos cement wallboard and pipe.

1.4.39 Worker

Individual (not designated as the Competent Person or a supervisor) who performs asbestos work and has completed asbestos worker training required by 29 CFR 1926.1101, to include EPA Model Accreditation Plan (MAP) "Worker" training; accreditation if required by the OSHA Class of work to be performed or by the state where the work is to be performed.

1.5 SYSTEM DESCRIPTION

This section covers all operations in which asbestos-containing materials (ACM) are encountered. These procedures and equipment are required to protect workers and building occupants from airborne asbestos fibers and ACM dust and debris. Activities may include OSHA Class I, Class II , Class III, or Class IV work operations. This section also includes containment, storage, transportation and disposal of the generated ACM wastes. Submit Detailed Drawings containing descriptions, and site layout to include worksite containment area(s), local exhaust systems locations, decontamination units and load-out units, other temporary waste storage facility, access tunnels, location of temporary utilities (electrical, water, sewer) and boundaries of each regulated area. Complete Table 1 and submit to NC.

1.5.1 Abatement Work Tasks

The specific ACM to be abated is identified on the detailed plans and project drawings.

1.5.2 Unexpected Discovery of Asbestos

For any previously untested building components suspected to contain asbestos and located in areas impacted by the work, notify the COR (CO) who will have the option of ordering the NC to collect bulk samples to be obtained and delivered to a laboratory accredited under the National Institute of Standards and Technology (NIST) "National Voluntary Laboratory Accreditation Program (NVLAP)" and analyzed by PLM. If the asbestos content is less than 10 percent, as determined by a method other than point counting, the asbestos content shall be verified by point counting or stated to be greater than 1% asbestos content. Any additional components identified as ACM that have been approved by the CO for removal shall be removed and will be paid for by an equitable adjustment to the contract

price under the CONTRACT CLAUSE titled "changes". Bulk sampling shall be conducted by personnel who have successfully completed the EPA Model Accreditation Plan (MAP) "Building Inspector" training course and is State certified and licensed as a CAC or CSST by the California Department of Occupational Safety and Health.

1.6 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings & Table 1

Detailed Drawings of regulated area layout including emergency egress, decontamination chamber and negative air machines

SD-03 Product Data

MSDS of all chemicals brought onsite
Respiratory Protection Program - 29 CFR Part 1910.B4
Procedures for Evacuation of injured workers
Training Program
DOSH Licenses for Asbestos Work
Contractor Insurance Policy for Asbestos Work
Notification for Proposed Asbestos Work to CAL/OSHA and BAAQMD

SD-06 Test Reports

SD-07 Certificates

Local Exhaust and Vacuum System On-site Dispersed Oil Particle (DOP) Testing
Training
Medical Surveillance Requirements
Fit testing

1.7 QUALITY ASSURANCE

In addition to detailed requirements of this specification, work performed under this contract shall comply with applicable federal, state, and local laws, ordinances, criteria, rules and regulations regarding handling, storing, transporting, and disposing of asbestos waste materials. Matters of interpretation of standards shall be submitted to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements shall apply. The following state and local laws, rules and regulations regarding demolition, removal, encapsulation, construction alteration, repair, maintenance, renovation, spill/emergency cleanup, housekeeping, handling, storing, transporting and disposing of asbestos material apply.

1.7.1 Written Qualifications and Organization Report

Submit a written qualifications and organization report providing evidence of qualifications of the Contractor, Contractor's Project Supervisor, Designated Competent Person, supervisors and workers; all subcontractors to be used including disposal transportation and disposal facility firms, subcontractor supervisors, subcontractor workers; and any others assigned to perform asbestos abatement and support activities. Include in the

report an organization chart showing the Contractor's staff organization chain of command and reporting relationship with all subcontractors.

1.7.2 Specific Requirements

Designate in writing, personnel meeting the following qualifications:

a. Asbestos Abatement Contractor: Certified/licensed by applicable state agencies to perform asbestos-related activities.

b. Designated Competent Person: Qualified in accordance with 29 CFR 1926.32 and 29 CFR 1926.1101, has EPA MAP "Contractor/Supervisor" training accreditation, has EPA/State certification/license as a "Contractor/Supervisor" and is experienced in the administration and supervision of asbestos abatement projects, including exposure assessment and monitoring, work practices, abatement methods, protective measures for personnel, setting up and inspecting asbestos abatement work areas, evaluating the integrity of containment barriers, placement and operation of local exhaust systems, ACM generated waste containment and disposal procedures, decontamination units installation and maintenance requirements, site safety and health requirements, notification of other employees onsite, etc. The Designated Competent Person shall be responsible for compliance with applicable federal, state and local requirements, the Contractor's Accident Prevention Plan (APP) and Asbestos Hazard Abatement Plan (AHAP). Submit the "Contractor/Supervisor" course completion certificate and the most recent certificate for required refresher training. The Designated Competent Person shall be onsite at all times during the conduct of this project.

d. Asbestos Abatement Workers: Meet the requirements contained in 29 CFR 1926.1101, 40 CFR 61, Subpart M, and other applicable federal, state and local requirements. Training documentation is required for each employee who will perform OSHA Class I, Class II, Class III, or Class IV asbestos abatement operations. Training course completion certificates (initial and most recent update refresher).

e. Independent Testing Laboratory: Identify the independent testing laboratory selected to perform the sample analyses and report the Phase Contrast Microscopy results of employee's personal air sampling. The testing laboratory shall be completely independent from the Contractor as recognized by federal, state or local regulations. All laboratories shall also participate in a national sample testing scheme such as the Proficiency Analytical Testing Program (PAT), or the Asbestos Registry sponsored by the American Industrial Hygiene Association (AIHA).

f. Disposal Facility, Transporter: Written evidence that the landfill to be used is approved for asbestos disposal by the local regulatory agencies. Copies of signed agreements between the Contractor (including subcontractors and transporters) and the asbestos waste disposal facility to accept and dispose of all asbestos containing waste shall be provided. The Contractor and transporters shall meet the DOT requirements of 49 CFR 171, 49 CFR 172, and 49 CFR 173 as well as registration requirements of 49 CFR 107 and other applicable state or local requirements. The disposal facility shall meet the requirements of 40 CFR 61, Sections .154 or .155, as required in 40 CFR 61 150(b), and other applicable state or local requirements.

1.7.3 Federal, State or Local Citations on Previous Projects

The Contractor and all subcontractors shall submit a statement, signed by an officer of the company, containing a record of any citations issued by Federal, State or local regulatory agencies relating to asbestos activities (including projects, dates, and resolutions); a list of penalties incurred through non-compliance with asbestos project specifications, including liquidated damages, overruns in scheduled time limitations and resolutions; and situations in which an asbestos-related contract has been terminated (including projects, dates, and reasons for terminations). If there are none, a negative declaration signed by an officer of the company shall be provided.

1.7.4 Preconstruction Conference

The Contractor and the Contractor's Designated Competent Person, Project Supervisor, shall meet with the COR (CO) and NASA Health and Safety Office's asbestos representative (NC) prior to beginning asbestos work at a safety preconstruction conference to discuss the details of the Contractor's submitted APP to include the AHAP and AHAs appendices. Deficiencies in the APP will be discussed. Onsite work shall not begin until the APP has been accepted.

1.8 SAFETY

Prepare a written comprehensive site-specific Accident Prevention Plan (APP) at least 30 days prior to the preconstruction conference. The APP shall incorporate an Asbestos Hazard Abatement Plan (AHAP), and Activity Hazard Analyses (AHAs) as separate appendices into one site-specific document. The APP shall take into consideration all the individual asbestos abatement work tasks identified in Table 1.

1.8.1 Asbestos Hazard Abatement Plan Appendix

The AHAP shall include, but not be limited to, the following:

a. The personal protective equipment to be used;

b. The location and description of regulated areas including clean and dirty areas,access tunnels, and decontamination unit (clean room, shower room, equipment room, storage areas such as load-out unit);

c. Initial exposure assessment in accordance with 29 CFR 1926.1101;

d. Level of supervision;

e. Method of notification of other employers at the worksite;

f. Abatement method to include containment and control procedures;

g. Interface of trades;

h. Sequencing of asbestos related work;

i. Storage and disposal procedures and plan;

j. Type of wetting agent and asbestos encapsulant;

k. Location of local exhaust equipment;

l. Air monitoring methods (personal, environmental and clearance);

m. Bulk sampling and analytical methods (if required);

n. A detailed description of the method to be employed in order to control the spread of ACM wastes and airborne fiber;

o. Fire and medical emergency response procedures;

p. The security procedures to be used for all regulated areas.

1.8.2 Local Exhaust System

Local exhaust units shall conform to AIHA Z9.2 and 29 CFR 1926.1101. Filters on local exhaust system equipment shall conform to AIHA Z9.2 and UL 586. Filter shall be UL labeled and DOP tested prior to use. Submit pressure differential recordings and Manufacturer's certifications showing compliance with AIHA Z9.2 for:

a. Vacuums

b. Water filtration equipment

c. Ventilation equipment

d. Other equipment required to contain airborne asbestos fibers

1.9 SECURITY

1.9.1 Licenses, Permits and Notifications

Obtain necessary licenses, permits and notifications in conjunction with the project's asbestos abatement, transportation and disposal actions and timely notification furnished of such actions as required by federal, state, regional, and local authorities. The Contractor shall notify the Regional Office of the USEPA, BAAQMD, state OSHA program and CALOSHA in writing, at least 10 days prior to the commencement of work, in accordance with 40 CFR 61, Subpart M, and state and local requirements to include the mandatory "Notification of Demolition and Renovation Record" form and other required notification documents. Local fire department shall be notified 3 days before fireproofing material is removed from a building and the notice shall specify whether or not the material contains asbestos. The Contractor is responsible for the associated fees/costs for licenses, permits, and notifications.

1.9.2 Regulated Areas

All Class I, II, and III asbestos work shall be conducted within regulated areas. The regulated area shall be demarcated to minimize the number of persons within the area and to protect persons outside the area from exposure to airborne asbestos. Control access to regulated areas, ensure that only authorized personnel enter, and verify that Contractor required medical surveillance, training and respiratory protection program requirements are met prior to allowing entrance.

1.9.3 Warning Signs and Tape

Warning signs and tape printed bilingually in English and Spanish shall be provided at the regulated boundaries and entrances to regulated areas. Signs shall be located to allow personnel to read the signs and take the necessary protective steps required before entering the area. Warning signs displaying the following legend in the lower panel shall be posted:

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA

1.9.4 Warning Labels

Warning labels shall be affixed to all asbestos disposal containers, asbestos materials, scrap, waste debris, and other products contaminated with asbestos. Containers with preprinted warning labels conforming to requirements are acceptable.

1.10 MEDICAL SURVEILLANCE REQUIREMENTS

Medical surveillance requirements shall conform to 29 CFR 1926.1101. Asbestos workers shall be enrolled in a medical surveillance program that meets 29 CFR 1926.1101 (m) requirements and other pertinent state or local requirements. This requirement shall have been satisfied within the last 12 months. Submit required medical certification and the Physician's written opinion.

1.10.1 Respiratory Protection Program

The Contractor shall establish in writing, and implement a respiratory protection program in accordance with 29 CFR 1926.1101 and 29 CFR 1910.134. The Contractor shall establish minimum respiratory protection requirements based on measured or anticipated levels of airborne asbestos fiber concentrations.

1.10.2 Respiratory Fit Testing

The Contractor shall conduct a qualitative or quantitative fit test conforming to Appendix A of 29 CFR 1910.134 for each worker required to wear a respirator, and any authorized visitors who enter a regulated area where respirators are required to be worn. A respirator fit test shall be performed prior to initially wearing a respirator and every 12 months thereafter. If physical changes develop that will affect the fit, a new fit test shall be performed. Functional fit checks shall be performed each time a respirator is put on and in accordance with the manufacturer's recommendation.

1.10.3 Respirator Selection and Use Requirements

Provide respirators, and ensure that they are used as required by 29 CFR 1926.1101 and 1910.134. Respirators shall be approved by the National Institute for Occupational Safety and Health NIOSH, under the provisions of 42 CFR 84, for use in environments containing airborne asbestos fibers. For air-purifying respirators, the particulate filter shall be high-efficiency particulate air (HEPA)/(N-,R-,P-100). The initial respirator selection and the decisions regarding the upgrading or

downgrading of respirator type shall be made by the NASA NC based on the measured or anticipated airborne asbestos fiber concentrations to be encountered.

1.10.4 Personal Protective Equipment

Provide workers with personal protective clothing and equipment and ensure that it is worn properly. The Designated Competent Person shall select and approve all the required personal protective clothing and equipment.

1.10.5 Whole Body Protection

Personnel exposed to or having the potential to be exposed to airborne concentrations of asbestos that exceed the PELs, or for all OSHA Classes of work for which a required negative exposure assessment is not produced, shall be provided with whole body protection and such protection shall be worn properly. Disposable whole body protection shall be disposed of as asbestos contaminated waste upon exiting from the regulated area. Reusable whole body protection worn shall be either disposed of as asbestos contaminated waste upon exiting from the regulated area or be properly laundered in accordance with 29 CFR 1926.1101. The Contractor's Designated Competent Person, in consultation with the Designated IH, has the authority to take immediate action to upgrade or downgrade whole body protection when there is an immediate danger to the health and safety of the wearer.

1.10.5.1 Gloves

Gloves shall be provided to protect the hands where there is the potential for hand injuries (i.e., scrapes, punctures, cuts, etc.).

1.10.5.2 Foot Coverings

Cloth socks shall be provided and worn next to the skin. Footwear, as required by OSHA and EM 385-1-1, that is appropriate for safety and health hazards in the area shall be worn. Reusable footwear removed from the regulated area shall be thoroughly decontaminated or disposed of as ACM waste.

1.10.5.3 Head Covering

Hood type disposable head covering shall be provided. In addition, protective head gear (hard hats) shall be provided as required. Hard hats shall only be removed from the regulated area after being thoroughly decontaminated.

1.10.5.4 Protective Eye Wear

Eye protection shall be provided, when operations present a potential eye injury hazard, and shall meet the requirements of ANSI/ISEA Z87.1.

1.11 HYGIENE

Establish a decontamination area for the decontamination of employees, material and equipment. Ensure that employees enter and exit the regulated area through the decontamination area.

1.11.1 3-Stage Decontamination Area

A temporary negative pressure decontamination unit that is adjacent and

attached in a leak-tight manner to the regulated area shall be provided during all Class I work. The decontamination unit shall have an equipment room and a clean room separated by a shower that complies with 29 CFR 1910.141, unless the Contractor can demonstrate that such facilities are not feasible. Equipment and surfaces of containers filled with ACM shall be cleaned prior to removing them from the equipment room or area. Provide a minimum of 1 shower. Wastewater shall be collected and filtered to remove asbestos contamination. Filters and residue shall be disposed of as asbestos contaminated material. Filtered water shall be discharged to the sanitary sewer system. Wastewater filters shall be installed in series with the first stage pore size of 20 microns and the second stage pore size of 5 microns. The floor of the decontamination unit's clean room shall be kept dry and clean at all times. Proper housekeeping and hygiene requirements shall be maintained. Soap and towels shall be provided for showering, washing and drying. Any cloth towels provided shall be disposed of as ACM waste or shall be laundered in accordance with 29 CFR 1926.1101.

1.11.2 Load-Out Unit

A temporary load-out unit that is adjacent and connected to the regulated area shall be provided. The load-out unit shall be attached in a leak-tight manner to each regulated area.

1.11.3 Single Stage Decontamination Area

A decontamination area (equipment room/area) shall be provided for Class I work involving less than 25 feet or 10 square feet of TSI or surfacing ACM, and for Class II and Class III asbestos work operations where exposures exceed the PELs or where there is no negative exposure assessment. The equipment room or area shall be adjacent to the regulated area for the decontamination of employees, material, and their equipment which could be contaminated with asbestos. The area shall be covered by an impermeable drop cloth on the floor or horizontal working surface. The area must be of sufficient size to accommodate cleaning of equipment and removing personal protective equipment without spreading contamination beyond the area.

1.11.4 Decontamination Area Exit Procedures

Ensure that the following procedures are followed:

a. Before leaving the regulated area, remove all gross contamination and debris from work clothing using a HEPA vacuum.

b. Employees shall remove their protective clothing in the equipment room and deposit the clothing in labeled impermeable bags or containers.

c. Employees shall not remove their respirators until showering.

d. Employees shall shower prior to entering the clean room. If a shower has not been located between the equipment room and the clean room or the work is performed outdoors, ensure that employees engaged in Class I asbestos jobs: a) Remove asbestos contamination from their work suits in the equipment room or decontamination area using a HEPA vacuum before proceeding to a shower that is not adjacent to the work area; or b) Remove their contaminated work suits in the equipment room, without cleaning worksuits, and proceed to a shower that is not adjacent to the work area.

1.11.5 Smoking

Smoking, if allowed by the Contractor, shall only be permitted in designated areas approved by the CO.

1.12 TRAINING PROGRAM

Establish and submit a training program as specified by EPA MAP, training requirements at 40 CFR 763, the State of California, OSHA requirements at 29 CFR 1926.1101 (k)(9). Contractor employees shall complete the required training for the type of work they are to perform and such training shall be documented and provided to the CO.

a. Class I and II operations 32 hours Asbestos Worker Training

b. Class II specific training to trades such as roofing, A/C piping, flooring, removal 8 hour Asbestos Worker Training

c. Class III operations 16 hour O & M Training

d. Class IV operations 2 hour Awareness Training

Prior to commencement of work the Contractor's Competent Person shall instruct each worker about:

a. The hazards and health effects of the specific types of ACM to be abated; and

b. The content and requirements of the Contractor's APP to include the AHAP and AHAs and site-specific safety and health precautions.

PART 2 PRODUCTS

2.1 ENCAPSULANTS

Encapsulants shall conform to USEPA requirements, shall contain no toxic or hazardous substances and no solvent. Submit certificates stating that encapsulants meet the applicable specified performance requirements.

2.2 ENCASEMENT PRODUCTS

Encasement shall consist of primary cellular polymer coat, polymer finish coat, and any other finish coat as approved by the CO.

2.3 RECYCLABLE MATERIALS

Recyclable materials shall conform to EPA requirements in accordance with Section 01 62 35 RECYCLED/RECOVERED MATERIALS.

2.4 EXPENDABLE SUPPLIES

2.4.1 Glovebag

Glovebags shall be provided as described in 29 CFR 1926.1101 and SET-UP DETAIL SHEET 10. The glovebag assembly shall be 6 mil thick plastic, prefabricated and seamless at the bottom with preprinted OSHA warning label. Inside of building glovebag work will require secondary containment. Secondary containment will need air circulation prior to removal.

2.4.2 Duct Tape

Industrial grade duct tape of appropriate widths suitable for bonding sheet plastic and disposal container.

2.4.3 Disposal Containers

Leak-tight (defined as solids, liquids, or dust that cannot escape or spill out) disposal containers shall be provided for ACM wastes as required by 29 CFR 1926.1101 and DETAIL SHEETS 9A, 9B, 9C and 14. Disposal containers can be in the form of:

a. Disposal Bags

b. Fiberboard Drums

c. Cardboard Boxes

2.4.4 Sheet Plastic

Sheet plastic shall be polyethylene of 6 mil minimum thickness and shall be provided in the largest sheet size necessary to minimize seams . Film shall be clear frosted and conform to ASTM D 4397, except as specified below:

2.4.4.1 Flame Resistant

Where a potential for fire exists, flame-resistant sheets shall be provided. Film shall be frosted and shall conform to the requirements of NFPA 701.

2.4.4.2 Reinforced

Reinforced sheets shall be provided where high skin strength is required, such as where it constitutes the only barrier between the regulated area and the outdoor environment. The sheet stock shall consist of translucent, nylon-reinforced or woven-polyethylene thread laminated between 2 layers of polyethylene film. Film shall meet flame resistant standards of NFPA 701.

2.4.5 Mastic Removing Solvent

Mastic removing solvent shall be nonflammable and shall not contain methylene chloride, glycol ether, or halogenated hydrocarbons. Solvents used onsite shall have a flash point greater than 140 degrees F.

2.4.6 Leak-tight Wrapping

Two layers of 6 mil minimum thick polyethylene sheet stock shall be used for the containment of removed asbestos-containing components or materials such as reactor vessels, large tanks, boilers, insulated pipe segments and other materials too large to be placed in disposal bags as described in DETAIL SHEET 9B. Upon placement of the ACM component or material, each layer shall be individually leak-tight sealed with duct tape.

2.4.7 Viewing Inspection Window

Per BAAQMD, a minimum of 1 clear, 1/8 inch thick, acrylic sheet, 18 by 24 inches, shall be installed as a viewing inspection window at eye level on a

wall in each containment enclosure. The windows shall be sealed leak-tight with industrial grade duct tape.

2.4.8 Wetting Agents

Removal encapsulant (a penetrating encapsulant) shall be provided when conducting removal abatement activities that require a longer removal time or are subject to rapid evaporation of amended water. The removal encapsulant shall be capable of wetting the ACM and retarding fiber release during disturbance of the ACM greater than or equal to that provided by amended water. Performance requirements for penetrating encapsulants are specified in paragraph ENCAPSULANTS above.

2.4.9 Strippable Coating

Strippable coating in aerosol cans shall be used to adhere to surfaces and to be removed cleanly by stripping, at the completion of work.

2.5 EQUIPMENT

2.5.1 Tools

Vacuums shall be equipped with HEPA filters, of sufficient capacity and necessary capture velocity at the nozzle or nozzle attachment to efficiently collect, transport and retain the ACM waste material. All HEPA vacuums shall be DOP tested onsite prior to abatement work. Power tools shall not be used to remove ACM unless the tool is equipped with effective, integral HEPA filtered exhaust ventilation capture and collection system. Reusable tools shall be thoroughly decontaminated prior to being removed from regulated areas.

2.5.2 Rental Equipment

If rental equipment is to be used, written notification shall be provided to the rental agency, concerning the intended use of the equipment, the possibility of asbestos contamination of the equipment and the steps that will be taken to decontaminate such equipment.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Asbestos abatement work tasks shall be performed as shown on the detailed plans and drawings, as summarized in Table 1. Use the engineering controls and work practices required in 29 CFR 1926.1101(g) in all operations regardless of the levels of exposure. Personnel shall wear and utilize protective clothing and equipment. Do not permit eating, smoking, drinking, chewing or applying cosmetics in the regulated area. Personnel of other trades, shall not be exposed at any time to airborne concentrations of asbestos unless all the administrative and personal protective provisions of the Contractor's APP are complied with. Power to the regulated area shall be locked-out and tagged in accordance with 29 CFR 1910.147, and temporary electrical service with ground fault circuit interrupters shall be provided as needed. Temporary electrical service shall be disconnected when necessary for wet removal. Stop abatement work in the regulated area immediately when the airborne total fiber concentration: (1) equals or exceeds 0.01 f/cc, or the pre-abatement concentration, whichever is greater, outside the regulated area; or (2) equals or exceeds 1.0 f/cc inside the regulated area. Correct the

condition to the satisfaction of the NC, including visual inspection and air sampling. Work shall resume only upon notification by the NC. Corrective actions shall be documented.

3.2 PROTECTION OF ADJACENT WORK OR AREAS TO REMAIN

Perform asbestos abatement without damage to or contamination of adjacent work or area. Where such work or area is damaged or contaminated, it shall be restored to its original condition or decontaminated at no expense to the Government. When spills occur, work shall stop in all effected areas immediately and the spill shall be cleaned. When satisfactory visual inspection and air sampling analysis results are obtained and have been evaluated by the NASA NC, work shall proceed.

3.3 OBJECTS

3.3.1 Removal of Mobile Objects

The Government will remove Furniture and equipment from the area of work before work begins unless contract states otherwise. Furnishings shall be precleaned using HEPA filtered vacuum followed by wet wiping. These objects shall be removed to an area or site designated by the CO. Carpets, draperies, and other items which may not be suitable for onsite wet cleaning methods shall be properly cleaned in accordance with 29 CFR 1926.1101.

3.3.2 Stationary Objects

Stationary objects, furniture, and equipment that needs to remain in place shall be precleaned using HEPA vacuum followed by adequate wet wiping. Stationary objects and furnishings shall be covered with 2 layers of polyethylene and edges sealed with duct tape.

3.4 BUILDING VENTILATION SYSTEM AND CRITICAL BARRIERS

Building ventilation system supply and return air ducts in a regulated area shall be shut down, if feasible, and isolated. The isolation of airtight seals shall consist of air-tight rigid covers for building ventilation supply and exhaust grills where the ventilation system is required to remain in service during abatement apply 2 layers of polyethylene. Edges to wall, ceiling and floor surfaces shall be sealed with industrial grade duct tape.

3.5 PRECLEANING

Surfaces shall be cleaned by HEPA vacuum and adequately wet wiped prior to establishment of containment.

3.6 METHODS OF COMPLIANCE

3.6.1 Mandated Practices

The specific abatement techniques and items identified shall be detailed in the Contractor's AHAP. Use the following engineering controls and work practices in all operations, regardless of the levels of exposure:

a. DOP tested vacuum cleaners equipped with HEPA filters.

b. Wet methods or wetting agents except where it can be demonstrated that

the use of wet methods is unfeasible due to the creation of electrical hazards, equipment malfunction, and in roofing that may be unsafe for wet methods.

c. Prompt clean-up and disposal.

d. Inspection and repair of polyethylene.

e. Cleaning of equipment and surfaces of containers prior to removing them from the equipment room or area.

3.6.2 Control Methods

Use the following control methods:

a. DOP tested local exhaust ventilation equipped with HEPA filter;

b. Enclosure or isolation of processes producing asbestos dust;

c. Where the feasible engineering and work practice controls are not sufficient to reduce employee exposure to or below the PELs, use them to reduce employee exposure to the lowest levels attainable and shall supplement them by the use of respiratory protection.

3.6.3 Unacceptable Practices

The following work practices shall not be used:

a. High-speed abrasive disc saws that are not equipped with point of cut ventilator or enclosures with HEPA filtered exhaust air.

b. Compressed air used to remove asbestos containing materials, unless the compressed air is used in conjunction with an enclosed ventilation system designed to capture the dust cloud created by the compressed air.

c. Dry sweeping, shoveling, or other dry clean up.

d. Employee rotation as a means of reducing employee exposure to asbestos.

3.6.4 Class I Work Procedures

In addition to requirements of paragraphs Mandated Practices and Control Methods, the following engineering controls and work practices shall be used:

a. A Competent Person shall supervise the installation and operation of the control methods.

b. For jobs involving the removal of more than 25 feet or 10 square feet of TSI or surfacing material, place critical barriers over all openings to the regulated area.

c. HVAC systems shall be isolated in the regulated area by sealing with a double layer of plastic or air-tight rigid covers.

d. Impermeable dropcloths (6 mil or greater thickness) shall be placed on surfaces beneath all removal activity.

e. Where a negative exposure assessment has not been provided or where

exposure monitoring shows the PEL was exceeded, the regulated area shall be ventilated with a HEPA unit and employees must use PPE.

3.6.5 Specific Control Methods for Class I Work

3.6.5.1 Negative Pressure Enclosure (NPE) System

The system shall provide at least 4 air changes per hour inside the containment. The local exhaust unit equipment shall be operated 24 hours per day until the containment is removed. The NPE shall be smoke tested for leaks at the beginning of each shift and be sufficient to maintain a minimum pressure differential of minus 0.02 inch of water column relative to adjacent, unsealed areas. Pressure differential shall be monitored continuously, 24 hours per day, with an automatic manometric recording instrument and Records shall be provided daily on the same day collected to the NC. The NC shall be notified immediately if the pressure differential falls below the prescribed minimum. The building ventilation system shall not be used as the local exhaust system for the regulated area. The NPE shall terminate outdoors unless an alternate arrangement is allowed by the Health and Safety Office representative (NC). All filters used shall be new at the beginning of the project and shall be periodically changed as necessary and disposed of as ACM waste.

3.6.5.2 Glovebag Systems

Glovebags shall be used without modification, smoke-tested for leaks, and completely cover the circumference of pipe or other structures where the work is to be done. Glovebags shall be used only once and shall not be moved. Glovebags shall not be used on surfaces that have temperatures exceeding 150 degrees F. All glovebags located inside a building, should have secondary containment. Prior to disposal, glovebags shall be collapsed using a HEPA vacuum. Before beginning the operation, loose and friable material adjacent to the glovebag operation shall be wrapped and sealed in 2 layers of plastic or otherwise rendered intact. At least 2 persons shall perform glovebag removal. Asbestos regulated work areas shall be established as shown on detailed drawings and plans and Table 1 for glovebag abatement. Designated boundary limits for the asbestos work shall be established with rope or other continuous barriers and all other requirements for asbestos control areas shall be maintained, including area signage and boundary warning tape.

a. Attach HEPA vacuum systems to the bag to prevent collapse during removal of ACM.

b. The negative pressure glove boxes shall be fitted with gloved apertures and a bagging outlet and constructed with rigid sides from metal or other material which can withstand the weight of the ACM and water used during removal. A negative pressure shall be created in the system using a HEPA filtration system. The box shall be smoke tested for leaks prior to each use.

3.6.5.3 Mini-Enclosures

Mini-enclosures may be used if the disturbance or removal can be completely contained by the enclosure. The mini-enclosure shall be inspected for leaks and smoke tested before each use. Air movement shall be directed away from the employee's breathing zone within the mini-enclosure.

3.6.5.4 Wrap and Cut Operation

Prior to cutting pipe, the asbestos-containing insulation shall be wrapped with polyethylene and securely sealed with duct tape to prevent asbestos becoming airborne as a result of the cutting process. The following steps shall be taken: install glovebag, strip back sections to be cut 6 inches from point of cut, and cut pipe into manageable sections.

3.6.6 Class II Work

In addition to the requirements of paragraphs Mandated Practices and Control Methods, the following engineering controls and work practices shall be used:

a. A Competent Person shall supervise the work.

b. For indoor work, critical barriers shall be placed over all openings to the regulated area.

c. Impermeable dropcloths shall be placed on surfaces beneath all removal activity.

3.6.7 Specific Control Methods for Class II Work

3.6.7.1 Vinyl and Asphalt Flooring Materials

Resilient sheeting shall be removed by adequately wet methods. Tiles shall be removed intact (if possible); wetting is not required when tiles are heated and removed intact. Flooring or its backing shall not be sanded. Scraping of residual adhesive and/or backing shall be performed using wet methods. Mechanical chipping is prohibited unless performed in a negative pressure enclosure. Dry sweeping is prohibited. Use vacuums equipped with HEPA filter, disposable dust bag, and metal floor tool (no brush) to clean floors.

3.6.7.2 Roofing Material

Roofing material shall be removed in an intact state. Wet methods shall be used to remove roofing materials that are not intact, or that will be rendered not intact during removal, unless such wet methods are not feasible or will create safety hazards. When removing built-up roofs, with asbestos-containing roofing felts and an aggregate surface, using a power roof cutter, all dust resulting from the cutting operations shall be collected by a HEPA dust collector, or shall be HEPA vacuumed by vacuuming along the cut line. Asbestos-containing roofing material shall not be dropped or thrown to the ground, but shall be lowered to the ground via covered, dust-tight chute, crane, hoist or other method approved by the Health and Safety Office representative (NC). Any ACM that is not intact shall be lowered to the ground as soon as practicable, but not later than the end of the work shift. While the material remains on the roof it shall be kept wet or placed in an impermeable waste bag or wrapped in plastic sheeting. Intact ACM shall be lowered to the ground as soon as practicable, but not later than the end of the work shift. Unwrapped material shall be transferred to a closed receptacle. Critical barriers shall be placed over roof level heating and ventilation air intakes.

3.6.7.3 Cementitious Siding and Shingles or Transite Panels

When removing cementitious asbestos-containing siding, shingles or transite

panels the ACM will be removed substantially intact. Intentionally cutting, abrading or breaking is prohibited. Each panel or shingle shall be sprayed with amended water prior to removal. Nails shall be cut with flat, sharp instruments. Unwrapped or unbagged panels or shingles shall be immediately lowered to the ground via covered dust-tight chute, crane or hoist, or placed in an impervious waste bag or wrapped in plastic sheeting and lowered to the ground no later than the end of the work shift.

3.6.7.4 Gaskets

Gaskets shall be thoroughly wetted with amended water prior to removal and immediately placed in a disposal container. If a gasket is visibly deteriorated and unlikely to be removed intact, removal shall be undertaken within a glovebag. Any scraping to remove residue shall be performed wet.

3.6.8 Specific Control Methods for Class III Work

Class III asbestos work shall be conducted using engineering and work practice controls which minimize the exposure to employees performing the asbestos work. The work shall be performed using wet methods and, to the extent feasible, using local exhaust. Use impermeable drop cloths and shall isolate the operation, using mini-enclosures or glovebag systems, where the disturbance involves drilling, cutting, abrading, sanding, chipping, breaking, or sawing of TSI or surfacing material.

3.6.9 Specific Control Methods for Class IV Work

Class IV jobs shall be conducted using wet methods and HEPA vacuums. Employees cleaning up debris and waste in a regulated area where respirators are required shall wear the selected respirators.

3.6.10 Methods for Asphaltic Wrap

Removal or disturbance of pipeline asphaltic wrap shall be performed using wet methods.

3.6.11 Abatement of Asbestos Contaminated Soil

Asbestos contaminated soil shall be removed from areas to a minimum depth of 2 inches. Soil shall be thoroughly dampened with amended water and then removed by manual shoveling into labeled containers.

3.6.12 Encapsulation of ACM

Prior to applying any encapsulant, the entire surface area shall be inspected for loose, or damaged asbestos material:

a. Penetrating Encapsulation: Before penetrating encapsulation is applied, asbestos removal work in the area shall be complete. Substrate shall be evaluated before application to ensure that the encapsulant will not cause the substrate to fail in any way. Plug samples shall be taken to determine if full penetration has been achieved. If full penetration has not been achieved, surfaces shall be recoated while the matrix is still wet, until full penetration is achieved.

b. Bridging Encapsulation: The surface shall be encapsulated in sections of 1000 square feet or less as recommended by the encapsulant manufacturer. Upon completion of each section, the dry thickness of

the bridging encapsulation shall be measured. Additional bridging encapsulant shall be applied to obtain the desited encapsulant thickness. Additional coats shall blend with the original bridging encapsulant. Bridging encapsulation shall include:

3.6.13 Combined Encapsulation of Acoustical Wall and Ceiling Plaster

The combination penetrating/bridging encapsulation system shall be installed by first applying the penetrating encapsulant and then the bridging encapsulant.

3.7 FINAL CLEANING AND VISUAL INSPECTION

After completion of all asbestos removal work and the gross amounts of asbestos have been removed from every surface, any remaining visible accumulations of asbestos shall be collected. For all classes of indoor asbestos abatement projects a final cleaning shall be performed using HEPA vacuum and wet cleaning of all exposed surfaces and objects in the regulated area. Upon completion of the cleaning, conduct a visual pre-inspection of the cleaned area in preparation for a final inspection before final air clearance monitoring. The Contractor and the NC shall conduct a final visual inspection of the cleaned regulated area in accordance with ASTM E 1368 and document the results on the Final Cleaning and Visual Inspection If the CO rejects the clean regulated area as not meeting final cleaning requirements, reclean as necessary and have a follow-on inspection conducted with the NC. Recleaning and follow-up reinspection shall be at the Contractor's expense.

3.8 LOCKDOWN

Prior to removal of plastic barriers and after final visual inspection, an encapsulant may be required to spray applied to ceiling, walls, floors, and other surfaces in the regulated area.

3.9 EXPOSURE ASSESSMENT AND AIR MONITORING

3.9.1 General Requirements

a. Exposure assessment, air monitoring and analysis of airborne concentration of asbestos fibers shall be performed in accordance with 29 CFR 1926.1101, and the Contractor's air monitoring plan. Results of breathing zone samples shall be posted at the job site and made available to the NC. Submit all documentation regarding initial exposure assessments, negative exposure assessments, and air-monitoring results.

b. Worker Exposure.

1. The Contractor shall collect samples representative of the exposure of each employee who is assigned to work within a regulated area. Breathing zone samples shall be taken for at least 25 percent of the workers in each shift, or a minimum of 2, whichever is greater.

2. Workers shall not be exposed to an airborne fiber concentration in excess of 1.0 f/cc, as averaged over a sampling period of 30 minutes. Should a personal excursion concentration of 1.0 f/cc expressed as a 30-minute sample occur inside a regulated work area, stop work immediately, notify the COR, and implement

additional engineering controls and work practice controls to reduce airborne fiber levels below prescribed limits in the work area. Do not restart work until authorized by the CO.

c. Environmental Exposure (Perimeter Sampling)

1. All environmental air monitoring shall be performed by NASA's Health and Safety Representative, NC.

2. Environmental air monitoring shall be performed using NIOSH 94-113 Method 7400 (PCM) with confirmation of results by OSHA TEM for samples above clearance criterion of .01 f/cc.

3. For environmental and final clearance, air monitoring shall be conducted at a sufficient velocity and duration to establish the limit of detection of the method used at 0.005 f/cc.

4. When confirming asbestos fiber concentrations (asbestos f/cc) from environmental samples, use TEM in accordance with NIOSH 94-113 Method 7402. When such confirmation is conducted, it shall be from the same sample filter used for the NIOSH 94-113 Method 7400 PCM analysis. All confirmation of asbestos fiber concentrations, using NIOSH 94-113 Method 7402, shall be at the Contractor's expense.

5. At the discretion of the COR, fiber concentration may exceed 0.1 f/cc but shall not exceed 1.0 f/cc expressed as an 8-hour TWA. Should an environmental concentration of 1.0 f/cc expressed as an 8-hour TWA occur inside a regulated work area, stop work immediately, notify the COR, and implement additional engineering controls and work practice controls to reduce airborne fiber levels below prescribed limits in the work area. Work shall not restart until authorized by the CO.

3.9.2 Negative Exposure Assessment

Provide a negative exposure assessment, if using, for reduced PPE for the specific asbestos job which will be performed within 10 days of the initiation of the project and conform to the following criteria:

a. Objective Data: Objective data demonstrating that the product or material containing asbestos minerals or the activity involving such product or material cannot release airborne fibers in concentrations exceeding the PEL-TWA and PEL-Excursion Limit under those work conditions having the greatest potential for releasing asbestos.

b. Prior Asbestos Jobs: Where the Contractor has monitored prior asbestos jobs for the PEL and the PEL-Excursion Limit within 12 months of the current job, the monitoring and analysis were performed in compliance with asbestos standard in effect; the data were obtained during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the Contractor's current operations; the operations were conducted by employees whose training and experience are no more extensive than that of employees performing the current job; and these data show that under the conditions prevailing and which will prevail in the current workplace, there is a high degree of certainty that the monitoring covered exposure from employee exposures will not exceed the PEL-TWA and

PEL-Excursion Limit.

c. Initial Exposure Monitoring: The results of initial exposure monitoring of the current job, made from breathing zone air samples that are representative of the 8-hour PEL-TWA and 30-minute short-term exposures of each employee. The monitoring covered exposure from operations which are most likely during the performance of the entire asbestos job to result in exposures over the PELs.

3.9.3 Environmental Air Monitoring During Abatement

Environmental air monitoring shall be conducted by the NC at locations and frequencies that will accurately characterize any evolving airborne asbestos fiber concentrations in NASA occupied buildings. The assessment shall demonstrate that the product or material containing asbestos minerals, or the abatement involving such product or material, cannot release airborne asbestos fibers in concentrations exceeding 0.01 f/cc as a TWA under those work conditions having the greatest potential for releasing asbestos. The monitoring shall be at least once per shift at locations including, but not limited to, outside entrances to a regulated area; close to glovebag operations; critical barriers outside of the perimeter of a regulated area; inside clean room; and at the exhaust discharge point of local exhaust system ducted to the outside of a containment, but inside the building. If the sampling outside regulated area shows airborne fiber levels have exceeded background or 0.01 f/cc, whichever is greater, work shall be stopped immediately, and the COR notified. The condition causing the increase shall be corrected. Work shall not restart until authorized by the CO.

3.9.4 Final Clearance Air Monitoring

NASA's Health and Safety respresentative, NC will conduct final clearance air monitoring using aggressive air sampling techniques as defined in 40 CFR 763, Subpart E, Appendix A, Unit III, TEM Method B.7(d-f) for all indoor asbestos abatement projects. Clearance air monitoring is not required for outside work or for soil cleanups.

3.9.4.1 Final Clearance Requirements, NIOSH PCM Method

For PCM sampling and analysis using NIOSH 94-113 Method 7400, the fiber concentration inside the abated regulated area, for each airborne sample, shall be less than 0.01 f/cc. The abatement inside the regulated area is considered complete when every PCM final clearance sample is below the clearance limit. If any sample result is greater than 0.01 total f/cc, the asbestos fiber concentration (asbestos f/cc) shall be confirmed from that same filter using NIOSH 94-113 Method 7402 (TEM) at Contractor's expense. If any confirmation sample result is greater than 0.01 asbestos f/cc, abatement is incomplete and cleaning shall be repeated. Upon completion of any required recleaning, resampling with results to meet the above clearance criteria shall be done.

3.9.4.2 Final Clearance Requirements, EPA TEM Method

For EPA TEM sampling and analysis, using the EPA Method specified in 40 CFR 763, abatement inside the regulated area is considered complete when the arithmetic mean asbestos concentration of the 5 inside samples is less than or equal to 70 structures per square millimeter (70 S/mm). When the arithmetic mean is greater than 70 S/mm, the 3 blank samples shall be analyzed. If the 3 blank samples are greater than 70 S/mm, resampling

shall be done. If less than 70 S/mm, the 5 outside samples shall be analyzed and a Z-test analysis performed. When the Z-test results are less than 1.65, the decontamination shall be considered complete. If the Z-test results are more than 1.65, the abatement is incomplete and cleaning shall be repeated. Upon completion of any required recleaning, resampling with results to meet the above clearance criteria shall be done.

3.9.4.3 Air Clearance Failure

If clearance sampling results fail to meet the final clearance requirements, pay all costs associated with the required recleaning, resampling, and analysis, until final clearance requirements are met.

3.9.5 Air-Monitoring Results and Documentation

Air sample fiber counting shall be completed and results provided within 24 hours (breathing zone samples), and 48 hours (environmental/clearance monitoring) after completion of a sampling period. The CO shall be notified immediately of any airborne levels of asbestos fibers in excess of established requirements. Written sampling results shall be provided within 5 working days of the date of collection. The written results shall be signed by testing laboratory analyst, testing laboratory principal and the Contractor's Designated IH or CO's IH. The air sampling results shall be documented on a Contractor's daily air monitoring log. The daily air monitoring log shall contain the following information for each sample:

a. Sampling and analytical method used;

b. Date sample collected;

c. Sample number;

d. Sample type: BZ = Breathing Zone (Personal), P = Preabatement, E = Environmental, C = Abatement Clearance;

e. Location/activity/name where sample collected;

f. Sampling pump manufacturer, model and serial number, beginning flow rate, end flow rate, average flow rate (L/min);

g. Calibration date, time, method, location, name of calibrator, signature;

h. Sample period (start time, stop time, elapsed time (minutes);

i. Total air volume sampled (liters);

j. Sample results (f/cc and S/mm square) if EPA methods are required for final clearance;

k. Laboratory name, location, analytical method, analyst, confidence level. In addition, the printed name and a signature and date block for the Industrial Hygienist who conducted the sampling and for the Industrial Hygienist who reviewed the daily air monitoring log verifying the accuracy of the information.

3.10 CLEARANCE CERTIFICATION

When asbestos abatement is complete, ACM waste is removed from the regulated areas, and final clean-up is completed, the NC will allow the

warning signs and boundary warning tape to be removed. HVAC, mechanical, and electrical systems shall be re-established in proper working order. The Contractor and the NC shall visually inspect all surfaces within the containment for residual material or accumulated debris. Reclean all areas showing dust or residual materials. The NC will certify in writing that the area is safe before unrestricted entry is permitted. The Government will have the option to perform monitoring to certify the areas are safe before entry is permitted.

3.11 CLEANUP AND DISPOSAL

3.11.1 Title to ACM Materials

ACM material resulting from abatement work, except as specified otherwise, shall become the property of the Contractor and shall be disposed of as specified and in accordance with applicable federal, state and local regulations.

3.11.2 Collection and Disposal of Asbestos

All ACM waste shall be collected including contaminated wastewater filters, scrap, debris, bags, containers, equipment, and asbestos contaminated clothing and placed in leak-tight 6 mil double bagged containers. Waste within the containers shall be wetted in case the container is breeched. Asbestos-containing waste shall be disposed of at an EPA, state and local approved asbestos landfill. For temporary storage, sealed impermeable containers shall be stored in an asbestos waste load-out unit or in a storage/transportation conveyance (i.e., dumpster, roll-off waste boxes, etc.) in a manner acceptable to and in an area assigned by the CO. Procedure for hauling and disposal shall comply with 40 CFR 61, Subpart M, state, regional, and local standards. All Friable ACM will be accompanied by a California Hazardous Waste Manifest. This manifest will be signed by a NASA representative responsible for tracking all hazardous waste removed from NASA Ames. All non-friable asbestos waste will be required to be accompanied by a non-hazardous waste manifest. Prior to the signature of both of these manifests, an inspection of the bagged waste, hauling vehicle and transporter's license will be inspected. Inform the NC at least 24 hours prior to need for this inspection.

3.11.3 Records and Management Plan

3.11.3.1 Asbestos Waste Shipment Records

Manifest must be inspected and signed by the NASA Representative prior to ACM Waste leaving the site.

3.11.3.2 Asbestos Management Plan

Provide a summary, in electronic form, of site activities (bulk samples, asbestos removed, repaired, encased, etc.) for updating the installation Asbestos Management Plan.

TABLE 1

INDIVIDUAL WORK TASK DATA ELEMENTS

Sheet_____ of _____

There is a separate data sheet for each individual work task.

1. WORK TASK DESIGNATION NUMBER _____
2. LOCATION OF WORK TASK_____
_____
3. BRIEF DESCRIPTION OF MATERIAL TO BE ABATED:_____
_____

   a. Type of Asbestos _____
   b. Percent asbestos content _____%

4. ABATEMENT TECHNIQUE TO BE USED_____
5. OSHA ASBESTOS CLASS DESIGNATION FOR WORK TASK_____
6. EPA NESHAP FRIABILITY DESIGNATION FOR WORK TASK
   Friable _____ Non-friable Category I _____
   Non-friable Category II_____
7. FORM _____ and CONDITION OF ACM: GOOD_____ FAIR_____ POOR_____
8. QUANTITY: METERS_____, SQUARE METERS_____
8a. QUANTITY: LINEAR FT._____, SQUARE FT._____
9. SET-UP DETAIL SHEET NUMBERS
   FOR WORK TASK _____, _____, _____, _____,
   _____, _____, _____, _____.

NOTES:

(1) Numeric sequence of individual work tasks (1,2,3,4, etc.) for each regulated area. Each category of EPA friability/OSHA class has a separate task.
(2) Specific location of work (building, floor, area, e.g., Building 1421, 2nd Floor, Rm 201)
(3) A description of material to be abated (example: horizontal pipe, cement wall panels, tile, stucco, etc.) type of asbestos (chrysotile, amosite, crocidolite, etc.); and % asbestos content.
(4) Technique to be used: Removal = REM; Encapsulation = ENCAP; Encasement = ENCAS; Enclosure = ENCL; Repair = REP.
(5) Class designation: Class I, II, III, or IV (OSHA designation).
(6) Friability of materials: Check the applicable EPA NESHAP friability designation.
(7) Form: Interior or Exterior Architectural = IA or EA; Mechanical/Electrical = ME.
Condition: Good = G; Fair = F; Poor = P.
(8) Quantity of ACM for each work task in meters or square meters.
(8a) Quantity of ACM for each work task in linear feet or square feet.

TABLE 3

NIOSH METHOD 7400

PCM ENVIRONMENTAL AIR SAMPLING PROTOCOL (NON-PERSONAL)

Sample Location	Minimum No. of Samples	Filter Pore Size (Note 1)	Min. Vol. (Note 2) (Liters)	Sampling Rate (liters/min.)
Inside Abatement Area	0.5/140 Square Meters (Notes 3 & 4)	0.45 microns	3850	2-16
Each Room in 1 Abatement Area Less than 140 Square meters		0.45 microns	3850	2-16
Field Blank	2	0.45 microns	0	0
Laboratory Blank	1	0.45 microns	0	0

Notes:

1. Type of filter is Mixed Cellulose Ester.

2. Ensure detection limit for PCM analysis is established at 0.005 fibers/cc.

3. One sample shall be added for each additional 140 square meters. (The corresponding I-P units are 5/1500 square feet).

4. A minimum of 5 samples are to be taken per abatement area, plus 2 field blanks.

TABLE 4

EPA AHERA METHOD: TEM AIR SAMPLING PROTOCOL

Location Sampled	Minimum No. of Samples	Filter Pore Size	Min. Vol. (Liters)	Sampling Rate (liters/min.)
Inside Abatement Area	5	0.45 microns	1500	2-16
Outside Abatement Area	5	0.45 microns	1500	2-16
Field Blank	2	0.45 microns	0	0
Laboratory Blank	1	0.45 microns	0	0

Notes:

1. Type of filter is Mixed Cellulose Ester.

2. The detection limit for TEM analysis is 70 structures/square mm.

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LEAD IN CONSTRUCTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA)

AIHA Z88.6	Respiratory Protection - Respirator Use-Physical Qualifications for Personnel

U.S. DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

HUD 6780	Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.103	Respiratory Protection
29 CFR 1926.21	Safety Training and Education
29 CFR 1926.33	Access to Employee Exposure and Medical Records
29 CFR 1926.55	Gases, Vapors, Fumes, Dusts, and Mists
29 CFR 1926.59	Hazard Communication
29 CFR 1926.62	Lead
29 CFR 1926.65	Hazardous Waste Operations and Emergency Response
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste

40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 745	Lead-Based Paint Poisoning Prevention in Certain Residential Structures
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 178	Specifications for Packagings

UNDERWRITERS LABORATORIES (UL)

UL 586	Standard for High-Efficiency Particulate, Air Filter Units

1.2 DEFINITIONS

1.2.1 Action Level

Employee exposure, without regard to use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air averaged over an 8 hour period.

1.2.2 Area Sampling

Sampling of lead concentrations within the lead control area and inside the physical boundaries which is representative of the airborne lead concentrations but is not collected in the breathing zone of personnel (approximately 5 to 6 feet above the floor).

1.2.3 Competent Person (CP)

As used in this section, refers to a person employed by the Contractor who is trained in the recognition and control of lead hazards in accordance with current federal, State, and local regulations and has the authority to take prompt corrective actions to control the lead hazard. A Certified Industrial Hygienist (CIH) certified by the American Board of Industrial Hygiene or a Certified Safety Professional (CSP) certified by the Board of Certified Safety Professionals is the best choice.

1.2.4 Contaminated Room

Refers to a room for removal of contaminated personal protective equipment (PPE).

1.2.5 Decontamination Shower Facility

That facility that encompasses a clean clothing storage room, and a

contaminated clothing storage and disposal rooms, with a shower facility in between.

1.2.6 High Efficiency Particulate Arrestor (HEPA) Filter Equipment

HEPA filtered vacuuming equipment with a UL 586 filter system capable of collecting and retaining lead-contaminated particulate. A high efficiency particulate filter demonstrates at least 99.97 percent efficiency against 0.3 micron or larger size particles.

1.2.7 Lead

Metallic lead, inorganic lead compounds, and organic lead soaps. Excludes other forms of organic lead compounds.

1.2.8 Lead Control Area

A system of control methods to prevent the spread of lead dust, paint chips or debris to adjacent areas that may include temporary containment, floor or ground cover protection, physical boundaries, and warning signs to prevent unauthorized entry of personnel. HEPA filtered local exhaust equipment may be used as engineering controls to further reduce personnel exposures or building/outdoor environmental contamination.

1.2.9 Lead Permissible Exposure Limit (PEL)

Fifty micrograms per cubic meter of air as an 8 hour time weighted average as determined by 29 CFR 1926.62. If an employee is exposed for more than eight hours in a work day, the PEL shall be determined by the following formula:

PEL (micrograms/cubic meter of air) = 400/No. hrs worked per day

1.2.10 Material Containing Lead/Paint with Lead (MCL/PWL)

Any material, including paint, which contains lead as determined by the testing laboratory using a valid test method. The requirements of this section does not apply if no detectable levels of lead are found using a quantitative method for analyzing paint or MCL using laboratory instruments with specified limits of detection (usually 0.01 percent). An X-Ray Fluorescence (XRF) instrument is not considered a valid test method.

1.2.11 Personal Sampling

Sampling of airborne lead concentrations within the breathing zone of an employee to determine the 8 hour time weighted average concentration in accordance with 29 CFR 1926.62. Samples shall be representative of the employees' work tasks. Breathing zone shall be considered an area within a hemisphere, forward of the shoulders, with a radius of 6 to 9 inches and centered at the nose or mouth of an employee.

1.2.12 Physical Boundary

Area physically roped or partitioned off around lead control area to limit unauthorized entry of personnel.

1.3 DESCRIPTION

1.3.1 Description of Work

See contract for Scope of Work.

1.3.2 Coordination with Other Work

The contractor shall coordinate with work being performed in adjacent areas. Coordination procedures shall be explained in the Plan and shall describe how the Contractor will prevent lead exposure to other contractors and/or Government personnel performing work unrelated to lead activities.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Occupational and Environmental Assessment Data Report (if objective data is used to justify excluding the initial occupational exposure assessment)

Lead Compliance Plan including CP approval (signature, date, and certification number)

Competent Person qualifications

Training Certification of workers and supervisors

lead waste management plan

if used, written evidence that TSD is approved for lead disposal

Certification of Medical Examinations

SD-06 Test Reports

sampling results

Occupational and Environmental Assessment Data Report

SD-07 Certificates

Testing laboratory qualifications

SD-11 Closeout Submittals

Completed and signed hazardous waste manifest from treatment or disposal facility; G

Waste turn-in documents or weight tickets for non-hazardous wastes that are disposed of at sanitary or construction and demolition landfills

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

1.5.1.1 Competent Person (CP)

Submit name, address, and telephone number of the CP selected to perform responsibilities specified in paragraph entitled "Competent Person (CP) Responsibilities." Provide documented construction project-related experience with implementation of OSHA's Lead in Construction standard (29 CFR 1926.62) which shows ability to assess occupational and environmental exposure to lead, experience with the use of respirators, personal protective equipment and other exposure reduction methods to protect employee health. Submit proper documentation that the CP is trained and certified in accordance with federal, State and local laws. The competent person shall be a licensed lead-based paint abatement Supervisor in the State of California.

1.5.1.2 Training Certification

Submit a certificate for each worker and supervisor, signed and dated by the accredited training provider, stating that the employee has received the required lead training specified in 29 CFR 1926.62(l) and is certified to perform or supervise deleading, lead removal or demolition activities in the state of California.

1.5.1.3 Third Party Consultant Qualifications

Submit the name, address and telephone number of any third party consultant selected to perform the wipe sampling for determining concentrations of lead in dust. Submit proper documentation that the consultant is trained and certified as an inspector technician or inspector/risk assessor by the USEPA authorized State (or local) certification and accreditation program.

1.5.2 Requirements

1.5.2.1 Competent Person (CP) Responsibilities

a. Verify training meets all federal, State, and local requirements.

b. Review and approve Lead Compliance Plan for conformance to the applicable referenced standards.

c. Continuously inspect PWL or MCL work for conformance with the approved plan.

d. Perform (or oversee performance of) air sampling. Recommend upgrades or downgrades (whichever is appropriate based on exposure) on the use of PPE (respirators included) and engineering controls.

e. Ensure work is performed in strict accordance with specifications at all times.

f. Control work to prevent hazardous exposure to human beings and to the environment at all times.

g. Supervise final cleaning of the lead control area, take clearance wipe samples if necessary; review clearance sample results and make recommendations for further cleaning.

h. Certify the conditions of the work as called for elsewhere in this specification.

1.5.2.2 Lead Compliance Plan

Submit a detailed job-specific plan of the work procedures to be used in the disturbance of PWL or MCL. The plan shall include a sketch showing the location, size, and details of lead control areas, critical barriers, physical boundaries, location and details of decontamination facilities, viewing ports, and mechanical ventilation system. Include a description of equipment and materials, work practices, controls and job responsibilities for each activity from which lead is emitted. Include in the plan, eating, drinking, smoking, hygiene facilities and sanitary procedures, interface of trades, sequencing of lead related work, collected waste water and dust containing lead and debris, air sampling, respirators, personal protective equipment, and a detailed description of the method of containment of the operation to ensure that lead is not released outside of the lead control area. Include site preparation, cleanup and clearance procedures, if needed. Include occupational and environmental sampling, training and strategy, sampling and analysis strategy and methodology, frequency of sampling, duration of sampling, and qualifications of sampling personnel in the air sampling portion of the plan. Include a description of arrangements made among contractors on multicontractor worksites to inform affected employees and to clarify responsibilities to control exposures.

In occupied buildings, the plan shall also include an occupant protection program that describes the measures that will be taken during the work to notify and protect the building occupants.

1.5.2.3 Occupational and Environmental Assessment Data Report

If initial monitoring is necessary, submit occupational and environmental sampling results to the COR within three working days of collection, signed by the testing laboratory employee performing the analysis, the employee that performed the sampling, and the CP.

In order to reduce the full implementation of 29 CFR 1926.62, the Contractor shall provide documentation. Submit a report that supports the determination to reduce full implementation of the requirements of 29 CFR 1926.62 and supporting the Lead Compliance Plan.

a. The initial monitoring shall represent each job classification, or if working conditions are similar to previous jobs by the same employer, provide previously collected exposure data that can be used to estimate worker exposures per 29 CFR 1926.62. The data shall represent the worker's regular daily exposure to lead for stated work.

b. Submit worker exposure data gathered during the task based trigger operations of 29 CFR 1926.62 with a complete process description. This includes manual demolition, manual scraping, manual sanding, heat gun, power tool cleaning, rivet busting, cleanup of dry expendable abrasives, abrasive blast enclosure removal, abrasive blasting, welding, cutting and torch burning where lead containing coatings are present.

c. The initial assessment shall determine the requirement for further monitoring and the need to fully implement the control and protective requirements including the lead compliance plan per 29 CFR 1926.62.

1.5.2.4 Medical Examinations

Initial medical surveillance as required by 29 CFR 1926.62 shall be made available to all employees exposed to lead at any time (1 day) above the action level. Full medical surveillance shall be made available to all employees on an annual basis who are or may be exposed to lead in excess of the action level for more than 30 days a year or as required by 29 CFR 1926.62. Adequate records shall show that employees meet the medical surveillance requirements of 29 CFR 1926.33, 29 CFR 1926.62 and 29 CFR 1926.103. Provide medical surveillance to all personnel exposed to lead as indicated in 29 CFR 1926.62. Maintain complete and accurate medical records of employees for the duration of employment plus 30 years.

1.5.2.5 Training

Train each employee performing work that disturbs lead, who performs MCL/PWL disposal, and air sampling operations prior to the time of initial job assignment and annually thereafter, in accordance with 29 CFR 1926.21, 29 CFR 1926.62, and State and local regulations where appropriate.

1.5.2.6 Respiratory Protection Program

a. Provide each employee required to wear a respirator a respirator fit test at the time of initial fitting and at least annually thereafter as required by 29 CFR 1926.62.

b. Establish and implement a respiratory protection program as required by AIHA Z88.6, 29 CFR 1926.103, 29 CFR 1926.62, and 29 CFR 1926.55.

1.5.2.7 Hazard Communication Program

Establish and implement a Hazard Communication Program as required by 29 CFR 1926.59.

1.5.2.8 Lead Waste Management

The Lead Waste Management Plan shall comply with applicable requirements of federal, State, and local hazardous waste regulations. and address:

a. Identification and classification of wastes associated with the work.

b. Estimated quantities of wastes to be generated and disposed of.

c. Names and qualifications of each contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location and a 24-hour point of contact.

d. Names and qualifications (experience and training) of personnel who will be working on-site with hazardous wastes.

e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.

f. Spill prevention, containment, and cleanup contingency measures including a health and safety plan to be implemented in accordance with 29 CFR 1926.65.

g. Work plan and schedule for waste containment, removal and disposal.

Proper containment of the waste includes using acceptable waste containers (e.g., 55-gallon drums) as well as proper marking/labeling of the containers. Wastes shall be cleaned up and containerized daily.

h. Include any process that may alter or treat waste rendering a hazardous waste non hazardous.

i. Unit cost for hazardous waste disposal according to this plan.

1.5.2.9 Environmental, Safety and Health Compliance

In addition to the detailed requirements of this specification, comply with laws, ordinances, rules, and regulations of federal, State, and local authorities regarding lead. Comply with the applicable requirements of the current issue of 29 CFR 1926.62. Submit matters regarding interpretation of standards to the COR for resolution before starting work. Where specification requirements and the referenced documents vary, the most stringent requirement shall apply. The following local and State laws, ordinances, criteria, rules and regulations regarding removing, handling, storing, transporting, and disposing of lead-contaminated materials apply:

Licensing in the state of California is required.

1.5.3 Pre-Construction Conference

Along with the CP, meet with the COR to discuss in detail the Lead Waste Management Plan and the Lead Compliance Plan, including procedures and precautions for the work.

1.6 EQUIPMENT

1.6.1 Respirators

Furnish appropriate respirators approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services, for use in atmospheres containing lead dust, fume and mist. Respirators shall comply with the requirements of 29 CFR 1926.62.

1.6.2 Special Protective Clothing

Furnish personnel who will be exposed to lead-contaminated dust with proper disposable protective whole body clothing, head covering, gloves, eye, and foot coverings as required by 29 CFR 1926.62. Furnish proper disposable plastic or rubber gloves to protect hands. Reduce the level of protection only after obtaining approval from the CP.

1.6.3 Rental Equipment Notification

If rental equipment is to be used during PWL or MCL handling and disposal, notify the rental agency in writing concerning the intended use of the equipment.

1.6.4 Vacuum Filters

UL 586 labeled HEPA filters.

1.6.5 Equipment for Government Personnel

Furnish the COR with two complete sets of personal protective equipment

(PPE) daily, as required herein, for entry into and inspection of the lead removal work within the lead controlled area. Personal protective equipment shall include disposable whole body covering, including appropriate foot, head, eye, and hand protection. PPE shall remain the property of the Contractor. The Government will provide respiratory protection for the COR.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Protection of Existing Work to Remain

Perform work without damage or contamination of adjacent areas. Where existing work is damaged or contaminated, restore work to its original condition or better as determined by the COR.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Protection

3.1.1.1 Notification

a. Notify the COR 5 days prior to the start of any lead work.

3.1.1.2 Lead Control Area

a. Physical Boundary - Provide physical boundaries around the lead control area by roping off the area designated in the work plan or providing curtains, portable partitions or other enclosures to ensure that lead will not escape outside of the lead control area.

b. Warning Signs - Provide warning signs at approaches to lead control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area. Signs shall comply with the requirements of 29 CFR 1926.62.

3.1.1.3 Furnishings

The Government will remove furniture and equipment from the building before lead work begins.

3.1.1.4 Heating, Ventilating and Air Conditioning (HVAC) Systems

Shut down, lock out, and isolate HVAC systems that supply, exhaust, or pass through the lead control areas. Seal intake and exhaust vents in the lead control area with 6 mil plastic sheet and tape. Seal seams in HVAC components that pass through the lead control area. Provide temporary HVAC system for areas in which HVAC has been shut down outside the lead control area.

3.1.1.5 Decontamination Shower Facility

Provide clean and contaminated change rooms and shower facilities in accordance with this specification and 29 CFR 1926.62.

3.1.1.6 Eye Wash Station

Where eyes may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes shall be provided within the work area.

3.1.1.7 Mechanical Ventilation System

a. To the extent feasible, use local exhaust ventilation or other collection systems, approved by the CP. Local exhaust ventilation systems shall be evaluated and maintained in accordance with 29 CFR 1926.62.

b. Vent local exhaust outside the building and away from building ventilation intakes or ensure system is connected to HEPA filters.

c. Use locally exhausted, power actuated tools or manual hand tools.

3.1.1.8 Personnel Protection

Personnel shall wear and use protective clothing and equipment as specified herein. Eating, smoking, or drinking or application of cosmetics is not permitted in the lead control area. No one will be permitted in the lead control area unless they have been appropriately trained and provided with protective equipment.

3.2 ERECTION

3.2.1 Lead Control Area Requirements

Establish a lead control area by completely establishing barriers and physical boundaries around the area or structure where PWL or MCL removal operations will be performed.

3.3 APPLICATION

3.3.1 Lead Work

Perform lead work in accordance with approved Lead Compliance Plan. Use procedures and equipment required to limit occupational exposure and environmental contamination with lead when the work is performed in accordance with 29 CFR 1926.62, and as specified herein. Dispose of all PWL or MCL and associated waste in compliance with federal, State, and local requirements.

3.3.2 Paint with Lead or Material Containing Lead Removal

Manual or power sanding or grinding of lead surfaces or materials is not permitted unless tools are equipped with HEPA attachments or wet methods. The dry sanding or grinding of surfaces that contain lead is prohibited. Provide methodology for removing lead in the Lead Compliance Plan. Select lead removal processes to minimize contamination of work areas outside the control area with lead-contaminated dust or other lead-contaminated debris or waste and to ensure that unprotected personnel are not exposed to hazardous concentrations of lead. Describe this removal process in the Lead Compliance Plan.

3.3.2.1 Paint with Lead or Material Containing Lead - Indoor Removal

Perform manual removal and thermal cutting in the lead control areas using enclosures, barriers or containments and powered locally exhausted tools. Collect residue debris for disposal in accordance with federal, State, and local requirements.

3.3.2.2 Paint with Lead or Material Containing Lead - Outdoor Removal

Perform outdoor removal as indicated in federal, State, and local regulations and in the Lead Compliance Plan. The worksite preparation (barriers or containments) shall be job dependent and presented in the Lead Compliance Plan.

3.3.3 Personnel Exiting Procedures

Whenever personnel exit the lead-controlled area, they shall perform the following procedures and shall not leave the work place wearing any clothing or equipment worn in the control area:

a. Vacuum all clothing before entering the contaminated change room.

b. Remove protective clothing in the contaminated change room, and place them in an approved impermeable disposal bag.

c. Shower.

c. Wash hands and face at the site, don appropriate disposable or uncontaminated reusable clothing, move to an appropriate shower facility, shower.

d. Change to clean clothes prior to leaving the clean clothes storage area.

3.4 FIELD QUALITY CONTROL

3.4.1 Tests

3.4.1.1 Air and Wipe Sampling

Conduct sampling for lead in accordance with 29 CFR 1926.62 and as specified herein. Air and wipe sampling shall be directed or performed by the CP.

a. The CP shall be on the job site directing the air and wipe sampling and inspecting the PWL or MCL removal work to ensure that the requirements of the contract have been satisfied during the entire PWL or MCL operation.

b. Collect personal air samples on employees who are anticipated to have the greatest risk of exposure as determined by the CP. In addition, collect air samples on at least twenty-five percent of the work crew or a minimum of two employees, whichever is greater, during each work shift.

c. Submit results of air samples, signed by the CP, within 72 hours after the air samples are taken.

d. Conduct area air sampling daily, on each shift in which lead-based paint removal operations are performed, in areas immediately adjacent to the

lead control area. Sufficient area monitoring shall be conducted to ensure unprotected personnel are not exposed at or above 30 micrograms per cubic meter of air. If 30 micrograms per cubic meter of air is reached or exceeded, stop work, correct the conditions(s) causing the increased levels. Notify the COR immediately. Determine if condition(s) require any further change in work methods. Removal work shall resume only after the CP and the COR give approval.

3.5 CLEANING AND DISPOSAL

3.5.1 Cleanup

Maintain surfaces of the lead control area free of accumulations of dust and debris. Restrict the spread of dust and debris; keep waste from being distributed over the work area. Do not dry sweep or use pressurized air to clean up the area. At the end of each shift and when the lead operation has been completed, clean the controlled area of visible contamination by vacuuming with a HEPA filtered vacuum cleaner, wet mopping the area and wet wiping the area as indicated by the Lead Compliance Plan. Reclean areas showing dust or debris. After visible dust and debris is removed, wet wipe and HEPA vacuum all surfaces in the controlled area. If adjacent areas become contaminated at any time during the work, clean, visually inspect, and then wipe sample all contaminated areas. The CP shall then certify in writing that the area has been cleaned of lead contamination before clearance testing.

3.5.1.1 Clearance Certification

NASA's on-site Health and Safety lead professional will perform a visual inspection of all lead work. Lead based paint work tht is removed to elevate a lead hazard may need lead wipe samples to determine if the area is clean. This deterrant will be on a project by project basis.

3.5.2 Disposal

a. All material, whether hazardous or non-hazardous shall be disposed in accordance with all laws and provisions and all federal, State or local regulations. Ensure all waste is properly characterized. The result of each waste characterization (TCLP for RCRA materials) will dictate disposal requirements.

b. Contractor is responsible for segregation of waste. Collect lead-contaminated waste, scrap, debris, bags, containers, equipment, and lead-contaminated clothing that may produce airborne concentrations of lead particles. Label the containers in accordance with 29 CFR 1926.62 and 40 CFR 261.

c. Dispose of lead-contaminated material classified as hazardous waste at an EPA approved hazardous waste treatment, storage, or disposal facility off Government property.

d. Store waste materials in U.S. Department of Transportation (49 CFR 178) approved 55 gallon drums. Properly label each drum to identify the type of waste (49 CFR 172) and the date the drum was filled. For hazardous waste, the collection drum requires marking/labeling in accordance with 40 CFR 262 during the accumulation/collection timeframe. The COR or an authorized representative will assign an area for interim storage of waste-containing drums. Do not store hazardous waste drums in interim storage longer than 90 calendar days from the date affixed to each drum.

e. Handle, store, transport, and dispose lead or lead-contaminated waste in accordance with 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 264, and 40 CFR 265. Comply with land disposal restriction notification requirements as required by 40 CFR 268.

3.5.2.1 Disposal Documentation

Submit written evidence to demonstrate the hazardous waste treatment, storage, or disposal facility (TSD) is approved for lead disposal by the EPA, State or local regulatory agencies. Submit one copy of the completed hazardous waste manifest, signed and dated by the initial transporter in accordance with 40 CFR 262. Contractor shall provide a certificate that the waste was accepted by the disposal facility.

3.5.2.2 Payment for Hazardous Waste

Payment for disposal of hazardous and non-hazardous waste will not be made until a signed copy of the manifest from the treatment or disposal facility certifying the amount of lead-containing materials or non-hazardous waste delivered is returned and a copy is furnished to the Government.

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SECTION 02 84 16

HANDLING OF LIGHTING BALLASTS CONTAINING PCBs AND LAMPS CONTAINING MERCURY

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for requirements for removal and disposal of polychlorinated biphenyl (PCB) containing lighting ballasts and mercury containing lamps, and the handling of resulting wastes.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants
40 CFR 260	Hazardous Waste Management System: General
40 CFR 261	Identification and Listing of Hazardous Waste
40 CFR 262	Standards Applicable to Generators of Hazardous Waste
40 CFR 263	Standards Applicable to Transporters of Hazardous Waste
40 CFR 264	Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 265	Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities
40 CFR 268	Land Disposal Restrictions
40 CFR 270	EPA Administered Permit Programs: The Hazardous Waste Permit Program
40 CFR 273	Standards For Universal Waste Management
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in

Commerce, and Use Prohibitions

49 CFR 178 Specifications for Packagings

1.3 REQUIREMENTS

Removal and disposal of PCB-containing lighting ballasts and associated mercury-containing lamps. Contractor may encounter leaking PCB ballasts.

1.4 DEFINITIONS

1.4.1 Certified Industrial Hygienist (CIH)

An industrial hygienist hired by the contractor shall be certified by the American Board of Industrial Hygiene.

1.4.2 Leak

Leak or leaking means any instance in which a PCB article, PCB container, or PCB equipment has any PCBs on any portion of its external surface.

1.4.3 Lamps

Lamp, also referred to as "universal waste lamp", is defined as the bulb or tube portion of an electric lighting device. A lamp is specifically designed to produce radiant energy, most often in the ultraviolet, visible, and infra-red regions of the electromagnetic spectrum. Examples of common universal waste electric lamps include, but are not limited to, fluorescent, high intensity discharge, neon, mercury vapor, high pressure sodium, and metal halide lamps.

1.4.4 Polychlorinated Biphenyls (PCBs)

PCBs as used in this specification shall mean the same as PCBs, PCB-containing lighting ballast, and PCB container, as defined in 40 CFR 761, Section 3, Definitions.

1.4.5 Spill

Spill means both intentional and unintentional spills, leaks, and other uncontrolled discharges when the release results in any quantity of PCBs running off or about to run off the external surface of the equipment or other PCB source, as well as the contamination resulting from those releases.

1.4.6 Universal Waste

Universal Waste means any of the following hazardous wastes that are managed under the universal waste requirements 40 CFR 273:

a. Batteries as described in Sec. 273.2 of this chapter;

b. Pesticides as described in Sec. 273.3 of this chapter;

c. Thermostats as described in Sec. 273.4 of this chapter; and

d. Lamps as described in Sec. 273.5 of this chapter.

1.5 QUALITY ASSURANCE

1.5.1 Regulatory Requirements

Perform PCB related work in accordance with 40 CFR 761. Perform mercury-containing lamps storage and transport in accordance with 40 CFR 261, 40 CFR 264, 40 CFR 265 and 40 CFR 273.

1.5.2 Training

Certified industrial hygienist (CIH) shall instruct and certify the training of all persons involved in the removal of PCB-containing lighting ballasts and mercury-containing lamps. The instruction shall include: The dangers of PCB and mercury exposure, decontamination, safe work practices, and applicable OSHA and EPA regulations. The CIH shall review and approve the PCB-containing lighting ballasts and Mercury-Containing Lamp Removal Work Plans.

1.5.3 Regulation Documents

Maintain at all times one copy each at the office and one copy each in view at the job site of 29 CFR 1910.1000, 40 CFR 260, 40 CFR 261, 40 CFR 262, 40 CFR 263, 40 CFR 265, 40 CFR 268, 40 CFR 270, 40 CFR 273 and of the Contractor removal work plan and disposal plan for PCB and for associated mercury-containing lamps.

1.6 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Qualifications of CIH

Training Certification

PCB and Lamp Removal Work Plan

PCB and Lamp Disposal Plan

SD-11 Closeout Submittals

Transporter certification of notification to EPA of their PCB waste activities and EPA ID numbers

Certification of Decontamination

Certificate of Disposal and/or recycling. Submit to the Government before application for payment within 30 days of the date that the disposal of the PCB-containing ballasts lighting and mercury-containing lamp waste identified on the manifest was completed.

1.7 ENVIRONMENTAL REQUIREMENTS

Use special clothing:

a. Disposable gloves (polyethylene)

b. Eye protection

c. PPE as required by CIH

1.8 SCHEDULING

Notify the COR 20 days prior to the start of PCB-containing ballasts lighting and mercury-containing lamp removal work.

1.9 QUALITY ASSURANCE

1.9.1 Qualifications of CIH

Submit the name, address, and telephone number of the Industrial Hygienist selected to perform the duties in paragraph entitled "Certified Industrial Hygienist." Submit training certification that the Industrial Hygienist is certified, including certification number and date of certification or re certification.

1.9.2 PCB and Lamp Removal Work Plan

Submit a job-specific plan within 20 calendar days after award of contract of the work procedures to be used in the removal, packaging, and storage of PCB-containing lighting ballasts and associated mercury-containing lamps. Include in the plan: Requirements for Personal Protective Equipment (PPE), spill cleanup procedures and equipment, eating, smoking and restroom procedures. The plan shall be approved and signed by the Certified Industrial Hygienist. Obtain approval of the plan by the COR prior to the start of PCB and/or lamp removal work.

1.9.3 PCB and Lamp Disposal Plan

Submit a PCB and lamp Disposal Plan with 45 calendar days after award of contract. The PCB and Lamp Disposal Plan shall comply with applicable requirements of Federal, State, and local PCB and Universal waste regulations and address:

a. Estimated quantities of wastes to be generated, disposed of, and recycled.

b. Names and qualifications of each Contractor that will be transporting, storing, treating, and disposing of the wastes. Include the facility location. Furnish two copies of EPA and state PCB and mercury-containing lamp waste permit applications and EPA identification numbers, as required.

c. Names and qualifications (experience and training) of personnel who will be working on-site with PCB-containing ballasts lighting and mercury-containing lamp wastes.

d. Spill prevention, containment, and cleanup contingency measures to be implemented.

e. Work plan and schedule for PCB-containing ballasts lighting and mercury-containing lamp waste removal, containment, storage, transportation, disposal and or recycling. Wastes shall be cleaned up and containerized daily.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 WORK PROCEDURE

Furnish labor, materials, services, and equipment necessary for the removal of PCB-containing lighting ballasts, associated mercury-containing fluorescent lamps, and high intensity discharge (HID) lamps in accordance with local, State, or Federal regulations. Do not expose PCBs to open flames or other high temperature sources since toxic decomposition by-products may be produced. Do not break mercury-containing fluorescent lamps or high intensity discharge lamps.

3.1.1 Work Operations

Ensure that work operations or processes involving PCB or PCB-contaminated materials are conducted in accordance with 40 CFR 761, 40 CFR 262 40 CFR 263, and the applicable requirements of this section, including but not limited to:

a. Obtaining suitable PCB-containing ballasts lighting and mercury-containing lamp storage sites.

b. Notifying COR prior to commencing the operation.

c. Reporting leaks and spills to the COR.

d. Cleaning up spills.

e. Inspecting PCB and PCB-contaminated items and waste containers for leaks and forwarding copies of inspection reports to the COR.

f. Maintaining inspection, inventory and spill records.

3.2 PCB SPILL CLEANUP REQUIREMENTS

3.2.1 PCB Spills

Immediately report to the COR any PCB spills.

3.2.2 PCB Spill Control Area

Rope off an area around the edges of a PCB leak or spill and post a "PCB Spill Authorized Personnel Only" caution sign. Immediately transfer leaking items to a drip pan or other container.

3.2.3 PCB Spill Cleanup

40 CFR 761, subpart G. Initiate cleanup of spills as soon as possible, but no later than 24 hours of its discovery. Mop up the liquid with rags or other conventional absorbent. The spent rags or absorbent shall be properly contained and disposed of as solid PCB waste.

3.2.4 Records and Certification

Document the cleanup with records of decontamination in accordance with

40 CFR 761, Section 125, Requirements for PCB Spill Cleanup. Provide test results of cleanup and certification of decontamination.

3.3 REMOVAL

3.3.1 Ballasts

As ballasts are removed from the lighting fixture, inspect label on ballast. Ballasts without a "No PCB" label shall be assumed to contain PCBs and shall be containerized and disposed of as required under paragraphs STORAGE FOR DISPOSAL and DISPOSAL.

3.3.2 Lighting Lamps

Remove lighting tubes/lamps from the lighting fixture and carefully place intact light tubes into appropriate containers (original transport boxes or equivalent). In the event of a lighting tube/lamp breaking, sweep and place waste in double plastic taped bags and dispose of as universal waste as specified herein.

3.4 STORAGE FOR DISPOSAL

3.4.1 Storage Containers for PCBs

49 CFR 178. Store PCB in containers approved by DOT for PCB.

3.4.2 Storage Containers for lamps

Store mercury-containing lamps in appropriate DOT containers. The boxes shall be stored and labeled for transport in accordance with 40 CFR 273.

3.4.3 Labeling of Waste Containers

Label with the following:

a. Date the item was placed in storage and the name of the cognizant activity/building.

b. "Caution Contains PCB," conforming to 40 CFR 761, CFR Subpart C. Affix labels to PCB waste containers.

c. Label mercury-containing lamp waste in accordance with 40 CFR 273. Affix labels to all lighting waste containers.

3.5 DISPOSAL

Dispose of off Government property in accordance with EPA, DOT, and local regulations at a permitted site.

3.5.1 Identification Number

Federal regulations 40 CFR 761, and 40 CFR 263 require that generators, transporters, commercial storers, and disposers of PCB waste possess U.S. EPA identification numbers. The contractor shall verify that the activity has a U.S. EPA generator identification number for use on the Uniform Hazardous Waste manifest. If not, the contractor shall advise the activity that it must file and obtain an I.D. number with EPA prior to commencement of removal work. For mercury-containing lamp removal, Federal regulations 40 CFR 273 require that large quantity handlers of Universal waste (LQHUW)

must provide notification of universal waste management to the appropriate EPA Region (or state director in authorized states), obtain an EPA identification number, and retain for three years records of off-site shipments of universal waste. The contractor shall verify that the activity has a U.S. EPA generator identification number for use on the Universal Waste manifest. If not, the contractor shall advise the activity that it must file and obtain an I.D. number with EPA prior to commencement of removal work.

3.5.2 Transporter Certification

Comply with disposal and transportation requirements outlined in 40 CFR 761 and 40 CFR 263. Before transporting the PCB waste, sign and date the manifest (as Transporter) acknowledging acceptance of the PCB waste from the Government. Return a signed copy (Generator's initial copy) to the Government before leaving the job site. Ensure that the manifest accompanies the PCB waste at all times. Submit transporter certification of notification to EPA of their PCB waste activities (EPA Form 7710-53).

3.5.2.1 Certificate of Disposal and/or Recycling

40 CFR 761. Certificate for the PCBs and PCB items disposed shall include:

a. The identity of the disposal and or recycling facility, by name, address, and EPA identification number.

b. The identity of the PCB waste affected by the Certificate of Disposal including reference to the manifest number for the shipment.

c. A statement certifying the fact of disposal and or recycling of the identified PCB waste, including the date(s) of disposal, and identifying the disposal process used.

d. A certification as defined in 40 CFR 761.

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SECTION 02 84 33

REMOVAL AND DISPOSAL OF POLYCHLORINATED BIPHENYLS (PCBs)

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for requirements for removal and disposal of polychlorinated biphenyl (PCB) containing lighting ballasts and mercury containing lamps, and the handling of resulting wastes.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants
29 CFR 1910.145	Accident Prevention Signs and Tags
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions
49 CFR 171	General Information, Regulations, and Definitions
49 CFR 172	Hazardous Materials Table, Special Provisions, Hazardous Materials Communications, Emergency Response Information, and Training Requirements
49 CFR 173	Shippers - General Requirements for Shipments and Packagings
49 CFR 174	Carriage by Rail
49 CFR 175	Carriage by Aircraft
49 CFR 176	Carriage by Vessel
49 CFR 177	Carriage by Public Highway
49 CFR 178	Specifications for Packagings
49 CFR 179	Specifications for Tank Cars

1.3 REQUIREMENTS

The work includes the removal and disposal of PCBs. Perform work in accordance with 40 CFR 761 and the requirements specified herein.

1.4 DEFINITIONS

1.4.1 Leak

Leak or leaking means any instance in which a PCB Article, PCB Container, or PCB Equipment has any PCBs on any portion of its external surface.

1.4.2 PCBs

PCBs as used in this specification shall mean the same as PCBs, PCB Article, PCB Article Container, PCB Container, PCB Equipment, PCB Item, PCB Transformer, PCB-Contaminated Electrical Equipment, as defined in 40 CFR 761, Section 3, Definitions.

1.4.3 Spill

Spill means both intentional and unintentional spills, leaks, and other uncontrolled discharges when the release results in any quantity of PCBs running off or about to run off the external surface of the equipment or other PCB source, as well as the contamination resulting from those releases.

1.5 QUALITY ASSURANCE

1.5.1 Training

Instruct employees on the dangers of PCB exposure, on respirator use, decontamination, and applicable OSHA and EPA regulations.

1.5.2 Certified Industrial Hygienist (CIH)

Obtain the services of an industrial hygienist certified by the American Board of Industrial Hygiene to certify training, and review and approve the PCB removal plan, including determination of the need for personnel protective equipment (PPE) in performing PCB removal work.

1.5.3 Regulation Documents

Maintain at all times one copy each at the office and one copy each in view at the job site 29 CFR 1910.1000, 40 CFR 761, and Contractor work practices for removal, storage and disposal of PCBs.

1.5.4 Surveillance Personnel

Surveillance personnel may enter PCB control areas for brief periods of time provided they wear disposable polyethylene gloves and disposable polyethylene foot covers, as a minimum. Additional protective equipment may be required if respiratory hazard is involved or if skin contact with PCB is involved.

1.6 SUBMITTALS

Government approval is required for submittals. Submit the following in

accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-07 Certificates

Training certification

Qualifications of CIH

PCB removal work plan

PCB disposal plan

Notification

Transporter certification of notification to EPA of their PCB waste activities and EPA ID numbers

Certification of Decontamination for PCB Spill
Post cleanup sampling data

Certificate of disposal

1.7 EQUIPMENT

1.7.1 Special Clothing

Work clothes shall consist of PPE as required by OSHA regulations, including, but not limited to the following:

a. Disposable coveralls

b. Gloves (Disposable rubber gloves may be worn under these)

c. Disposable foot covers (polyethylene)

d. Chemical safety goggles

e. Half mask cartridge respirator.

1.7.2 Special Clothing for Government Personnel

Provide PPE specified in paragraph entitled "Special Clothing" to the COR as required for inspection of the work.

1.7.3 PCB Spill Kit

Assemble a spill kit to include the following items:

ITEM	MINIMUM QUANTITY
1. Disposable gloves (polyethylene)	6 prs
2. Gloves with a high degree of impermeability to PCB	6 prs
3. Disposable coveralls with permeation resistance to PCB	4 ea
4. Chemical safety goggles	2 ea
5. Disposable foot covers (polyethylene)	6 prs
6. PCB Caution Sign: "PCB Spill--Authorized	

ITEM	MINIMUM QUANTITY
Personnel Only"	2 ea
7. Banner guard or equivalent banner material	100 feet
8. Absorbent material	5 bags)
9. Blue polyethylene waste bags	5 ea
10. Cloth backed tape	1 roll
11. Area access logs, blank	10 ea
12. Brattice cloth, 6' x 6'	1 piece
13. Rags	20 ea
14. Ball point pens	2 ea
15. Herculite, 4' x 4' and 8' x 8'	2 ea
16. Blank metal signs and grease pencils	
17. Waste containers 55 gallon	2 ea
drum, (may be used as container for kit)	1 ea

1.8 QUALITY ASSURANCE

1.8.1 Training Certification

Submit certificates, prior to the start of work but after the main abatement submittals, signed and dated by the CIH and by each employee stating that the employee has received training. Certificates shall be organized by individual worker, not grouped by type of certificates.

1.8.2 Qualifications of CIH

Submit the name, address, and telephone number of the Industrial Hygienist selected to perform the duties in paragraph entitled "Certified Industrial Hygienist." Submit proper documentation that the Industrial Hygienist is certified, including certification number and date of certification/recertification.

1.8.3 PCB Removal Work Plan

Submit a detailed job-specific plan of the work procedures to be used in the removal of PCB-containing materials, not to be combined with other hazardous abatement plans. Provide a Table of Contents for each abatement submittal which shall follow the sequence of requirements in the contract. The plan shall include a sketch showing the location, size, and details of PCB control areas, location and details of decontamination rooms, change rooms, shower facilities, and mechanical ventilation system. Include in the plan, eating, drinking, smoking and restroom procedures, interface of trades, sequencing of PCB related work, PCB disposal plan, respirators, protective equipment, and a detailed description of the method of containment of the operation to ensure that PCB contamination is not spread or carried outside of the control area. Obtain approval of the plan prior to the start of PCB removal work.

1.8.4 PCB Disposal Plan

Submit a PCB Disposal Plan within 30 working days after award of contract for COR's approval. The PCB Disposal Plan shall comply with applicable requirements of Federal, State, and local PCB waste regulations and address:

a. Identification of PCB wastes associated with the work.

b. Estimated quantities of wastes to be generated and disposed of.

c. Names and qualifications of each contractor that will be transporting and disposing of the wastes. Include the facility location and a 24-hour point of contact.

d. Names and qualifications (experience and training) of personnel who will be working on-site with PCB wastes.

e. List of waste handling equipment to be used in performing the work, to include cleaning, volume reduction, and transport equipment.

f. Spill prevention, containment, and cleanup contingency measures to be implemented.

g. Work plan and schedule for PCB waste containment, removal and disposal. Wastes shall be cleaned up and containerized daily.

1.8.5 Notification

Notify the COR 20 days prior to the start of PCB removal work.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Decontamination Room, Clean Room and Shower Facilities

a. Provide material and labor for construction of a decontamination room, a clean room, and shower facilities. Provide rooms with doors and attach to the exit ways of PCB work areas. Rooms shall be of sufficient size to accommodate the Contractor's operation within. Provide portable toilet and shower facilities. Locate shower facilities between the clean room and decontamination room. Provide separate clothing lockers or containers in each room to prevent contamination of street and work clothes.

b. Remove PCB-contaminated PPE in the decontamination room. Workers shall then proceed to showers. Workers shall shower before lunch and at the end of each day's work. Hot water, towels, soap, and hygienic conditions are the responsibility of the Contractor.

3.1.2 PCB Control Area

Isolate PCB control area by physical boundaries to prevent unauthorized entry of personnel. Food, drink and smoking materials shall not be permitted in areas where PCBs are handled or PCB items are stored.

3.1.3 Personnel Protection

Workers shall wear and use PPE, as recommended by the Industrial Hygienist, upon entering a PCB control area. If PPE is not required per the CIH, specify in the PCB removal work plan.

3.1.4 Footwear

Work footwear shall remain inside work area until completion of the job.

3.1.5 Permissible Exposure Limits (PEL)

PEL for PCBs is 3.1 E-08 lb/cubic foot on an 8-hour time weighted average basis.

3.1.6 Special Hazards

a. PCBs shall not be exposed to open flames or other high temperature sources since toxic decomposition by-products may be produced.

b. PCBs shall not be heated to temperatures of 135 degrees F or higher without COR's concurrence.

3.1.7 PCB Caution Label

40 CFR 761, Subpart C. Affix labels to PCB waste containers and other PCB-contaminated items. Provide label with sufficient print size to be clearly legible, with bold print on a contrasting background, displaying the following: CAUTION: Contains PCBs (Polychlorinated Biphenyls).

3.1.8 PCB Caution Sign

29 CFR 1910.145. Provide signs at approaches to PCB control areas. Locate signs at such a distance that personnel may read the sign and take the necessary precautions before entering the area.

3.2 WORK PROCEDURE

Furnish labor, materials, services, and equipment necessary for the complete removal of PCBs located at the site as indicated or specified in accordance with local, State, or Federal regulations. Package and mark PCB as required by EPA and DOT regulations and dispose of off Government property in accordance with EPA, DOT, and local regulations at a permitted site.

3.2.1 No Smoking

Smoking is not permitted within 50 feet of the PCB control area. Provide "No Smoking" signs as directed by the COR.

3.2.2 Work Operations

Ensure that work operations or processes involving PCB or PCB-contaminated materials are conducted in accordance with 40 CFR 761 and the applicable requirements of this section, including but not limited to:

a. Obtaining advance approval of PCB storage sites.

b. Notifying COR prior to commencing the operation.

c. Reporting leaks and spills to the COR.

d. Cleaning up spills.

e. Maintaining an access log of employees working in a PCB control area

and providing a copy to the COR upon completion of the operation.

f. Inspecting PCB and PCB-contaminated items and waste containers for leaks and forwarding copies of inspection reports to the COR.

g. Maintaining a spill kit as specified in paragraph entitled "PCB Spill Kit."

h. Maintaining inspection, inventory and spill records.

3.3 PCB TRANSFORMERS

3.3.1 Draining of Transformer Liquid

Perform work in accordance with 49 CFR 171, 49 CFR 172, 49 CFR 173, 49 CFR 174, 49 CFR 175, 49 CFR 176, 49 CFR 177, 49 CFR 178, and 49 CFR 179, Subchapter C and as specified herein. Drain the transformer, switches, and regulators of free flowing liquid prior to transportation. Place the drained liquids in DOT Spec 1A1 drums. The drums shall not contain more than 50 gallons of oil. If the equipment cannot be drained, then place it in DOT Spec 1A2 drums.

3.3.2 Markings

Provide drums and drained PCB-contaminated electrical equipment with caution label markings as specified in paragraph entitled "PCB Caution Label."

3.4 PCB REMOVAL

Select PCB removal procedure to minimize contamination of work areas with PCB or other PCB-contaminated debris/waste. Handle PCBs such that no skin contact occurs. PCB removal process should be described in the work plan.

3.4.1 Confined Spaces

As feasible, do not carry out PCB handling operations in confined spaces. A confined space shall mean a space having limited means of egress and inadequate cross ventilation.

3.4.2 Control Area

Establish a PCB control area around the PCB item as specified in paragraph entitled "PCB Control Area." Only personnel briefed on the elements in the paragraph entitled "Training" and on the handling precautions shall be allowed into the area.

3.4.3 Exhaust Ventilation

If used, exhaust ventilation for PCB operations shall discharge to the outside and away from personnel.

3.4.4 Temperatures

As feasible, handle PCBs at ambient temperatures and not at elevated temperatures.

3.4.5 Solvent Cleaning

Clean contaminated tools, containers, etc., after use by rinsing three times with an appropriate solvent or by wiping down three times with a solvent wetted rag. Suggested solvents are stoddard solvent or hexane.

3.4.6 Drip Pans

Drip pans are required under portable PCB transformers and rectifiers in use or stored for use. The pans shall have a containment volume of at least one and one-half times the internal volume of PCBs in the item.

3.4.7 Evacuation Procedures

Procedures shall be written for evacuation of injured workers. Aid for a seriously injured worker shall not be delayed for reasons of decontamination.

3.5 PCB SPILL CLEANUP REQUIREMENTS

3.5.1 PCB Spills

Immediately report to the COR any PCB spills on the ground or in the water, PCB spills in drip pans, or PCB leaks.

3.5.2 PCB Spill Control Area

Rope off an area around the edges of a PCB leak or spill and post a "PCB Spill Authorized Personnel Only" caution sign. Immediately transfer leaking items to a drip pan or other container.

3.5.3 PCB Spill Cleanup

40 CFR 761, Subpart G. Initiate cleanup of spills as soon as possible, but no later than 48 hours of its discovery. To clean up spills, personnel shall wear the PPE prescribed in paragraph entitled "Special Clothing" of this section. If misting, elevated temperatures or open flames are present, or if the spill is situated in a confined space, notify the COR. Mop up the liquid with rags or other conventional absorbent. The spent rags or absorbent shall be properly contained and disposed of as solid PCB waste.

3.5.4 Records and Certification

Document the cleanup with records of decontamination in accordance with 40 CFR 761, Section 125, Requirements for PCB Spill Cleanup. Provide certification of decontamination.

3.5.5 Sampling Requirements

Perform post cleanup sampling as required by 40 CFR 761, Section 130, Sampling Requirements. Do not remove boundaries of the PCB control area until site is determined satisfactorily clean by the COR.

3.6 STORAGE FOR DISPOSAL

3.6.1 Storage Containers for PCBs

49 CFR 178. Store liquid PCBs in Department of Transportation (DOT)

Specification 1A1 containers. Store nonliquid PCB mixtures, articles, or equipment in DOT Specification 1A2 containers with removable heads.

3.6.2 Waste Containers

Label with the following:

a. "Solid (or Liquid) Waste Polychlorinated Biphenyls"

b. The PCB Caution Label, paragraph 3.1.7 entitled "PCB Caution Label"

c. The date the item was placed in storage and the name of the cognizant activity/building.

3.6.3 PCB Articles and PCB-Contaminated Items

Label with items b. through c. above.

3.6.4 Approval of Storage Site

Obtain in advance COR approval using the following criteria without exception.

a. Adequate roof and walls to prevent rainwater from reaching the stored PCBs.

b. An adequate floor which has continuous curbing with a minimum 6 inch high curb. Such floor and curbing shall provide a containment volume equal to at least two times the internal volume of the largest PCB article or PCB container stored therein or 25 percent of the total internal volume of all PCB equipment or containers stored therein, whichever is greater.

c. No drain valves, floor drains, expansion joints, sewer lines, or other openings that would permit liquids to flow from the curbed area.

d. Floors and curbing constructed of continuous smooth and impervious materials such as portland cement, concrete or steel to prevent or minimize penetrations of PCBs.

e. Not located at a site which is below the 100-year flood water elevation.

f. Each storage site shall be posted with the PCB Caution Sign, paragraph 3.1.7 entitled "PCB Caution Sign."

3.7 CLEANUP

Maintain surfaces of the PCB control area free of accumulations of PCBs. Restrict the spread of dust and debris; keep waste from being distributed over work area.

Do not remove the PCB control area and warning signs prior to the COR's approval. Reclean areas showing residual PCBs.

3.8 DISPOSAL

Comply with disposal requirements and procedures outlined in 40 CFR 761. Do not accept PCB waste unless it is accompanied by a manifest signed by the Government. Before transporting the PCB waste, sign and date the

manifest as Transporter acknowledging acceptance of the PCB waste from the Government. Return a signed copy to the Government before leaving the job site. Ensure that the manifest accompanies the PCB waste at all times. Submit transporter certification of notification to EPA of their PCB waste activities.

3.8.1 Certificate of Disposal

40 CFR 761. Submit to the Government within 30 days of the date that the disposal of the PCB waste identified on the manifest was completed. Certificate for the PCBs and PCB items disposed shall include:

a. The identity of the disposal facility, by name, address, and EPA identification number.

b. The identity of the PCB waste affected by the Certificate of Disposal including reference to the manifest number for the shipment.

c. A statement certifying the fact of disposal of the identified PCB waste, including the date(s) of disposal, and identifying the disposal process used.

d. A certification as defined in 40 CFR 761, Section 3.

3.8.1.1 Payment Upon Furnishing Certificate of Disposal of PCBs

Payment will not be made until the certificate of disposal has been furnished to the COR.

-- End of Section --

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MOLD REMEDIATION

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for the demolition, cleaning, removal, and disposal of mold contaminated materials.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN INDUSTRIAL HYGIENE ASSOCIATION (AIHA)

AIHA IMOM08-679	Recognition, Evaluation, and Control of Indoor Mold
AIHA Z9.2	Fundamentals Governing the Design and Operation of Local Exhaust Ventilation Systems

INSTITUTE OF INSPECTION, CLEANING, AND RESTORATION CERTIFICATION (IICRC)

IICRC S100	Standard Reference Guide for Professional Carpet Cleaning
IICRC S500	Standard and Reference Guide for Professional Water Damage Restoration

NATIONAL AIR DUCT CLEANERS ASSOCIATION (NADCA)

ACR	Standard for Assessment, Cleaning, and Restoration of HVAC Systems

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134	Respiratory Protection
29 CFR 1926.1101	Asbestos

UNDERWRITERS LABORATORIES (UL)

UL 586	Standard for High-Efficiency Particulate, Air Filter Units

NASA Ames Health & Safety Handbook

APR 1700.1, Chapter 37	Ames Health & Safety Procedural Requirements - Indoor Air Quality

http://www.osha.gov/Publications/preventing_mold.pdf

http://www.osha.gov/SLTC/molds/

The Contractor will not be hiring an IH or CIH; all verification work shall be done by Code QH Safety Health and Medical Services Division.

Post abatement/mitigation inspection and air sampling, if required, shall be done by Code QY Safety Health and Medical Services.

1.3 DEFINITIONS

1.3.1 AIHA

American Industrial Hygiene Association.

1.3.2 AFU

Air filtration unit with High Efficiency particulate air (HEPA) filtered vacuum and / or exhaust ventilation equipment with a filter system capable of collecting and retaining microbial contamination AIHA Z9.2. Filters shall retain 99.97 percent of particles 1.2 by 10-6 inch or larger as indicated in UL 586.

1.3.3 Categories of Water

(IICRC S500) Category 1 Water: Water originating from a source that does not pose substantial harm to humans. Also referred to as "clean water."

Category 2 Water: Water containing a significant degree of chemical, biological and/or physical contamination and having the potential to cause discomfort or sickness if consumed by or exposed to humans. Also referred to as "gray water."

Category 3 Water: Grossly unsanitary water, containing pathogenic agents, arising from sewage or other contaminated water sources and having the likelihood of causing discomfort or sickness if consumed by or exposed to humans. This category includes all forms of seawater, ground surface water and rising water from rivers or streams. Also referred to as "black water."

1.3.4 Certified Industrial Hygienist (CIH)

A Certified Industrial Hygienist refers to an individual that has been certified by the American Board of Industrial Hygiene (ABIH), with professional qualifications and experience as required for an industrial hygienist, as presented in the definition of "Industrial Hygienist."

1.3.5 Complete Interior Building Demolition (Complete Gut)

Interior finishes of the building have been removed to expose basic structural elements.

1.3.6 Containment

Physical separation and engineering controls required to prevent contamination of undamaged materials and occupied areas. The level of containment varies depending on the extent of the contamination.

1.3.6.1 Source Containment

Use when the contaminated surface area is less than 10 square feet, in non-residential buildings only. At a minimum, source containment shall include the following:

a. Isolation of Work Areas. Install polyethylene barriers to isolate the areas or material to be demolished / remediated from non-remediation areas.

b. Floor protection. Maintain protection for finished floors through all construction activities.

c. HEPA vacuum to control dust created during the demolition. Hold HEPA vac intake at source of dust.

1.3.6.2 Limited Containment

Use when contaminated surface area is between 10 square feet and 100 square feet per room in non-residential buildings and contaminated surface area less than 100 square feet per room in residential buildings. At a minimum, limited containment shall include the following:

a. Containment. For residential buildings, a containment shall include the entire room where work is being performed. The containment shall not extend past the extents of the room unless there are instances of contamination extending from one room to the next. For non-residential buildings, the containment shall include the area to be remediated, plus enough additional area to allow for all equipment and work activities.

b. Isolation of Work Areas. Install polyethylene barriers to isolate the areas to be demolished / remediated.

c. Floor protection. Maintain protection for finished floors through all construction activities.

d. Air Filtration / Pressurization Control. Install AFUs with HEPA filters in the containment. Configure the AFUs with splitters / diverters to allow some of the air to recirculate within the containment. Discharge the remainder of the air directly to the outside to maintain an overall negative pressure in the containment of 0.02 inch water column minimum to 0.04 inch water column maximum relative to the outside and other adjacent spaces not undergoing remediation. AFUs shall filter a minimum of four air changes per hour and a maximum of six air changes per hour.

e. Protection for all items remaining in the containment. Protective

devices shall prevent physical damage (e.g., scratches and dents) and shall provide a positive seal to prevent dust from settling in or on the items.

f. Containment Entrance. Install a triple-flap poly "door" to be used during demolition to minimize egress and provide a good separation between containment and occupied areas of the house / building.

1.3.6.3 Full Containment

Use when contaminated surface area is greater than 100 square feet in both residential and nonresidential buildings. At a minimum, full containment shall include the following:

a. Containment. For residential buildings, a containment shall include the entire room where work is being performed. The containment shall not extend past the extents of the room unless there are instances of contamination extending from one room to the next. For non-residential buildings, the containment shall include the area to be remediated, plus enough additional area to allow for all equipment and work activities.

b. Isolation of Work Areas. Construct polyethylene barriers to isolate the areas to be demolished / remediated.

c. Floor protection. Maintain protection for finished floors through all construction activities.

d. Air Filtration / Pressurization Control. Install AFUs with HEPA filters in the containment. Configure the AFUs with splitters / diverters to allow some of the air to recirculate within the containment. Discharge the remainder of the air directly to the outside to maintain an overall negative pressure in the containment of 0.02 inch water column minimum to 0.04 inch water column maximum relative to the outside and other adjacent spaces not undergoing remediation. AFUs shall filter a minimum of four air changes per hour and a maximum of six air changes per hour.

e. Protection for all items remaining in the containment. Protective devices shall prevent physical damage (e.g., scratches and dents) and shall provide a positive seal to prevent dust from settling in or on the items.

f. Decontamination. Construct a decontamination airlock for entry into and exit from the work area. The airlock shall be used to HEPA vacuum the sealed bags of contaminated debris. When possible, the decontamination airlock shall be located so that the sealed bags can be passed directly from the airlock to the outside, through a door or window.

g. Containment Entrance. Install a triple-flap poly "door" at the entrance to the airlock, and between the airlock and the work area during demolition to minimize egress and provide a good separation between containment and occupied areas of the house / building.

1.3.6.4 Unoccupied Building Containment

Use when a building is unoccupied and large amounts of mold growth are present throughout the building:

a. Containment. The containment consists of the entire building. Install AFUs with HEPA filters in the building. Configure the AFUs to recirculate within the active remediation area. AFUs shall filter a minimum of four air changes per hour and a maximum of six air changes per hour based on the size of the area undergoing active remediation.

b. Isolation of Work Areas. Install polyethylene barriers to isolate the areas where remediation is not required. AFU discharge may be used to positively pressurize non-remediation areas from areas undergoing remediation to prevent the movement of spores into "clean" areas.

c. Floor Protection. Maintain protection for finished floors through all construction activities.

d. Protection for all items remaining in the containment. Protective devices shall prevent physical damage (e.g., scratches and dents) and shall provide a positive seal to prevent dust from settling in or on the items.

e. Decontamination. Construct a decontamination airlock for entry into and exit from the building.

f. Containment Entrance. A triple-flap poly "door" shall be used at the entrance to the work area during demolition to minimize egress.

1.3.6.5 Cleaning Containment

A temporary containment structure set up to clean items removed from the containment. At a minimum, the cleaning area shall contain:

a. Two chambers. Construct walls with polyethylene. Items will be cleaned in the first chamber. The clean items shall be stored in the second chamber.

b. Air Filtration / Pressurization Control Cleaning Chamber. Install AFUs with HEPA filters in the cleaning chamber. Configure the AFUs with splitters / diverters to allow some of the air to recirculate within the containment. Discharge the remainder of the air directly to the outside to maintain an overall negative pressure in the containment of 0.02 inch water column minimum to 0.04 inch water column (maximum) relative to the storage chamber.

c. Air Filtration, Storage Chamber. Install AFUs with HEPA filters in the storage chamber. The AFUs shall be configured to allow air to recirculate within the chamber. AFUs shall filter a minimum of four air changes per hour and a maximum of six air changes per hour.

d. Containment Entrance. Install a triple-flap poly "door" at the entrance to the cleaning chamber, between the cleaning and storage chambers, and at the exit of the storage chamber to minimize egress and provide a good separation between the chambers.

1.3.7 Decontamination Unit (Airlock)

An enclosed area adjacent to, and connected to, a regulated work area. It consists of various rooms that are used for the decontamination of workers, equipment, and materials.

1.3.8 Dehumidifier

Mechanism or machine to remove moisture from the air.

1.3.9 Detergent

A cleaning agent. The term refers to a prepared compound that may include surfactants, builders, dry solvents, softeners, etc, but does not include true soap.

1.3.10 Disinfectants or Biocide Sanitizing Solutions

One of three groups of antimicrobials registered by the EPA for public health uses. The EPA considers an antimicrobial to be a disinfectant when it destroys or irreversibly inactivates infectious or other undesirable organisms, but not necessarily their spores.

1.3.11 EPA

U.S. Environmental Protection Agency.

1.3.12 Fungicidal Agents, (EPA)

A coating material that contains an EPA registered fungicide that inhibits the spread and growth of mold with the ability to withstand moist and humid conditions.

1.3.13 HEPA Filter

A High Efficiency Particulate Air (HEPA) filter capable of trapping and retaining 99.97 percent of all particulate larger than 1.2 by 10-6 inch.

1.3.14 HVAC

Heating, Ventilating, and Air Conditioning (System).

1.3.15 Industrial Hygienist (IH)

Industrial Hygienist (IH) refers to an individual designated and provided by the Government that is a professional qualified by education, training, and experience to anticipate, recognize, evaluate, and develop controls for occupational and indoor air quality hazards. Education must include a minimum 12 semester hours or quarter hour equivalent of chemistry and 18 additional semester hours or quarter hour equivalent of courses in any combination of chemistry, physics, engineering, health physics, environmental health, biostatistics, biology, physiology, toxicology, epidemiology, or industrial hygiene. The Industrial Hygienist shall be under the supervision of a Certified Industrial Hygienist.

1.3.16 Microbial Remediation Supervisor

Individual responsible for the execution of the microbial remediation work as defined by the scope of work. This individual shall have documented training in microbial remediation and have at least three years experience in microbial remediation work. Remediation contractor's on-site supervisor shall have one of the following certifications: Council-Certified Mold Remediator (CMR), or Council-Certified Mold Remediation Supervisor (CMRS) as certified by the American Council for Accredited Certification, or Applied Microbial Remediation Specialist (AMRS), Institute of Inspection,

Cleaning, and Restoration Certification (IICRC) or COR approved equivalent.

1.3.17 Non-Porous Material

A material that does not absorb nor is easily penetrated by liquids, especially water. Generally, non-porous materials have a permeable factor of less than 1. Some examples are metal, glass, plastic, ceramic tile, etc.

1.3.18 Occupied Spaces (Areas)

The phrase "occupied space" within this specification refers to spaces that are occupied by unprotected non-remediation personnel while work is in progress. It also refers to areas adjacent to work areas that are not currently undergoing remediation.

1.3.19 Personal Protective Equipment (PPE)

Any material or device worn to protect a worker from exposure to, or contact with, any harmful material or force. PPE must be cleaned or disposed of prior to removal from the remediation work area.

1.3.20 Poly

Polyethylene sheet with a minimum thickness of 6 mils.

1.3.21 Porous Material

Permeable materials having the physical properties that allow liquids or gasses to pass through. These materials include but are not limited to the following: gypsum wall board, insulation, wallpaper, ceiling material, carpet, padding, paper goods (i.e., cardboard boxes, loose paper, books, etc.), stuffed furniture, wicker, fabrics, etc.

1.3.22 Pressure Differential Measuring Instrument

Device used to measure the relative pressure difference between the work area and areas outside the work area. For mold remediation, the device must measure accurately in the 0 to 0.04 inch range.

1.3.23 Semi-porous Material

A material that can absorb liquids if exposed over long periods of time. These materials include but are not limited to wood, concrete, linoleum, vinyl wall covering, wooden or hardboard furniture, plaster, etc.

1.3.24 Ventilation System Mold Remediator Qualifications (VSMR)

An individual certified by the North American Duct Cleaning Association (NADCA) to clean HVAC systems.

1.3.25 Work Area

The area where remediation operations are actively performed and controlled to prevent the spread of dust / spores and entry by unauthorized personnel. A work area is the space, group of spaces, or the building, as defined by the Microbial Assessment Survey.

1.4 REQUIREMENTS

1.4.1 Description of Work

The COR will furnish the Contractor, in the contract documents, an initial Microbial Assessment Survey with containment categories and remediation methods specified for each work area and material within the work area.

The COR's initial Microbial Assessment Survey specified below shall be furnished and certified by a qualified assessor authorized by the COR to do such work. The initial survey is included in the solicitation documents at the end of this specification section.

Provide mold remediation work including the handling and control of mold contaminated materials and the resultant procedures and equipment required to protect workers, the environment and occupants of the building or area, or both, from contact with mold products and spores. The work also includes the disposal of any mold contaminated materials generated by the work. Provide containment and engineering control techniques as outlined in this specification. All mold contaminated material removal work shall be supervised by a microbial remediation supervisor as specified herein.

No work in this specification section shall be provided by any person, contractor, or contracting entity involved in the preparation of the contract documents of which this specification section is a part.

The following microbial remediation specifications apply to the cleaning / removal and disposal of fungally-contaminated porous, semi-porous and non-porous surfaces within various types of structures. The level of containment and requirements for cleaning and remediation of materials will depend on the condition of the space and materials being remediated.

Immediately after award of the contract, prepare a preliminary visual assessment report using the standard microbial assessment form (Appendix A) to document the differences in the pre-remediation condition of the work areas as compared to the government provided Microbial Assessment Survey. Only address the differences between the pre-remediation condition of the work areas and the government provided Microbial Assessment Survey. If required to indicate the differences, include the HVAC systems inspection required elsewhere in this specification section. Submit this written pre-remediation condition report to the COR for approval and instructions to proceed.

After approval of the preliminary visual assessment report and having instructions from the COR to proceed, prepare a microbial remediation plan for approval by the COR's Code QH representative. Microbial remediation plan shall include an assessment of the risk for people to occupy areas adjoining the remediation area while remediation work is occurring. Upon the Contractor's CIH approval of the plan, submit the plan to the COR for approval.

The Safety, Health and Medical Assurance's representative CIH or IH shall monitor the site on a daily basis while remediation work is in progress, identifying work and/or work practices that are not in compliance with the approved microbial remediation plan, and performing all inspections required by this specification. The COR may require the removal of any individual for non-compliance with quality requirements specified in the contract.

This specification section includes the protocol regarding proper disposal of the removed building material components from within the work site.

Use proper cleaning procedures, engineering controls, and apply best management practices to remove microbial growth and spore fallout from all surfaces and building materials to minimize the further release of microbial spores. Address semi-porous and nonporous surfaces within the facility in each cleaning phase of the project. Damp wipe and HEPA vacuum all surfaces, at a minimum. Remove and dispose of porous building materials that are supporting microbial growth.

1.4.2 Security Requirements

Prior to granting access to any work area (i.e., building, area, room, or space) for mold remediation work, a determination must be made by the government agency whether classified or controlled unclassified information (paper material and / or electronic media) or equipment is contained in the work area(s).

If Contractor personnel require access to classified information or spaces to perform mold remediation work, the Government must issue the Contractor facility a DD Form 254 (Contract Security Classification Specification) prior to the initiation of the work under the contract. If the Contractor facility does not possess a valid DD Form 254 issued by the Defense Security Service (DSS), the Government will be required to submit a sponsorship request to DSS requesting that the Contractor be processed for and issued a current DD Form 254 at the appropriate level.

Access to classified information (paper material, electronic media, and equipment) must only be granted to authorized and appropriately cleared government and U.S. contractor personnel that possess a personnel security clearance commensurate with the level of information contained in the work area that requires a mold remediation effort.

Access to Controlled Unclassified information (i.e., For Official Use Only, Sensitive but Unclassified, Privacy Act Information, Export Controlled unclassified, etc.) can be granted to DOD cleared contractors, consultants and grantees that are conducting official business for the DOD or DON. Non-cleared U.S. contractor personnel who only require access to controlled unclassified information can be granted access if they get a favorable trustworthiness determination on an individual Facility Access Determination National Agency Check (FADNAC) submitted on their behalf by the government agency issuing the contract.

Classified information and controlled unclassified information must be safeguarded / secured, reproduced, and destroyed in accordance with SECNAV M-5510.36.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Preliminary Visual Assessment Report

Microbial Remediation Plan

Worker Records

Respiratory Protection Program

Certified Industrial Hygienist (CIH)/Industrial Hygienist (IH) Qualifications

Microbial Remediation Supervisor Qualifications

Ventilation System Mold Remediator Qualifications (VSMR)

Injury Illness Prevention Plan (IIPP)

Code of Safe Practices

SD-03 Product Data

Personal Protective Equipment (PPE)

Air Filtration Units

Dehumidifiers

Pressure Differential Measuring Instrument

Fungicidal Agents, (EPA)

Disinfectants or Biocide Sanitizing Solutions

SD-06 Test Reports

Daily Reports

SD-11 Closeout Submittals

Submittals at Completion of Remediation Work

1.5.1 Preconstruction Submittals

Within ten (10) days from the award of the contract and prior to the start of the work, submit to the COR six copies of the following items for review and permanent file.

1.5.1.1 Preliminary Visual Assessment Report

A written report to document the pre-remediation condition of the work areas compared to the government provided Microbial Assessment Survey and the results of the HVAC systems inspection.

1.5.1.2 Microbial Remediation Plan

Submit a job-specific, detailed plan Approved by the Safety, Health and Medical Services (Code QH) CIH to the COR for final approval prior to start of work. The plan shall address the following items at a minimum:

a. Description of materials to be remediated, providing location and quantities (map if available), and methods to be used for remediation.

b. Types of biocides and fungicidal agents, (EPA).

c. Containment procedures to include description and locations of engineering controls and decontamination unit to include entry and exit procedures (provide sketch of floor plan showing location of containment barriers and decontamination units). Plan shall include locations of AFUs and AFU discharges to the outside.

d. Description of personal protective equipment to be used during the remediation.

e. Construction barricades and barriers in occupied areas.

f. HVAC Shut down and start-up procedures.

g. HVAC Evaluation and remediation procedures.

h. Moisture and relative humidity control procedures and equipment.

i. Packaging and disposal procedures.

j. Safety Precautions to include lockout / tag-out, fall protection, confined space entry procedures, and fire protection.

k. Description of the method to be employed to control cross contamination of areas not in the work area. This shall include a risk assessment related to the suitability of people to occupy areas adjoin the remediation area while remediation activities are ongoing.

l. IH Quality Control procedures to include visual inspection.

m. Procedures to control, abate, and dispose of Asbestos Containing Materials (ACM) and Lead Based Paint (LBP) coincident with microbial remediation. Before work in areas containing ACM and PACM is begun; Contractor shall identify the presence, location, and quantity of ACM, and/or PACM therein pursuant to paragraph (k)(1) of 29 CFR 1926.1101.

1.5.1.3 Respiratory Protection Program

Provide written copy of Contractor's Respiratory Protection program.

1.5.1.4 Worker Records

Provide the following documents for all workers, including supervisory personnel. If new workers are added to the crew, provide the same documentation for them.

Employee Instruction and Release Form: Provide documentation showing that each employee has been instructed on the following items:

a. Use and fit of respirators (for employees entering and working in the containment).

b. Protective clothing.

c. Protective measures.

d. Safety and Emergency Egress Procedures.

e. Site specific fall protection plan and training.

f. Microbial remediation hazards and practices including engineering controls and isolation. Training should include "hands on" training for microbial remediation supervisors.

g. Workers' release forms stating the potential hazards involved with the scope of the work.

Worker Training Certification: Submit copies of training certificates for each employee indicating that the employee has received training at the appropriate level for the work prescribed in the description of work.

1.5.1.5 Certified Industrial Hygienist (CIH)/Industrial Hygienist (IH) Qualifications

Submit the name, address, and telephone number of the Certified Industrial Hygienist (CIH) and Industrial Hygienist (IH). Provide copies of board certificates, resume to document field experience, and evidence that the CIH and IH have successfully completed training in microbial investigation and remediation.

1.5.1.6 Microbial Remediation Supervisor Qualifications

Onsite supervisor shall have one of the following certifications: Certified Mold Remediator (CMR), Certified Mold Remediation Supervisor (CMRS), or Applied Microbial Remediation Specialist (AMRS). Submit copies of supervisory training certificates.

1.5.2 Product Data

Within 10 days of contract award, submit product data for items identified for use in Microbial Remediation Plan.

1.5.3 Daily Reports

Prepare a written report for each day that microbial remediation work is being accomplished. Submit this report to the COR by 1000 hours of the following day, attached to the Contractor Quality Control Report. Referred to collectively as the IH Daily Report, the report at a minimum shall include measurements of differential pressure and temperature and relative humidity in work areas, and detail any non-compliance issues observed.

1.5.4 Submittals at Completion of Remediation Work

Within 14 days of completion, provide the following information:

a. Supervisor Logs.

b. IH Daily Reports.

c. Photographic Logs.

d. Contractor's Industrial Hygienist Report certifying the microbial remediation is complete.

1.6 RECORD KEEPING

A Daily Project Log shall form a permanent record of the project. Secure

and maintain these logs and any other required documentation as part of the permanent project file.

1.6.1 Daily Log

The Microbial Remediation Supervisor shall maintain a Daily Project Log. The Daily Project Log shall be used each day of the project to document the following information.

a. Date.

b. Name of Microbial Remediation Supervisor.

c. Number of workers on site.

d. Equipment utilized.

e. Brief description of daily work activities.

g. Listing of any non-compliance noted, emergencies, stop work orders (with detailed explanation), and descriptions of any other significant events.

PART 2 PRODUCTS

2.1 DISINFECTANTS, BIOCIDES, SANITIZING SOLUTIONS AND FUNGICIDAL AGENTS, (EPA)

Shall be approved by EPA for the use detailed in the Microbial Remediation Plan and used in accordance with the manufacturer's specifications.

Shall be approved by the Safety Office prior to use.

PART 3 EXECUTION

3.1 EQUIPMENT

Provide protective clothing and respirators as required by the Microbial Remediation Plan for use by any authorized visitors. Provide manufacturer's certificate of compliance for all equipment used to contain the microbial contamination. Contractor shall not be required to certify that visitors entering work areas be capable of wearing respirators.

3.1.1 Respirators

Select respirators from those approved by the National Institute for Occupational Safety and Health (NIOSH), Department of Health and Human Services. Provide personnel engaged in set-up, pre-cleaning, cleanup, handling, and removal of contaminated materials with the appropriate respiratory protection as specified in 29 CFR 1910.134. Microbial remediation plan shall consider Table 17.1 in AIHA IMOM08-679 "Recognition, Evaluation, and Control of Indoor Mold", which lists the minimum levels of respiratory protection based on the activity and size of the remediated area.

3.1.2 Protective Clothing

Provide all workers with protective clothing as appropriate for the work being accomplished, as required by the Microbial Remediation Plan.

Do not permit any person to enter the work area without the appropriate protective clothing and equipment.

3.1.3 Warning Signs and Labels

Provide bilingual warning signs printed in English and Spanish at all approaches to the work areas. Locate signs at such a distance that personnel may read the sign and take the necessary protective steps required before entering the area. Warning signs may be in the form of continuous plastic tape. The warning signs shall have black characters on a yellow background.

WARNING
DO NOT ENTER
MICROBIAL REMEDIATION WORK IN PROGRESS

Alternate wording for the warning signs will be approved by the COR.

3.1.4 Dehumidifiers

Install and use dehumidifiers as needed during the remediation to maintain relative humidity below 60 percent in the work area. Drain the condensate water to a permanent drain, or empty as needed to prevent water overflowing from the dehumidifiers.

3.1.5 Air Filtration Units (AFU)

Install and use AFUs with HEPA filters, and manufacturer specified pre-filters, as part of the exhaust ventilation system to develop and maintain the specified desited air pressure differential inside the enclosed work area relative to the outside areas. The Contractor shall be responsible for acquiring and paying for any licenses needed for use of any equipment, including but not limited to, air pressure differential systems and air filtration systems.

Replace HEPA filters and pre-filters for AFUs as required to maintain pressurization performance requirements during demolition and cleaning. Do not reuse filters. Bag used filters at a minimum in clear 6 mil polyethylene bags within the containment and disposed as contaminated waste.

Discharge air from any AFUs located in the work area containment to the outside environment when creating a negative pressure containment to create a negative pressure relative to occupied areas of 0.02 inch H2O to 0.04 inch H20. Discharge air in excess of that required for creating the proper negative pressure to the work area. The AFUs shall provide four to six air changes per hour in the work area. Under no circumstances may air from AFUs discharge to an occupied area. Coordinate location of window sashes or doors required for discharge openings with the COR. Seal around openings used for discharge of exhaust air airtight. Exhaust discharge openings may be constructed of plywood.

Seal all exhaust and intake openings in AFUs with one layer of 6 mil polyethylene sheeting when not in use.

3.1.6 Vacuum Cleaners Equipped with HEPA Filters

Provide vacuum cleaners equipped with HEPA filters designed for continuous operation to perform the work in a timely and efficient manner.

Provide nozzle attachments as required to adequately remove all dust. As a minimum, nozzle attachments shall include crevice and extended bristle brush nozzles. Any vacuum that is not equipped with a HEPA filter shall not be used at anytime.

Provide sufficient vacuum cleaners equipped with HEPA filters designed for continuous operation in the work area during microbial remediation inside the containment area.

Provide additional vacuum cleaners equipped with HEPA filters in the enclosed work area during remediation or cleaning work as required by the size (area) of the containment and to maintain timely progress of the work.

3.2 GENERAL REQUIREMENTS

3.2.1 Pre-Microbial Remediation Work Conference

Meet with the COR prior to beginning work to discuss in detail the Microbial Remediation Plan, including work procedures and safety precautions. Once approved by the COR, the plan shall be enforced as if a part of this specification. Any variances to the specification as a result of the plan shall be specifically identified to allow for free discussion and approved by the COR in writing prior to starting work. Before work in areas containing Asbestos Containing Material (ACM) and Presumed Asbestos Containing Materials (PACM) and Lead is begun, Contractor shall identify the presence, location, and quantity of ACM, PACM and Lead. Ensure proper notification of regulatory authorities. Contractor shall consult with COR to obtain facility ACM / LBP surveys.

3.2.2 Containment Entry / Exit Procedure

Ensure that each worker and authorized visitor follows entry and exit procedures detailed in the Microbial Remediation Plan.

3.3 REMOVAL PROCEDURES

3.3.1 Protection of Existing Work Areas

Perform work in a manner to minimize the damage or contamination to areas outside or directly adjacent to the work area. Contractor is required to inspect areas inside and outside proposed work areas to identify existing damage and notify COR prior to start of work.

Where materials outside work area are damaged or contaminated as a result of the Contractors work efforts as verified by the COR using visual inspection or sample analysis, it shall be restored to its original condition or decontaminated by the Contractor at no expense to the Government as deemed appropriate by the COR. Should adjacent or outside areas become contaminated as a result of the Contractors work efforts the work shall stop immediately. The newly contaminated areas shall be cleaned and verified by visual inspection by the IH. The work may proceed at the discretion of the COR once the area has been verified as restored.

3.3.2 Remediation of Fungally Contaminated Building Materials

The removal of contaminated materials shall follow in general the listed sequence of work. The Contractor may make changes to improve work flow with the approval of the COR.

a. Provide level of containment and PPE required by the Microbial Remediation Plan.

b. Disable all HVAC units and exhaust fans in the area to be remediated.

c. Protect materials to remain in work area. Where possible, all materials to be salvaged should be cleaned in place to prevent possible cross-contamination created by moving materials through non-remediation areas.

d. Remove undamaged items and materials to be cleaned and salvaged from the work area. Materials shall be stored in an area with relative humidity maintained below 60 percent and where temperatures will not damage the material. Notify COR of existing damage to items prior to removal.

e. Set up containments, including protection of materials remaining within the containment and AFUs. Notify COR that the area is prepared for remediation activities.

f. Pre-demolition inspection by the COR.

g. Demolition and removal / cleaning of contaminated materials.

h. Post-remediation inspection by the COR.

i. Perform final cleaning in the containment.

j. Clean carpet in the containment.

k. Clearance inspection by the COR.

l. Duct and HVAC cleaning, if necessary.

m. Deconstruction of containment, removal of AFUs.

n. Clean previously removed items prior to returning to occupied area.

3.3.3 Remediation Procedures

Procedures for remediation depend on the amount of mold growth and the type of material with fungal growth.

3.3.3.1 Remediation of Non-Porous Materials

The method of remediating non-porous items shall be:

a. HEPA vacuum all surfaces.

b. Damp wipe all surfaces using clean water or a detergent solution.

3.3.3.2 Semi-Porous Materials (Unfinished Wood)

The method of remediating unfinished wood-based items, including wood and wood framing in wall cavities, shall be:

a. Cleaning

1. HEPA vacuum all surfaces.

2. Scrub surfaces with a brush and detergent to remove mold.

3. HEPA vacuum all surfaces to remove dust.

4. Repair finishes as required to match original.

b. Removal

Where unfinished wood product has been structurally damaged, remove and replace with an equivalent product. This shall include wall studs and sheathing, such as OSB used in flooring, wall, or roof construction.

3.3.3.3 Semi-Porous Materials

The method of surface cleaning semi-porous materials such as concrete, vinyl wall covering, linoleum, leather furniture, and finished wood products shall be:

a. HEPA vacuum all surfaces.

b. Damp wipe surfaces with using clean water or a detergent solution. Avoid over-wetting the material.

3.3.3.4 Porous Materials

a. Carpet

1. Removal: Replace carpet that has remained wet for 48 hours or longer.

2. Cleaning: Use a dry absorbent compound cleaning method as designated by IICRC S100. This method uses an absorbent compound to dissolve, suspend and absorb carpet soils. It does not add moisture back into the carpet.

b. Gypsum Wallboard (GWB)

1. Removal: Replace Gypsum Wallboard that has remained wet for 48 hours or longer, or has visible mold growth. Where removal of GWB exposes insulation, remove and replace the insulation with an insulation having equal characteristics for insulating value and permeability.

2. Surface Cleaning: Where GWB has a small amount of surface mold growth and the GWB is structurally sound, a surface cleaning method may be used with the permission of the COR. The method of surface cleaning GWB shall be HEPA vacuum all surfaces. Surface cleaning shall not be used where mold growth penetrates wallboard substrate.

c. Ceiling Tile

1. Removal: Replace ceiling tile that has remained wet for 48 hours or longer, or has visible mold growth.

2. Surface Cleaning: Where settled dust on ceiling tiles contains mold spores and the ceiling tile is structurally sound, is not

sagging, and has not been wet, a surface cleaning method may be used with the permission of the COR. The method of surface cleaning ceiling tile shall be HEPA vacuum all surfaces. Surface cleaning shall not be used where mold growth is occurring on ceiling tiles.

d. Paper Materials

Contractor personnel cannot be granted access to classified information and / or Controlled Unclassified Information until they have met the security requirements stated in the paragraph SECURITY REQUIREMENTS.

1. Removal: Discard paper materials that have remained wet for 48 hours or longer, or that have visible mold growth. Classified and Controlled Unclassified Information must be destroyed by appropriately cleared contractor personnel using an approved DOD destruction method that is authorized for the specific level of information.

2. Containment: Where paper materials, such as personnel records must be retained, the following containment methods may be used with the permission of the COR. The method of containment for paper products shall be:

(a) Thoroughly dry the paper material. Classified and Controlled Unclassified Information must be safeguarded at all times in a GSA approved security container, restricted area, vault, or under the direct physical control of appropriately cleared contractor personnel.

(b) Where routine access to the material is required, a copy shall be made. Contractor personnel shall not reproduce copies of classified information or controlled unclassified information without the prior written approval of the COR and the NAVFAC LANT security department. If approval is obtained, only appropriately cleared Contractor personnel shall be authorized to reproduce the information and they must use only DOD authorized reproduction equipment.

(c) When not in use, the classified and controlled unclassified information must be secured in an approved GSA security container, restricted area, or vault. Limit access to the container to only appropriately cleared Contractor personnel. Implement an access procedure involving opening the container in a secure area with provision for capturing mold spores and respiratory protection for workers opening the container for these materials. Store the container in an area where the relative humidity is maintained below 60 percent to prevent further mold growth.

e. Textiles

1. Discard textiles with visible mold growth.

2. Clean textile based items, including clothing, linens, and toys that do not have visible mold growth, but have been wet, in standard commercial or residential washing machines with standard washing machine detergent.

3. Dry all items completely before returning to the building / house.

(a) When possible, use dryers to dry items.

(b) If dryers will cause irreversible harm to the item, hang the item on a drying rack in a temperature and humidity controlled space. Discard items not dry within 48 hours.

f. Upholstered Furniture

1. Removal: Discard upholstered furniture that has remained wet for 48 hours or longer, or that have visible mold growth.

2. Cleaning: Clean upholstered furniture that has been exposed to mold spores but does not have visible mold growth by HEPA vacuuming upholstery and wood or metal structure, followed by a damp wipe of semi-porous or non-porous portions of the furniture.

3.4 DETAILED SEQUENCE OF WORK FOR MOLD REMOVAL UNDER CONTAINMENT

3.4.1 Preparation for Remediation Work

a. Provide level of containment and PPE required for the remediation based on the Microbial Remediation Plan.

b. Disable all HVAC units and exhaust fans in the area to be remediated.

c. Remove undamaged materials from the work area if they are to be salvaged but cannot be cleaned in place. Store materials in an area with relative humidity maintained below 60 percent and where temperatures will not damage the material. Notify COR of existing damage to items prior to removal. Clean materials using procedures detailed in Remediation Procedures.

d. Remove supply diffusers, return grilles and exhaust grilles. Clean diffusers and grilles using procedures detailed in Remediation Procedures.

e. Construct containment barriers. Existing walls can be used as a portion of the containment barriers if existing openings in walls (such as doors, wall openings, vents, etc.) are sealed using polyethylene.

f. Install the AFUs and dehumidifiers.

g. Seal supply, return, and exhaust openings with polyethylene sheeting and protect intakes to air handling units. Air handling units shall remain off.

h. Install all equipment needed for removal work in the containment area to minimize egress during demolition.

i. The COR's representative (Code QH) will inspect the containment to verify that the containment is properly constructed and the containment area has an overall negative pressure of 0.02 to 0.04 inch water column relative to the outside and adjacent work areas not undergoing active remediation, prior to beginning demolition work.

3.4.2 Demolition

a. Remove mold contaminated materials to be discarded, such as paper, and

furniture. Double bag material in 6 mil poly bags. Seal poly bags using duct tape inside the containment. HEPA vacuum bags before removing them from the containment or airlock. When possible, pass the bags directly from the containment or airlock to the outside. Transport bags to a dumpster. Do not leave the bags at the building / house.

b. Remove contaminated gypsum wallboard (GWB) at the preliminary limits of demolition specified in the Microbial Remediation Plan. Inspect back side of removed GWB. If mold is observed on the back side of the GWB, report this condition to the COR. After obtaining COR approval, continue removing GWB until no mold is observed. If hidden mold is discovered that will extend past the extents of the containment, stop work immediately and reconstruct the containment to extend past the suspected contamination. Re-evaluate level of containment and PPE. Continue to operate AFUs during reconfiguring of containment.

c. Remove drywall by cutting in pieces as large as possible to minimize aerosolization of fungal spores. Drywall screws can either be backed out during removal or later during cleanup.

d. Use dust collection attachments on all power tools, such as sanders, saws, etc., to capture dust created when using the tools. Outlet of dust collector should discharge into inlet of AFU.

e. Remove fiberglass insulation behind removed gypsum board.

f. If wood studs are contaminated, scrub them with a brush and detergent to remove mold. Replace wood studs with damage severe enough to reduce the structural capacity of the member. Prior to removal of any structural member consult with the COR.

g. Clean all metal framing with a dilute detergent solution. Clean metal framing with light rust using steel wool and coat with a rust inhibiting paint. Replace metal framing with rust damage severe enough to reduce the structural capacity of the member. Prior to removal of any structural material, consult with the COR.

h. Remove contaminated carpet scheduled for removal.

i. Place removed gypsum board, insulation, carpet and remaining debris in two layers of 6 mil poly bags. Seal poly bags using duct tape inside the containment. HEPA vacuum bags before removing them from the containment or airlock. When possible pass the bags directly from the containment or airlock to the outside. Transport bags to a dumpster. Do not leave the bags at the building / house. Remediation workers shall HEPA vacuum their PPE, then remove them within the airlock chamber. Discard disposable coverall suits into a 6 mil poly bag.

3.4.3 Post-Demolition Inspection

a. The COR will inspect the containment area to verify that all contaminated materials have been removed.

b. Allow a minimum of 12 hours after completion of removal work, with AFUs operating, for airborne dust in the containment to settle and / or be removed by the AFUs.

3.4.4 Cleaning after Demolition, and Cleaning of Settled Spores from Porous / Non-Porous Materials

a. Continue to operate AFUs during cleaning.

b. Clean exposed surfaces.

1. HEPA vacuum all surfaces.

2. Damp wipe all non-porous exposed surfaces including polyethylene sheets used to protect materials, external surfaces of ductwork, studs, and floors with clean rag and clean potable water or detergent solution.

3. Remove poly sheeting inside the containment.

4. HEPA vacuum all surfaces protected by poly sheeting.

5. Damp wipe non-porous surfaces protected by poly sheeting with clean water or a detergent solution.

6. Clean carpet using procedures in Remediation of Fungally Contaminated Building Materials.

c. Final clearance inspection will be conducted by COR. Clearance inspections will be performed using the procedures detailed in Post-Remediation Inspection. Maintain containments in place until spaces are inspected and accepted by the Government as being fully remediated. The Government will determine whether the Contractor shall conduct additional cleaning and repeat the clearance process.

3.5 DUCT AND HVAC SYSTEM CLEANING

3.5.1 Contractor Qualifications

a. The HVAC cleaning contractor shall be a certified member of NADCA.

b. The HVAC cleaning contractor shall have at least one individual with Ventilation System Mold Remediator Qualifications certified by NADCA onsite during duct and HVAC system cleaning.

3.5.2 Inspection

IH shall visually inspect the HVAC system serving all work areas (or as required in the initial Microbial Assessment Survey performed by the Government), and determine if additional remediation is needed to clean the HVAC system, thus preventing re-contamination. Notify the COR of the inspection results. The Contractor must receive written approval from the COR before proceeding with HVAC microbial remediation.

a. Follow requirements of the NADCA ACR "Standard for Assessment, Cleaning, and Restoration of HVAC Systems".

b. Using a "gassing" or "fogging" method of cleaning with gaseous chlorine dioxide or ozone will not be allowed.

c. Disable all HVAC equipment prior to cleaning any component of the system.

d. The method of cleaning the air handling units, terminal units, blowers and exhaust fans shall be:

1. Construct a limited containment around equipment to be cleaned. Provide appropriate PPE for workers.

2. Remove filters. Seal filters in 6 mil poly bags for disposal.

3. Disassemble units as necessary to clean components. Contractor is responsible for reassembling equipment after cleaning.

4. Clean disassembled components within the containment or in a separate two chamber cleaning containment. Seal disassembled components in 6 mil poly bags for transport out of building / house.

5. HEPA vacuum all surfaces.

6. Damp wipe all non-porous surfaces and components with clean water or a detergent solution.

e. The method of cleaning HVAC coils shall be:

1. Clean coils using a method which will render the coil visibly clean. Coil cleaners shall be non-acidic / alkaline, detergent based. Clean condensate drain pans. The drain for the condensate drain pan shall be operational during the cleaning.

2. Rinse coils and drain pans with clean water to remove any latent residues.

3. Cleaning methods shall not cause damage to the coil surface or fins.

4. Cleaning must restore the coil pressure drop to within 10 percent of the pressure drop measured when the coil was first installed. If the original pressure drop is not known, the coil shall be considered clean only if the coil is free of foreign matter and chemical residue.

f. The method of cleaning the duct system shall be:

1. During cleaning, connect a vacuum collection system to the downstream end of the section being cleaned. The vacuum collection device must be of sufficient power to render all areas of duct being cleaned under negative pressure relative to rooms and areas of duct not being cleaned. Negative pressure must be verified at the furthest point from the collection system with a micromanometer and verification measurements included in the Daily Report.

2. Equip the vacuum collection systems with HEPA filters. Exhaust the vacuum collection systems directly to the outside.

3. Use mechanical agitation devices to dislodge debris adhered to the ductwork, such that debris may be safely conveyed to vacuum collection devices. Cleaning methods shall not damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork.

4. HEPA vacuum duct surfaces.

5. When possible, damp wipe metal duct surfaces with clean water or detergent solution. Do not wet fibrous glass thermal or acoustical insulation.

6. Identify areas where there is evidence of damage to or uncleanable mold in duct insulation. The COR will make the decision to discard the insulation, if necessary.

g. Final clearance of HVAC and duct system will be based on a visual assessment (no visible dust, no visible mold) by COR's representative (Code QH).

3.6 FIRE PROTECTION

The Contractor shall provide portable fire extinguishers within the containment area and outside the decontamination unit. Fire extinguishers shall be rated for the class of fire hazards in the work area and shall be sized for coverage of the areas within the containment. At a minimum, one 10 pound ABC fire extinguisher for every 1,000 square feet shall be strategically placed around the containment. Personnel shall be trained for emergency egress and the use of fire extinguishers. Notify fire officials of work activities as required.

3.7 CONSTRUCTION BARRIERS

a. Provide interior shoring, bracing, or support to prevent movement, settlement, or collapse of structure or element to be demolished and adjacent facilities or work to remain. Shoring, bracing or support will be necessary when structural wood studs or metal framing need to be removed and replaced when they cannot be cleaned.

b. Do not disturb microbial-contaminated building materials while isolating work areas. This precaution prevents the release of microbial spores.

c. Workers shall wear respirators and other PPE as outlined in the microbial remediation plan when installing critical barriers where microbial contaminated surfaces (walls or surfaces with visible settled dusts) are likely to be disturbed. Operate an AFU if disturbance is likely during setup.

d. Monitor the air pressure differential across work area containments. The monitoring system shall be in place before the start of remedial activities. Verification by the Industrial Hygienist is required prior to the start of the microbial remediation.

3.8 QUALITY ASSURANCE / QUALITY CONTROL REQUIREMENTS

3.8.1 Contractor Qualifications

Work shall be performed by a qualified remediation contractor. Contractor shall carry insurance that specifically covers mold remediation.

Remediation contractor's on-site supervisor shall have one of the following certifications: Certified Mold Remediator (CMR), Certified Mold Remediation Supervisor (CMRS), or Applied Microbial Remediation Specialist

(AMRS). Qualified supervisor shall be onsite whenever active remediation is being performed. Set-up activities may be performed without supervisor present; qualified supervisor shall review set-up prior to start of work.

Mold remediation workers shall be given training in PPE and mold remediation activities as required for their particular job. Microbial remediation plan shall provide details of worker training.

3.8.2 Waste Management and Removal

Keep the site and work area free from accumulations of dust, waste materials, or rubbish caused by Contractor operations and free from any flammable materials or other sources of fire hazard. Remove all waste materials and rubbish from and about the work site in strict accordance with the specifications and applicable codes and regulations.

3.8.3 Post-Remediation Inspection

Clean up all debris and dust in interior spaces outside the work area resulting from the Contractor's remediation work.

After all visible accumulations of material and debris are removed from the containment, provide the COR a 24-hour notice for a final clearance visual inspection. The COR and Contractor's Industrial Hygienist shall conduct a thorough visual inspection of the work area. If during this inspection any visible debris and/or microbial contamination are observed, the Contractor shall re-clean the work area without additional cost to the Government.

3.8.3.1 Clearance

a. Clearance Criteria

Clearance will be based on visual assessment (all visible mold removed, all visible dust removed, based on a "white glove" test) by COR. "White glove" test shall consist of wiping the surface with a clean cloth of color suitable to reveal expected type of dust. For most surfaces, a white cloth is suitable. For GWB dust, a dark cloth may be more appropriate.

b. Failed remediation areas will be recleaned and the AFUs kept in operation another 12 hours, followed by another visual assessment. Subsequent failures will follow the same routine until a pass condition is secured.

3.9 CLEAN-UP AND DISPOSAL

3.9.1 Disposal of Material

Dispose of contaminated bagged waste materials removed during this remediation as general construction debris. Follow all applicable local, State, and Federal requirements for the disposal of this material.

3.9.2 Material Packaging

Place waste, as waste is removed, into a disposal container promptly. Disposal containers shall consist of at a minimum, two layers of clear 6 mil polyethylene bags. Tape bags in a gooseneck fashion to form an airtight seal and label appropriately. Bag waste from vacuums equipped with HEPA filters in 6 mil polyethylene bags.

3.9.3 Building Exit (Waste Disposal)

HEPA vacuum and damp wipe bags of contaminated waste material prior to removal from the building.

3.9.4 Hazardous Material

Should the Contractor encounter any hazardous materials, notify the COR immediately for direction.

3.10 Appendices

Appendix A - Microbial Assessment Visual Field Report Form
Appendix B - Sample Mold Remediation Clearance Criteria
For Buildings Housing Sensitive Populations

Appendix A

Microbial Assessment Visual Field Report Form

TO DOWNLOAD THIS FORM, SEE UFGS GRAPHICS
Go to http://www.wbdg.org/ccb/NAVGRAPH/graphtoc.pdf.

Appendix B

Sample Mold Remediation Clearance Criteria
For Buildings Housing Sensitive Populations

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CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

This covers the requirements for cast-in-place concrete.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats
AASHTO M 322M/M 322	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI/MCP-1	Manual of Concrete Practice Part 1
ACI/MCP-2	Manual of Concrete Practice Part 2
ACI/MCP-3	Manual of Concrete Practice Part 3
ACI/MCP-4	Manual of Concrete Practice Part 4
ACI 308R	Guide to Curing Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	Basic Hardboard

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4/D1.4M	Structural Welding Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel

	Products
ASTM A185/A185M	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A496/A496M	Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A497/A497M	Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A615/A615M	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A706/A706M	Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A767/A767M	Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A775/A775M	Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A82/A82M	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A934/A934M	Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A996/A996M	Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM C1017/C1017M	Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C1107/C1107M	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C1116/C1116M	Standard Specification for Fiber-Reinforced Concrete
ASTM C1240	Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C1260	Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar

	Method)
ASTM C143/C143M	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	Standard Specification for Portland Cement
ASTM C156	Standard Test Method for Water Retention by Concrete Curing Materials
ASTM C1567	Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C171	Standard Specification for Sheet Materials for Curing Concrete
ASTM C172/C172M	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C192/C192M	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C231/C231M	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C233/C233M	Standard Test Method for Air-Entraining Admixtures for Concrete
ASTM C260/C260M	Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C295	Spectrographic Examination of Aggregates for Concrete
ASTM C309	Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C311	Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
ASTM C33/C33M	Standard Specification for Concrete Aggregates
ASTM C330	Standard Specification for Lightweight Aggregates for Structural Concrete
ASTM C39/C39M	Standard Test Method for Compressive

	Strength of Cylindrical Concrete Specimens
ASTM C42/C42M	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C494/C494M	Standard Specification for Chemical Admixtures for Concrete
ASTM C567	Determining Density of Structural Lightweight Concrete
ASTM C595/C595M	Standard Specification for Blended Hydraulic Cements
ASTM C618	Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C881/C881M	Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM C932	Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering
ASTM C94/C94M	Standard Specification for Ready-Mixed Concrete
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM C990	Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C990M	Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants (Metric)
ASTM D 1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion

ASTM D 2628	Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 5759	Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM D 6690	Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
ASTM D 7116	Standard Specification for Joint Sealants, Hot Applied, Jet Fuel Resistant Types, for Portland Cement Concrete Pavement
ASTM E 1155	Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM E 1745	Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
ASTM E 329	Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI 10MSP	Manual of Standard Practice

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001	Principles and Criteria for Forest Stewardship

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	DOC Voluntary Product Standard PS 1-07, Structural Plywood

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 572	Corps of Engineers Specifications for Polyvinylchloride Waterstops

U.S. DEPARTMENT OF COMMERCE (DOC)

DOC/NIST PS1	Construction and Industrial Plywood with Typical APA Trademarks

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS SS-S-200	Sealant, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement
FS UU-B-790	Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

1.3 DEFINITIONS

a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, ground granulated blast-furnace slag.

b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.

c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.

d. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desited work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Reinforcing steel

Reproductions of contract drawings are unacceptable.

Provide erection drawings for concrete reinforcing that show placement of reinforcement and accessories, with reference to the contract drawings.

SD-03 Product Data

Materials for curing concrete
Joint sealants

Submit manufacturer's product data, indicating VOC content. Manufacturer's catalog data for the following items must include printed instructions for admixtures, bonding agents, epoxy-resin adhesive binders, waterstops, and liquid chemical floor hardeners.

Joint filler
Recycled Aggregate Materials
Cement
Portland Cement
Ready-Mix Concrete
Vapor retarder and Vapor barrier
Bonding Materials
Concrete Curing Materials
Reinforcement
Reinforcement Materials

Vapor retarder and Vapor barrier

Epoxy bonding compound

Waterstops

Wood Forms

Local/Regional Materials

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Biodegradable Form Release Agent

Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

SD-05 Design Data

Concrete mix design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, ground slag and admixtures; and applicable reference specifications. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which produce a range of strength encompassing those required for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the COR. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregate changes. Submit copies of the fly ash, and pozzolan test results, in addition. The approval of fly ash, and pozzolan test results must be within 6 months of submittal date. Obtain acknowledgement of receipt prior to concrete placement.

SD-06 Test Reports

Concrete mix design

Fly ash

Pozzolan

Ground granulated blast-furnace slag

Compressive strength tests

Unit weight of structural lightweight concrete

Air Content

Slump

Air Entrainment

SD-08 Manufacturer's Instructions

Fly ash

Ground granulated blast-furnace slag

1.5 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the COR.

1.6 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until vapor retarder, vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. ACI/MCP-2 for job site storage of materials. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed. Do not store concrete curing compounds or sealers with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions. Do not store concrete curing compounds or sealers in occupied spaces.

1.6.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.7 QUALITY ASSURANCE

1.7.1 Drawings

1.7.1.1 Reinforcing Steel

ACI/MCP-4. Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars.

1.7.2 Control Submittals

1.7.2.1 Curing Concrete Elements

Submit proposed materials and methods for curing concrete elements.

1.7.2.2 VOC Content for form release agents, curing compounds, and concrete penetrating sealers

Submit certification for the form release agent, curing compounds, and

concrete penetrating sealers that indicate the VOC content of each product.

1.7.2.3 Material Safety Data Sheets

Submit Material Safety Data Sheets (MSDS) for all materials that are regulated for hazardous health effects. Prominently post the MSDS at the construction site.

1.7.3 Test Reports

1.7.3.1 Concrete Mix Design

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix must be suitable for the job conditions. Include mill test and all other test for cement, aggregates, and admixtures in the laboratory test reports. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Submit test reports along with the concrete mix design. Obtain approval before concrete placement.

1.7.3.2 Fly Ash and Pozzolan

Submit test results in accordance with ASTM C618 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date. Submit manufacturer's policy statement on fly ash use in concrete.

1.7.3.3 Ground Granulated Blast-Furnace Slag

Submit test results in accordance with ASTM C989 for ground granulated blast-furnace slag. Submit test results performed within 6 months of submittal date. Submit manufacturer's policy statement on slag use in concrete.

1.8 SUSTAINABLE DESIGN REQUIREMENTS

1.8.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

1.8.2 Forest Stewardship Council (FSC) Certification

Use FSC-certified wood where specified. Provide letter of certification signed by lumber supplier. Indicate compliance with FSC STD 01 001 and identify certifying organization. Submit FSC certification numbers; identify each certified product on a line-item basis. Submit copies of invoices bearing the FSC certification numbers.

1.9 QUALIFICATIONS FOR CONCRETE TESTING SERVICE

Perform concrete testing by an approved laboratory and inspection service experienced in sampling and testing concrete. Testing agency must meet the requirements of ASTM E 329.

PART 2 PRODUCTS

2.1 MATERIALS FOR FORMS

Provide wood, plywood, plastic, carton, or steel. Use plywood or steel forms where a smooth form finish is required.

2.1.1 Wood Forms

Use lumber as specified in Section 06 10 00 ROUGH CARPENTRY and as follows. Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with DOC/NIST PS1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining.

2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.2 FORM TIES AND ACCESSORIES

The use of wire alone is prohibited. Provide form ties and accessories that do not reduce the effective cover of the reinforcement.

2.2.1 Polyvinylchloride Waterstops

COE CRD-C 572.

2.3 CONCRETE

2.3.1 Contractor-Furnished Mix Design

ACI/MCP-1, ACI/MCP-2, and ACI/MCP-3 and as specified below.

Location	f'c (Min. 28-Day Comp. Strength) (psi)	ASTM C33/C33M Maximum Nominal Aggregate (Size No.)	Range of Slump (inches)	Maximum Water-Cement Ratio (by weight)	Air Entr. (percent)
Floor Slabs	4000	67	4	.45	6
Foundation Walls and Footings	3000	57	4	.50	6
Walks, Curbs, Gutters, Pavement & Utility Structures	3000	67	4	.5	5

Maximum slump shown above may be increased 1 inch for methods of consolidation other than vibration. Slump may be increased to 8 inches when superplasticizers are used. Provide air entrainment using air-entraining admixture. Provide air entrainment within plus or minus 1.5 percent of the value specified.

2.3.1.1 Mix Proportions for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified are the responsibility of the Contractor. Base mixture proportions on compressive strength as determined by test specimens fabricated in accordance with ASTM C192/C192M and tested in accordance with ASTM C39/C39M. Samples of all materials used in mixture proportioning studies must be representative of those proposed for use in the project and must be accompanied by the manufacturer's or producer's test report indicating compliance with these specifications. Base trial mixtures having proportions, consistencies, and air content suitable for the work on methodology described in ACI/MCP-1. In the trial mixture, use at least three different water-cement ratios for each type of mixture, which must produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratio required must be based on equivalent water-cement ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan, and ground granulated blast-furnace slag by weight equivalency method. Design laboratory trial mixture for maximum permitted slump and air content. Each combination of material proposed for use must have separate trial mixture, except for accelerator or retarder use can be provided without separate trial mixture. Report the temperature of concrete in each trial batch. For each water-cement ratio, at least three test cylinders for each test age must be made and cured in accordance with ASTM C192/C192M and tested in accordance with ASTM C39/C39M for 7 and 28 days. From these results, plot a curve showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, plot a curve showing the relationship between 7 and 28 day strengths.

2.3.1.2 Lightweight Concrete Proportion

ACI/MCP-1, using weight method. Provide ASTM C330 aggregates for concrete; 115 pcf (dry) for floors with a 3000 psi minimum compressive strength at 28 days. Provide aggregate size No. 67. Range of slump must be between 2 and 4 inches. Provide 5 - 7 percent air entrainment using an air-entraining admixture. Maximum water-cement ratio must be 0.45.

2.3.1.3 Required Average Strength of Mix Design

The selected mixture must produce an average compressive strength exceeding the specified strength by the amount indicated in ACI/MCP-2. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation must be calculated and the required average compressive strength must be determined in accordance with ACI/MCP-2. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength must follow ACI/MCP-2 requirements.

2.3.2 Ready-Mix Concrete

Provide concrete that meets the requirements of ASTM C94/C94M.

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by ASTM C94/C94M:

Type and brand cement

Cement content in 95-pound bags per cubic yard of concrete

Maximum size of aggregate

Time truck was loaded at plant

Amount and brand name of admixtures

Design mix log in number

Total water content expressed by water/cement ratio

2.3.3 Concrete Curing Materials

2.3.3.1 Absorptive Cover

Provide burlap, cotton mats, and other absorbent materials for curing concrete, as described in ACI 308R.

2.3.3.2 Moisture-Retaining Cover

Provide waterproof paper cover for curing concrete conforming to ASTM C171, regular or white, or polyethylene sheeting conforming to ASTM C171, or polyethylene-coated burlap consisting of a laminate of burlap and a white opaque polyethylene film permanently bonded to the burlap; burlap must conform to ASTM C171, Class 3, and polyethylene film must conform to ASTM C171. When tested for water retention in accordance with ASTM C156, weight of water lost 72 hours after application of moisture retaining covering material must not exceed 0.039 gram per square centimeter of the mortar specimen surface.

2.3.3.3 Membrane-Forming Curing Compound

Provide liquid type compound conforming to ASTM C309, Type 1, clear, Type 1D with fugitive dye for interior work and Type 2, white, pigmented for exterior work.

2.4 MATERIALS

2.4.1 Cement

ASTM C150/C150M, Type I or I. Provide blended cement that consists of a mixture of ASTM C150/C150M, Type II, cement and one of the following materials: ASTM C618 pozzolan or fly ash, ASTM C989 ground granulated blast-furnace slag. For portland cement manufactured in a kiln fueled by hazardous waste, maintain a record of source for each batch. Supplier must certify that no hazardous waste is used in the fuel mix or raw materials. For exposed concrete, use one manufacturer for each type of cement, ground slag, fly ash, and pozzolan.

2.4.1.1 Fly Ash and Pozzolan

ASTM C618, Type F, or C, except that the maximum allowable loss on ignition must be 6 percent for Type F. Add with cement. Fly ash content must be a minimum of 25 percent by weight of cementitious material, provided the fly ash does not reduce the amount of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level, provide the maximum amount of fly ash permittable that meets the code requirements for cement content. Report

the chemical analysis of the fly ash in accordance with ASTM C311. Evaluate and classify fly ash in accordance with ASTM D 5759.

High contents of supplementary cementitious materials can have some detrimental effects on the concrete properties, such as slowing excessively the strength gain rate, and delaying and increasing the difficulty of finishing. The recommended maximum content (by weight of the total cementitious material) for these materials are:

1. For GGBF slag: 50 percent

2. For fly ash or natural pozzolan: 40 percent (25 percent in cold climates)

2.4.1.2 Ground Granulated Blast-Furnace Slag

ASTM C989, Grade 100. Slag content must be a minimum of 25 percent by weight of cementitious material.

2.4.1.3 Portland Cement

Provide cement that conforms to ASTM C150/C150M, Type I, IA, II, or IIA. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

2.4.2 Water

Minimize the amount of water in the mix. The amount of water must not exceed 45 percent by weight of cementitious materials (cement plus pozzolans), and in general, improve workability by adjusting the grading rather than by adding water. Water must be fresh, clean, and potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

2.4.3 Aggregates

ASTM C33/C33M, except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Provide aggregates that do not contain any substance which may be deleteriously reactive with the alkalies in the cement.

2.4.3.1 Aggregates for Lightweight Concrete

ASTM C330.

2.4.4 Nonshrink Grout

ASTM C1107/C1107M.

2.4.5 Admixtures

ASTM C494/C494M: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures.

2.4.5.1 Air-Entraining

ASTM C260/C260M.

2.4.5.2 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C494/C494M, Type F and ASTM C1017/C1017M.

2.4.5.3 Pozzolan

Provide fly ash or other pozzolans used as admixtures that conform to ASTM C618.

2.4.6 Vapor Retarder and Vapor Barrier

ASTM E 1745 Class A polyethylene sheeting, minimum 10 mil thickness or other equivalent material.

Waterproof Paper. Kraft paper, glass reinforcing fibers and layers of polyethylene laminated under heat and pressure to form a single layer meeting the requirements of FS UU-B-790, Type I, Grade A, Style 4; or waterproof paper, regular, conforming to ASTM C171, consisting of two sheets of kraft paper cemented together with bituminous material in which are embedded cords or strands of fiber running in both directions not more than 1 1/4 inch apart.

Consider plastic vapor retarders and adhesives with a high recycled content, low toxicity low VOC (Volatile Organic Compounds) levels.

2.4.7 Materials for Curing Concrete

Use water-based curing compounds, sealers, and coatings with low (maximum 160 grams/liter, less water and less exempt compounds) zero VOC content.

Consider the use of water based or vegetable or soy based curing agents in lieu of petroleum based products. Consider agents that are not toxic and emit low or no Volatile Organic Compounds (VOC). Consider the use of admixtures that offer high performance to increase durability of the finish product but also have low toxicity and are made from bio-based materials such as soy, and emit low levels of Volatile Organic Compounds (VOC).

2.4.7.1 Impervious Sheeting

ASTM C171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.4.7.2 Pervious Sheeting

AASHTO M 182.

2.4.7.3 Liquid Membrane-Forming Compound

ASTM C309, white-pigmented, Type 2, Class B.

2.4.8 Liquid Chemical Sealer-Hardener Compound

Provide surface treatments containing certain chemicals, including sodium silicate and the fluosilicates of magnesium and zinc. Provide compound that does not reduce the adhesion of resilient flooring, tile, paint, roofing, waterproofing, or other material applied to concrete.

2.4.9 Expansion/Contraction Joint Filler

ASTM D 1751, ASTM D 1752, cork or 100 percent post-consumer paper meeting ASTM D 1752 (subparagraphs 5.1 to 5.4). Material must be 1/2 inch thick, unless otherwise indicated.

2.4.9.1 Preformed Joint Filler Strips

Provide nonextruding and resilient bituminous type filler strips conforming to ASTM D 1751.

Provide nonextruding and resilient nonbituminous type filler strips conforming to ASTM D 1752, Type I or II.

2.4.10 Joint Sealants

Use concrete penetrating sealers with a low (maximum 100 grams/liter, less water and less exempt compounds) VOC content.

2.4.10.1 Horizontal Surfaces, 3 Percent Slope, Maximum

ASTM D 6690 or ASTM C920, Type M, Class 25, Use T. ASTM D 7116 for surfaces subjected to jet fuel.

2.4.10.2 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C920, Type M, Grade NS, Class 25, Use T. FS SS-S-200.

2.4.10.3 Waterstops

Provide waterstops that are flat dumbbell type, not less than 3/16 inch for widths up to 5 inches, and not less than 3/8 inch for widths 5 inches and over.

Provide waterstops made of rubber and that conform to ASTM D 1752.

2.4.10.4 Joint Sealant Compound

Provide cold-applied, two-component, elastomeric polymer type compound conforming to FS SS-S-200.

2.4.11 Epoxy Bonding Compound

ASTM C881/C881M. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces. Provide Class A if placement temperature is below 40 degrees F; Class B if placement temperature is between 40 and 60 degrees F; or Class C if placement temperature is above 60 degrees F.

2.4.12 Biodegradable Form Release Agent

Provide form release agent that is colorless, biodegradable, and water-based, with a zero VOC content. A minimum of 85 percent of the total product must be biobased material. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent that does not

contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene.

2.5 REINFORCEMENT

Fabrics, connectors, and chairs.

2.5.1 Reinforcing Bars

ACI/MCP-2 unless otherwise specified. Use deformed steel. ASTM A615/A615M Grade 60ASTM A706/A706M.

2.5.2 Wire

ASTM A82/A82M or ASTM A496/A496M.

2.5.2.1 Welded Wire Fabric

ASTM A185/A185M or ASTM A497/A497M. Provide flat sheets of welded wire fabric for slabs and toppings.

2.5.2.2 Steel Wire

Wire must conform to ASTM A82/A82M.

2.5.3 Reinforcing Bar Supports

Provide bar ties and supports of coated or non corrodible material. Use recycled plastic with 100 percent recycled content.

2.5.4 Chairs and Bolsters: Plastic Steel

Minimum 10 percent post-consumer recycled content, or minimum 20 percent post-industrial recycled content.

2.5.5 Supports for Reinforcement

Supports include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening reinforcing bars and wire fabric in place.

Provide wire bar type supports conforming to ACI/MCP-3, ACI/MCP-4 and CRSI 10MSP.

Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

2.6 BONDING MATERIALS

2.6.1 Concrete Bonding Agent

Provide aqueous-phase, film-forming, nonoxidizing, freeze and thaw-resistant compound agent suitable for brush or spray application conforming to ASTM C932.

2.6.2 Epoxy-Resin Adhesive Binder

Provide two-component, epoxy-polysulfide polymer type binder with an amine-type curing-agent conforming to ASTM C881/C881M.

2.7 FLOOR FINISH MATERIALS

2.7.1 Liquid Chemical Floor Hardener

Hardener must be a colorless aqueous solution containing a blend of magnesium fluorosilicate and zinc fluorosilicate combined with a wetting agent. Solution must contain not less than 1/2 pounds of fluorosilicates per gallon. An approved proprietary chemical hardener may be used provided hardener is delivered ready for use in manufacturer's original containers.

PART 3 EXECUTION

3.1 EXAMINATION

Do not begin installation until substrates have been properly constructed; verify that substrates are plumb and true.

If substrate preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before processing.

Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Architect/Engineer and wait for instructions before beginning installation.

3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before the concrete is poured.

3.2.1 General

Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.

Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

3.2.2 Subgrade Under Foundations and Footings

When subgrade material is semiporous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited. When subgrade material is porous, seal subgrade surface by covering surface with specified vapor retarder; this may also be used over semiporous, dry subgrade material instead of water sprinkling.

3.2.3 Subgrade Under Slabs on Ground

Before construction of slabs on ground, have underground work on pipes and conduits completed and approved.

Previously constructed subgrade or fill must be cleaned of foreign materials and inspected by the Contractor for adequate compaction and surface tolerances as specified.

Actual density of top 12 inches of subgrade soil material-in-place must not be less than the following percentages of maximum density of same soil material compacted at optimum moisture content in accordance with

ASTM D 1557.

SOIL MATERIAL	PERCENT MAXIMUM DENSITY
Capillary water barrier	100
Cohesionless soil material	100
Cohesive soil material	95

Finish surface of capillary water barrier under interior slabs on ground must not show deviation in excess of 1/4 inch when tested with a 10-foot straightedge parallel with and at right angles to building lines.

Finished surface of subgrade or fill under exterior slabs on ground must not be more than 0.02-foot above or 0.10-foot below elevation indicated.

Prepare subgrade or fill surface under exterior slabs on ground as specified for subgrade under foundations and footings.

3.2.4 Formwork

Complete and approve formwork. Remove debris and foreign material from interior of forms before start of concrete placing.

3.2.5 Edge Forms and Screed Strips for Slabs

Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

3.2.6 Reinforcement and Other Embedded Items

Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.

3.3 FORMS

ACI/MCP-2. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete 0.75 inch unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water must be watertight.

3.3.1 General

Construct forms to conform, within the tolerances specified, to shapes dimensions, lines, elevations, and positions of cast-in-place concrete members as indicated. Forms must be supported, braced, and maintained sufficiently rigid to prevent deformation under load.

3.3.2 Design and Construction of Formwork

Provide forms that are tight to prevent leakage of cement paste during concrete placing.

Support form facing materials by structural members spaced close to prevent deflection of form facing material. Fit forms placed in successive units for continuous surfaces to accurate alignment to ensure a smooth completed surface within the tolerances specified. Where necessary to maintain the tolerances specified, such as long spans where immediate supports are not possible, camber formwork for anticipated deflections in formwork due to weight and pressure of fresh concrete and to construction loads.

Chamfer exposed joints, edges, and external corners a minimum of 3/4 inch by moldings placed in corners of column, beam, and wall forms.

Provide shores and struts with a positive means of adjustment capable of taking up formwork settlement during concrete placing operations. Obtain adjustment with wedges or jacks or a combination thereof. When adequate foundations for shores and struts cannot be secured, provide trussed supports.

Provide temporary openings in wall forms, column forms, and at other points where necessary to permit inspection and to facilitate cleaning.

Provide forms that are readily removable without impact, shock, or damage to concrete.

3.3.3 Coating

Before concrete placement, coat the contact surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats of nitrocellulose lacquer. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

3.3.4 Reshoring

Reshore concrete elements where forms are removed prior to the specified time period. Do not permit elements to deflect or accept loads during form stripping or reshoring. Forms on columns, walls, or other load-bearing members may be stripped after 2 days if loads are not applied to the members. After forms are removed, reshore slabs and beams over 10 feet in span and cantilevers over 4 feet for the remainder of the specified time period in accordance with paragraph entitled "Removal of Forms." Perform reshoring operations to prevent subjecting concrete members to overloads, eccentric loading, or reverse bending. Provide reshoring elements with the same load-carrying capabilities as original shoring and spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

3.3.5 Reuse

Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised.

3.3.6 Forms for Standard Rough Form Finish

Give rough form finish concrete formed surfaces that are to be concealed by other construction, unless otherwise specified.

Form facing material for standard rough form finish must be the specified concrete form plywood or other approved form facing material that produces concrete surfaces equivalent in smoothness and appearance to that produced

by new concrete form plywood panels.

For concrete surfaces exposed only to the ground, undressed, square-edge, 1-inch nominal thickness lumber may be used. Provide horizontal joints that are level and vertical joints that are plumb.

3.3.7 Form Ties

Provide ties that are factory fabricated metal, adjustable in length, removable or snap-off type that do allow form deflection or do not spall concrete upon removal. Portion of form ties remaining within concrete after removal of exterior parts must be at least 1-1/2 inches back from concrete surface. Provide form ties that are free of devices that leave a hole larger than 7/8 inch or less than 1/2 inch in diameter in concrete surface. Form ties fabricated at the project site or wire ties of any type are not acceptable.

3.3.8 Tolerances for Form Construction

Construct formwork to ensure that after removal of forms and prior to patching and finishing of formed surfaces, provide concrete surfaces in accordance with tolerances specified in ACI/MCP-1 and ACI/MCP-2.

3.3.9 Removal of Forms and Supports

After placing concrete, forms must remain in place for the time periods specified in ACI/MCP-4. Do not remove forms and shores (except those used for slabs on grade and slip forms) until the client determines that the concrete has gained sufficient strength to support its weight and superimposed loads. Base such determination on compliance with one of the following:

a. The plans and specifications stipulate conditions for removal of forms and shores, and such conditions have been followed, or

b. The concrete has been properly tested with an appropriate ASTM standard test method designed to indicate the concrete compressive strength, and the test results indicate that the concrete has gained sufficient strength to support its weight and superimposed loads.

Prevent concrete damage during form removal. Clean all forms immediately after removal.

3.3.9.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C39/C39M test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached a minimum of 85 percent of the design strength.

3.4 WATERSTOP SPLICES

Fusion weld in the field.

3.5 FORMED SURFACES

3.5.1 Preparation of Form Surfaces

Coat contact surfaces of forms with form-coating compound before

reinforcement is placed. Provide a commercial formulation form-coating compound that does not bond with, stain, nor adversely affect concrete surfaces and impair subsequent treatment of concrete surfaces that entails bonding or adhesion nor impede wetting of surfaces to be cured with water or curing compounds. Do not allow excess form-coating compound to stand in puddles in the forms nor to come in contact with concrete against which fresh concrete is placed. Make thinning of form-coating compound with thinning agent of the type, in the amount, and under the conditions recommended by form-coating compound manufacturer's printed or written directions.

3.5.2 Tolerances

ACI/MCP-4 and as indicated.

3.5.3 As-Cast Form

Provide form facing material producing a smooth, hard, uniform texture on the concrete. Arrange facing material in an orderly and symmetrical manner and keep seams to a practical minimum. Support forms as necessary to meet required tolerances. Do not use material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which can impair the texture of the concrete surface.

3.6 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI/MCP-2. Provide bars, wire fabric, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement must not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

3.6.1 General

Provide details of reinforcement that are in accordance with ACI/MCP-3 and ACI/MCP-4 and as specified.

3.6.2 Vapor Retarder and Vapor Barrier

Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 12 inches and tape. Remove torn, punctured, or damaged vapor retarder and vapor barrier material and provide with new vapor retarder and vapor barrier prior to placing concrete. Concrete placement must not damage vapor retarder and vapor barrier material. Place a 2 inch layer of clean concrete sand on vapor retarder and vapor barrier before placing concrete.

3.6.3 Reinforcement Supports

Place reinforcement and secure with galvanized or non corrodible chairs, spacers, or metal hangers. For supporting reinforcement on the ground, use concrete or other non corrodible material, having a compressive strength equal to or greater than the concrete being placed.

3.6.4 Splicing

As indicated. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 2 inches. AWS D1.4/D1.4M. Approve welded splices prior to use only for ASTM A706 rebar.

3.6.5 Cover

ACI/MCP-2 for minimum coverage, unless otherwise indicated.

3.6.6 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.6.7 Construction Joints

Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated.

3.6.8 Expansion Joints and Contraction Joints

Provide expansion joint at edges of interior floor slabs on grade abutting vertical surfaces, and as indicated. Make expansion joints 1/2 inch wide unless indicated otherwise. Fill expansion joints not exposed to weather with preformed joint filler material. Completely fill joints exposed to weather with joint filler material and joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used. Provide contraction joints, either formed or saw cut or cut with a jointing tool, to the indicated depth after the surface has been finished. Complete saw joints within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

3.6.9 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

Provide fabrication tolerances that are in accordance with ACI/MCP-1, ACI/MCP-2 and ACI/MCP-3.

Provide hooks and bends that are in accordance with ACI/MCP-3 and ACI/MCP-4.

Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not be permitted. Bending must be in accordance with standard approved practice and by approved machine methods.

Tolerance on nominally square-cut, reinforcing bar ends must be in accordance with ACI/MCP-3.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal with bar size, length, mark, and other information pressed in by machine. Marks must correspond with those used on the placing drawings.

Do not use reinforcement that has any of the following defects:

a. Bar lengths, depths, and bends beyond specified fabrication tolerances

b . Bends or kinks not indicated on drawings or approved shop drawings

c. Bars with reduced cross-section due to rusting or other cause

Replace defective reinforcement with new reinforcement having required shape, form, and cross-section area.

3.6.10 Placing Reinforcement

Place reinforcement in accordance with ACI/MCP-3 and ACI/MCP-4.

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire fabric on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion is less than 1 inch from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than 3-1/2 by 3-1/2 inches, and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

Contractor must cooperate with other trades in setting of anchor bolts, inserts, and other embedded items. Where conflicts occur between locating reinforcing and embedded items, the Contractor must notify the COR so that conflicts may be reconciled before placing concrete. Anchors and embedded items must be positioned and supported with appropriate accessories.

3.6.11 Spacing of Reinforcing Bars

Spacing must be as indicated.

Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to approval.

3.6.12 Concrete Protection for Reinforcement

Concrete protection must be in accordance with the ACI/MCP-3 and ACI/MCP-4.

3.7 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

ASTM C94/C94M, and ACI/MCP-2, except as modified herein. Batching equipment must be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.7.1 Measuring

Make measurements at intervals as specified in paragraphs entitled "Sampling" and "Testing."

3.7.2 Mixing

ASTM C94/C94M and ACI/MCP-2. Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 84 degrees F. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 84 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. If the entrained air content falls below the specified limit, add a sufficient quantity of admixture to bring the entrained air content within the specified limits. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

3.7.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.8 PLACING CONCRETE

Place concrete as soon as practicable after the forms and the reinforcement have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other. Position grade stakes on 10 foot centers maximum in each direction when pouring interior slabs and on 20 foot centers maximum for exterior slabs.

3.8.1 General Placing Requirements

Deposit concrete continuously or in layers of such thickness that no concrete is placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as specified. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to procedures which cause segregation.

Concrete to receive other construction must be screeded to proper level to avoid excessive skimming or grouting.

Do not use concrete which becomes nonplastic and unworkable or does not meet quality control limits as specified or has been contaminated by foreign materials. Use of retempered concrete is permitted. Remove rejected concrete from the site.

3.8.2 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the COR. Excavation width must be a minimum of 4 inches greater than indicated.

3.8.3 Vibration

ACI/MCP-2. Furnish a spare, working, vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than 4 inches in depth with high frequency mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate internal vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Penetrate the previously placed lift with the vibrator when more than one lift is required. Use external vibrators on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.

3.8.4 Application of Epoxy Bonding Compound

Apply a thin coat of compound to dry, clean surfaces. Scrub compound into the surface with a stiff-bristle brush. Place concrete while compound is stringy. Do not permit compound to harden prior to concrete placement. Follow manufacturer's instructions regarding safety and health precautions when working with epoxy resins.

3.8.5 Pumping

ACI/MCP-2. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed 2 inches. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of course aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

3.8.5.1 Pumping Lightweight Concrete

ACI/MCP-1. Presoak or presaturate aggregates. Cement content must be minimum of 564 pounds per cubic yard and be sufficient to accommodate a 4 to 6 inch slump.

3.8.6 Cold Weather

ACI/MCP-2. Do not allow concrete temperature to decrease below 50 degrees F. Obtain approval prior to placing concrete when the ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain 50 degrees F minimum adjacent to both the formwork and the

structure while curing. Limit the rate of cooling to 37 degrees F in any 1 hour and 50 degrees F per 24 hours after heat application.

3.8.7 Hot Weather

Maintain required concrete temperature using Figure 2.1.5 in ACI/MCP-2 to prevent the evaporation rate from exceeding 0.2 pound of water per square foot of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.8.8 Follow-up

Check concrete within 24 hours of placement for flatness, levelness, and other specified tolerances. Adjust formwork and placement techniques on subsequent pours to achieve specified tolerances.

3.8.9 Placing Concrete in Forms

Deposit concrete placed in forms in horizontal layers not exceeding 24 inches.

Remove temporary spreaders in forms when concrete placing has reached elevation of spreaders.

Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Provide vibrating equipment adequate in number of units and power of each unit to properly consolidate concrete. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced points not farther apart than visible effectiveness of machine. Do not insert vibrator into lower courses of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of concrete mix.

Do not start placing of concrete in supporting elements until concrete previously placed in columns and walls is no longer plastic and has been in place a minimum of 2 hours.

3.8.10 Placing Concrete Slabs

Place and consolidate concrete for slabs in a continuous operation, within the limits of approved construction joints until placing of panel or section is completed.

During concrete placing operations, consolidate concrete by mechanical vibrating equipment so that concrete is worked around reinforcement and other embedded items and into corners. Consolidate concrete placed in beams and girders of supported slabs and against bulkheads of slabs on

ground by mechanical vibrators as specified. Consolidate concrete in remainder of slabs by vibrating bridge screeds, roller pipe screeds, or other approved method. Limit consolidation operations to time necessary to obtain consolidation of concrete without bringing an excess of fine aggregate to the surface. Concrete to be consolidated must be as dry as practical and surfaces thereof must not be manipulated prior to finishing operations. Bring concrete correct level with a straightedge and struck-off. Use bull floats or darbies to smooth surface, leaving it free of humps or hollows. Sprinkling of water on plastic surface is not permitted.

Provide finish of slabs as specified.

3.8.11 Bonding

Surfaces of set concrete at joints, except where bonding is obtained by use of concrete bonding agent, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of fresh concrete.

At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.

Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

Bonding of fresh concrete to concrete that has set may be obtained by use of a concrete bonding agent. Apply such bonding material to cleaned concrete surface in accordance with approved printed instructions of bonding material manufacturer.

3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.9.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1 square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete must not vary more than the

allowable tolerances of ACI/MCP-4. Exposed surfaces must be uniform in appearance and finished to a smooth form finish unless otherwise specified.

3.9.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

3.9.3 Formed Surfaces

3.9.3.1 Tolerances

ACI/MCP-1 and as indicated.

3.9.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view. Patch these holes and defects and level abrupt irregularities. Remove or rub off fins and other projections exceeding 0.25 inch in height.

3.9.3.3 Standard Smooth Finish

Finish must be as-cast concrete surface as obtained with form facing material for standard smooth finish. Repair and patch defective areas as specified; and all fins and remove other projections on surface.

3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI/MCP-2, unless otherwise specified. Slope floors uniformly to drains where drains are provided. Depress the concrete base slab where quarry tile, ceramic tile, are indicated. Steel trowel and fine-broom finish concrete slabs that are to receive quarry tile, ceramic tile, or paver tile. Where straightedge measurements are specified, Contractor must provide straightedge.

3.10.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.10.1.1 Scratched

Use for surfaces intended to receive bonded applied cementitious applications. After the concrete has been placed, consolidated, struck off, and leveled to a Class C tolerance as defined below,roughen the surface with stiff brushes of rakes before final set.

3.10.1.2 Floated

Use for surfaces to receive roofing, waterproofing membranes, sand bed terrazzo, and exterior slabs where not otherwise specified. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further, until ready for floating. Whether floating with a wood, magnesium, or composite hand float, with a bladed power trowel equipped with float shoes, or with a powered disc, float must begin when

the surface has stiffened sufficiently to permit the operation. During or after the first floating, check surface with a 10 foot straightedge applied at no less than two different angles, one of which is perpendicular to the direction of strike off. Cut down high spots and fill low spots during this procedure to produce a surface level within 1/4 inch in 10 feet.

3.10.1.3 Steel Troweled

Use for floors intended as walking surfaces, and for reception of floor coverings. First, provide a floated finish. Next, the finish must be power troweled two times, and finally hand troweled. The first troweling after floating needs to produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Perform additional trowelings done by hand after the surface has hardened sufficiently. The final troweling is done when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate the surface by the hand troweling operations. The finished surface must be essentially free of trowel marks and uniform in texture and appearance. The finished surface must produce a surface level to within 1/4 inch in 10 feet. On surfaces intended to support floor coverings, remove any defects of sufficient magnitude to show through the floor covering by grinding.

3.10.1.4 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Perform a floated finish, then draw a broom or burlap belt across the surface to produce a coarse scored texture. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3.10.1.5 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by belting. Lay belt flat on the concrete surface and advance with a sawing motion; continue until a uniform but gritty nonslip surface is obtained a burlap drag. Drag a strip of clean, wet burlap from 3 to 10 feet wide and 2 feet longer than the pavement width across the slab. Produce a fine, granular, sandy textured surface without disfiguring marks. Round edges and joints with an edger having a radius of 1/8 inch.

3.10.1.6 Concrete Toppings Placement

The following requirements apply to the placement of toppings of concrete on base slabs that are either freshly placed and still plastic, or on hardened base slabs.

a. Placing on a Fresh Base: Screed and bull float the base slab. As soon as the water sheen has disappeared, lightly rake the surface of the base slab with a stiff bristle broom to produce a bonding surface for the topping. Immediately spread the topping mixture evenly over the roughened base before final set takes place. Give the topping the finish indicated on the drawings or specified herein.

b. Bonding to a Hardened Base: When the topping is to be bonded to a floated or troweled hardened base, roughen the base by scarifying,

grit-blasting, scabbling, planing, flame cleaning, or acid-etching to lightly expose aggregate and provide a bonding surface. Remove dirt, laitance, and loose aggregate by means of a stiff wire broom. Keep the clean base wet for a period of 12 hours preceding the application of the topping. Remove excess water and apply a 1:1:1/2 cement-sand-water grout, and brush into the surface of the base slab. Do not allow the cement grout to dry, and spread it only short distances ahead of the topping placement. Do not allow the temperature differential between the completed base and the topping mixture to exceed 41 degrees F at the time of placing. Place the topping and finish as.

3.10.1.7 Chemical-Hardener Treatment

Apply liquid-chemical floor hardener where indicated after curing and drying concrete surface. Dilute liquid hardener with water and apply in three coats. First coat must be one-third strength, second coat one-half strength, and third coat two-thirds strength. Apply each coat evenly and allow to dry 24 hours between coats.

Approved proprietary chemical hardeners must be applied in accordance with manufacturer's printed directions.

3.10.1.8 Colored Wear-Resistant Finish

3.10.2 Concrete Walks

Provide 4 inches thick minimum. Provide contraction joints spaced every 5 linear feet unless otherwise indicated. Cut contraction joints one inch deep with a jointing tool after the surface has been finished. Provide 0.5 inch thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 50 feet maximum. Give walks a broomed finish. Unless indicated otherwise, provide a transverse slope of 1/48. Limit variation in cross section to 1/4 inch in 5 feet.

3.10.3 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.10.4 Curbs and Gutters

Provide contraction joints spaced every 10 feet maximum unless otherwise indicated. Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum unless otherwise indicated. Perform pavement finish.

3.10.5 Splash Blocks

Provide at outlets of downspouts emptying at grade. Splash blocks may be precast concrete, and must be 24 inches long, 12 inches wide and 4 inches thick, unless otherwise indicated, with smooth-finished countersunk dishes sloped to drain away from the building.

3.11 CURING AND PROTECTION

ACI/MCP-2 unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of

formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Provide moist curing for those areas receiving liquid chemical sealer-hardener or epoxy coating. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs.

3.11.1 General

Protect freshly placed concrete from premature drying and cold or hot temperature and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of cement and proper hardening of concrete.

Start initial curing as soon as free water has disappeared from surface of concrete after placing and finishing. Keep concrete moist for minimum 72 hours.

Final curing must immediately follow initial curing and before concrete has dried. Continue final curing until cumulative number of hours or fraction thereof (not necessarily consecutive) during which temperature of air in contact with the concrete is above 50 degrees F has totaled 168 hours. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, final curing may be terminated when the average compressive strength has reached 70 percent of the 28-day design compressive strength. Prevent rapid drying at end of final curing period.

3.11.2 Moist Curing

Remove water without erosion or damage to the structure. Prevent water run-off.

3.11.2.1 Ponding or Immersion

Continually immerse the concrete throughout the curing period. Water must not be more than 50 degrees F less than the temperature of the concrete. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.11.2.2 Fog Spraying or Sprinkling

Apply water uniformly and continuously throughout the curing period. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.11.2.3 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Provide sheeting that is at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor

over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.11.2.4 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting; overlap and continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

3.11.3 Liquid Membrane-Forming Curing Compound

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Apply in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Provide and maintain compound on the concrete surface throughout the curing period. Do not use this method of curing where the use of Figure 2.1.5 in ACI/MCP-2 indicates that hot weather conditions cause an evaporation rate exceeding 0.2 pound of water per square foot per hour.

3.11.3.1 Application

Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. Mechanically agitate curing compound thoroughly during use. Use approved power-spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the two coats must be 200 square feet maximum per gallon of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound must form a uniform, continuous, coherent film that does not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Re-spray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

3.11.3.2 Protection of Treated Surfaces

Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.11.4 Liquid Chemical Sealer-Hardener

Apply sealer-hardener to interior floors not receiving floor covering and floors located under access flooring. Apply the sealer-hardener in accordance with manufacturer's recommendations. Seal or cover joints and openings in which joint sealant is to be applied as required by the joint sealant manufacturer. Do not apply the sealer hardener until the concrete has been moist cured and has aged for a minimum of 30 days. Apply a minimum of two coats of sealer-hardener.

3.11.5 Requirements for Type III, High-Early-Strength Portland Cement

The curing periods are required to be not less than one-fourth of those specified for portland cement, but in no case less than 72 hours.

3.11.6 Curing Periods

ACI/MCP-2 except 10 days for retaining walls, pavement or chimneys, 21 days for concrete that is in full-time or intermittent contact with seawater, salt spray, alkali soil or waters. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the COR.

3.11.7 Curing Methods

Accomplish curing by moist curing, by moisture-retaining cover curing, by membrane curing, and by combinations thereof, as specified.

Moist curing:

Accomplish moisture curing by any of the following methods:

Keeping surface of concrete wet by covering with water

Continuous water spraying:

Covering concrete surface with specified absorptive cover for curing concrete saturated with water and keeping absorptive cover wet by water spraying or intermittent hosing. Place absorptive cover to provide coverage of concrete surfaces and edges with a slight overlap over adjacent absorptive covers.

Moisture-cover curing:

Accomplish moisture-retaining cover curing by covering concrete surfaces with specified moisture-retaining cover for curing concrete. Place cover directly on concrete in widest practical width, with sides and ends lapped at least 3 inches. Weight cover to prevent displacement; immediately repair tears or holes appearing during curing period by patching with pressure-sensitive, waterproof tape or other approved method.

Membrane curing:

Accomplish membrane curing by applying specified membrane-forming curing compound to damp concrete surfaces as soon as moisture film has disappeared. Apply curing compound uniformly in a two-coat operation by power-spraying equipment using a spray nozzle equipped with a wind guard. Apply second coat in a direction at right angles to direction of first coat. Total coverage for two coats must be not more than 200 square feet per gallon of curing compound. Respray concrete surfaces which are subjected to heavy rainfall within 3 hours after curing compound has been applied by method and at rate specified. Maintain continuity of coating for entire curing period and immediately repair damage to coating during this period.

Membrane-curing compounds must not be used on surfaces that are to be covered with coating material applied directly to concrete or with a covering material bonded to concrete, such as other concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, painting, and other coatings and finish materials.

3.11.8 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.

3.11.9 Curing Unformed Surfaces

Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.

Unless otherwise specified, accomplish final curing of unformed surfaces by any of curing methods specified above, as applicable.

Accomplish final curing of concrete surfaces to receive liquid floor hardener of finish flooring by moisture-retaining cover curing.

3.11.10 Temperature of Concrete During Curing

When temperature of atmosphere is 41 degrees F and below, maintain temperature of concrete at not less than 55 degrees F throughout concrete curing period or 45 degrees F when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 80 degrees F and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 37 degrees F in any 1 hour nor 80 degrees F in any 24-hour period.

3.11.11 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.11.12 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

3.12 FIELD QUALITY CONTROL

3.12.1 Sampling

ASTM C172/C172M. Collect samples of fresh concrete to perform tests specified. ASTM C31/C31M for making test specimens.

3.12.2 Testing

3.12.2.1 Slump Tests

ASTM C143/C143M. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete.

3.12.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.12.2.3 Compressive Strength Tests

ASTM C39/C39M. Make five test cylinders for each set of tests in accordance with ASTM C31/C31M. Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Take samples for strength tests of each mix design of concrete placed each day not less than once a day, nor less than once for each 160 cubic yards of concrete, nor less than once for each 5400 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f'c or if any strength test result falls below f'c by more than 450 psi, take a minimum of three ASTM C42/C42M core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test is considered structurally adequate if the average of three cores is equal to at least 85 percent of f'c and if no single core is less than 75 percent of f'c. Retest locations represented by erratic core strengths. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.12.2.4 Air Content

ASTM C173/C173M or ASTM C231/C231M for normal weight concrete and ASTM C173/C173M for lightweight concrete. Test air-entrained concrete for air content at the same frequency as specified for slump tests.

3.12.2.5 Unit Weight of Structural Lightweight Concrete

ASTM C567. Determine unit weight of lightweight concrete. Perform test for every 20 cubic yards maximum.

3.12.2.6 Strength of Concrete Structure

Compliance with the following is considered deficient if it fails to meet the requirements which control strength of structure in place, including following conditions:

Failure to meet compressive strength tests as evaluated

Reinforcement not conforming to requirements specified

Concrete which differs from required dimensions or location in such a manner as to reduce strength

Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified

Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration

Poor workmanship likely to result in deficient strength

3.12.2.7 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements, make cores drilled from hardened concrete for compressive strength determination in accordance with ASTM C42/C42M, and as follows:

Take at least three representative cores from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the COR.

Test cores after moisture conditioning in accordance with ASTM C42/C42M if concrete they represent is more than superficially wet under service.

Air dry cores, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.

Strength of cores from each member or area are considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

Core specimens will be taken and tested by the Government. If the results of core-boring tests indicate that the concrete as placed does not conform to the drawings and specification, the cost of such tests and restoration required must be borne by the Contractor.

Fill core holes solid with patching mortar and finished to match adjacent concrete surfaces.

Correct concrete work that is found inadequate by core tests in a manner approved by the COR.

3.13 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows.

3.13.1 Mixing Equipment

Before concrete pours, designate Company-owned site meeting environmental standards or on-site area to be paved later in project for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.13.2 Hardened, Cured Waste Concrete

Crush and reuse hardened, cured waste concrete as fill or as a base course for pavement. Use hardened, cured waste concrete as aggregate in concrete mix if approved by COR.

3.13.3 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.13.4 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material. Return excess cement to supplier. Institute deconstruction and construction waste separation and recycling for use in manufacturer's programs. When such a program is not available, seek local recyclers to reclaim the materials.

3.14 JOINTS

3.14.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Locate construction joints as follows:

a. In walls at not more than 60 feet in any horizontal direction; at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall

b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier

c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.

d. In slabs on ground, so as to divide slab into areas not in excess of 1,200 square feet

Provide keyways at least 1-1/2-inches deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

Joints must be perpendicular to main reinforcement. Reinforcement must be continued across construction joints.

3.14.2 Waterstops

Provide waterstops in construction joints as indicated.

Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Make field joints in waterstops in accordance with waterstop manufacturer's printed instructions, as approved. Protect waterstops protruding from joints from damage.

3.14.3 Isolation Joints in Slabs on Ground

Provide joints at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

Fill joints with premolded joint filler strips 1/2 inch thick, extending full slab depth. Install filler strips at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily secured to top of filler strip to form a groove not less than 3/4 inch in depth where joint is sealed with sealing compound and not less than 1/4 inch in depth where joint sealing is not required. Remove wood strip after concrete has set. Contractor must clean groove of foreign matter and loose particles after surface has dried.

3.14.4 Control Joints in Slabs on Ground

Provide joints to form panels as indicated.

Under and on exact line of each control joint, cut 50 percent of welded wire fabric reinforcement before placing concrete.

Joints must be 1/8-inch wide by 1/5 to 1/4 of slab depth and formed by inserting hand-pressed fiberboard strip into fresh concrete until top surface of strip is flush with slab surface or by cutting the concrete with a saw after the concrete has set. After concrete has cured for at least 7 days, the Contractor must remove inserts and clean groove of foreign matter and loose particles.

3.14.5 Sealing Joints in Slabs on Ground

Isolation and control joints which are to receive finish flooring material must be sealed with joint sealing compound after concrete curing period. Slightly underfill groove with joint sealing compound to prevent extrusion of compound. Remove excess material as soon after sealing as possible.

Sealing is not required for isolation and control joints to be covered with finish flooring material. Groove must be left ready to receive filling material that is provided as part of finish floor covering work.

3.15 INSTALLATION OF ANCHORAGE DEVICES

3.15.1 General

Anchorage devices and embedded items required for other work that is attached to, or supported by, set and build in cast-in-place concrete as part of the work of this section, using setting drawings, instructions, and directions for work to be attached thereto.

3.15.2 Placing Anchorage Devices

Anchorage devices and embedded items must be positioned accurately and supported against displacement. Fill openings in anchorage devices such as slots and threaded holes with an approved, removable material to prevent entry of concrete into openings.

3.16 CONCRETE CONVEYING

3.16.1 Transfer of Concrete At Project Site

Handle concrete from point of delivery and transfer to concrete conveying equipment and to locations of final deposit as rapidly as practical by methods which prevent segregation and loss of concrete mix materials.

3.16.2 Mechanical Equipment for Conveying Concrete

Equipment must ensure a continuous flow of concrete at delivery end, as approved. Provide runways for wheeled concrete-conveying equipment from concrete delivery point to locations of final deposit. Interior surfaces of concrete conveying equipment must be free of hardened concrete, debris, water, snow, ice, and other deleterious substances.

3.17 CONCRETE FLOOR TOPPING

3.17.1 Standard Floor Topping

Provide topping for treads and platforms of metal steel stairs and elsewhere as indicated.

Materials

Provide materials that conform to requirements specified, except aggregate must be as follows:

TYPE OF AGGREGATE	SIEVE	PERCENT PASSING
Fine aggregate	3/8 inch	100
	No. 4	95 to 100
	No. 8	80 to 90
	No. 16	50 to 75
	No. 30	30 to 50
	No. 50	10 to 20
	No. 100	2 to 5
Coarse aggregate	1/2 inch	100
	3/8 inch	95 to 100
	No. 4	40 to 60
	No. 8	0 to 5

Standard Topping Mixture

Provide mixture that consists of one part portland cement, one part fine aggregate, and two parts coarse aggregate, by volume. Adjust exact proportions of fine and coarse aggregates to produce a well-graded total aggregate. Mixing water must not exceed 5 gallons per 94-pound sack of cement including unabsorbed moisture in aggregate. Maximum slump must be 2 inches.

Preparations Prior to Placing

When mixture is placed on a green concrete base slab, screed surface of base slab to a level not more than 1-1/2 inches nor less than 1 inch below required finish surface. Remove water and laitance from surface of base slab before placing topping mixture. As soon as water ceases to rise to surface of base slab, place topping mixture as specified.

When mixture is placed on a hardened concrete base slab, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants from base slab surface, leaving a clean surface. Prior to placing topping mixture, (2-1/2-inches minimum) slab surface must be dampened and left free of standing water. Immediately before topping mixture is placed, broom a coat of neat cement grout onto surface of slab. Do not allow cement grout to set or dry before topping mixture is placed.

When mixture is placed on a metal surface, such as metal pans for steel stairs, remove dirt, loose material, oil, grease, asphalt, paint, and other contaminants from metal surface. Immediately before topping mixture is placed, spray or brush a coating of concrete bonding agent onto metal surfaces and do not be allow to set or dry before topping mixture is applied.

Mixing

Do the mixing of topping material at the site in a mechanical mixer of the batch type. Equip batch mixer with a suitable charging hopper, water storage tank, and water-measuring device and must be capable of mixing aggregates, cement, and water into a uniform mix within specified mixing time and of discharging mix without segregation. Provide mixer that bear a rating plate indicating rated capacity and recommended revolutions per minute.

Mix each batch of 2 cubic yards or less for not less than 1-1/2 minutes. Increase mixing time 15 seconds for each additional cubic yard or fraction thereof.

Clean mixer, and replace blades in drum when they have lost 10 percent of their original depth.

Truck-mixed topping may be used when approved. Specify truck-mixed topping for ready-mix concrete.

Placing

Spread standard topping mixture evenly on previously prepared base slab or metal surface, brought to correct level with a straightedge, and struck off. Topping must be consolidated, floated, checked for trueness of surface, and refloated as specified for float finish.

Finishing

Give trowel finish standard floor topping surfaces.

-- End of Section --

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DIVISION 04 - MASONRY

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SECTION 04 20 00

MASONRY

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for reinforced and nonreinforced masonry.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 318	Building Code Requirements for Structural Concrete and Commentary
ACI 318M	Building Code Requirements for Structural Concrete & Commentary
ACI 530/530.1	Building Code Requirements and Specification for Masonry Structures and Related Commentaries
ACI SP-66	ACI Detailing Manual

ASTM INTERNATIONAL (ASTM)

ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A615/A615M	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A641/A641M	Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A82/A82M	Standard Specification for Steel Wire, Plain, for Concrete Reinforcement

ASTM B370	Standard Specification for Copper Sheet and Strip for Building Construction
ASTM C1019	Standard Test Method for Sampling and Testing Grout
ASTM C1072	Standard Test Method for Measurement of Masonry Flexural Bond Strength
ASTM C1142	Standard Specification for Extended Life Mortar for Unit Masonry
ASTM C129	Standard Specification for Nonloadbearing Concrete Masonry Units
ASTM C140	Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
ASTM C144	Standard Specification for Aggregate for Masonry Mortar
ASTM C150/C150M	Standard Specification for Portland Cement
ASTM C207	Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C216	Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C27	Fireclay and High-Alumina Refractory Brick
ASTM C270	Standard Specification for Mortar for Unit Masonry
ASTM C315	Clay Flue Linings
ASTM C476	Standard Specification for Grout for Masonry
ASTM C494/C494M	Standard Specification for Chemical Admixtures for Concrete
ASTM C55	Concrete Brick
ASTM C593	Fly Ash and Other Pozzolans for Use with Lime for Soil Stabilization
ASTM C62	Building Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C641	Staining Materials in Lightweight Concrete Aggregates
ASTM C652	Hollow Brick (Hollow Masonry Units Made from Clay or Shale)
ASTM C67	Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile

ASTM C73	Calcium Silicate Brick (Sand-Lime Brick)
ASTM C780	Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C90	Loadbearing Concrete Masonry Units
ASTM C91	Masonry Cement
ASTM C94/C94M	Standard Specification for Ready-Mixed Concrete
ASTM C989	Standard Specification for Slag Cement for Use in Concrete and Mortars
ASTM D 1972	Standard Practice for Generic Marking of Plastic Products
ASTM D 2000	Standard Classification System for Rubber Products in Automotive Applications
ASTM D 2240	Standard Test Method for Rubber Property - Durometer Hardness
ASTM D 2287	Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 119	Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 2129	Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 514/E 514M	(2009) Standard Test Method for Water Penetration and Leakage Through Masonry

INTERNATIONAL CODE COUNCIL (ICC)

CBC	California Building Code

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	Seismic Design for Buildings

1.3 SYSTEM DESCRIPTION

1.3.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

1.3.2 Design Requirements

1.3.2.1 Unit Strength Method

Compute compressive strength of masonry system "Unit Strength Method", ACI 530/530.1. Submit calculations and certifications of unit and mortar strength.

1.3.2.2 Seismic Requirement

In addition to design requirements of CBC, provide additional seismic reinforcement as detailed on the drawings. The total minimum reinforcing percentage for structural walls shall be 0.20 percent and non-structural walls shall be 0.15 percent. The maximum spacing of reinforcing bars shall be as follows:

Wall Type	Vertical	Horizontal
Structural	24 inches	48 inches
Non-structural	48 inches	80 inches

Bond beams are required at the top of footings, at the bottom and top of openings at roof and floor levels, and at the top of parapet walls.

1.3.2.3 Special Inspection

Perform special inspections and testing for seismic resisting systems and components in accordance with Chapter 17 "Structural Tests and Special Inspections" of current California Building Code.

1.3.2.4 Masonry Strength

Determine masonry strength in accordance with ACI 530/530.1; submit test reports on three prisms as specified in ACI 530/530.1. The cost of testing shall be paid by the Contractor.

1.3.3 Additional Requirements

a. Maintain at least one spare vibrator on site at all times.

b. Provide bracing and scaffolding necessary for masonry work. Design bracing to resist wind pressure as required by local code.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Local/Regional Materials
Cement
Cold Weather Installation

Water-Repellant Admixture

SD-04 Samples

Concrete Masonry Units (CMU)

SD-05 Design Data

Pre-mixed Mortar
Unit Strength Method

SD-06 Test Reports

Efflorescence Test
Field Testing of Mortar
Field Testing of Grout

SD-07 Certificates

Concrete Masonry Units (CMU)
Anchors, Ties, and Bar Positioners
Expansion-Joint Materials
Admixtures for Masonry Mortar
Admixtures for Grout

1.5 QUALITY ASSURANCE

1.5.1 Masonry Inspector Qualifications

A qualified masonry inspector approved by the COR shall perform inspection of the masonry work. Minimum qualifications for the masonry inspector shall be 5 years of reinforced masonry inspection experience or acceptance by a State, municipality, or other governmental body having a program of examining and certifying inspectors for reinforced masonry construction. The masonry inspector shall be present during preparation of masonry prisms, sampling and placing of masonry units, placement of reinforcement (including placement of dowels in footings and foundation walls), inspection of grout space, immediately prior to closing of cleanouts, and during grouting operations. The masonry inspector shall assure compliance with the drawings and specifications. The masonry inspector shall keep a complete record of all inspections and shall submit daily written reports to the Quality Control Supervisory Representative reporting the quality of masonry construction. Submit copies of masonry inspector reports.

1.5.2 Detail Drawings

Submit detail drawings showing bar splice locations. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1/4 inch per foot. Reinforcement bending details shall conform to the requirements of ACI SP-66. Submit drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners

and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; lintels; and wall openings.

1.6 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered, stored, handled, and protected to avoid chipping, breakage, and contact with soil or contaminating material. Store and prepare materials in already disturbed areas to minimize project site disturbance and size of project site.

1.6.1 Masonry Units

Cover and protect moisture-controlled concrete masonry units and cementitious materials from precipitation. Conform to all handling and storage requirements of ASTM C90. Mark prefabricated lintels on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.6.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.6.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Store sand and aggregates in a manner to prevent contamination or segregation.

1.7 PROJECT/SITE CONDITIONS

Conform to ACI 530/530.1 for hot and cold weather masonry erection.

1.7.1 Hot Weather Installation

Take the following precautions if masonry is erected when the ambient air temperature is more than 99 degrees F in the shade and the relative humidity is less than 50 percent or the ambient air temperature exceeds 90 degrees F and the wind velocity is more than 8 mph. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 4 feet ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

1.7.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 40 degrees F or temperature of masonry units is below 40 degrees F, submit a written statement of proposed cold weather construction procedures for approval.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with COR's approval. Submit sample of colored mortar with applicable masonry unit and color samples of three stretcher units and one unit for each type of special shape. Units shall show the full range of color and texture. Submit test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project. Submit certificates of compliance stating that the materials meet the specified requirements.

2.2 CONCRETE MASONRY UNITS (CMU)

Submit samples and certificates as specified. Cement shall have a low alkali content and be of one brand. Units shall be of modular dimensions and air, water, or steam cured. Surfaces of units which are to be plastered or stuccoed shall be sufficiently rough to provide bond; elsewhere, exposed surfaces of units shall be smooth and of uniform texture. Exterior concrete masonry units shall have water-repellant admixture added during manufacture.

a. Hollow Load-Bearing Units: ASTM C90, made with or medium weight aggregate. Provide load-bearing units for exterior walls, foundation walls, load-bearing walls, and shear walls.

2.3 MORTAR FOR STRUCTURAL MASONRY

ASTM C270, Type M or S. Strength (f'm) as indicated. Test in accordance with ASTM C780. Use Type II portland cement. Do not use admixtures containing chlorides. When structural reinforcement is incorporated, maximum air-content shall be 12 percent in cement-lime mortar.

2.4 MASONRY MORTAR

Type M mortar shall conform to ASTM C270 and shall be used for foundation walls, basement walls, and piers. Mortar Type S shall conform to the proportion specification of ASTM C270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate. Type S mortar shall be used for non-load-bearing, non-shear-wall interior masonry; and Type S for remaining masonry work; except where higher compressive strength is indicated on structural drawings. When masonry cement ASTM C91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C780 and ASTM C1072. Pointing mortar in showers and kitchens shall contain ammonium stearate, or aluminum tri-stearate, or calcium stearate in an amount equal to 3 percent by weight of cement used. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.4.1 Admixtures for Masonry Mortar

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C494/C494M, Type C. Submit the required certifications.

2.4.2 Hydrated Lime and Alternates

Hydrated lime shall conform to ASTM C207, Type S or SA.

2.4.3 Cement

Portland cement shall conform to ASTM C150/C150M, Type II. Containers shall bear complete instructions for proportioning and mixing to obtain the required types of mortar.

2.4.4 Pre-Mixed Mortar

Pre-mixed mortar shall conform to ASTM C1142, Type RS or RM. Submit pre-mixed mortar composition.

2.4.5 Sand and Water

Sand shall conform to ASTM C144. Water shall be clean, potable, and free from substances which could adversely affect the mortar.

2.5 WATER-REPELLANT ADMIXTURE

Polymeric type formulated to reduce porosity and water penetration and water absorption of the mortar and masonry units.

2.6 GROUT AND READY-MIXED GROUT

Grout shall conform to ASTM C476, fine or coarse. Cement used in grout shall have a low alkali content. Grout slump shall be between 8 and 10 inches. Minimum grout strength shall be 2000 psi in 28 days, as tested by ASTM C1019. Use grout subject to the limitations of Table III. Do not change proportions and do not use materials with different physical or chemical characteristics in grout for the work unless additional evidence is furnished that the grout meets the specified requirements. Ready-Mixed grout shall conform to ASTM C94/C94M.

2.6.1 Admixtures for Grout

In cold weather, a non-chloride based accelerating admixture may be used subject to approval; accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C494/C494M, Type C. In general, air-entrainment, anti-freeze or chloride admixtures shall not be used except as approved by the COR. Submit required certifications.

2.6.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

2.7 ANCHORS, TIES, AND BAR POSITIONERS

2.7.1 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

2.8 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A615/A615M, Grade 60.

2.9 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 5/8 inch thick and 3/8 inch thick flanges, with a tolerance of plus or minus 1/16 inch. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 30 degrees F after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

2.10 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to Section 07 92 00 JOINT SEALANTS, and shall be penetrating.

PART 3 EXECUTION

3.1 PREPARATION

Prior to start of work, masonry inspector shall verify the applicable conditions as set forth in ACI 530/530.1, inspection. The COR will serve as inspector or will select a masonry inspector.

3.1.1 Protection

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

a. Air Temperature 40 to 32 Degrees F. Sand or mixing water shall be heated to produce mortar temperatures between 40 and 120 degrees F

b. Air Temperature 32 to 25 Degrees F. Sand and mixing water shall be heated to produce mortar temperatures between 40 and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing.

c. Air Temperature 25 to 20 Degrees F. Sand and mixing water shall be heated to provide mortar temperatures between 40 and 120 degrees F. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 15 mph.

d. Air Temperature 20 Degrees F and below. Sand and mixing water shall be heated to provide mortar temperatures between 40 and 120 degrees F. Enclosure and auxiliary heat shall be provided to maintain air temperature above 32 degrees F. Temperature of units when laid shall

not be less than 20 degrees F.

3.1.2 Completed Masonry and Masonry Not Being Worked On

a. Mean daily air temperature 40 to 32 degrees F. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

b. Mean daily air temperature 32 to 25 degrees F. Masonry shall be completely covered with weather-resistant membrane for 24 hours.

c. Mean Daily Air Temperature 25 to 20 degrees F. Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.

d. Mean Daily Temperature 20 degrees F and Below. Masonry temperature shall be maintained above 32 degrees F for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

3.1.3 Stains

Protect exposed surfaces from mortar and other stains. When mortar joints are tooled, remove mortar from exposed surfaces with fiber brushes and wooden paddles. Protect base of walls from splash stains by covering adjacent ground with sand, sawdust, or polyethylene.

3.1.4 Loads

Do not apply uniform loads for at least 12 hours or concentrated loads for at least 72 hours after masonry is constructed. Provide temporary bracing as required.

3.1.5 Surfaces

Clean surfaces on which masonry is to be placed of laitance, dust, dirt, oil, organic matter, or other foreign materials and slightly roughen to provide a surface texture with a depth of at least 1/8 inch. Sandblast, if necessary, to remove laitance from pores and to expose the aggregate.

3.2 LAYING MASONRY UNITS

a. Coordinate masonry work with the work of other trades to accommodate built-in items and to avoid cutting and patching. Masonry units shall be laid in running as indicated bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 1/2 inch. Each unit shall be adjusted to its final position while mortar is still soft and plastic.

b. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb.

c. Units being laid and surfaces to receive units shall be free of water

film and frost. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 1/2 inch into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below.

3.2.1 Forms and Shores

Provide bracing and scaffolding as required. Design bracing to resist wind pressure as required by local codes. Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

3.2.2 Reinforced Concrete Masonry Units Walls

Where vertical reinforcement occurs, fill cores solid with grout. Lay units in such a manner as to preserve the unobstructed vertical continuity of cores to be filled. Embed the adjacent webs in mortar to prevent leakage of grout. Remove mortar fins protruding from joints before placing grout. Minimum clear dimensions of vertical cores shall be 2 by 3 inches. Position reinforcing accurately as indicated before placing grout. As masonry work progresses, secure vertical reinforcing in place at vertical intervals not to exceed 160 bar diameters. Use puddling rod or vibrator to consolidate the grout. Minimum clear distance between masonry and vertical reinforcement shall be not less than 1/2 inch. Unless indicated or specified otherwise, form splices by lapping bars not less than 40 bar diameters and wire tying them together.

3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 Tolerances

Lay masonry plumb, true to line, with courses level. Keep bond pattern plumb throughout. Square corners unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, lay masonry within the following tolerances (plus or minus unless otherwise noted):

TABLE II

TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises	
In adjacent masonry units	1/8 inch
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations from the plumb for external corners, expansion joints, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from the level for exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	
In 20 feet	1/4 inch
In 40 feet or more	1/2 inch

Variation from level for bed joints and top surfaces of bearing walls	
In 10 feet	1/4 inch
In 40 feet or more	1/2 inch

Variations from horizontal lines	
In 10 feet	1/4 inch
In 20 feet	3/8 inch
In 40 feet or more	1/2 inch

Variations in cross sectional dimensions of columns and in thickness of walls	
Minus	1/4 inch
Plus	1/2 inch

3.2.5 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the

masonry bed joints. Reinforced masonry lintels shall be provided above openings over 12 inches wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.6 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.6.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight. Flush joints for architectural units, such as fluted units, shall completely fill both the head and bed joints.

3.2.6.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.6.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 3/8 inch.

3.2.7 Joint Widths

Joint widths shall be as follows:

3.2.7.1 Concrete Masonry Units

Concrete masonry units shall have 3/8 inch joints, except for prefaced concrete masonry units.

3.2.8 Embedded Items

Fill spaces around built-in items with mortar. Point openings around flush-mount electrical outlet boxes in wet locations with mortar. Embed anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in as the masonry work progresses. Fully embed anchors, ties and joint reinforcement in the mortar. Fill cells receiving anchor bolts and cells of the first course below bearing plates with grout.

3.2.9 Unfinished Work

Step back unfinished work for joining with new work. Toothing may be resorted to only when specifically approved. Remove loose mortar and thoroughly clean the exposed joints before laying new work.

3.2.10 Masonry Wall Intersections

Masonry bond each course at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.2.11 Partitions

Partitions shall be continuous from floor to underside of floor or roof deck where shown. Openings in firewalls around joists or other structural members shall be filled as indicated or approved. Where suspended ceilings on both sides of partitions are indicated, the partitions other than those shown to be continuous may be stopped approximately 4 inches above the ceiling level. An isolation joint shall be placed in the intersection between partitions and structural or exterior walls as shown. Interior partitions having 4 inch nominal thick units shall be tied to intersecting partitions of 4 inch units, 5 inches into partitions of 6 inch units, and 7 inches into partitions of 8 inch or thicker units. Cells within vertical plane of ties shall be filled solid with grout for full height of partition or solid masonry units may be used. Interior partitions having masonry walls over 4 inches thick shall be tied together with joint reinforcement. Partitions containing joint reinforcement shall be provided with prefabricated pieces at corners and intersections or partitions.

3.3 MORTAR MIX

Mix mortar in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measure ingredients for mortar by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Mix water with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Retemper mortar that has stiffened because of loss of water through evaporation by adding water to restore the proper consistency and workability. Discard mortar that has reached its initial set or that has not been used within 2.5 hours after mixing.

3.4 REINFORCING STEEL

Clean reinforcement of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 2 inches of tops of walls.

3.4.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 1/2 inch shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.4.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement. COR's approval shall be obtained before welding or mechanically connected reinforcements.

3.5 PLACING GROUT

Fill cells containing reinforcing bars with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.5.1 Vertical Grout Barriers for Fully Grouted Walls

Provide grout barriers not more than 30 feet apart, or as required, to limit the horizontal flow of grout for each pour.

3.5.2 Horizontal Grout Barriers

Embed grout barriers in mortar below cells of hollow units receiving grout.

3.5.3 Grout Holes and Cleanouts

3.5.3.1 Grout Holes

Provide grouting holes in slabs, spandrel beams, and other in-place overhead construction. Locate holes over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Provide additional openings spaced not more than 16 inches on centers where grouting of all hollow unit masonry is indicated. Openings shall not be less than 4 inches in diameter or 3 by 4 inches in horizontal dimensions. Upon completion of grouting operations, plug and finish grouting holes to match surrounding surfaces.

3.5.3.2 Cleanouts for Hollow Unit Masonry Construction

Provide cleanout holes at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 5 feet. Where all cells are to be grouted, construct cleanout courses using bond beam units in an inverted position to permit cleaning of all cells. Provide cleanout holes at a maximum spacing of 32 inches where all cells are to be filled with grout. Establish a new series of cleanouts if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 3 by 4 inch openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, close cleanout holes in an approved manner

to match surrounding masonry.

3.5.4 Grouting Equipment

3.5.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Operate pumps to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon completion of each day's pumping, remove waste materials and debris from the equipment, and dispose of outside the masonry.

3.5.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. Maintain at least one spare vibrator at the site at all times. Apply vibrators at uniformly spaced points not further apart than the visible effectiveness of the machine. Limit duration of vibration to time necessary to produce satisfactory consolidation without causing segregation.

3.5.5 Grout Placement

Lay masonry to the top of a pour before placing grout. Do no place grout in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 5 feet in height. High-lift grout methods shall be used on pours exceeding 5 feet in height.

3.5.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 1/2 inch into the grout space shall be removed before beginning the grouting operation. Grout pours 12 inches or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 12 inches in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.5.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 1/4 inch into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being

immediately encased in the grout lift. The individual lifts of grout shall be limited to 4 feet in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 12 to 18 inches into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (feet) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (in.) (1,2) Multiwythe Masonry (3)	Hollow-unit Masonry
1	Fine	Low Lift	3/4	1-1/2 x 2
5	Fine	Low Lift	2	2 x 3
8	Fine	High Lift	2	2 x 3
12	Fine	High Lift	2-1/2	2-1/2 x 3
24	Fine	High Lift	3	3 x 3
1	Coarse	Low Lift	1-1/2	1-1/2 x 3
5	Coarse	Low Lift	2	2-1/2 x 3
8	Coarse	High Lift	2	3 x 3
12	Coarse	High Lift	2-1/2	3 x 3
24	Coarse	High Lift	3	3 x 4

Notes:

(1) The actual grout space or cell dimension shall be larger than the sum of the following items:

a) The required minimum dimensions of total clear areas given in the table above;

b) The width of any mortar projections within the space;

c) The horizontal projections of the diameters of the horizontal reinforcing bars within a cross section of the grout space or cell.

(2) The minimum dimensions of the total clear areas shall be made up of one or more open areas, with at least one area being 3/4 inch or greater in width.

(3) For grouting spaces between masonry wythes.

(4) Where only cells of hollow masonry units containing reinforcement are grouted, the maximum height of the pour shall not exceed the

distance between horizontal bond beams.

3.6 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 1/2 inch shall be maintained between reinforcement and interior faces of units.

3.7 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using special control-joint units in accordance with the details shown on the drawings. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 3/4 inch; backer rod and sealant shall be installed in accordance with Section 07 92 00 JOINT SEALANTS. Exposed interior control joints shall be raked to a depth of 1/4 inch. Concealed control joints shall be flush cut.

3.8 LINTELS

3.8.1 Masonry Lintels

Construct masonry lintels with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 24 inches, whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 1/2 inch above the bottom inside surface of the lintel unit.

3.9 SILLS AND COPINGS

Sills and copings shall be set in a full bed of mortar with faces plumb and true.

3.10 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, completely remove mortar and grout daubs or splashings from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.10.1 Dry-Brushing

a. Exposed concrete masonry unit

b. shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.11 BEARING PLATES

Set bearing plates for beams, joists, joist girders and similar structural members to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.12 PROTECTION

Protect facing materials against staining. Cover top of walls with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 2 feet down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.13 WASTE MANAGEMENT

Manage waste according to the Waste Management Plan and as follows. Minimize water used to wash mixing equipment. Use trigger operated spray nozzles for water hoses.

3.13.1 Separate and Recycle Waste

Place materials defined as hazardous or toxic waste in designated containers. Fold up metal banding, flatten, and place in designated area for recycling. Collect wood packing shims and pallets and place in designated area. Use leftover mixed mortar as retaining wall footing ballast underground utility pipe kickers where lower strength mortar meets the requirements for bulk fill. Separate masonry waste and place in designated area for use as structural fill. Separate selected masonry waste and excess for landscape uses, either whole or crushed as ground cover.

3.13.2 Take-Back Program

Collect information from manufacturer for take-back program options. Set aside masonry units, full and partial scrap packaging to be returned to manufacturer for recycling into new product. When such a service is not available, local recyclers shall be sought after to reclaim the materials. Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

3.14 TEST REPORTS

3.14.1 Field Testing of Mortar

Take at least three specimens of mortar each day. Spread a layer of mortar 1/2 to 5/8 inch thick on the masonry units and allowed to stand for one

minute. Prepare and test the specimens for compressive strength in accordance with ASTM C780. Submit test results. Testing is not required for structures having 2000 sq. ft. or less of wall area, including openings.

3.14.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 2000 psi at 28 days. Submit test results. Testing is not required for structures having 2000 sq. ft. or less of wall area, including openings.

-- End of Section --

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SECTION 05 12 00

STRUCTURAL STEEL

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for structural steel used in building construction.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	Standard Specifications for Highway Bridges

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 201	AISC Certification Program for Structural Steel Fabricators
AISC 303	Code of Standard Practice for Steel Buildings and Bridges
AISC 325	Steel Construction Manual
AISC 326	Detailing for Steel Construction
AISC 810	Design Guide 10: Erection Bracing of Low-Rise Structural Steel Buildings
ANSI/AISC 341	Seismic Provisions for Structural Steel Buildings
ANSI/AISC 360	Specification for Structural Steel Buildings

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Eng Man	Manual for Railway Engineering

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1/D1.1M	Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B46.1	Surface Texture, Surface Roughness, Waviness and Lay

ASTM INTERNATIONAL (ASTM)

ASTM A108	Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished
ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A143/A143M	Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A193/A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A242/A242M	Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A276	Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A325	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A325M	Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A490	Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength

ASTM A490M	Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A500/A500M	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A501	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A514/A514M	Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A529/A529M	Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A572/A572M	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A588/A588M	Standard Specification for High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A6/A6M	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A618/A618M	Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A668/A668M	Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A709/A709M	Standard Specification for Structural Steel for Bridges
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A992/A992M	Standard Specification for Structural

	Steel Shapes
ASTM B695	Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C1107/C1107M	Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C827/C827M	Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
ASTM F 1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F 436	Hardened Steel Washers
ASTM F 436M	Hardened Steel Washers (Metric)
ASTM F 844	Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959	Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
ASTM F 959M	Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners (Metric)

CRANE MANUFACTURERS ASSOCIATION OF AMERICA (CMAA)

CMAA 70	EnviroTop Running and Bridge and Gantry Type Multiple Girder Electric Overhead Traveling Cranes, No. 70

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	Shop, Field, and Maintenance Painting of Steel
SSPC PS 13.01	Epoxy Polyamide Painting System
SSPC Paint 25	Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
SSPC SP 3	Power Tool Cleaning
SSPC SP 6/NACE No.3	Commercial Blast Cleaning

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.756	Steel Erection; Beams and Columns

1.3 SYSTEM DESCRIPTION

Provide the structural steel system, including shop primer or galvanizing,

as shown on drawings, complete and ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with ANSI/AISC 360 and ANSI/AISC 341 except as modified in this contract.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Erection Plan, including description of temporary supports

Fabrication drawings including description of connections

SD-03 Product Data

Shop primer

Welding electrodes and rods

Load indicator washers

Non-Shrink Grout

Load indicator bolts

Include test report for Class B primer.

SD-06 Test Reports

Class B coating

Bolts, nuts, and washers

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements together with the actual test results for the supplied fasteners.

SD-07 Certificates

Steel

Bolts, nuts, and washers

Galvanizing

AISC Quality Certification

Welding procedures and qualifications

1.5 SEISMIC PROVISIONS

The structural steel system shall be provided in accordance with ANSI/AISC 341.

1.6 QUALITY ASSURANCE

1.6.1 Drawing Requirements

Submit fabrication drawings for approval prior to fabrication. Prepare in accordance with AISC 326 and AISC 325. Fabrication drawings shall not be reproductions of contract drawings. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Double connections that require an erection seat to comply with OSHA 29 CFR 1926.756(c)(1) shall be shown on the shop drawings, reviewed and approved by the structural engineer of record. Use AWS A2.4 standard welding symbols. Member substitutions of details shown on the contract drawings shall be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.6.2 Certifications

1.6.2.1 Erection Plan

Submit for record purposes. Indicate the sequence of erection, temporary shoring and bracing.

1.6.2.2 Welding Procedures and Qualifications

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests. If the qualification date of the welding operator is more than one-year old, the welding operator's qualification certificate shall be accompanied by a current certificate by the welder attesting to the fact that he has been engaged in welding since the date of certification, with no break in welding service greater than 6 months.

Conform to all requirements specified in AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.1 STEEL

2.1.1 Structural Steel

ASTM A36/A36M.

2.1.2 High-Strength Structural Steel

2.1.2.1 Low-Alloy Steel

ASTM A572/A572M, Grade 50. ASTM A992/A992M Grade 50.

2.1.3 Structural Shapes for Use in Building Framing

Wide flange shapes, ASTM A992/A992M.

2.1.4 Structural Steel Tubing

ASTM A500/A500M, Grade B.

2.1.5 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B, weight class STD (Standard).

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 Structural Steel, Steel Pipe

2.2.1.1 Bolts

ASTM A307, Grade A; ASTM A325, Type 1. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications.

2.2.1.2 Nuts

ASTM A563, Grade and Style for applicable ASTM bolt standard recommended.

2.2.1.3 Washers

ASTM F 844 washers for ASTM A307 bolts, and ASTM F 436 washers for ASTM A325 bolts.

2.2.2 High-Strength Structural Steel and Structural Steel Tubing

2.2.2.1 Bolts

ASTM A325, Type 1.

2.2.2.2 Nuts

ASTM A563, Grade and Style as specified in the applicable ASTM bolt standard.

2.2.2.3 Washers

ASTM F 436, plain carbon steel.

2.2.3 Foundation Anchorage

2.2.3.1 Anchor Bolts

ASTM F 1554.

2.2.3.2 Anchor Nuts

ASTM A563, Grade A, hex style.

2.2.3.3 Anchor Washers

ASTM F 844.

2.2.3.4 Anchor Plate Washers

ASTM A36/A36M.

2.2.4 Load Indicator Washers

ASTM F 959.

2.2.5 Load Indicator Bolts

ASTM A325, Type 1; with a manufactured notch between the bolt tip and threads. The bolt shall be designed to react to the opposing rotational torques applied by the installation wrench, with the bolt tip automatically shearing off when the proper tension is obtained.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.

2.3.2 Non-Shrink Grout

ASTM C1107/C1107M, with no ASTM C827/C827M shrinkage. Grout shall be nonmetallic.

2.3.3 Welded Shear Stud Connectors

AWS D1.1/D1.1M.

2.4 SHOP PRIMER

SSPC Paint 25, (alkyd primer) or SSPC PS 13.01 epoxy-polyamide, green primer (Form 150) type 1, except provide a Class B coating in accordance with AISC 325 for slip critical joints. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the surface prior to application of primer.

2.5 GALVANIZING

ASTM A123/A123M or ASTM A153/A153M, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 FABRICATION

2.6.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

2.6.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, surfaces to receive sprayed-on fireproofing, surfaces to receive epoxy coatings, surfaces designed as part of a composite steel concrete section, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a Class B coating. Prior to

assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the COR.

2.6.2.1 Cleaning

SSPC SP 6/NACE No.3, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.6.2.2 Primer

Apply primer to a minimum dry film thickness of 2.0 mil except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

2.6.3 Fireproofing and Epoxy Coated Surfaces

Surfaces to receive sprayed-on fireproofing epoxycoatings shall be cleaned and prepared in accordance with the manufacturer's recommendations.

2.7 DRAINAGE HOLES

Adequate drainage holes shall be drilled to eliminate water traps. Hole diameter shall be 1/2 inch and location shall be indicated on the detail drawings. Hole size and location shall not affect the structural integrity.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC 325. Fabrication and assembly shall be done in the shop to the greatest extent possible.

Compression joints depending on contact bearing shall have a surface roughness not in excess of 500 micro inch as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A6/A6M.

Structural steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with endorsement "P" of AISC 201 and primed with the specified paint.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the COR.

3.2 ERECTION

a. For low-rise structural steel buildings (60 feet tall or less and a maximum of 2 stories), the erection plan shall conform to AISC 303 and

the structure shall be erected in accordance withAISC 810.

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.2.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.3 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with ANSI/AISC 360. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member. Holes shall not be cut or enlarged by burning. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.3.1 Common Grade Bolts

ASTM A307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the COR for further instructions.

3.3.2 High-Strength Bolts

Provide load indicator bolts or washers in all ASTM A325M or ASTM A490 bolted connections, except provide only load indicator washers for slip critical connections. Direct tension indicator tightening, shall be the only acceptable tightening methods. Use only direct tension indicator tightening for slip critical connections. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.3.2.1 Installation of Load Indicator Washers (LIW)

ASTM F 959. Where possible, the LIW shall be installed under the bolt head and the nut shall be tightened. If the LIW is installed adjacent to the turned element, provide a flat ASTM F 436 washer between the LIW and nut when the nut is turned for tightening, and between the LIW and bolt head when the bolt head is turned for tightening. In addition to the LIW, provide flat ASTM F 436 washers under both the bolt head and nut when ASTM A490 bolts are used.

3.4 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors will not be permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the COR.

3.5 WELDING

AWS D1.1/D1.1M. Grind exposed welds smooth as indicated. Provide AWS D1.1/D1.1M qualified welders, welding operators, and tackers.

The Contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

3.5.1 Removal of Temporary Welds, Run-Off Plates, and Backing Strips

Remove only from finished areas.

3.6 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.6.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

3.7 GALVANIZING REPAIR

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.8 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing, except that electric power for field tests will be furnished as set forth in Division 1. The COR shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.8.1 Welds

3.8.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

The Contractor's independent inspector shall inspect proper preparation, size, gaging location, and acceptability of welds; identification marking; operation and current characteristics of welding sets in use. The Government shall be notified in advance for observation.

3.8.1.2 Nondestructive Testing

AWS D1.1/D1.1M. Test locations shall be as indicated or selected by the COR. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the COR. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

Testing frequency: Provide the following types and number of tests:

Test Type	Number of Tests
Radiographic (complete penetration butt joints.	100%
Ultrasonic (all other complete penetrations)	100%
Magnetic Particle (fillet welds)	25%
Dye Penetrant (fillet welds)	25%

3.8.2 Load Indicator Washers

3.8.2.1 Load Indicator Washer Compression

Load indicator washers shall be tested in place to verify that they have been compressed sufficiently to provide the 0.015 inch gap when the load indicator washer is placed under the bolt head and the nut is tightened, and to provide the 0.005 inch gap when the load indicator washer is placed under the turned element, as required by ASTM F 959.

3.8.3 High-Strength Bolts

3.8.3.1 Inspection

Inspection procedures shall be in accordance with ANSI/AISC 360 . Confirm and report to the COR that the materials meet the project specification and that they are properly stored. Confirm that the faying surfaces have been properly prepared before the connections are assembled. Observe the specified job site testing and calibration, and confirm that the procedure to be used provides the required tension. Monitor the work to ensure the testing procedures are routinely followed on joints that are specified to be fully tensioned.

Inspection by the Government will include calibration of torque wrenches for high-strength bolts.The Contractor shall inspect calibration of torque wrenches for high-strength bolts.

3.8.3.2 Testing

The Government has the option to have the Contractor's independent inspector to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the COR. If more than 10

percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested. Retest new bolts after installation.

3.8.4 Testing for Embrittlement

ASTM A143/A143M for steel products hot-dip galvanized after fabrication.

-- End of Section --

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DIVISION 05 - METALS

SECTION 05 30 00

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SECTION 05 30 00

STEEL DECKS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for steel floor and roof decks, including accessories.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

ANSI/AISC 360	Specification for Structural Steel Buildings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI D100	Cold-Formed Steel Design Manual
AISI SG03-3	Cold-Formed Steel Design Manual Set

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code - Steel
AWS D1.3/D1.3M	Structural Welding Code - Sheet Steel

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A1011/A1011M	Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability and Ultra-High Strength
ASTM A108	Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A792/A792M	Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
ASTM C423	Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM D 1056	Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1149	Standard Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber
ASTM D 746	Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM APP GUIDE	Approval Guide http://www.approvalguide.com/
FM DS 1-28	Design Wind Loads

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

STEEL DECK INSTITUTE (SDI)

SDI 31	Design Manual for Composite Decks, Form Decks, and Roof Decks
SDI DDMO3	Diaphragm Design Manual; 3rd Edition
SDI DDP	Deck Damage and Penetrations

SDI MOC2	Manual of Construction with Steel Deck

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 20	Zinc-Rich Primers (Type I, Inorganic, and Type II, Organic)

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-301-01	Structural Engineering

UNDERWRITERS LABORATORIES (UL)

UL 209	Cellular Metal Floor Raceways and Fittings
UL 580	Tests for Uplift Resistance of Roof Assemblies
UL Bld Mat Dir	Building Materials Directory

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings

Metal Floor Deck Units

Cant Strips

Ridge and Valley Plates

Metal Closure Strips

SD-03 Product Data

Accessories

Deck Units

Galvanizing Repair Paint

Joint Sealant Material

Mechanical Fasteners

Metal Floor Deck Units

Repair Paint

Welder Qualifications

Welding Equipment

Welding Rods and Accessories

SD-05 Design Data

Deck Units

Submit manufacturer's design calculations, or applicable published literature for the structural properties of the proposed deck units.

SD-07 Certificates

Welding Procedures

Fire Safety

Wind Storm Resistance

1.4 QUALITY ASSURANCE

1.4.1 Deck Units

Furnish deck units and accessory products from a manufacturer regularly engaged in manufacture of steel decking. Provide manufacturer's certificates attesting that the decking material meets the specified requirements.

1.4.2 Qualifications for Welding Work

Follows Welding Procedures in accordance with AWS D1.1/D1.1M.

Submit qualified Welder Qualifications in accordance with AWS D1.1/D1.1M, or under an equivalent approved qualification test.

1.4.3 Regulatory Requirements

1.4.3.1 Fire Safety

Test roof deck as a part of a roof deck construction assembly of the type used for this project, listing as fire classified in the UL Bld Mat Dir, or listing as Class I construction in the FM APP GUIDE, and so labeled.

1.4.3.2 Wind Storm Resistance

Provide roof construction assembly capable of withstanding an uplift pressure of 60 pounds per square foot when tested in accordance with the uplift pressure test described in the FM DS 1-28 or as described in UL 580 and in general compliance with UFC 3-301-01.

1.4.4 Fabrication Drawings

Show type and location of units, location and sequence of connections, bearing on supports, methods of anchoring, attachment of accessories, adjusting plate details, size and location of holes to be cut and reinforcement to be provided, the manufacturer's erection instructions and other pertinent details.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver deck units to the site in a dry and undamaged condition. Store and

handle steel deck in a manner to protect it from corrosion, deformation, and other types of damage. Do not use decking for storage or as working platform until units have been fastened into position. Exercise care not to damage material or overload decking during construction. The maximum uniform distributed storage load must not exceed the design live load. Stack decking on platforms or pallets and cover with weathertight ventilated covering. Elevate one end during storage to provide drainage. Maintain deck finish at all times to prevent formation of rust. Repair deck finish using touch-up paint. Replace damaged material.

1.6 DESIGN REQUIREMENTS FOR ROOF DECKS

1.6.1 Properties of Sections

Properties of metal roof deck sections must comply with engineering design width as limited by the provisions of AISI D100.

1.6.2 Allowable Loads

Indicate total uniform dead and live load for detailing purposes.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel Sheet

Flat rolled carbon steel sheets of structural quality, thickness not less than indicated meeting the requirements of AISI SG03-3, except as modified herein.

2.1.2 Steel Coating

ASTM A653/A653M designation G90 galvanized. Apply coating to both sides of sheet. Conform to UL 209 for coating on decking provided as wire raceways.

2.1.3 Mixes

2.1.3.1 Galvanizing Repair Paint for Floor Decks

Provide a high-zinc-dust content paint for regalvanizing welds in galvanized steel conforming to ASTM A780/A780M.

2.1.4 Galvanized Steel Angles for Roof Decks

Provide hot-rolled carbon steel angles conforming to ASTM A36/A36M, merchant quality, Grade Designation SAE/AISI 1023 or SAE/AISI 1025, and hot-dip galvanized in accordance with ASTM A123/A123M.

2.1.5 Joint Sealant Material for Roof Decks

Provide a nonskinning, gun-grade, bulk compound material as recommended by the manufacturer.

2.1.6 Galvanizing Repair Paint for Roof Decks

Provide a high zinc-dust content paint for regalvanizing welds in galvanized steel and shall conform to ASTM A780/A780M.

2.2 ACCESSORIES

Provide accessories of same material as deck, unless specified otherwise. Provide manufacturer's standard type accessories, as specified.

2.2.1 Adjusting Plates

Provide adjusting plates, or segments of deck units, of same thickness and configuration as deck units in locations too narrow to accommodate full size units. Provide factory cut plates of predetermined size where possible.

2.2.2 End Closures

Fabricated of sheet metal by the deck manufacturer. Provide end closures minimum 0.028 inch thick to close open ends at exposed edges of floors, parapets, end walls, eaves, and openings through deck.

2.2.3 Closure Plates for Composite Deck

Support and retain concrete at each floor level. Provide edge closures at all edges of the slab of sufficient strength and stiffness to support the wet concrete. Provide metal closures for all openings in composite steel deck 1/4 inch and over.

2.2.4 Sheet Metal Collar

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.2.5 Cover Plates

Sheet metal to close panel edge and end conditions, and where panels change direction or butt. Polyethylene-coated, self-adhesive, 2 inch wide joint tape may be provided in lieu of cover plates on flat-surfaced decking butt joints.

Fabricate cover plates for abutting floor deck units from the specified structural-quality steel sheets not less than nominalthick before galvanizing. Provide 6 inch wide cover plates and form to match the contour of the floor deck units.

2.2.6 Roof Sump Pans

Sump pans must be provided for roof drains and must be minimum 0.075 inch thick steel, flat or recessed type. Shape sump pans to meet roof slope by the supplier or by a sheet metal specialist. Provide bearing flanges of sump pans to overlap steel deck a minimum of 3 inch. Shape, size, and reinforce the opening in bottom of the sump pan to receive roof drain.

2.2.7 Column Closures

Sheet metal, minimum 0.0358 inch thick or metal rib lath.

2.2.8 Access Hole Covers

Sheet metal, minimum 0.0474 inch thick.

2.2.9 Miscellaneous Accessories

Furnish the manufacturer's standard accessories to complete the deck installation. Furnish metal accessories of the same material as the deck and with the minimum design thickness as follows: saddles, 0.0474 inch welding washers, 0.0598 inch cant strip, 0.0295 inch other metal accessories, 0.0358 inch unless otherwise indicated. Accessories must include but not be limited to saddles, welding washers, fasteners, cant strips, butt cover plates, underlapping sleeves, and3.3
2. ridge and valley plates.

2.3 FABRICATION

2.3.1 Length of Floor Deck Units

Provide floor deck units of sufficient length to span three or more spacings where possible.

2.3.2 Roof Deck

Fabricate roof deck units of the steel design thickness required by the design drawings and galvanized zinc-coated in conformance with ASTM A653/A653M, G90 coating class.

2.3.2.1 Cant Strips for Roof Decks

Fabricate cant strips from the specified commercial-quality steel sheets not less than nominal 0.0359 inch thick before galvanizing. Bend strips to form a 45-degree cant not less than 5 inch wide, with top and bottom flanges a minimum 3 inch wide. Length of strips 10 feet.

2.3.2.2 Ridge and Valley Plates for Roof Decks

Fabricate plates from the specified structural-quality steel sheets, not less than nominal 0.0359 inch thick before galvanizing. Provide plates of minimum 4-1/2 inch wide and bent to provide tight fitting closures at ridges and valleys. Provide a minimum length of ridge and valley plates of 10 feet.

2.3.2.3 Metal Closure Strips for Roof Decks

Fabricate strips from the specified commercial-quality steel sheets not less than nominal 0.0359 inch thick before galvanizing. Provide strips from the configuration required to provide tight-fitting closures at open ends and sides of steel roof decking.

2.3.3 Touch-Up Paint

Provide touch-up paint for zinc-coated units of an approved galvanizing repair paint with a high-zinc dust content. Touch-up welds with paint conforming to SSPC Paint 20 in accordance with ASTM A780/A780M. Maintain finish of deck units and accessories by using touch-up paint whenever necessary to prevent the formation of rust.

For floor decking installation, wire brush, clean, and touchup paint the scarred areas on the top and bottom surfaces of the metal floor decking and on the surface of supporting steel members. Include welds, weld scars, bruises, and rust spots for scarred areas. Touched up the galvanized surfaces with galvanizing repair paint.

After roof decking installation, wire brush, clean, and touchup paint the scarred areas on top and bottom surfaces of metal roof decking. The scarred areas include welds, weld scars, bruises, and rust spots. Touchup galvanized surfaces with galvanizing repair paint.

PART 3 EXECUTION

3.1 EXAMINATION

Prior to installation of decking units and accessories, examine worksite to verify that as-built structure will permit installation of decking system without modification.

3.2 INSTALLATION

Install steel deck units in accordance with SDI DDMO3 and approved shop drawings. Place units on structural supports, properly adjusted, leveled, and aligned at right angles to supports before permanently securing in place. Damaged deck and accessories including material which is permanently stained or contaminated, deformed, or with burned holes shall not be installed. Extend deck units over three or more supports unless absolutely impractical. Report inaccuracies in alignment or leveling to the COR and make necessary corrections before permanently anchoring deck units. Locate deck ends over supports only. Ends of floor deck may be lapped or butted. Do not use unanchored deck units as a work or storage platform. Do not fill unanchored deck with concrete. Permanently anchor units placed by the end of each working day. Do not support suspended ceilings, light fixtures, ducts, utilities, or other loads by steel deck unless indicated. Distribute loads by appropriate means to prevent damage.

3.2.1 Attachment

Immediately after placement and alignment, and after correcting inaccuracies, permanently fasten steel deck units to structural supports and to adjacent deck units by welding with normal 5/8 inch diameter puddle welds as indicated on the design drawings and in accordance with manufacturer's recommended procedure. Clamp or weight deck units to provide firm contact between deck units and structural supports while performing welding. Anchoring the deck to structural supports with powder-actuated fasteners or pneumatically driven fasteners is prohibited. Attachment of adjacent deck units by button-punching is prohibited.

3.2.1.1 Welding

Perform welding in accordance with AWS D1.3/D1.3M using methods and electrodes recommended by the manufacturers of the base metal alloys being used. Ensure only operators previously qualified by tests prescribed in AWS D1.1/D1.1M and AWS D1.3/D1.3M make welds. Immediately recertify, or replace qualified welders, that are producing unsatisfactory welding. Do not use welding washers at the connections of the deck to supports. Do not use welding washers at sidelaps. Holes and similar defects will not be acceptable. Lap 2 inch or butted deck ends. Attach all partial or segments of deck units to structural supports in accordance with Section 2.5 of SDI DDMO3. Attach shear connectors as shown and welded as per AWS D1.1/D1.1M through the steel deck to the steel member. Immediately clean welds by chipping and wire brushing. Heavily coat welds, cut edges and damaged portions of coated finish with zinc-dust paint conforming to ASTM A780/A780M finish with the manufacturer's standard touch-up paint.

3.2.1.2 Fastening Floor Deck Units

Fasten floor deck units to the steel supporting members at ends and at all intermediate supports, both parallel and perpendicular to deck span, by welds as indicated on the drawings. Blow holes shall be cause for rejection.

3.2.2 Openings

Cut or drill all holes and openings required and be coordinated with the drawings, specifications, and other trades. Frame and reinforce openings through the deck in conformance with SDI DDP. Reinforce holes and openings 6 to 12 inch across by 0.0474 inch thick steel sheet at least 12 inch wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 6 inch on center. Reinforce holes and openings larger than 12 inch by steel channels or angles installed perpendicular to the steel joists and supported by the adjacent steel joists. Install steel channels or angles perpendicular to the deck ribs and fasten to the channels or angles perpendicular to the steel joists. Deck manufacturer shall approve holes or openings larger than 6 inch in diameter prior to drilling or cutting. Openings must not interfere with seismic members such as chords and drag struts.

3.2.3 Deck Damage

SDI MOC2, for repair of deck damage.

3.2.4 Accessory Installation

3.2.4.1 Adjusting Plates

Provide in locations too narrow to accommodate full-size deck units and install as shown on shop drawings.

3.2.4.2 End Closures

Provide end closure to close open ends of cells at columns, walls, and openings in deck.

3.2.4.3 Cover Plates

Where concrete leakage would be a problem, provide metal cover plates, or joint tape, at joints between decking sheets, cellular or noncellular, to be covered with concrete fill.

3.2.4.4 Column Closures

Provide for spaces between floor decking and columns which penetrate the deck. Field cut closure plate to fit column in the field and tack weld to decking and columns.

3.2.4.5 Access Hole Covers

Provide to seal holes cut in decking to facilitate welding of decking to structural supports.

3.2.5 Concrete Work

Prior to placement of concrete, inspect installed decking to ensure that there has been no permanent deflection or other damage to decking. Replace decking which has been damaged or permanently deflected as approved by the COR. Place concrete on metal deck in accordance with Construction Practice of SDI 31.

3.2.6 Preparation of Fire-Proofed Surfaces

Provide deck surfaces, both composite and noncomposite, which are to receive sprayed-on fireproofing, galvanized and free of all grease, mill oil, paraffin, dirt, salt, and other contaminants which impair adhesion of the fireproofing. Complete any required cleaning prior to steel deck installation using a cleaning method that is compatible with the sprayed-on fireproofing.

3.3 JOINT SEALING FOR ROOF DECKS

Seal sidelaps and endlaps with manufacturer's recommended joint sealing material. Shop or field apply the material. Before applying the sealing material, completely remove dust, dirt, moisture, and other foreign material from the surfaces to which the sealing material is to be applied. Apply sealing material in strict accordance with the sealing material manufacturer's printed instructions.

3.4 ROOF SUMP PANS

Place sump pans over openings in roof decking and fusion welded to top surface of roof decking. Do not exceed spacing of welds of 12 inch with not less than one weld at each corner. Field cut opening in the bottom of each roof sump pan to receive the roof drain as part of the work of this section.

3.5 CANT STRIPS FOR ROOF DECKS

Provide strips to be fusion welded to surface of roof decking, secured to wood nailers by galvanized screws or to steel framing by galvanized self-tapping screws or welds. Do not exceed spacing of welds and fasteners of 12 inch. Lap end joints a minimum 3 inch and secure with galvanized sheet metal screws spaced a maximum 4 inch on center.

3.6 RIDGE AND VALLEY PLATES FOR ROOF DECKS

Provide plates to be fusion welded to top surface of roof decking. Lap end joints a minimum 3 inch. For valley plates, provide endlaps to be in the direction of water flow.

3.7 CLOSURE STRIPS FOR ROOF DECKS

Provide closure strips at open, uncovered ends and edges of the roof decking and in voids between roof decking and top of walls and partitions where indicated. Install closure strips in position in a manner to provide a weathertight installation.

3.8 ROOF INSULATION SUPPORT FOR ROOF DECKS

Provide metal closure strips for support of roof insulation where rib openings in top surface of metal roof decking occur adjacent to edges and

openings. Weld metal closure strips in position.

3.9 CLEANING AND PROTECTION FOR ROOF DECKS

Upon completion of the deck, sweep surfaces clean and prepare for installation of the roofing.

3.10 FIELD QUALITY CONTROL

3.10.1 Decks Not Receiving Concrete

Inspect the decking top surface for distortion after installation. For roof decks not receiving concrete, verify distortion by placing a straight edge across three adjacent top flanges. The maximum allowable gap between the straight edge and the top flanges is 1/16 inch; when gap is more than 1/16 inch, provide corrective measures or replacement. Reinspect decking after performing corrective measures or replacement.

-- End of Section --

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SECTION 05 50 13

MISCELLANEOUS METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for miscellaneous metalwork.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	Designation System for Aluminum Finishes

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 303	Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-10	Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF SAFETY ENGINEERS (ASSE/SAFE)

ASSE/SAFE A10.3	Operations - Safety Requirements for Powder Actuated Fastening Systems

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code - Steel

ASME INTERNATIONAL (ASME)

ASME B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	Standard for Square and Hex Nuts
ASME B18.21.1	Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series)
ASME B18.21.2M	Lock Washers (Metric Series)

ASME B18.22M	Metric Plain Washers
ASME B18.6.2	Slotted Head Cap Screws, Square Head Set Screws, and Slotted Headless Set Screws: Inch Series
ASME B18.6.3	Machine Screws and Machine Screw Nuts

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A283/A283M	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A36/A36M	Standard Specification for Carbon Structural Steel
ASTM A467/A467M	Standard Specification for Machine Coil Chain
ASTM A47/A47M	Standard Specification for Ferritic Malleable Iron Castings
ASTM A475	Standard Specification for Zinc-Coated Steel Wire Strand
ASTM A48/A48M	Standard Specification for Gray Iron Castings
ASTM A500/A500M	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A786/A786M	Standard Specification for Hot-Rolled

	Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates
ASTM A924/A924M	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 108/B 108M	Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM B 209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 26/B 26M	Standard Specification for Aluminum-Alloy Sand Castings
ASTM C 1513	Standard Specification for Steel Tapping Screws for Cold-Formed Steel Framing Connections
ASTM D 1187	Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM D 2047	Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine
ASTM E 488	Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F 1267	Metal, Expanded, Steel

MASTER PAINTERS INSTITUTE (MPI)

MPI 79	Alkyd Anti-Corrosive Metal Primer

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	Metal Bar Grating Manual
NAAMM MBG 532	Heavy Duty Metal Bar Grating Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211	Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 3	Power Tool Cleaning
SSPC SP 6/NACE No.3	Commercial Blast Cleaning

OCCUPATIONAL SAFETY & HEALTH ASSOCIATION (OSHA)

29 CFR 1910.27	Fixed Ladders

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication drawings of structural steel door frames, metal railing
Access doors and panels, installation drawings
Cover plates and frames, installation drawings

Floor gratings, installation drawings

Window and door guards, installation drawings

Embedded angles and plates, installation drawings

Roof hatch

Steel shapes, plates, bars and strips

Submit fabrication drawings showing layout(s), connections to structural system, and anchoring details as specified in AISC 303.

Submit templates, erection and installation drawings indicating thickness, type, grade, class of metal, and dimensions. Show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Access doors and panels

Cover plates and frames

Control-joint covers

Expansion joint covers

Floor gratings and roof walkways

Structural steel door frames

Steel shapes, plates, bars and strips

Wheel guards

Window and door guards

Roof hatch

Anchorage and fastening system

Aluminum railings and handrails

SD-04 Samples

Expansion joint covers

Floor grating

Control-joint covers

Provide full size samples, taken from manufacturer's stock, and be complete as required for installation in the structure. Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

1.4 QUALIFICATION OF WELDERS

Qualify welders in accordance with AWS D1.1/D1.1M. Use procedures, materials, and equipment of the type required for the work.

1.5 DELIVERY, STORAGE, AND PROTECTION

Protect from corrosion, deformation, and other types of damage. Store items in an enclosed area free from contact with soil and weather. Remove and replace damaged items with new items.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Structural Carbon Steel

ASTM A36/A36M.

2.1.2 Structural Tubing

ASTM A500/A500M.

2.1.3 Steel Pipe

ASTM A53/A53M, Type E or S, Grade B.

2.1.4 Fittings for Steel Pipe

Standard malleable iron fittings ASTM A47/A47M.

2.1.5 Floor Gratings

a. Metal bar type grating NAAMM MBG 531.

2.1.6 Floor Plates, Patterned

Floor plate ASTM A786/A786M. Steel plate shall not be less than 14 gage.

2.1.7 Anchor Bolts

ASTM A307. Where exposed, shall be of the same material, color, and finish as the metal to which applied.

2.1.7.1 Expansion Anchors, Sleeve Anchors, Adhesive Anchors

Provide expansion anchors, sleeve anchors and adhesive anchors as indicated on drawings. Minimum concrete and masonry embedment shall be as indicated on drawings. Design values listed shall be as tested according to ASTM E 488.

a. Minimum allowable pullout value shall be per ACI 318 Appendix D.

b. Minimum ultimate shear value shall be per ACI 318 Appendix D.

2.1.7.2 Lag Screws and Bolts

ASME B18.2.1, type and grade best suited for the purpose, as indicated on the drawings.

2.1.7.3 Toggle Bolts

ASME B18.2.1.

2.1.7.4 Bolts, Nuts, Studs and Rivets

ASME B18.2.2 or ASTM A307.

2.1.7.5 Powder Actuated Fasteners

Follow safety provisions of ASSE/SAFE A10.3.

2.1.7.6 Screws

ASME B18.2.1, ASME B18.6.2, ASME B18.6.3 and ASTM C 1513.

2.1.7.7 Washers

Provide plain washers to conform to ASME B18.21.1. Provide beveled washers for American Standard beams and channels, square or rectangular, tapered in thickness, and smooth. Provide lock washers to conform to ASME B18.21.1.

2.1.8 Aluminum Alloy Products

Conform to ASTM B 209 for sheet plate, ASTM B 221 for extrusions and ASTM B 26/B 26M or ASTM B 108/B 108M for castings, as applicable. Provide aluminum extrusions at least 1/8 inch thick and aluminum plate or sheet at least 0.050 inch thick.

2.2 FABRICATION FINISHES

2.2.1 Galvanizing

Hot-dip galvanize items specified to be zinc-coated, after fabrication where practicable. Galvanizing: ASTM A123/A123M, ASTM A153/A153M, ASTM A653/A653M or ASTM A924/A924M, G90, as applicable.

2.2.2 Galvanize

Anchor bolts, grating fasteners, washers, and parts or devices necessary for proper installation, unless indicated otherwise.

2.2.3 Repair of Zinc-Coated Surfaces

Repair damaged surfaces with galvanizing repair method and paint conforming to ASTM A780/A780M or by application of stick or thick paste material specifically designed for repair of galvanizing, as approved by COR. Clean areas to be repaired and remove slag from welds. Heat surfaces to which stick or paste material is applied, with a torch to a temperature sufficient to melt the metallics in stick or paste; spread molten material uniformly over surfaces to be coated and wipe off excess material.

2.2.4 Shop Cleaning and Painting

2.2.4.1 Surface Preparation

Blast clean surfaces in accordance with SSPC SP 6/NACE No.3. Surfaces that will be exposed in spaces above ceiling or in attic spaces, crawl spaces, furred spaces, and chases may be cleaned in accordance with SSPC SP 3 in lieu of being blast cleaned. Wash cleaned surfaces which become contaminated with rust, dirt, oil, grease, or other contaminants with solvents until thoroughly clean. Steel to be embedded in concrete shall be free of dirt and grease. Do not paint or galvanize bearing surfaces, including contact surfaces within slip critical joints, but coat with rust preventative applied in the shop.

2.2.4.2 Pretreatment, Priming and Painting

Apply pretreatment, primer, and paint in accordance with manufacturer's printed instructions. On surfaces concealed in the finished construction or not accessible for finish painting, apply an additional prime coat to a minimum dry film thickness of 1.0 mil. Tint additional prime coat with a small amount of tinting pigment.

2.2.5 Nonferrous Metal Surfaces

Protect by plating, anodic, or organic coatings.

2.2.6 Aluminum Surfaces

2.2.6.1 Surface Condition

Before finishes are applied, remove roll marks, scratches, rolled-in scratches, kinks, stains, pits, orange peel, die marks, structural streaks, and other defects which will affect uniform appearance of finished surfaces.

2.2.6.2 Aluminum Finishes

Unexposed sheet, plate and extrusions may have mill finish as fabricated. Sandblast castings' finish, medium, AA DAF-45. Unless otherwise specified, provide all other aluminum items with an anodized finish. Provide a coating thickness not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Provide a polished satin finish on items to be anodized.

2.3 ACCESS DOORS AND PANELS

Provide flush type access doors and panels unless otherwise indicated. Fabricate frames for access doors of steel not lighter than 14 gage with welded joints and anchorage for securing into construction. Provide access doors with a minimum of 14 by 20 inches and of not lighter than 14 gage steel, with stiffened edges and welded attachments. Provide access doors hinged to frame and with a flush-face, turn-screw-operated latch. Provide exposed metal surface with a baked enamel finish.

2.4 CORNER GUARDS AND SHIELDS

For jambs and sills of openings and edges of platforms provide steel shapes and plates anchored in masonry or concrete with welded steel straps or end-weld stud anchors. Form corner guards for use with glazed or ceramic tile finish on walls with 0.0625 inch thick corrosion-resisting steel with polished or satin finish, extend 5 feet above the top of cove base or to the top of the wainscot, whichever is less, and securely anchor to the supporting wall. Corner guards on exterior shall be galvanized.

2.5 COVER PLATES AND FRAMES

Fabricate cover plates of thickness indicated on drawings with rolled steel weighing not more than 100 pounds per plate with a selected raised pattern nonslip top surface. Plate shall be galvanized. Reinforce to sustain a live load as indicated on drawings. Frames shall be structural steel shapes and plates, with headed anchors welded to frame for anchoring to concrete securely fastened to the structure as indicated. Miter and weld all corners. Butt joint straight runs. Allow for expansion on straight runs over 15 feet. Provide holes for lifting tools. Provide holes and openings with 1/2 inch clearance for pipes and equipment. Remove sharp edges and burrs from cover plates and exposed edges of frames. Weld all connections and grind top surface smooth. Weld bar stops every six inches. Provide 1/8 inch clearance at edges and between cover plates.

2.6 FLOOR GRATINGS

Design steel grating in accordance with NAAMM MBG 531 NAAMM MBG 532 for bar type grating or manufacturer's charts for plank grating. Galvanize steel floor gratings.

a. Design floor gratings to support a live load of 100 pounds per square foot for the spans indicated or vehicular load indicated on the drawings, with maximum deflection of L/240.

b. NAAMM MBG 531, band edges of grating with bars of the same size as the bearing bars. Weld banding in accordance with the manufacturer's standard for trim unless otherwise indicated. Design tops of bearing bars, cross or intermediate bars to be in the same plane and match grating finish.

c. Attach gratings to structural members with welded-on anchors. Anchor gratings to structural members with saddle clips. bolts, toggle bolts, or expansion shields and bolts.

d. Slip resistance requirements must exceed both wet and dry a static coefficient of friction of 0.6.

2.7 GAS-TIGHT MANHOLE COVER AND FRAME

Provide a heavy duty type made of ductile cast-iron with bolted lid, machined bearing surfaces and gasket grooves, continuous neoprene gasket, counter sunk bronze hex head cap screws, and concealed watertight pickholes. Provide frame with a 30 inch diameter clear opening. Maximum weight of frame and cover together to be 530 pounds.

2.8 GUARD POSTS (BOLLARDS/PIPE GUARDS)

Provide 4 inch galvanizedstandard weight steel pipe as specified in ASTM A53/A53M. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strength of 3000 psi.

2.9 MISCELLANEOUS PLATES AND SHAPES

Provide for items that do not form a part of the structural steel framework, such as lintels, sill angles, support framing for ceiling-mounted toilet partitions, miscellaneous mountings and frames. Provide lintels fabricated from structural steel shapes over openings in masonry walls and partitions as indicated and as required to support wall loads over openings. Provide with connections and fasteners or welds. Construct to have at least 8 inches bearing on masonry at each end.

Provide angles and plates, ASTM A36/A36M, for embedment as indicated. Galvanize embedded items exposed to the elements according to ASTM A123/A123M.

2.10 SAFETY CHAINS

Construct safety chains of galvanized steel, straight link type, 3/16 inch diameter, with at least twelve links per foot, and with snap hooks on each end. Test safety chain in accordance with ASTM A467/A467M, Class CS. Provide snap hooks of boat type. Provide galvanized 3/8 inch bolt with 3/4 inch eye diameter for attachment of chain, anchored as indicated. Supply two chains, 4 inches longer than the anchorage spacing, for each guarded area. Locate safety chain where indicated. Mount the top chain 3 feet 6 inches above the floor or ground and mount the lower chain 2 feet above the floor or ground.

2.11 SECURITY GRILLES

Fabricate of channel frames with not less than two masonry anchors at each jamb and 1/2 inch hardened steel bars spaced not over 4 inches both ways and welded to frame. Provide 18 by 16 mesh screen and two layers of 1/4 inch hardware cloth clamped to frame.

2.12 STEEL PLATE WAINSCOTS FOR CONCRETE OR MASONRY COLUMNS

Shop bend to radius for round columns and at right angles for square and rectangular columns with slight 1/4 inch radius on corners, with no horizontal joints and not more than 2 vertical joints single strapped and butt welded with a thickness of plate.

2.13 STRUCTURAL STEEL DOOR FRAMES

a. Provide frames as indicated. If not otherwise shown, construct frames of structural shapes, or shape and plate composite, to form a full depth channel shape with at least 1 1/2 inchoutstanding legs. For

single swing doors, provide continuous 5/8 by 1 1/2 inch bar stock stops at head and jambs. For freight elevator hoistway entrance, include a non-skid metal sill as indicated.

b. Where track, guides, hoods, hangers, operators, and other such accessories are required, provide support as indicated.

c. Provide jamb anchors near top, bottom, and at not more than 24 inch intervals. Provide the bottom of each jamb member with a clip angle welded in place with two 1/2 inchdiameter floor bolts for adjustment.

d. Provide spreaders between bottoms of floor jamb members. When floor construction permits, they may be left in place, concealed in the floor.

2.14 CHIMNEYS, VENTS, AND SMOKESTACKS

Design and construct chimneys and vents in accordance with NFPA 211. Form chimney connectors of not lighter than 20 gauge galvanized steel. Design and construct stacks to withstand a wind velocity of 85 miles/h in accordance with ASCE 7-10. Construct unlined stacks of black-steel plates not less than 3/16 inch thick conforming to ASTM A36/A36M. Weld seams and joints, except provide an angle flange for connection to the boiler, other equipment, and stack support.

2.15 CLEANOUT DOORS

Provide galvanized cleanout doors with frames, and unless otherwise indicated sized to match flues. Provide a continuous flange and anchors for securing frames into masonry. The doors shall be smokeproof, hinged, and have fastening devices to hold the door closed.

2.16 DOWNSPOUT BOOTS

Provide cast iron downspout boots with receiving bells sized to fit downspouts.

2.17 GUY CABLES

Guy cables shall be prestretched, galvanized wire rope of the sizes indicated. Wire rope shall conform to ASTM A475, high strength grade with Class A coating. Guys shall have a factory attached clevis top-end fitting; a factory attached open-bridge strand socket bottom-end fitting; and be complete with oval eye, threaded anchor rods. Fittings and accessories shall be hot-dip galvanized.

2.18 LADDERS

a. Fabricate vertical ladders conforming to Section 7 of 29 CFR 1910.27. Use 2-1/2 by 3/8 inch steel flats for stringers and 3/4 inch diameter steel rods for rungs. Rungs to be not less than 16 inches wide, spaced one foot apart, plug welded or shouldered and headed into stringers. Install ladders so that the distance from the rungs to the finished wall surface will not be less than 7 inches. Provide heavy clip angles riveted or bolted to the stringer and drilled for not less than two 1/2 inch diameter expansion bolts, as indicated. Provide intermediate clip angles not over 48 inches on centers.

b. Ladders, brackets and fasteners - Galvanized.

2.19 LADDER CAGES

a. Provide ladder cage when the length of climb is 20 feet or more. Conform to 29 CFR 1910.27. Fabricate 2 by 1/4 inch horizontal bands and 1 1/2 by 3/16 inch vertical bars. Provide attachments for fastening bands to the side rails of ladders or directly to the structure. Provide and fasten vertical bars on the inside of the horizontal bands. Extend cages not less than 27 inches or more than 28 inches from the centerline of the rungs, excluding the flare at the bottom of the cage, and not less than 27 inches in width. Clear the inside of the cage of projections.

b. Ladder safety cages and fasteners - Galvanized.

2.20 STEEL PIPE RAILINGS

a. Provide steel pipe railings, including guard at open-sided areas, consisting of top rail, intermediate rail and posts, and handrails at walls, as indicated.

b. Minimum sizes: 1.5 in. nominal diameter, and standard weight pipe conforming to ASTM A53/A53M, Type E or Type S, Grade B; or 1.5 in. nominal diameter, 2.72 lbs/ft, round structural steel tubing.

c. Join posts, rails, and corners by one of following methods:

1. Use flush-type steel railing fittings, welded and ground smooth, and secure railing splice locks with 2/5 in diameter hexagonal recessed-head setscrews.

2. Make mitered and welded joints by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices - Butted and reinforced by a tight-fitting interior sleeve 6 in. long minimum.

d. Railings may be bent at corners instead of joining, provided bends are made in suitable jigs and cylindrical cross section of pipe is maintained throughout entire bend.

e. Provide kickplates between railing posts where indicated, comprising steel flat bars minimum 6 in. high x 0.24 in. thick. Secure kickplates as indicated.

f. Railings, including pipe, fittings, brackets, fasteners, and other ferrous metal components - Galvanized.

2.21 STEEL STAIRS

a. Steel stairs - Constructed to conform to sizes and arrangements indicated. Provide steel framing, hangers, columns, struts, clips, brackets, bearing plates, and other components as required to support stairs and platforms.

b. Stringers - Structural steel channels or structural steel plates, or a combination thereof, as indicated. Close exposed ends of stringers.

c. Construct platform of structural steel channel headers and miscellaneous framing members as indicated. Bolt headers to stringers and newels; bolt framing members to stringers and headers.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Install items at locations indicated, according to manufacturer's instructions. Verify all measurements and take all field measurements necessary before fabrication. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and harmonize with the material to which fastenings are applied. Include materials and parts necessary to complete each item, even though such work is not definitely shown or specified. Poor matching of holes for fasteners shall be cause for rejection. Conceal fastenings where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Form joints exposed to the weather shall be formed to exclude water. Items listed below require additional procedures.

3.2 WORKMANSHIP

Provide miscellaneous metalwork that is well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Provide continuous welding along the entire area of contact except where tack welding is permitted. Do not tack weld exposed connections of work in place and ground smooth. Provide a smooth finish on exposed surfaces of work in place and unless otherwise approved, flush exposed riveting. Mill joints where tight fits are required. Corner joints shall be coped or mitered, well formed, and in true alignment. Accurately set work to established lines and elevations and securely fastened in place. Install in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

3.3 ANCHORAGE, FASTENINGS, AND CONNECTIONS

Provide anchorage where necessary for fastening miscellaneous metal items securely in place. Include for anchorage not otherwise specified or indicated slotted inserts, expansion shields, and powder-driven fasteners, when approved for concrete; machine and carriage bolts for steel; through bolts, lag bolts, and screws for wood. Do not use wood plugs in any material. Provide non-ferrous attachments for non-ferrous metal. Make exposed fastenings of compatible materials, generally matching in color and finish, to which fastenings are applied. Conceal fastenings where practicable.

3.4 BUILT-IN WORK

Form for anchorage metal work built-in with concrete or masonry, or provide with suitable anchoring devices as indicated or as required. Furnish metal work in ample time for securing in place as the work progresses.

3.5 WELDING

Perform welding, welding inspection, and corrective welding, in accordance with AWS D1.1/D1.1M. Use continuous welds on all exposed connections. Grind visible welds smooth in the finished installation.

3.6 FINISHES

3.6.1 Dissimilar Materials

Where dissimilar metals are in contact, protect surfaces with a anti-corrosive metal alkyd primer similar to MPI 79 with a VOC content of less than 250 g/L, to prevent galvanic or corrosive action. Where aluminum is in contact with concrete, plaster, mortar, masonry, wood, or absorptive materials subject to wetting, protect with ASTM D 1187, asphalt-base emulsion.

3.6.2 Field Preparation

Remove rust preventive coating just prior to field erection, using a remover approved by the rust preventive manufacturer. Surfaces, when assembled, shall be free of rust, grease, dirt and other foreign matter.

3.6.3 Environmental Conditions

Do not clean or paint surface when damp or exposed to foggy or rainy weather, when metallic surface temperature is less than 5 degrees F above the dew point of the surrounding air, or when surface temperature is below 45 degrees F or over 95 degrees F, unless approved by the COR.

3.7 ACCESS PANELS

Install a removable access panel not less than 12 by 12 inches directly below each valve, flow indicator, damper, or air splitter that is located above the ceiling, other than an acoustical ceiling, and that would otherwise not be accessible.

3.8 CONTROL-JOINT COVERS

Provide covers over control-joints and fasten on one side only with fasteners spaced to give positive contact with wall surfaces on both sides of joint throughout the entire length of cover.

3.9 COVER PLATES AND FRAMES

Install the tops of cover plates and frames flush with floor.

3.10 ROOF HATCH (SCUTTLES)

Provide zinc-coated steel sheets not less than 14 gage, with 3 inch beaded flange, welded and ground at corner. Provide a minimum clear opening of 30 by 36 inches. Construction and accessories as follows:

a. Insulate cover and curb with one inch thick rigid fiberboard insulation covered and protected by zinc-coated steel liner not less than 26 gage with 12 inches high curb, formed with 3 inch mounting flange with holes provided for securing to the roof deck. Equip the curb with an integral metal cap flashing of the same gage and metal as the curb, full welded and ground at corners for weather tightness.

b. Provide hatch completely assembled with pintle hinges, compression spring operators enclosed in telescopic tubes, positive snap latch with turn handles on inside and outside, and neoprene draft seal. Provide fasteners for padlocking on the inside. Equip the cover with an automatic hold-open arm complete with grip handle to permit one-hand

release. Cover action shall be smooth through its entire range with an operating pressure of approximately 30 pounds.

3.11 INSTALLATION OF CHIMNEYS, VENTS, AND SMOKESTACKS

Install chimneys and vents in accordance with NFPA 211. Provide a cleanout opening with a tight-fitting, hinged, cast-iron door and frame at the base of each smokestack. Provide a top band on stacks for attachment of painter's rigging. Provide roof housing, rain cap, downdraft diverter, fire damper, and other accessories required for a complete installation. Join sections of prefabricated lined stacks with acid-resisting high-temperature cement and steel draw bands. Provide means to prevent accumulation of water in the smokestack.

3.12 DOOR GUARD FRAME

Mount door guard frame over the glazed opening using 1/4 inch lag bolts on the interior of wood doors or tamperproof through bolts on the interior of metal doors.

3.13 INSTALLATION OF GUARD POSTS (BOLLARDS/PIPE GUARDS)

Set pipe guards vertically in concrete piers. Construct piers of, and the hollow cores of the pipe filled with, concrete having a compressive strength of 3000 psi.

3.14 INSTALLATION OF DOWNSPOUT BOOTS

Secure downspouts to building through integral lips with appropriate fasteners.

3.15 RECESSED FLOOR FRAMES & MATS

Verify field measurements prior to releasing materials for fabrication by the manufacturer. Use a mat frame to ensure recess accuracy in size, shape and depth. Form drain pit by blocking out concrete when frames are installed, dampproof after concrete has set. Assemble frames onsite and install so that upper edge will be level with finished floor surface. Screeded the concrete base inside the mat recess frame area using the edge provided by the frame as a guide and anchor into the cement with anchor pins a minimum of 24 inches on centers.

3.16 MOUNTING OF SAFETY CHAINS

Mount safety chains 3 feet 6 inches and 2 feet above the floor.

3.17 STRUCTURAL STEEL DOOR FRAMES

Secure door frames to the floor slab by means of angle clips and expansion bolts. Weld continuous door stops to the frame or tap screwed with countersunk screws at no more than 18 inchcenters, assuring in either case full contact with the frame. Make any necessary reinforcements and drill and tap the frames as required for hardware.

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SECTION 06 10 00

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for framing, grounds, nailers, blocking, and sheathing of light wooden structures and includes the use of preassembled components and plastic lumber.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN FOREST & PAPER ASSOCIATION (AF&PA)

AF&PA T10	Wood Frame Construction Manual for One- and Two-Family Dwellings
AF&PA T101	National Design Specification (NDS) for Wood Construction

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4	Basic Hardboard

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

AITC 111	Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection
AITC TCM	Timber Construction Manual, 5th Edition
ANSI/AITC A190.1	American National Standard, Structural Glued Laminated Timber

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

ALSC PS 20	American Softwood Lumber Standard

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Eng Man	Manual for Railway Engineering

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA BOOK	AWPA Book of Standards
AWPA M2	Standard for Inspection of Treated Wood Products
AWPA M6	Brands Used on Forest Products
AWPA P17	Fire Retardant Formulations
AWPA P18	Nonpressure Preservatives
AWPA P5	Standard for Waterborne Preservatives
AWPA T1	Use Category System: Processing and Treatment Standard
AWPA U1	Use Category System: User Specification for Treated Wood

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA E30	Engineered Wood Construction Guide
APA E445S	Performance Standards and Qualification Policy for Structural-Use Panels (APA PRP-108)
APA EWS R540C	Builder Tips Proper Storage and Handling of Glulam Beams
APA EWS T300E	Technical Note: Glulam Connection Details
APA F405L	Performance Rated Panels
APA PS 1	Voluntary Product Standard for Construction and Industrial Plywood
APA PS 2	Voluntary Product Standard for Wood-Based Structural-Use Panels

ASME INTERNATIONAL (ASME)

ASME B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	Standard for Square and Hex Nuts
ASME B18.5.2.1M	Metric Round Head Short Square Neck Bolts
ASME B18.5.2.2M	Metric Round Head Square Neck Bolts
ASME B18.6.1	Wood Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile

	Strength
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C1136	Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C1396/C1396M	Standard Specification for Gypsum Board
ASTM C208	Cellulosic Fiber Insulating Board
ASTM D 1435	Standard Practice for Outdoor Weathering of Plastics
ASTM D 1972	Standard Practice for Generic Marking of Plastic Products
ASTM D 198	Standard Test Methods of Static Tests of Lumber in Structural Sizes
ASTM D 2344/D 2344M	Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
ASTM D 2898	Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
ASTM D 3498	Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems
ASTM D 6007	Standard Test Method for Determining Formaldehyde Concentration in Air from Wood Products Using a Small Scale Chamber
ASTM D 6108	Standard Test Method for Compressive Properties of Plastic Lumber and Shapes
ASTM D 6109	Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastic Lumber and Related Products
ASTM D 6111	Standard Test Method for Bulk Density and Specific Gravity of Plastic Lumber and Shapes by Displacement
ASTM D 6112	Compressive and Flexural Creep and Creep-Rupture of Plastic Lumber and Shapes
ASTM D 6117	Standard Test Methods for Mechanical Fasteners in Plastic Lumber and Shapes
ASTM D 6330	Standard Practice for Determination of Volatile Organic Compounds (Excluding Formaldehyde) Emissions from Wood-Based

	Panels Using Small Environmental Chambers Under Defined Test Conditions
ASTM D 696	Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 degrees C With a Vitreous Silica Dilatometer
ASTM E 1333	Determining Formaldehyde Concentrations in Air and Emission Rates from Wood Products Using a Large Chamber
ASTM E 96/E 96M	Standard Test Methods for Water Vapor Transmission of Materials
ASTM F 1667	Driven Fasteners: Nails, Spikes, and Staples
ASTM F 547	Nails for Use with Wood and Wood-Base Materials

COMPOSITE PANEL ASSOCIATION (CPA)

CPA A208.1	Medium Density Fiberboard (MDF) For Interior Applications

FM GLOBAL (FM)

FM 4435	Roof Perimeter Flashing

FOREST STEWARDSHIP COUNCIL (FSC)

FSC STD 01 001	Principles and Criteria for Forest Stewardship

GREEN SEAL (GS)

GS-36	Commercial Adhesives

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	International Building Code

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules	Rules for the Measurement & Inspection of Hardwood & Cypress

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules	Standard Grading Rules for Northeastern Lumber

REDWOOD INSPECTION SERVICE (RIS) OF THE CALIFORNIA REDWOOD ASSOCIATION (CRA)

RIS Grade Use	Redwood Lumber Grades and Uses

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	Adhesive and Sealant Applications

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Spec	Standard Specifications for Grades of Southern Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003	Standard Grading Rules for Southern Pine Lumber

TRUSS PLATE INSTITUTE (TPI)

TPI 1	National Design Standard for Metal Plate Connected Wood Truss Construction; Commentary and Appendices
TPI HIB	Commentary and Recommendations for Handling, Installing and Bracing Metal Plate Connected Wood Trusses

U.S. DEPARTMENT OF COMMERCE (DOC)

DOC/NIST PS56	Structural Glued Laminated Timber
DOC/NIST PS58	Basic Hardboard (ANSI A135.4)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1923	Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
CID A-A-1924	Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors
CID A-A-1925	Shield Expansion (Nail Anchors)
FS UU B 790	Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17	Standard Grading Rules

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA G-5	Western Lumber Grading Rules

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Structural glued laminated members

Trussed rafters

Trussed joists

Fabricated structural members

Modifications of structural members

Drawings of structural laminated members, fabricated wood trusses, engineered wood joists and rafters, and other fabricated structural members indicating materials, shop fabrication, and field erection details; including methods of fastening.

Nailers and Nailing Strips

Drawings of field erection details, including materials and methods of fastening nailers in conformance with Factory Mutual wind uplift rated systems specified in other Sections of these specifications.

SD-05 Design Data

Modifications of structural members

Design analysis and calculations showing design criteria used to accomplish the applicable analysis.

SD-06 Test Reports

Preservative-treated lumber and plywood

SD-07 Certificates

Certificates of grade

Manufacturer's certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material not normally grade marked meet the specified requirements. Certificate of Inspection for grade marked material by an American Lumber Standards Committee (ALSC) recognized inspection agency prior to shipment.

Preservative treatment

1.4 DELIVERY AND STORAGE

Deliver materials to the site in an undamaged condition. Store, protect, handle, and install prefabricated structural elements in accordance with manufacturer's instructions and as specified. Store materials off the ground to provide proper ventilation, with drainage to avoid standing water, and protection against ground moisture and dampness. Store materials with a moisture barrier at both the ground level and as a cover forming a well ventilated enclosure. Store wood I-beams and glue-laminated beams and joists on edge. Adhere to requirements for stacking, lifting, bracing, cutting, notching, and special fastening requirements. Laminated timber shall be handled and stored in accordance with AITC 111 or APA EWS R540C. Remove defective and damaged materials and provide new

materials. Store separated reusable wood waste convenient to cutting station and area of work.

1.5 GRADING AND MARKING

1.5.1 Lumber

Mark each piece of framing and board lumber or each bundle of small pieces of lumber with the grade mark of a recognized association or independent inspection agency. Such association or agency shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

1.5.2 Structural Glued Laminated Timber

Mark each member with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of structural glued laminated timber products. The marking shall indicate compliance with ANSI/AITC A190.1 and shall include all identification information required by ANSI/AITC A190.1.

1.5.3 Plywood

Mark each sheet with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the plywood. The mark shall identify the plywood by species group or span rating, exposure durability classification, grade, and compliance with APA PS 1.Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks.

1.5.4 Structural-Use and OSB Panels

Mark each panel with the mark of a recognized association or independent inspection agency that maintains continuing control over the quality of the panel. The mark shall indicate end use, span rating, and exposure durability classification. Oriented Strand Board (OSB), APA F405L.

1.5.5 Preservative-Treated Lumber and Plywood

The Contractor shall be responsible for the quality of treated wood products. Each treated piece shall be inspected in accordance with AWPA M2 and permanently marked or branded, by the producer, in accordance with AWPA M6. The Contractor shall provide COR's Representative (COR) with the inspection report of an approved independent inspection agency that offered products comply with applicable AWPA Standards. The appropriate Quality Mark on each piece will be accepted, in lieu of inspection reports, as evidence of compliance with applicable AWPA treatment standards.

1.5.6 Fire-Retardant Treated Lumber

Mark each piece in accordance with AWPA M6, except pieces that are to be natural or transparent finished. In addition, exterior fire-retardant lumber shall be distinguished by a permanent penetrating blue stain. Labels of a nationally recognized independent testing agency will be accepted as evidence of conformance to the fire-retardant requirements of AWPA M6.

1.5.7 Hardboard, Gypsum Board, and Fiberboard

Mark each sheet or bundle to identify the standard under which the material is produced and the producer.

1.6 SIZES AND SURFACING

ALSC PS 20 for dressed sizes of yard and structural lumber. Lumber shall be surfaced four sides. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced. Other measurements are IP or SI standard.

1.7 MOISTURE CONTENT

Air-dry or kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products shall be as follows at the time of delivery to the job site:

a. Framing lumber and board, 19 percent maximum

b. Timbers 5 inches and thicker, 25 percent maximum

c. Materials other than lumber; moisture content shall be in accordance with standard under which the product is produced

1.8 PRESERVATIVE TREATMENT

Treat wood products with waterborne wood preservatives conforming to AWPA P5. Pressure treatment of wood products shall conform to the requirements of AWPA BOOK Use Category System Standards U1 and T1. Pressure-treated wood products shall not contain arsenic, chromium, or other agents classified as carcinogenic, probably carcinogenic, or possibly carcinogenic to humans (compounds in Groups 1, 2A, or 2B) by the International Agency for Research on Cancer (IARC), Lyon, France. Pressure-treated wood products shall not exceed the limits of the U.S. EPA's Toxic Characteristic Leaching Procedure (TCLP), and shall not be classified as hazardous waste. Submit certification from treating plant stating chemicals and process used and net amount of preservatives retained are in conformance with specified standards.

a. 0.25 pcf intended for above ground use.

b. 0.40 pcf intended for ground contact and fresh water use. 0.60 pcf intended for Ammoniacal Copper Quaternary Compound (ACQ)-treated foundations. 0.80 to 1.00 pcf intended for ACQ-treated pilings. All wood shall be air or kiln dried after treatment. Specific treatments shall be verified by the report of an approved independent inspection agency, or the AWPA Quality Mark on each piece. Minimize cutting and avoid breathing sawdust. Brush coat areas that are cut or drilled after treatment with either the same preservative used in the treatment or with a 2 percent copper naphthenate solution. The following items shall be preservative treated:

1. Wood framing, woodwork, and plywood up to and including the subflooring at the first-floor level of structures having crawl spaces when the bottoms of such items are 24 inches or less from the earth underneath.

2. Wood members that are in contact with water.

3. Exterior wood steps, platforms, and railings; and all wood framing of open, roofed structures.

4. Wood sills, soles, plates, furring, and sleepers that are less than 24 inches from the ground, furring and nailers that are set into or in contact with concrete or masonry.

5. Nailers, edge strips, crickets, curbs, and cants for roof decks.

1.8.1 Existing Structures

Use borate, permathrin, or a sodium silicate wood mineralization process to treat wood. Use borate for interior applications only.

1.8.2 New Construction

Use a boron-based preservative conforming to AWPA P18, sodium silicate wood mineralization process, or Ammoniacal Copper Quaternary Compound to treat wood. Use boron-based preservatives for above-ground applications only.

1.9 FIRE-RETARDANT TREATMENT

Fire-retardant treated wood shall be pressure treated with fire retardants conforming to AWPA P17. Fire retardant treatment of wood products shall conform to the requirements of AWPA U1, Commodity Specification H and AWPA T1, Section H. Treatment and performance inspection shall be by an independent and qualified testing agency that establishes performance ratings. Each piece or bundle of treated material shall bear identification of the testing agency to indicate performance in accordance with such rating. Treated materials to be exposed to rain wetting shall be subjected to an accelerated weathering technique in accordance with ASTM D 2898 prior to being tested. Such items which will not be inside a building, and such items which will be exposed to heat or high humidity, shall receive exterior fire-retardant treatment.

1.10 QUALITY ASSURANCE

1.10.1 Drawing Requirements

For fabricated structural members, trusses, qlu-lam members, indicate materials, details of construction, methods of fastening, and erection details. Include reference to design criteria used and manufacturers design calculations. Submit drawings for all proposed modifications of structural members. Do not proceed with modifications until the submittal has been approved.

1.10.2 Data Required

Submit calculations and drawings for all proposed modifications of structural members. Do not proceed with modifications until the submittal has been approved.

1.10.3 Certificates of Grade

Submit certificates attesting that products meet the grade requirements specified in lieu of grade markings where appearance is important and grade marks will deface material.

1.10.4 Humidity Requirements

Sequence work to minimize use of temporary HVAC to dry out building and control humidity.

1.11 ENVIRONMENTAL REQUIREMENTS

During and immediately after installation of treated wood, engineered wood products, and laminated wood products at interior spaces, provide temporary ventilation.

1.12 SUSTAINABLE DESIGN REQUIREMENTS

1.12.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Virgin Lumber

Lumber fabricated from old growth timber is not permitted. Avoid companies who buy,sell, or use old growth timber in the operations.

2.1.2 Engineered Wood Products

Products shall contain no added urea-formaldehyde if exposed to interior spaces.

2.2 LUMBER

2.2.1 Structural Lumber

Allowable unit stresses for structural lumber shall be as indicated and specified on the drawings.

2.2.2 Framing Lumber

Framing lumber such as studs, plates, caps, collar beams, cant strips, bucks, sleepers, nailing strips, and nailers and board lumber such as subflooring and wall and roof sheathing shall be one of the species listed in the table below. Minimum grade of species shall be as listed.

Table of Grades for Framing and Board Lumber

Grading Rules	Species	Framing	Board Lumber
WWPA G-5 standard grading rules	Douglas Fir-Larch	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size,	All Species: No. 3 Common

Table of Grades for Framing and Board Lumber

Grading Rules	Species	Framing 10 feet and shorter)	Board Lumber
WCLIB 17 standard grading rules	Douglas Fir-Larch	All Species: Standard Light Framing or No. 3 Structural Light Framing (Stud Grade for 2x4 nominal size, 10 feet and shorter)	All Species: Standard

2.2.3 Structural Glued Laminated Timber

ANSI/AITC A190.1, allowable working stress values for loads of normal duration in pounds per square inch (psi) as indicated on the drawings

Fabricated with wet-use adhesives. Beams shall use glue-laminated and laminated-strand laminated-veneer lumber. Posts and studs shall use laminated-strand lumber. Joists shall use laminated-veneer lumber. Members shall be Architectural Appearance Grade, sealed with a penetrating sealer, and bundle wrapped as standard with the manufacturer and approved. Members shall be complete with hardware for joining laminated members and for their connection to other construction.

2.3 PLYWOOD, STRUCTURAL-USE, AND ORIENTED STRAND BOARD (OSB) PANELS

APA PS 1, APA PS 2, APA E445S, and APA F405L respectively.

2.3.1 Subflooring

2.3.1.1 Plywood

C-D Grade, Exposure 1 durability classification, Span rating of 24/16 or greater.

2.3.1.2 Structural-Use and OSB Panels

Sheathing grade with durability equivalent to Exposure 1, Span Rating of 32/16 or greater. OSB, APA E445S, Rated Sturd-I-Floor.

2.3.2 Combination Subfloor-Underlayment

2.3.2.1 Plywood

Underlayment Grade, Exposure 1, or Exterior Type, C-C (Plugged) Grade. Minimum thickness shall be as listed below except where indicated to have greater thickness.

Support Spacing	Underlayment Minimum Thickness
16 inches	1/2 inch for Group 1 species 19/32 inch for Group 2 and 3 species 23/32 inch for Group 4 species

Support Spacing	Underlayment Minimum Thickness
24 inches	23/32 inch for Group 1 species 7/8 inch for Group 2 and 3 species one inch for Group 4 species

2.3.2.2 Structural-Use Panel

Combination subfloor-underlayment grade with durability equivalent to Exterior plywood, Span Rating of 16 or greater.

2.3.3 Wall Sheathing

2.3.3.1 Plywood

C-D Grade, Exposure 1, and a minimum thickness of 1/2 inch, except where indicated to have greater thickness.

2.3.3.2 Structural-Use and OSB Panels

Sheathing grade with durability equivalent to Exposure 1, Span Rating of 16/0 or greater. OSB, APA Rated Sheathing. OSB shall be a phenolic-glued, low-formaldehyde board.

2.3.4 Diaphragms

2.3.4.1 Plywood

Structural I, C-C C-D grade, Exposure 1, and a minimum thickness as indicated on the drawings.

2.3.4.2 Structural-Use and OSB Panels

Sheathing grade with durability equivalent to Exposure 1 and a minimum thickness as indicated on the drawings.

2.3.5 Shear Walls

2.3.5.1 Plywood

Structural I, C-C C-D Grade and a minimum thickness as indicated on the drawings.

2.3.5.2 Structural-Use and OSB Panels

Sheathing grade with durability equivalent to Interior plywood with Exterior glue (Exposure 1) and a minimum thickness as indicated on the drawings.

2.4 UNDERLAYMENT

Underlayment shall conform to one of the following:

2.4.1 Hardboard

AHA A135.4 service class, sanded one side, 1/4 inch thick, 4 feet wide.

2.4.2 Plywood

Plywood shall conform to APA PS 1, underlayment grade with exterior glue, or C-C (Plugged) exterior grade 11/32 inch thick, 4 feet wide.

2.4.3 Oriented Strand Board

OSB underlayment grade 0.225 inch.

2.5 OTHER MATERIALS

2.5.1 Building Paper

FS UU B 790, Type I, Grade D. Style. 1.

2.5.2 Trussed Rafters

Metal plate connected trusses designed in accordance with TPI 1 and TPI HIB and fabricated in accordance with TPI 1.

2.5.3 Trussed Joists

Metal plate connected parallel chord word trusses designed and fabricated in accordance with TPI 1.

2.6 ROUGH HARDWARE

Unless otherwise indicated or specified, rough hardware shall be of the type and size necessary for the project requirements. Sizes, types, and spacing of fastenings of manufactured building materials shall be as recommended by the product manufacturer unless otherwise indicated or specified. Rough hardware exposed to the weather or embedded in or in contact with preservative treated wood, exterior masonry, or concrete walls or slabs shall be zinc-coated.

2.6.1 Bolts, Nuts, Studs, and Rivets

ASME B18.2.1, ASME B18.5.2.1M, ASME B18.5.2.2M and ASME B18.2.2.

2.6.2 Anchor Bolts

ASTM A307, size as indicated, complete with nuts and washers.

2.6.3 Expansion Shields

CID A-A-1923, CID A-A-1924, and CID A-A-1925. Except as shown otherwise, maximum size of devices shall be 3/8 inch.

2.6.4 Lag Screws and Lag Bolts

ASME B18.2.1.

2.6.5 Wood Screws

ASME B18.6.1.

2.6.6 Nails

ASTM F 547, size and type best suited for purpose; staples shall be as

recommended by the manufacturer of the materials to be joined. For sheathing and subflooring, length of nails shall be sufficient to extend 1 inch into supports. In general, 8-penny or larger nails shall be used for nailing through 1 inch thick lumber and for toe nailing 2 inch thick lumber; 16-penny or larger nails shall be used for nailing through 2 inch thick lumber. Nails used with treated lumber and sheathing shall be galvanized. Nailing shall be in accordance with the recommended nailing schedule contained in AF&PA T10. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AF&PA T101. Reasonable judgment backed by experience shall ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

2.6.7 Wire Nails

ASTM F 1667.

2.6.8 Timber Connectors

Unless otherwise specified, timber connectors shall be in accordance with TPI 1, APA EWS T300E or AITC TCM.

2.6.9 Clip Angles

Steel, 3/16 inch thick, size except as indicated otherwise, best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood members.

2.6.10 Joist Hangers

Steel or iron, zinc coated, sized to fit the supported member, of sufficient strength to develop the full strength of the supported member in accordance with ICC IBC, and furnished complete with any special nails required.

2.6.11 Tie Straps

For joists supported by the lower flange of steel beams, provide 1/8 by 1-1/2 inch steel strap, 2 feet long, except as indicated otherwise.

2.6.12 Joist Anchors

For joists supported by masonry walls, provide anchors 3/16 by 1 1/2 inch steel tee or strap, bent and of length to provide 4 inches embedment into wall and 12 inches along joist except as indicated otherwise. For joists parallel to masonry or concrete walls, provide anchors 1/4 by 1-1/4 inch minimum cross-sectional area, steel strap, length as necessary to extend over top of first three joists and into wall 4 inches, and with wall end of bend or pin type, except as indicated otherwise.

2.6.13 Door Buck Anchors

Metal anchors, 1/8 by 1-1/4 inch steel, 12 inches long, with ends bent 2 inches, except as indicated otherwise. Anchors shall be screwed to the backs of bucks and built into masonry or concrete. Locate 8 inches above sills and below heads and not more than 24 inches intermediately between. Anchorage of bucks to steel framing shall be as necessary to suit the

conditions.

2.6.14 Metal Bridging

Where not indicated or specified otherwise, No. 16 U.S. Standard gage, cadmium-plated or zinc-coated.

2.6.15 Toothed Rings and Shear Plates

AF&PA T101.

2.6.16 Beam Anchors

Steel U-shaped strap anchors 1/4 inch thick by 1-1/2 inches wide, except as indicated otherwise.

2.6.17 Metal Framing Anchors

Construct anchors to the configuration shown using hot dip zinc-coated steel conforming to ASTM A653/A653M, G90. Steel shall be not lighter than 18 gage. Special nails supplied by the manufacturer shall be used for all nailing.

2.6.18 Panel Edge Clips

Extruded aluminum or galvanized steel, H-shaped clips to prevent differential deflection of roof sheathing.

PART 3 EXECUTION

3.1 INSTALLATION

Conform to AF&PA T10 and install in accordance with the National Association of Home Builders (NAHB) Advanced Framing Techniques: Optimum Value Engineering, unless otherwise indicated or specified. Select lumber sizes to minimize waste. Fit framing lumber and other rough carpentry, set accurately to the required lines and levels, and secure in place in a rigid manner Do not splice framing members for the passage of pipes, conduits, and ducts. Provide adequate support as appropriate to the application, climate, and modulus of elasticity of the product. Do not cut or bore structural members for the passage of ducts or pipes without approval of COR. Reinforce all members damaged by such cutting or boring by means of specially formed and approved sheet metal or bar steel shapes, or remove and provide new, as approved. Provide as necessary for the proper completion of the work all framing members not indicated or specified. Spiking and nailing not indicated or specified otherwise shall be in accordance with the Nailing Schedule contained in ICC IBC; perform bolting in an approved manner. Spikes, nails, and bolts shall be drawn up tight. Use slate or steel shims when leveling joists, beams, and girders on masonry or concrete. Do not use shimming on wood or metal bearings. When joists, beams, and girders are placed on masonry or concrete, a wood base plate shall be positioned and leveled with grout. The joist, beam, or girder shall then be placed on the plate. When joists, beams, and girders are set into masonry or concrete, a pocket shall be formed into the wall. The joist, beam, or girder shall then be placed into the pocket and leveled with a steel shim.

3.1.1 Sills

Set sills level and square and wedge with steel or slate shims; point or grout with non-shrinking cement mortar to provide continuous and solid bearing. Anchor sills to the foundations as indicated. Where sizes and spacing of anchor bolts are not indicated, provide not less than 5/8 inch diameter bolts at all corners and splices and space at a maximum of 6 feet o.c. between corner bolts. Provide at least two bolts for each sill member. Lap and splice sills at corners and bolt through the laps or butt the ends and through-bolt not more than 6 inches from the ends. Provide bolts with plate washers and nuts. Bolts in exterior walls shall be zinc-coated.

3.1.1.1 Anchors in Masonry

Except where indicated otherwise, Embed anchor bolts not less than 15 inches in masonry unit walls and provide each with a nut and a 2 inch diameter washer at bottom end. Fully grout bolts with mortar.

3.1.1.2 Anchors in Concrete

Except where indicated otherwise, Embed anchor bolts not less than 8 inches in poured concrete walls and provide each with a nut and a 2 inch diameter washer at bottom end.

3.1.2 Beams and Girders

Set beams and girders level and in alignment and anchor to bearing walls, piers, or supports with U-shaped steel strap anchors. Embed anchors in concrete or masonry at each bearing and through-bolt to the beams or girders with not less than two bolts. Provide bolts not less than 1/2 inch in diameter and with plate washers under heads and nuts. Install beams and girders not indicated otherwise with 8 inch minimum end bearing on walls or supports. Install beams and girders into walls with 1/2 inch clearance at the top, end, and sides. Provide joints and splices over bearings only and bolt or spike together.

3.1.3 Roof Framing or Rafters

Tops of supports or rafters shall form a true plane. Valley, ridge, and hip members shall be of depth equal to cut on rafters where practicable, but in no case less than depth of rafters and nominally 2 inches thick. Rafters shall have full and solid bearing on plates. Valleys, hips, and ridges shall be straight and true intersections of roof planes. Necessary crickets and watersheds shall be formed. Rafters, except hip and valley rafters, shall be bolted by angles. Rafters shall be toe-nailed to ridge, valley, or hip members with at least three 8-penny nails. Rafters shall be braced to prevent movement until permanent bracing, decking or sheathing is installed. Hip and valley rafters shall be secured to wall plates by clip angles. Openings in roof shall be framed with headers and trimmers. Unless otherwise indicated, headers carrying more than two rafters and trimmers supporting headers carrying more than one rafter shall be double. Hip rafters longer than the available lumber shall be butt jointed and scabbed. Valley rafters longer than the available lumber shall be double, with pieces lapped not less than 4 feet and well spiked together. Trussed rafters shall be installed in accordance with TPI HIB. Engineered wood joists shall be installed in accordance with distributor's instructions.

3.1.4 Joists

Provide joists of the sizes and spacing indicated, accurately and in alignment, and of uniform width. Joists shall have full bearing on sills, plates, beams, girders, and trusses; provide laps over bearing only and spike. Where joists are of insufficient length to produce a 12 inch lap, butt joists over bearing and provide wood scabs 2 nominal inches thick by depth of joists by 24 inches long or metal straps 1/4 by 1 1/2 inch by not less than 18 inches long nailed to each joist with not less than four 10-penny nails, or approved sheet metal connectors installed in accordance with the manufacturer's recommendations. Provide joists built into masonry with a beveled fire cut so that the top of the joist does not enter the wall more than one inch or standard steel wall bearing boxes. Provide metal hangers for joists framing into the side of headers, beams, or girders. When a portion of the joist extends above the top flange of a steel beam or girder, provide a 3/8 inch space between the top flange and the extended portion of the joists to allow for shrinkage of joists. The minimum joist end bearing shall be 4 inches, and joists built into concrete or masonry shall have a 1/2 inch minimum clearance at the top, end, and sides. For joists approved to be bored for the passage of pipes or conduits, bore through the neutral axis of the joist. Provide steel joist hangers of proper size and type to receive the ends of all framed joists.

3.1.4.1 Floor (Ceiling) Framing

Except where otherwise indicated joists shall have bearings not less than 4 inches on concrete or masonry and 1-1/2 inches on wood or metal. Joists, trimmers, headers, and beams framing into carrying members at the same relative levels shall be carried on joist hangers. Joists shall be lapped and spiked together at bearings or butted end-to-end with scab ties at joint and spiked to plates. Openings in floors shall be framed with headers and trimmers. Headers carrying more than two tail joists and trimmers supporting headers carrying more than one tail joist shall be doubled, unless otherwise indicated. Joists built into masonry shall be provided with a beveled fire cut so that the top of the joist does not enter the wall more than 1 inch or standard steel wall bearing boxes. Engineered wood joists shall be installed in accordance with distributor's instructions.

3.1.4.2 Doubled Joists

Provide under bearing walls and partitions running parallel with the floor joists, around stairways, chimneys, and at other openings where joists are cut and framed. Double, space for clearance, block apart 4 feet on center, rigidly frame, and spike together joists under partitions that are to receive ducts, pipes, and conduits.

3.1.4.3 Tie Straps

For joists supported by the lower flange of steel beams, provide straps at every fourth joist and the corresponding fourth joist on the opposite side. Tie joists across the top of the steel beam with a steel strap. Form straps to lie flat across the top of the beam and twist at the ends to provide flat contact with the side of each joist. Nail each strap at each end with three 10-penny nails spaced 2 inches o.c.

3.1.4.4 Joist Anchors

Provide anchors for each fourth joist supported by a masonry wall. Build

wall end of anchors into the wall. Nail anchor to the joist with three 10-penny nails spaced 2 inches o.c. Anchor the first three joists parallel to concrete or masonry walls at bridging points, but not less than 8 feet o.c. from end walls. Let anchors into the tops of each joist and spike to the top of joist with one 10-penny nail. Extend anchors at least 8 inches into the wall.

3.1.5 Bridging

Provide bridging for floor and ceiling joists and for roof rafters having slopes of less than 1/3. Locate bridging as indicated and as specified herein. Provide bridging for spans greater than 6 feet, but do not exceed 8 feet maximum spacing between rows of bridging. Install rows of bridging uniformly. Provide metal or wood cross-bridging, except where solid bridging is indicated. Do not nail the bottom end of cross-bridging until the subfloor has been laid.

3.1.5.1 Wood Cross-Bridging

Provide wood cross-bridging not less than 2 by 4 nominal size. Nail wood cross-bridging at each end with three 8-penny nails for 2 by thick material.

3.1.5.2 Metal Cross-Bridging

Shall be the manufacturer's standard product, not less than 16 gage before forming and coating. Metal bridging shall be the compression type, lodged into or nailed to the wide faces of opposite joists at points diagonally across from each other near the bottoms and tops of joists.

3.1.6 Subflooring

3.1.6.1 Plywood, Structural-Use, and OSB Panels

Apply best side up with the grain of outer plies or the long dimension at right angles to joists. Stagger end joints and locate over the centerline of joists. Support panel edges by nominal 2 by 4 members framed between joists so the edge joints of subfloor occur over the centerline of blocking. Allow 1/8 inch spacing at panel ends and 1/4 inch at panel edges. Panels shall be continuous over two or more spans. Nail panels 6 inches o.c. at supported edges and 10 inches o.c. over intermediate bearing. Nails shall be 8-penny common or 6-penny threaded. Provide at least 1/2 inch clearance between subflooring and masonry or concrete walls. Subflooring may be installed with adhesive conforming to ASTM D 3498and nails spaced at 12 inches on center unless otherwise shown.

3.1.6.2 Combination Subfloor-Underlayment

Apply with the grain of the face plies or the long dimension at right angles to joists. Panels shall be continuous over two or more spans. Stagger end joints of adjacent panels. Panel edges shall be T&G or supported by 2 by 4 members framed between joists so the edge joints of subfloor-underlayment occur over the centerline of blocking. Provide end joints of panels over the centerline of joists. Allow 1/8 inch spacing between panel edge and end joints. Nail panels 6 inches o.c. at ends and edges and 10 inches o.c. along intermediate bearings unless they are glue-nailed in accordance with APA E30. Nails shall be 8-penny coated common or 6-penny threaded. Provide at least 1/2 inch clearance between subfloor-underlayment and masonry or concrete walls.

3.1.6.3 Wood

Subflooring shall be applied diagonally with end joints made over supports. Each board shall bear on at least three supports and shall be nailed at each support using two nails for boards 6 inches and less in width and three nails for boards more than 6 inches in width.

3.1.6.4 Depressed Subfloors

Provide depressed subfloors to receive ceramic and quarry tile floors. Nail cleats or ledgers of one by four material to the sides of joists to support the flooring material. Place the cleats at a depth below the top of the joists sufficient to allow the installation of the subflooring below the tops of joists. Snugly fit subflooring as specified herein between joists.

3.1.7 Underlayment

Install underlayment over subfloor just prior to laying of resilient flooring and protect from water and physical damage. Underlayment shall be hardboardor plywood or OSB. Stagger end joints of underlayment with respect to each other, and stagger all joints with respect to paralleling panel joints in subfloor. Space panels 1/16 inch apart at ends and 1/8 inch apart at edges and at least 1/2 inch from concrete or masonry walls. Nail panels 6 inches o.c. along edges and 6 inches o.c. each way throughout panel, but not closer than 3/8 inch to panel edges. Nails shall be 4-penny annular ring or screw type and shall be countersunk 1/16 inch.

3.1.8 Columns and Posts

Set columns and posts, plumb, in alignment, and with full and uniform bearing. Do not embed the bottom and bearing surfaces of posts columns in concrete or set in direct contact with concrete slabs on grade. Provide post and beam construction with steel post caps in such a manner that the post above will tier directly over the one below; fabricate the assembly in a rigid and substantial manner using bolts or lag screws.

3.1.9 Wall Framing

3.1.9.1 Studs

Select studs for straightness and set plumb, true, and in alignment. In walls and partitions more than eight feet tall, provide horizontal bridging at not more than 8 feet o.c. using nominal 2 inch material of the same width as the studs; install the bridging flat. Sizes and spacing of studs shall be as indicated. Double studs at jambs and heads of openings and triple at corners to form corner posts. Frame corner posts to receive sheathing, lath, and interior finish. Truss over openings exceeding 4 feet in width or use a header of sufficient depth. Toe-nail studs to sills or sole plates with four 8-penny nails or fasten with metal nailing clips or connectors. Anchor studs abutting concrete or masonry walls thereto near the top and bottom and at midheight of each story using expansion bolts or powder-actuated drive studs. Use powder-driven fasteners only when approved, in writing by the COR.

3.1.9.2 Plates

Use plates for walls and partitions of the same width as the studs to form continuous horizontal ties. Splice single plates; stagger the ends of

double plates. Double top plates in walls and bearing partitions, built up of two nominal 2 inch thick members. Top plates for nonbearing partitions shall be single or double plates of the same size as the studs. Nail lower members of double top plates and single top plates to each stud and corner post with two 16-penny nails. Nail the upper members of double plates to the lower members with 10-penny nails, two near each end, and stagger 16 inches o.c. intermediately between. Nail sole plates on wood construction through the subfloor to each joist and header; stagger nails. Anchor sole plates on concrete with expansion bolts, one near each end and at not more than 6 feet o.c., or with powder-actuated fasteners, one near each end and at not more than 3 feet o.c. Provide plates cut for the passage of pipes or ducts with a steel angle as a tie for the plate and bearing for joist. Use powder-driven fasteners only when approved, in writing by the COR.

3.1.9.3 Firestops

Provide firestops for wood framed walls and partitions and for furred spaces of concrete or masonry walls at each floor level and at the ceiling line in the top story. Where firestops are not automatically provided by the framing system used, they shall be formed of closely fitted wood blocks of nominal 2 inch thick material of the same width as the studs and joists.

3.1.9.4 Diagonal Bracing

Provide diagonal bracing at all external corners and internal angles and at maximum 40 foot centers in stud walls, except that bracing may be omitted where diagonally applied wood sheathing, plywood or structural-use panel sheathing, 4 by 8 foot fiberboard sheathing, or gypsum board sheathing is used. Bracing shall be of 1 by 6 material, let into the exterior face of studs. Extend bracing from top plates to sill at an angle of approximately 45 degrees and double nail at each stud. When openings occur near corners, provide diagonal knee braces extending from the corner post above headers to top plates and from below window sills to the main sill. Nail bracing at each bearing with two 8-penny nails.

3.1.10 Wall Sheathing

3.1.10.1 Plywood, Structural-Use, and OSB Panel Wall Sheathing

Apply horizontally or vertically. Extend sheathing over and nail to sill and top plate. Abut sheathing edges over centerlines of supports. Allow 1/8 inch spacing between panels and 1/8 inch at windows and doors. If sheathing is applied horizontally, stagger vertical end joints. Nail panels with 6-penny nails spaced 6 inches o.c. along edges of the panel and 12 inches o.c. over intermediate supports. Keep nails 3/8 inches away from panel ledges. Provide 2 by 4 blocking for horizontal edges not otherwise supported.

3.1.10.2 Gypsum Sheathing Board

Apply gypsum sheathing board either horizontally or vertically. Butt joints and locate over the centerlines of supports. Horizontally applied sheathing shall be T&G, applied with tongued edge up. Stagger vertical joints and abut sheet closely to frames of openings. Nail sheathing with 11 gage, 3/8 inch head, zinc-coated nails 1-1/2 inches long for 1/2 inch sheathing and 1-3/4 inches long for 5/8 inch sheathing, spaced 3/8 inch minimum from edges. Provide 2 by 4 blocking for horizontal edges of 4 foot wide panels not otherwise supported.

a. Gypsum Sheathing Board Used with Diagonal-Braced Framing: Sheathing shall be either 2 or 4 feet wide. Apply sheathing 2 feet wide horizontally. Nail 4 inches maximum o.c. at edges and over intermediate bearings. Apply sheathing 4 feet wide either horizontally or vertically. Nail 4 inches maximum o.c. at edges and 8 inches maximum o.c. at intermediate bearings.

b. Gypsum Sheathing Board Used with Unbraced Frames: Sheathing shall be 4 feet wide and applied vertically. Extend sheathing over and nail to both sill and top plates. Nail 4 inches maximum o.c. at edges and 8 inches maximum o.c. at intermediate bearings.

3.1.11 Building Paper

Provide building paper where indicated on wood board sheathing for all types of exterior siding. Apply paper shingle fashion, horizontally, beginning at the bottom of the wall. Lap edges 4 inches, and nail with one inch, zinc-coated roofing nails, spaced 12 inches o.c. and driven through tin discs.

3.1.12 Ceiling Joists

Size as indicated and set accurately and in alignment. Toe-nail joists to all plates with not less than three 10-penny nails. Frame openings in ceilings with headers and trimmers.

3.1.13 Metal Framing Anchors

Provide framing anchors at every rafter or trussed rafter to fasten rafter or trussed rafter to plates and studs against uplift movement and forces as indicated. Anchors shall be punched and formed for nailing so that nails will be stressed in shear only. Nails shall be zinc-coated; drive a nail in each nail hole provided in the anchor.

3.1.14 Trusses

Metal plate connected wood trusses shall be handled, erected, and braced in accordance with TPI HIB and as indicated.

3.1.15 Structural Glued Laminated Timber Members

Brace members before erection. Align members and complete all connections before removal of bracing. Unwrap individually wrapped members only after adequate protection by a roof or other cover has been provided. Treat scratches and abrasions of factory applied sealer with two brush coats of the same sealer used at the factory.

3.1.16 Stair Framing

Cut carriages to exact shape required to receive treads and risers, with risers of uniform height and treads of uniform width. Provide trimmers, nailers, and blocking as required to support finish materials.

3.2 MISCELLANEOUS

3.2.1 Wood Roof Nailers, Edge Strips, Crickets, Curbs, and Cants

Provide sizes and configurations indicated or specified and anchored securely to continuous construction.

3.2.1.1 Roof Nailing Strips

Provide roof nailing strips for roof decks as indicated. Apply nailing strips in straight parallel rows in the direction and spacing indicated Strips shall be surface applied.

a. Surface-Applied Nailers: Shall be 3 inches wide and of thickness to finish flush with the top of the insulation. Anchor strips securely to the roof deck with powder actuated fastening devices or expansion shields and bolts, spaced not more than 24 inches o.c. On decks with slopes of one inch or more, provide surface applied wood nailers for securing insulation and for nailing of roofing felts. Use powder-driven fasteners only when approved, in writing by the COR.

3.2.1.2 Roof Edge Strips and Nailers

Provide at perimeter of roof, around openings through roof, and where roofs abut walls, curbs, and other vertical surfaces. Except where indicated otherwise, nailers shall be 6 inches wide and the same thickness as the insulation. Anchor nailers securely to underlying construction. Anchor perimeter nailers in accordance with FM 4435.

3.2.1.3 Crickets, Cants, and Curbs

Provide wood saddles or crickets, cant strips, curbs for scuttles and ventilators, and wood nailers bolted to tops of concrete or masonry curbs and at expansion joints, as indicated, specified, or necessary and of lumber.

3.2.2 Wood Blocking

Provide proper sizes and shapes at proper locations for the installation and attachment of wood and other finish materials, fixtures, equipment, and items indicated or specified.

3.2.3 Wood Grounds

Provide for fastening wood trim, finish materials, and other items to plastered walls and ceilings. Install grounds in proper alignment and true with an 8 foot straightedge.

3.2.4 Wood Furring

Provide where shown and as necessary for facing materials specified. Except as shown otherwise, furring strips shall be nominal one by 3, continuous, and spaced 16 inches o.c. Erect furring vertically or horizontally as necessary. Nail furring strips to masonry. Do not use wood plugs. Provide furring strips around openings, behind bases, and at angles and corners. Furring shall be plumb, rigid, and level and shall be shimmed as necessary to provide a true, even plane with surfaces suitable to receive the finish required. Form furring for cornices, offsets and breaks in walls or ceilings on 1 by 4 wood strips spaced 16 inches o.c.

3.2.5 Temporary Closures

Provide with hinged doors and padlocks and install during construction at exterior doorways and other ground level openings that are not otherwise closed. Cover windows and other unprotected openings with polyethylene or other approved material, stretched on wood frames. Provide dustproof

barrier partitions to isolate areas as directed.

3.2.6 Temporary Centering, Bracing, and Shoring

Provide for the support and protection of masonry work during construction as specified in Section 04 20 00. Forms and centering for cast-in-place concrete work are specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.2.7 Wood Sleepers

Run wood sleepers in lengths as long as practicable and stagger end joints in adjacent rows.

3.2.8 Diaphragms

Install plywood, structural-use, or OSB panels with the long dimension parallel or perpendicular to supports. End joints shall be continuous or staggered and located over the centerline of supports. Longitudinal joints shall be continuous or staggered and provided with blocking. Nail panels with 8 or 10-penny nails spaced as indicated on the drawings.

3.2.9 Shear Walls

Install plywood or structural-use panels with long dimension parallel or perpendicular to supports. Provide blocking behind edges not located over supports. Nail panels with 8 or 10-penny nails spaced as indicated on the drawings.

3.2.10 Bridging

Wood bridging shall have ends accurately bevel-cut to afford firm contact and shall be nailed at each end with two nails. Metal bridging shall be installed as recommended by the manufacturer. The lower ends of bridging shall be driven up tight and secured after subflooring or roof sheathing has been laid and partition framing installed.

3.2.11 Corner Bracing

Corner bracing shall be installed when required by type of sheathing used or when siding, other than panel siding, is applied directly to studs. Corner bracing shall be let into the exterior surfaces of the studs at an angle of approximately 45 degrees, shall extend completely over wall plates, and shall be secured at each bearing with two nails.

3.2.12 Sill Plates

Sill plates shall be set level and square and anchor bolted at not more than 6 feet on centers and not more than 12 inches from end of each piece. A minimum of two anchors shall be used for each piece.

3.3 INSTALLATION OF TIMBER CONNECTORS

Installation of timber connectors shall conform to applicable requirements of AF&PA T101.

3.4 ERECTION TOLERANCES

a. Framing members which will be covered by finishes such as wallboard, plaster, or ceramic tile set in a mortar setting bed, shall be within

the following limits:

1. Layout of walls and partitions: 1/4 inch from intended position;

2. Plates and runners: 1/4 inch in 8 feet from a straight line;

3. Studs: 1/4 inch in 8 feet out of plumb, not cumulative; and

4. Face of framing members: 1/4 inch in 8 feet from a true plane.

b. Framing members which will be covered by ceramic tile set in dry-set mortar, latex-portland cement mortar, or organic adhesive shall be within the following limits:

1. Layout of walls and partitions: 1/4 inch from intended position;

2. Plates and runners: 1/8 inch in 8 feet from a straight line;

3. Studs: 1/8 inch in 8 feet out of plumb, not cumulative; and

4. Face of framing members: 1/8 in 8 feet from a true plane.

3.5 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with requirements of Chapter 17 "Structural Test and Special Inspection" of the California Building Code.

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SECTION 06 20 00

FINISH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for covers general exterior and interior finish carpentry.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.6	Hardboard Siding

AMERICAN LUMBER STANDARDS COMMITTEE (ALSC)

ALSC PS 20	American Softwood Lumber Standard

AMERICAN NATIONAL STANDARD INSTITUTE (ANSI)

ANSI A156.9	Cabinet Hardware
ANSI A156.16	Auxiliary Hardware
ANSI A156.18	Materials & Finishes

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C20	Structural Lumber Fire-Retardant Treatment by Pressure Processes
AWPA C27	Plywood - Fire-Retardant Treatment by Pressure Processes
AWPA M2	Standard for Inspection of Treated Wood Products
AWPA M4	Standard for the Care of Preservative-Treated Wood Products
AWPA P5	Standard for Waterborne Preservatives

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA E445S	Performance Standards and Qualification Policy for Structural-Use Panels (APA PRP-108)
APA PS 1	Voluntary Product Standard for Construction and Industrial Plywood
APA PS 2	Voluntary Product Standard for Wood-Based Structural-Use Panels

FEDERAL SPECIFICATIONS (FS)

FS FF-H-1819	Hardware Builders'; Auxiliary Locks
FS MMM-A-125	Adhesive, Casein-Type, Water and Mold Resistant

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds	AWI Quality Standards

ASME INTERNATIONAL (ASME)

ASME B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	Standard for Square and Hex Nuts
ASME B18.6.1	Wood Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM C1036	Standard Specification for Flat Glass
ASTM D1037	Evaluating Properties of Wood-Base Fiber & Particle Panel Materials
ASTM D 2898	Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
ASTM F 547	Nails for Use with Wood and Wood-Base Materials

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.9	Cabinet Hardware

COMPOSITE PANEL ASSOCIATION (CPA)

CPA A208.1	Medium Density Fiberboard (MDF) For Interior Applications

HARDWOOD PLYWOOD AND VENEER ASSOCIATION (HPVA)

HPVA HP-1	American National Standard for Hardwood and Decorative Plywood

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA LD 3	Standard for High-Pressure Decorative Laminates
ANSI/NEMA LD 3.1	Performance, Application, Fabrication, and Installation of High-Pressure Decorative Laminates

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules	Rules for the Measurement & Inspection of Hardwood & Cypress

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules	Standard Grading Rules for Northeastern Lumber

REDWOOD INSPECTION SERVICE (RIS) OF THE CALIFORNIA REDWOOD ASSOCIATION (CRA)

RIS Grade Use	Redwood Lumber Grades and Uses

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1003	Standard Grading Rules for Southern Pine Lumber

U.S. DEPARTMENT OF COMMERCE (DOC)

DOC/NIST PS58	Basic Hardboard (ANSI A135.4)

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB 17	Standard Grading Rules

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA G-5	Western Lumber Grading Rules

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 4	Water-Repellent Preservative Non-Pressure Treatment for Millwork

WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION (WMMPA)

WMMPA WM 6	Industry Standard for Non-Pressure Treating of Wood Millwork

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Manufacturer's Catalog Data

Manufacturer's Catalog Data for hardware and plastic laminate.

SD-02, Manufacturer's Standard Color Charts

Manufacturer's Standard Color Charts for plastic laminate and finished wood, including color charts.

SD-04 Shop Drawings

Shop Drawings for cabinets, shelving, and casework.

SD-06 Manufacturer's Instructions

Manufacturer's Instructions for plastic laminate.

SD-07 Certificates

Certificates for labeled materials indicating flame spread, fuel contributed, and smoke-developed ratings.

1.4 DETAIL DRAWINGS

The Contractor shall submit detail drawings showing fabricated items and special mill and woodwork items. Drawings shall indicate materials and details of construction, methods of fastening, erection, and installation.

1.5 CERTIFICATES

Provide certificates of grade from the grading agency on graded but unmarked lumber or plywood attesting that materials meet the grade requirements specified herein.

Provide certificates of compliance unless materials bear certification markings or statements.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver lumber, plywood, trim, and millwork to job site in an undamaged condition. Stack materials to ensure ventilation and drainage. Protect against dampness before and after delivery. Store materials under cover in a well-ventilated enclosure and protect against extreme changes in temperature and humidity. Do not store products in building until wet trade materials are dry.

a. Protect materials from damage during delivery, when stored, and during construction. Remove and replace damaged and defective materials

b. Deliver trim, paneling, cabinet work, and other finish millwork items and bring into building only after building has dried out, after installation of wet materials, and when there is no danger of damage to materials due to excessive moisture.

c. Store hardboard, plywood paneling and particleboard as recommended by the manufacturer for minimum 48 hours in rooms where they are to be installed.

1.7 QUALITY ASSURANCE

1.7.1 Lumber

Identify each piece or each bundle of lumber, millwork, and trim by the grade mark of a recognized association or independent inspection agency that is certified by the Board of Review, American Lumber Standards Committee, to grade the species.

1.7.2 Plywood

Each sheet of plywood shall bear the mark of a recognized association or independent inspection agency that maintains continuing control over quality of the plywood. Mark shall identify plywood by species group or span rating, and shall show exposure durability classification, grade, and compliance with APA PS 1.

1.7.3 Hardboard and Particleboard

Materials shall bear a marking or statement identifying the producer and the applicable standard.

1.7.4 Pressure-Treated Lumber and Plywood

Each treated piece shall be inspected in accordance with AWPA M2.

1.7.5 Nonpressure-Treated Woodwork and Millwork

Mark, stamp, or label, indicating compliance with WDMA I.S. 4.

1.7.6 Fire-Retardant Treated Lumber

Each piece to bear Underwriters Laboratories label or the label of another nationally recognized independent testing laboratory.

1.8 FIELD MEASUREMENTS

Take field measurements before fabrication and installation of materials to verify and supplement indicated dimensions.

PART 2 PRODUCTS

2.1 WOOD

2.1.1 Sizes and Patterns of Wood Products

Yard and board lumber sizes shall conform to ALSC PS 20. Provide shaped lumber and millwork in the patterns indicated and standard patterns of the association covering the species. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the applicable standard.

2.1.2 Trim, Finish, and Frames

Provide species and grades listed for materials to be paint finished. Provide materials that are to be stain, natural, or transparent finished one grade higher than that listed. Provide species indicated for materials to be transparent finished. Run trim, except window stools and aprons with hollow backs.

TABLE OF GRADES FOR WOOD TO RECEIVE PAINT FINISH

Grading Rules	Species	Exterior and Interior Trim, Finish, and Frames
WWPA G-5 grading rules	Aspen Douglas Fir-Larch Douglas Fir-South Engelmann Spruce -Lodgepole Pine Engelmann Spruce Hem-Fir Idaho White Pine Lodgepole Pine Mountain Hemlock Mountain Hemlock -Hem-Fir Ponderosa Pine-Sugar Pine (Ponderosa Pine -Lodgepole Pine) White Woods (Western Woods) Western Cedars Western Hemlock	All Species: C & Btr. Select (Choice & Btr Idaho White Pine) or Superior Finish. Western Red Cedar may be graded C & Btr. Select or A & Btr. per Special Western Red Cedar Rules.
WCLIB 17 standard grading rules	Douglas Fir-Larch Hem-Fir Mountain Hemlock Sitka Spruce Western Cedars Western Hemlock	All Species: C & Btr VG, except A for Western Red Cedar
SPIB 1003 grading rules	Southern Pine	C & Btr
NHLA Rules	Cypress	C-Select
NELMA Grading Rules standard grading rules	Balsam Fir Eastern Hemlock-Tamarack Eastern Spruce Eastern White Pine Norway Pine Northern Pine Northern White Cedar	All Species: C-Select except C & Btr for Eastern White Pine and Norway Pine
RIS Grade Use standard specifications	Redwood	Clear Clear All Heart
NHLA Rules rules	Cypress	B Finish
	Red Gum Soft Elm Birch	Select or Btr (for interior use only)

2.1.3 Utility Shelving

Utility shelving shall be a suitable species equal to or exceeding requirements of No. 3 Common white fir under WWPA G-5, 1 inch thick; or plywood, interior type, Grade A-B, 1/2 inch thick, any species group.

2.1.4 Softwood Plywood

APA PS 1, thicknesses as indicated.

a. Plywood for Shelving: Interior type, A-B Grade, any species group.

b. Plywood for Countertops: Exterior type, A-C Grade.

2.1.5 Plywood Paneling Materials

a. Quality and Construction

1. Hardwood plywood - HPMA HP-1, Grade A, with specialty grade characteristics as specified herein. Face veneers - Manufactured with a 3-ply particleboard core or, at mill option, with a lumber or veneer core; match approved samples.

2. Panels - Good one side. Backing veneer - HPMA HP-1, Backing Grade 4 or better, hardwood veneer suitable for balancing face veneer. Exposed edges - Provide factory-applied edge banding of same species as face veneer.

3. Hardwood plywood - Type II, bonded with water-resistant adhesives.

4. Moisture content of hardwood plywood paneling - Certified to not exceed 12 percent at time of mill shipment.

5. Hardwood plywood paneling - Polish sanded, sealed, and factory finished. Back surfaces - Factory sealed. Cut edges - Sealed at worksite. Face veneers - Provide manufacturer's standard seal, stain-filler, and conversion varnish, applied in minimum four separate coats to a total dry film thickness of 0.003 in. Color of finish - Match approved color sample.

6. Hardwood plywood paneling used for interior finish - Maximum flame spread 75 and maximum smoke development 100, unless more stringent requirements are indicated.

b. Architectural Grade Hardwood Plywood: 3/4 in. thick, with following specialty grade characteristics:

1. Face veneers - Plain sliced, NWWD IS-1.

2. Panel faces - Stock panels, lotted and numbered. Install in running match indicated by panel numbers and as recommended by manufacturer.

3. Panels - Attached to furring and wall framing by concealed mechanical fasteners with no exposed face nailing.

c. Hardwood Plywood Paneling - Selected 5-ply, 0.24 in. thick, prefinished and backsealed material, face veneer, indicated species; HPMA HP-1, Grade A.

1. Sizes: 4 ft wide by maximum required length for full height of wall.

2. Provide grooves 16 in. on center, and random intermediate grooves at joints in veneer.

2.1.6 Particleboard (Utility Plywood Shelving)

CPA A208.1, Grade 1-M-2 or 2-M-2 or better; 3/4 inch thick.

2.2 SOLID WOOD MATERIALS

a. Solid Wood Trim: 300-S-4, Economy Grade, milled to indicated profile. Moldings, joint tolerances, miters, construction quality, and surface finish - Conform to AWI-01 Standing and Running Trim and Rails.

b. Material furnished in maximum practical length for end use.

c. Material - Kiln-dried; maximum moisture content 12 percent at time of delivery to Worksite.

d. Corners - Mitered, tightly butted, and secured.

e. Wood Trim - Carefully selected to match hardwood plywood paneling.

f. Exposed Nailing - Countersunk finishing nails. Fill countersunk holes with matching wood filler or putty.

g. Wood Trim - Hand sanded at Worksite to a smooth clean finish, free of machine or tool marks, abrasions, raised grain, or similar imperfections.

2.3 CABINETS, COUNTERS, AND CASEWORK

a. Materials and Construction

1. Hardwood plywood for cabinets, counters, shelving, and casework - HPMA HP-1, Grade A, of specified thickness and face-veneer species, good two sides. Veneers - Type II, bonded with water-resistant adhesives. Exposed edges - Provide factory-applied edge banding, same species as face veneer.

2. Cabinets, counters, shelving, and casework - Economy grade and mill built to AWI-01 quality standards for casework.

3. Flush cabinet doors - Hardwood plywood with matching solid hardwood edges. Lipped doors - Hardwood plywood with lumber core. Drawer fronts - Minimum ¾ in. thick solid wood or edge-banded hardwood plywood with veneer species to match cabinet.

4. Cabinet doors - Lumber core or, at mill option, veneer core or particleboard edged with solid hardwood matching face veneer species.

5. Cabinet plywood - Prefinished and matching hardwood wall paneling for type and cut of veneer; polish sanded, sealed, and ready for finishing. Face veneers - Rotary cut or plain sliced with no sapwood allowed.

b. Particleboard Core Materials

1. Wood particleboard - Mat-formed particleboard, ANSI A208.1, Type 1 (interior) medium density, Grade 1-M-2; laminated construction, composed of large wood flakes at core and finer wood flakes at each surface. When tested in accordance with ASTM D1037, minimum modulus of rupture of 2393 psi, maximum water absorption of 15 percent in 24 hours, maximum swelling thickness of 6 percent in 24 hours, maximum moisture content of 7 percent, and maximum linear expansion of 0.15 percent.

2. Wood particleboard for exposed shelving or casework - Sanded and sealed on both surfaces, exposed edges trimmed with ¾ in. x 2/5 in. solid poplar, birch, or oak; tongue-and-groove or butt joints glued to particleboard with water-resistant glue.

c. Glass Shelving and Doors

1. Glass shelving and all-glass cabinet doors: 0.24 in. thick, clear, polished, plate glass with ground and swiped edges; FS DD-G-451, Type I, Class 1, Quality q3.

2. Finger pulls for all-glass doors - Flush, chrome plated, 27 mm diameter.

3. Glass cabinet doors in wood frames - Minimum 0.12 in. thick, flat sheet clear glass; ASTM C1036, Type I, Class 1, Quality q4.

2.4 CABINET HARDWARE

ANSI A156.9. Screws and attachments - Finished to match hardware item. Finishes - ANSI A156.18.

a. Adjustable Shelf Supports and Rests

1. Shelf supports - Adjustable, wrought brass, nickel plated, with 0.50 in. increment adjustment slots and with provision for screw fastening 6 in. on center vertically. Flush-applied supports - B24072. Surface-applied supports - B24062. Shelf rests - Type B240Q2, wrought brass, nickel plated, minimum projection of 0.80 in. and minimum width of 0.60 in.

2. Shelf rests for use in drilled holes - B84021, wrought steel, nickel plated with 0.40 in. long, 0.24 in. diameter pin; overall length 1.25 in.

b. Cabinet Hinges - Wrought steel, ANSI A156.9.

1. Full mortise, loose-pin hinges - B81021, 5-knuckle, button tip, wrought steel, finish 652 or 639.

2. Semiconcealed cabinet hinges for flush plywood gates and doors - B21201, 5-knuckle, button tip, finish 639 or 652.

3. Continuous hinges - B81491, wrought steel, chrome plated, 0.03 in. thick with 0.09 in. steel pin, countersunk screw holes 2 in. on center; width when open, 1 in.

4. Hinges for lipped door cabinets - B81382, 0.05 in. wrought steel, with 2 in. high barrel, fast button tip pins, mortise jamb leaf, finish 639 or 652.

c. Cabinet Catches

1. Cabinet catches - B83091, friction catch, with wrought steel case and strike, and spring-cushioned rubber rollers.

2. Magnetic catches - B43141, Type 1, aluminum case, minimum 4 lbs-force pull.

d. Pulls

1. Door and drawer pulls - B12012, contemporary-design, 3 in. centers, screw attached from inside.

e. Drawer Slides - B85072, ball bearing full extension drawer slides for attachment to each side of drawer. Provide rubber stops at striking points.

f. Closet Hanger Bars - ANSI A156.16, Type L03131, wrought-brass, nickel-plated, telescoping tubing, 0.0315 in. minimum wall thickness. Seamless outer tube diameter - Minimum 1 in. Provide each wall plate with minimum two screw holes for attachment. Provide nickel-plated wrought steel center supports for spans over 4 ft.

g. Locks - FS FF-H-1819; all brass, ANSI A156.18, finish US26D, pin-tumbler type with dead bolt.

1. Drawer locks and cabinet locks - Half-mortise, minimum 5-pin tumblers, 1.10 in. diameter cylinder, 0.32 in. throw dead bolt with brass strike.

2. Sliding cabinet door locks - Push-bolt type, 4-pin tumbler, 1 in. diameter cylinder with brass cup strike.

h. Sliding Door Hardware

1. Track for all-glass sliding cabinet doors - Steel, zinc-plated, ball bearing assembly consisting of upper channel guide, shoes for glass doors, ball-bearing carrier, and a lower track.

2. Upper channel guides: 1 in. wide by 0.60 in. high with a minimum mass of 0.41 lbs/ft.

3. Shoes for glass doors - Designed for 0.236 in. thick glass; 0.433 in. high with a curved underside, minimum mass of 0.13 lbs/ft.

4. Ball bearing carrier to carry hardened steel ball bearings spaced 3 in. on center with two-point suspension between shoe and anvil of lower track; minimum mass of carrier 0.26 lbs/ft.

5. Lower track: 1 in. x 1 in. double-channel track, designed with a center anvil in each channel to carry ball bearings, minimum mass of 0.75 lbs/ft.

2.5 PLASTIC LAMINATES

a. Color, Pattern, and Finish - Selected by COR from samples of approved manufacturer.

b. Countertop Surface, Edges, and Backsplash: 0.04 in. thick, high-pressure laminate NEMA LD 3 and NEMA LD 3.1.

c. Plastic Laminate Surfaces for Counter Fronts, Gates, and Paneling: 0.031 in. thick, high-pressure laminate.

d. Backing Sheets for Plastic-laminate Panels - Minimum 0.020 in. thick laminated plastic.

e. Backing Sheets for Plastic-laminate Veneer Panels - Bonded to core material with an adhesive as recommended by plastic laminate manufacturer.

f. Adhesives for Plastic-laminate Panels - Phenol-resorcinol and melamine or contact adhesive.

2.6 PRIMING AND SEALING

a. Plywood Paneling - Factory finished, with back surfaces sealed.

b. Mill-fabricated Cabinets, Casework, and Solid Wood Trim scheduled for clear, natural finish - Provide one mill-applied coat of an approved clear sealer of a type compatible with final finish.

2.7 MOISTURE CONTENT OF WOOD PRODUCTS

Kiln-dry lumber. Kiln-dry treated lumber after treatment. Maximum moisture content of wood products at time of delivery to the job site, and when installed, shall be as follows:

a. Interior Paneling: 12 percent.

b. Interior Finish Lumber, Trim, and Millwork 1-1/4 Inches Nominal or Less in Thickness: 12 percent.

c. Moisture content of other materials shall be in accordance with the applicable standards.

2.8 HARDWARE

Provide sizes, types, and spacings of manufactured building materials recommended by the product manufacturer except as otherwise indicated or specified.

2.8.1 Wood Screws

ASME B18.6.1.

2.8.2 Bolts, Nuts, Lag Screws, and Studs

ASME B18.2.1 and ASME B18.2.2.

2.8.3 Nails

Nails shall be the size and type best suited for the purpose and shall conform to ASTM F 547. Nails shall be hot-dip galvanized or aluminum when used on exterior work. Screws for use where nailing is impractical shall be size best suited for purpose.

2.9 FABRICATION

2.9.1 Countertops

Fabricate with lumber and a core of exterior plywood, glued and screwed to form an integral unit. Bond laminated plastic under pressure to exposed surfaces, using type of glue recommended by plastic manufacturer. Countertop unit shall be post-formed type with no-drip nose, cove moulding, and Style A back splash, and covered with ANSI/NEMA LD 3, Grade PF 42 plastic. Back splash shall be not less than 3-1/2 inches nor more than 4-1/2 inches high.

2.9.2 Cabinets

Wall and base cabinets shall be of the same construction and appearances. Fabricate with solid ends and frame fronts, or with frames all around. Frames shall be solid hardwood not less than 3/4 by 1-1/2 inches. Ends, bottom, back, partitions, and doors shall be hardwood plywood. Mortise and tenon, dovetail, or dowel and glue joints to produce a rigid unit. Cover exposed edges of plywood with hardwood strips. Doors, frames, and solid exposed ends shall be 3/4 inch thick; bottom, partitions, and framed ends 1/2 inch minimum; shelves 5/8 inch minimum; back 1/4 inch minimum.

2.9.3 Workbenches

Fabricate as indicated. Dovetail and glue drawer corners. Fasten frames with suitable wood screws or bolts. Sand exposed surfaces smooth, and ease exposed edges. Provide drawer slides for each drawer, and at least two surface-mounted hinges and a magnetic catch, for each door.

PART 3 EXECUTION

3.1 FINISH WORK

Provide sizes, materials, and designs as indicated and as specified. Apply primer to finish work before installing. Where practicable, shop assemble and finish items of built-up millwork. Joints shall be tight and constructed in a manner to conceal shrinkage. Miter trim and moldings at exterior angles and cope at interior angles and at returns. Material shall show no warp after installation. Install millwork and trim in maximum practical lengths. Fasten finish work with finish nails. Provide blind nailing where practicable. Set face nails for putty stopping.

3.1.1 Interior Finish Work

After installation, sand exposed surfaces smooth. Provide window and door trim in single lengths.

3.2 SHELVING

One inch nominal thick wood shelf material or 3/4 or 23/32 inch thick plywood shelf material supported substantially with end and intermediate

supports and arranged to prevent buckling and sagging. Hook strips shall be 1 by 4 inches nominal and cleats 1 by 2 inches nominal. Provide cleats except where hook strips are specified or indicated. Where adjustable shelving is indicated, provide standards and brackets or shelf rests for each shelf. Anchor standards to wall at not more than 2 feet o.c.

3.3 MISCELLANEOUS

3.3.1 Counters

Construct as indicated. Conceal fastenings where practicable, fit counter neatly, install in a rigid and substantial manner, and scribe to adjoining surfaces. Provide counter sections in longest lengths practicable; keep joints in tops to a minimum; and where joints are necessary, provide tight hairline joints drawn up with concealed-type heavy pull-up bolts. Glue joints with water-resistant glue and, in addition, make rigid and substantial with screws, bolts, or other approved fastenings.

3.3.2 Cabinets

Install level, plumb, and tight against adjacent walls. Secure cabinets to walls with concealed toggle bolts, and secure top to cabinet with concealed screws. Make cut-outs for fixtures to templates supplied by fixture manufacturer. Carefully locate cut-outs for pipes so that edges of holes will be covered by escutcheons.

3.3.3 Workbenches

Construct as indicated. Install level, plumb, and tight against adjacent construction. Fasten to walls with screws or toggle bolts and to floors with expansion bolts.

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SECTION 07 21 16

MINERAL FIBER BLANKET INSULATION

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for mineral fiber blanket thermal insulation in attics, ceilings, walls, and floors.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM C 665	Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 930	Potential Health and Safety Concerns Associated with Thermal Insulation Materials and Accessories
ASTM D 3833/D 3833M	Water Vapor Transmission of Pressure-Sensitive Tapes
ASTM D 4397	Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 136	Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 96/E 96M	Standard Test Methods for Water Vapor Transmission of Materials

GREENGUARD ENVIRONMENTAL INSTITUTE (CEI)

CEI	Greenguard Standards for Low Emitting Products

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 211	Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA 31	Standard for the Installation of Oil-Burning Equipment
NFPA 54	National Fuel Gas Code
NFPA 70	(2011; Errata 2 2012) National Electrical Code

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS) Indoor Advantage

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T803 OM	Puncture Test of Container Board

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.134	Respiratory Protection

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Blanket insulation

Sill sealer insulation

Vapor retarder

Pressure sensitive tape

Accessories

Certification

SD-08 Manufacturer's Instructions

Insulation

1.4 SUSTAINABLE DESIGN CERTIFICATION

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials to site in original sealed wrapping bearing manufacturer's name and brand designation, specification number, type, grade, R-value, and class. Store and handle to protect from damage. Do not allow insulation materials to become wet, soiled, crushed, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storing, and protecting of materials before and during installation.

1.5.2 Storage

Inspect materials delivered to the site for damage; unload and store out of weather in manufacturer's original packaging. Store only in dry locations, not subject to open flames or sparks, and easily accessible for inspection and handling.

1.6 SAFETY PRECAUTIONS

1.6.1 Respirators

Provide installers with dust/mist respirators, training in their use, and protective clothing, all approved by National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) in accordance with 29 CFR 1910.134.

1.6.2 Smoking

Do not smoke during installation of blanket thermal insulation.

1.6.3 Other Safety Concerns

Consider other safety concerns and measures as outlined in ASTM C 930.

PART 2 PRODUCTS

2.1 BLANKET INSULATION

ASTM C 665, Type I, blankets without membrane coverings and II, blankets with non-reflecting coverings and III, blankets with reflective coverings; Class A, membrane-faced surface with a flame spread of 25 or less, except a flame spread rating of 25 or less and a smoke developed rating of 150 or less when tested in accordance with ASTM E 84.

2.1.1 Thermal Resistance Value (R-VALUE)

As indicated

2.1.2 Recycled Materials

Provide Thermal Insulation containing recycled materials to the extent practicable, provided the material meets all other requirements of this section. The minimum required recycled materials content by weight are:

Rock Wool: 75 percent slag
Fiberglass: 20 to 25 percent glass cullet

2.1.3 Prohibited Materials

Do not provide asbestos-containing materials.

2.2 SILL SEALER INSULATION

ASTM C 665, Type I.

2.3 BLOCKING

Wood, metal, unfaced mineral fiber blankets in accordance with ASTM C 665, Type I, or other approved materials. Use only non-combustible materials meeting the requirements of ASTM E 136 for blocking around chimneys and heat producing devices.

2.4 VAPOR RETARDER

a. 6 mil thick polyethylene sheeting conforming to ASTM D 4397 and having a water vapor permeance of 1 perm or less when tested in accordance with ASTM E 96/E 96M.

b. Membrane with the following properties:

Water Vapor Permeance: ASTM E 96/E 96M: 1 perm
Maximum Flame Spread: ASTM E 84: 25
Combustion Characteristics: Passing ASTM E 136

2.5 PRESSURE SENSITIVE TAPE

As recommended by the vapor retarder manufacturer and having a water vapor permeance rating of one perm or less when tested in accordance with ASTM D 3833/D 3833M.

2.6 ACCESSORIES

2.6.1 Adhesive

As recommended by the insulation manufacturer.

2.6.2 Mechanical Fasteners

Corrosion resistant fasteners as recommended by the insulation manufacturer.

2.6.3 Wire Mesh

Corrosion resistant and as recommended by the insulation manufacturer.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

Before installing insulation, ensure that areas that will be in contact with the insulation are dry and free of projections which could cause voids, compressed insulation, or punctured vapor retarders. If moisture or other conditions are found that do not allow the workmanlike installation of the insulation, do not proceed but notify COR of such conditions.

3.2 PREPARATION

3.2.1 Blocking at Attic Vents and Access Doors

Prior to installation of insulation, install permanent blocking to prevent insulation from slipping over, clogging, or restricting air flow through soffit vents at eaves. Install permanent blocking to maintain accessibility to equipment or controls that require maintenance or adjustment.

3.2.2 Blocking Around Heat Producing Devices

Install non-combustible blocking around heat producing devices to provide the following clearances:

a. Recessed lighting fixtures, including wiring compartments, ballasts, and other heat producing devices, unless these are certified by the manufacturer for installation surrounded by insulation: 3 inches from outside face of fixtures and devices or as required by CEC and NFPA 70 and, if insulation is to be placed above fixture or device, 24 inches above fixture.

b. Masonry chimneys or masonry enclosing a flue: 2 inches from outside face of masonry. Masonry chimneys for medium and high heat operating appliances: Minimum clearances required by NFPA 211.

c. Vents and vent connectors used for venting the products of combustion, flues, and chimneys other than masonry chimneys: Minimum clearances as required by NFPA 211.

d. Gas Fired Appliances: Clearances as required in NFPA 54.

e. Oil Fired Appliances: Clearances as required in NFPA 31.

Blocking around flues and chimneys is not required when insulation blanket, including any attached vapor retarder, passed ASTM E 136, in addition to meeting all other requirements stipulated in Part 2. Blocking is also not required if the chimneys are certified by the manufacturer for use in contact with insulating materials.

3.3 INSTALLATION

3.3.1 Insulation

Install and handle insulation in accordance with manufacturer's instructions. Keep material dry and free of extraneous materials. Ensure personal protective clothing and respiratory equipment is used as required. Observe safe work practices.

3.3.1.1 Electrical wiring

Do not install insulation in a manner that would sandwich electrical wiring between two layers of insulation.

3.3.1.2 Continuity of Insulation

Install blanket insulation to butt tightly against adjoining blankets and to studs, rafters, joists, sill plates, headers and any obstructions. Where insulation required is thicker than depth of joist, provide full

width blankets to cover across top of joists. Provide continuity and integrity of insulation at corners, wall to ceiling joints, roof, and floor. Avoid creating thermal bridges.

3.3.1.3 Installation at Bridging and Cross Bracing

Insulate at bridging and cross bracing by splitting blanket vertically at center and packing one half into each opening. Butt insulation at bridging and cross bracing; fill in bridged area with loose or scrap insulation.

3.3.1.4 Insulation Blanket with Affixed Vapor Retarder

Locate vapor retarder as indicated. Do not install blankets with affixed vapor retarders unless so specified. Unless the insulation manufacturer's instructions specifically recommend not to staple the flanges of the vapor retarder facing, staple flanges of vapor retarder at 6 inch intervals flush with face or set in the side of truss, joist, or stud. Avoid gaps and bulges in insulation and "fishmouth" in vapor retarders. Overlap both flanges when using face method. Seal joints and edges of vapor retarder with pressure sensitive tape. Stuff pieces of insulation into small cracks between trusses, joists, studs and other framing, such as at attic access doors, door and window heads, jambs, and sills, band joists, and headers. Cover these insulated cracks with vapor retarder material and tape all joints with pressure sensitive tape to provide air and vapor tightness.

3.3.1.5 Insulation without Affixed Vapor Retarder

Provide snug friction fit to hold insulation in place. Stuff pieces of insulation into cracks between trusses, joists, studs and other framing, such as at attic access doors, door and window heads, jambs, and sills, band joists, and headers.

3.3.1.6 Sizing of Blankets

Provide only full width blankets when insulating between trusses, joists, or studs. Size width of blankets for a snug fit where trusses, joists or studs are irregularly spaced.

3.3.1.7 Special Requirements for Ceilings

Place insulation under electrical wiring occurring across joists. Pack insulation into narrowly spaced framing. Do not block flow of air through soffit vents. Attach insulation to attic door by adhesive or staples.

3.3.1.8 Installation of Sill Sealer

Size sill sealer insulation and place insulation over top of masonry or concrete perimeter walls or concrete perimeter floor slab on grade. Fasten sill plate over insulation.

3.3.1.9 Special Requirements for Floors

Hold insulation in place with corrosion resistant wire mesh, wire fasteners, or wire lacing.

3.3.1.10 Access Panels and Doors

Affix blanket insulation to access panels greater than one square foot and access doors in insulated floors and ceilings. Use insulation with same

R-Value as that for floor or ceiling.

3.3.2 Installation of Separate Vapor Retarder

Apply continuous vapor retarder as indicated. Overlap joints at least 6 inches and seal with pressure sensitive tape. Seal at sill, header, windows, doors and utility penetrations. Repair punctures or tears with pressure sensitive tape.

3.4 INSPECTION AND ACCEPTANCE

a. Building insulation work will be rejected for any of the following deficiencies: thermal insulation material not conforming to type and nominal thickness indicated; insulated construction not having small areas between closely spaced framing members fully insulated; installed thermal-insulation material damaged or wetted by exposure to inclement weather; installed vapor barriers having tears, breaks, or ruptures that cannot be sealed with vapor-barrier tape or other approved method.

b. Remove defective work and replace with acceptable work, at no expense to the Government.

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SECTION 07 22 00

ROOF AND DECK INSULATION

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for insulation materials used below built-up roofing and single ply roofing systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM C 1177/C 1177M	Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C 1289	Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C208	Cellulosic Fiber Insulating Board
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM 4470	Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction
FM APP GUIDE	Approval Guide http://www.approvalguide.com/
FM P9513	Specialist Data Book Set for Roofing Contractors; contains 1-22 (2001), 1-28 (2002), 1-29 (2002), 1-28R/1-29R (1998), 1-30 (2000), 1-31 (2000), 1-32 (2000), 1-33 (2000), 1-34 (2001), 1-49 (2000), 1-52 (2000), 1-54 (2001)

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir Building Materials Directory

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wood nailers

Tapered roof insulation system

Taper cants and crickets

Show location and spacing of wood nailers that are required for securing insulation and for backnailing of roofing felts. Show a complete description of the procedures for the installation of each phase of the system indicating the type of materials, thicknesses, identity codes, sequence of laying insulation, location of ridges and valleys, special methods for cutting and fitting of insulation, and special precautions. The drawings shall be based on field measurements.

SD-03 Product Data

Fasteners

Insulation

Certification

SD-06 Test Reports

Flame spread and smoke developed ratings

Submit in accordance with ASTM E 84.

SD-07 Certificates

Installer qualifications

SD-08 Manufacturer's Instructions

Nails and fasteners

Roof insulation, including field of roof and perimeter attachment requirements.

1.4 MANUFACTURER'S CERTIFICATE

Submit certificate from the insulation manufacturer attesting that the installer has the proper qualifications for installing tapered roof insulation systems.

Certificate attesting that the expanded perlite or polyisocyanurate insulation contains recovered material and showing estimated percent of

recovered material. Certificates of compliance for felt materials.

1.5 QUALITY ASSURANCE

1.5.1 Insulation on Combustible Steel or Concrete Decks

Roof insulation shall have a flame spread rating not greater than 75 and a smoke developed rating not greater than 150, exclusive of covering, when tested in accordance with ASTM E 84. Insulation bearing the UL label and listed in the UL Bld Mat Dir as meeting the flame spread and smoke developed ratings will be accepted in lieu of copies of test reports. Compliance with flame spread and smoke developed ratings will not be required when insulation has been tested as part of a roof construction assembly of the type used for this project and the construction is listed as fire-classified in the UL Bld Mat Dir or listed as Class I roof deck construction in the FM APP GUIDE. Insulation tested as part of a roof construction assembly shall bear UL or FM labels attesting to the ratings specified herein.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery

Deliver materials to site in manufacturer's unopened and undamaged standard commercial containers bearing the following legible information:

a. Name of manufacturer;

b. Brand designation;

c. Specification number, type, and class, as applicable, where materials are covered by a referenced specification; and

Deliver materials in sufficient quantity to allow continuity of the work.

1.6.2 Storage and Handling

Store and handle materials in a manner to protect from damage, exposure to open flame or other ignition sources, and from wetting, condensation or moisture absorption. Store in an enclosed building or trailer that provides a dry, adequately ventilated environment. Replace damaged material with new material.

1.7 ENVIRONMENTAL CONDITIONS

Do not install roof insulation during inclement weather or when air temperature is below 40 degrees F and interior humidity is 45 percent or greater, or when there is visible ice, frost, or moisture on the roof deck.

PART 2 PRODUCTS

2.1 INSULATION

2.1.1 Insulation Types

Roof insulation shall be one or an assembly of a maximum of three of the following materials and compatible with attachment methods for the specified insulation and roof membrane:

a. Polyisocyanurate Board: ASTM C 1289 Type I -- foil faced both sides or Type II, fibrous felt or glass mat membrane both sides, except minimum compressive strength shall be 20 pounds per square inch (psi).

2.1.2 Insulation Thickness

As indicated on drawings.

2.1.3 Cants and Tapered Edge Strips

Provide preformed cants and tapered edge strips of the same material as the roof insulation; or, when roof insulation material is unavailable, provide pressure-preservative treated wood, wood fiberboard, or rigid perlite board cants and edge strips as recommended by the roofing manufacturer, unless otherwise indicated. Face of cant strips shall have incline of 45 degrees and vertical height of 4 inches. Taper edge strips at a rate of one to 1 1/2 inch per foot down to approximately 1/8 inch thick.

2.2 PROTECTION BOARD

For use as a protection board for roofing membrane over roof insulation.

2.2.1 Glass Mat Gypsum Roof Board

ASTM C 1177/C 1177M, 0 Flame Spread and 0 Smoke Developed when tested in accordance with ASTM E 84, 500 psi, Class A, non-combustible, 1/2 inch thick, 4 by 8 feet board size.

2.2.2 High Density Fiberboard Insulation for Use with PVC Roof Systems

Rigid insulation board 1/2 inch thick and composed of interlocking organic fibers.

Asphalt treated on both sides to reduce bitumen absorption.

ASTM C 208, ASTM C 209.

Performance

Property	Method	Value
Water Absorption	ASTM C 208	7% max.
	ASTM C 209	
Weight per 1 inch		1.7 pounds min.
Compressive Strength		(45 psi nom.)

2.3 FASTENERS

Flush-driven through flat round or hexagonal steel or plastic plates. Steel plates shall be zinc-coated, flat round not less than 1 3/8 inch diameter or hexagonal not less than 28 gage. Plastic plates shall be high-density,

molded thermoplastic with smooth top surface, reinforcing ribs and not less than 3 inches in diameter. Fastener head shall recess fully into the plastic plate after it is driven. Plates shall be formed to prevent dishing. Do not use bell-or cup-shaped plates. Fasteners shall conform to insulation manufacturer's recommendations except that holding power, when driven, shall be not less than 120 pounds each in steel deck. Fasteners for steel or concrete decks shall conform to FM APP GUIDE for Class I roof deck construction, and shall be spaced to withstand an uplift pressure of90 pounds per square foot.

2.3.1 Roofing Nails for Wood Decks

Barbed 11 gage, zinc-coated nails with 7/16 to 5/8 inch diameter heads or annular ring shank, square head, one-piece composite nails. Nails shall be long enough to penetrate wood deck at least 5/8 inch but shall not protrude through underside of decking.

2.3.2 Fasteners for Plywood Decks

Annular ring shank, square head, one-piece composite nails long enough to penetrate into plywood decks approximately 1/2 inch but not protrude through underside of decking.

2.3.3 Fasteners for Steel Decks

Approved hardened penetrating fasteners or screws conforming to FM 4470 and listed in FM APP GUIDE for Class I roof deck construction. Quantity and placement to withstand a minimum uplift pressure of 90 psf conforming to FM APP GUIDE.

2.3.4 Fasteners for Poured Concrete Decks

Approved hardened fasteners or screws to penetrate deck at least one inch but not more than 1 1/2 inches, conforming to FM 4470, and listed in FM APP GUIDE for Class I roof deck construction. Quantity and placement to withstand an uplift pressure of 90 psf conforming to FM APP GUIDE.

2.4 WOOD NAILERS

Pressure-preservative-treated as specified in Section 06 10 00 ROUGH CARPENTRY.

PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

3.1.1 Surface Inspection

Surfaces shall be clean, smooth, and dry. Check roof deck surfaces, including surfaces sloped to roof drains and outlets, for defects before starting work.

The Contractor shall inspect and approve the surfaces immediately before starting installation. Prior to installing insulation, perform the following:

a. Examine wood decks to ascertain that deck boards have been properly nailed and that exposed nail heads have been set.

b. Examine steel decks to ensure that panels are properly secured to structural members and to each other and that surfaces of top flanges are flat or slightly convex.

c. Prior to installing any roof system on a concrete deck, conduct a test per ASTM D 4263. The deck is acceptable for roof system application when there is no visible moisture on underside of plastic sheet after 24 hours.

3.1.2 Surface Preparation

Correct defects and inaccuracies in roof deck surface to eliminate poor drainage and hollow or low spots and perform the following:

a. Install wood nailers the same thickness as insulation at eaves, edges, curbs, walls, and roof openings for securing cant strips, gravel stops, and flashing flanges. On decks with slopes of one inch per foot or more, install wood nailers perpendicular to slope for securing insulation. Space nailers in accordance with approved shop drawings.

b. Fill or cover cracks or knot holes larger than 1/2 inch in diameter in wood decks as necessary to form an unyielding surface.

3.2 INSULATION INSTALLATION

3.2.1 Installation Using Only Mechanical Fasteners

Secure total thickness of insulation with penetrating type fasteners.

3.2.2 Special Precautions for Installation of Foam Insulation

3.2.2.1 Polyisocyanurate Insulation

Where polyisocyanurate foam board insulation is provided, install 1/2 inch glass mat gypsum roof board over top surface of foam board insulation. Stagger joints of insulation with respect to foam board insulation below.

3.2.3 Cant Strips

Where indicated, provide cant strips at intersections of roof with walls, parapets, and curbs extending above roof. Wood cant strips shall bear on and be anchored to wood blocking. Fit cant strips flush against vertical surfaces. Where possible, nail cant strips to adjoining surfaces. Where cant strips are installed against non-nailable materials, install in an approved adhesive.

3.2.4 Tapered Edge Strips

Where indicated, provide edge strips in the right angle formed by junction of roof and wood nailing strips that extend above level of roof. Install edge strips flush against vertical surfaces of wood nailing strips. Where possible, nail edge strips to adjoining surfaces. Where installed against non-nailable materials, install in an approved adhesive.

3.3 PROTECTION

3.3.1 Protection of Applied Insulation

Completely cover each day's installation of insulation with the finished

roofing specified in Sections 07 54 19 or 07 51 13 on same day. Do not permit phased construction. Protect open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, until permanent roofing and flashing are applied. Do not permit storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces. Provide smooth, clean board or plank walkways, runways, and platforms near supports, as necessary, to distribute weight to conform to indicated live load limits of roof construction. Exposed edges of the insulation shall be protected by cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs shall be 2 layers of bituminous-saturated felt set in plastic bituminous cement or single ply set in roof cement. Fill all profile voids in cut-offs to prevent entrapping of moisture into the area below the membrane. Cutoffs shall be removed when work is resumed.

3.3.2 Damaged Work and Materials

Restore work and materials that become damaged during construction to original condition or replace with new materials.

3.4 INSPECTION

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed roof insulation with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.

b. Verification of certification, listing or label compliance with FM P9513.

c. Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.

d. Inspection of vapor retarder application, including edge envelopes and mechanical fastening.

e. Inspection of mechanical fasteners; type, number, length, and spacing.

f. Coordination with other materials, cants, sleepers, and nailing strips.

g. Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.

h. Installation of cutoffs and proper joining of work on subsequent days.

i. Continuation of complete roofing system installation to cover insulation installed same day.

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SECTION 07 51 13

BUILT-UP ASPHALT ROOFING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for aggregate surfaced bituminous built-up roofing, and built-up roofing with granule-surfaced modified bitumen cap sheet on slopes from 1/4 inch to 1-1/2 inch per foot.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/SPRI RD-1	Performance Standard for Retrofit Drains

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-10	Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM C 1153	Standard Practice for Location of Wet Insulation in Roofing Systems Using Infrared Imaging
ASTM C 208	Cellulosic Fiber Insulating Board
ASTM C 728	Perlite Thermal Insulation Board
ASTM D 1863	Mineral Aggregate Used on Built-Up Roofs
ASTM D 1864/D 1864M	Moisture in Mineral Aggregate Used on Built-Up Roofs
ASTM D 1970	Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
ASTM D 2178	Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D 312	Standard Specification for Asphalt Used in

	Roofing
ASTM D 3617	Sampling and Analysis of New Built-Up Roof Membranes
ASTM D 4402	Viscosity Determination of Asphalt at Elevated Temperatures Using a Rotational Viscometer
ASTM D 4586	Asphalt Roof Cement, Asbestos-Free
ASTM D 4601	Asphalt-Coated Glass Fiber Base Sheet Used in Roofing
ASTM D 4869	Standard Specification for Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing
ASTM D 4897/D 4897M	Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing
ASTM D 517	Asphalt Plank
ASTM D 6162	Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements
ASTM D 6163	Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcements
ASTM D 6757	Standard Specification for Underlayment Felt Containing Inorganic Fibers Used in Steep-Slope Roofing
ASTM D2170/D2170M	Kinematic Viscosity of Asphalts (Bitumens)
ASTM D41/D41M	Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D4637/D4637M	EPDM Sheet Used in Single-Ply Roof Membrane
ASTM D6164/D6164M	Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Polyester Reinforcements
ASTM E 108	Fire Tests of Roof Coverings

FM GLOBAL (FM)

FM 4470	Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction
FM APP GUIDE	Approval Guide http://www.approvalguide.com/

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 0405	Roofing and Waterproofing Manual

UNDERWRITERS LABORATORIES (UL)

UL 790	Standard Test Methods for Fire Tests of Roof Coverings
UL RMSD	Roofing Materials and Systems Directory

1.3 DESCRIPTION OF ROOF MEMBRANE SYSTEMS

Asphalt applied, three-ply felt with granule-surfaced standard cap sheet conforming to ASTM 3909 built-up roof membrane system. Over a wood or gypsum deck mechanically fastened base sheet shall not be considered one of the three ply felts.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Wind uplift calculations

Asphalt

Felts, including ply felt, base sheet and ventilating felt as applicable

Granule Surface Modified Bitumen Cap Sheet

FLASHING MEMBRANE

Fasteners

Primer

Asphalt Roof Cement

Walkpad Materials

Vapor Pressure Relief Vents

Cant Strips

Certificate attesting that the fiberboard furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

Pre-Manufactured Accessories to be incorporated in the system installation

Roof Walkways

Sample warranties certificates

Submit all data required with requirements of this section. Include in Data written acceptance by the roof membrane manufacturer of the products and accessories provided. List products in the applicable wind uplift and fire rating classification listings, unless approved otherwise by the COR.

SD-06 Test Reports

Samples of Built-Up Roofing

Submit test results on roofing field samples as required, verifying composition of sample. Submit six copies of laboratory analysis within 20 working days after samples are taken. Submit reports in accordance with ASTM D 3617.

SD-07 Certificates

bill of lading

Submit when labels of asphalt containers do not indicate the finished blowing temperature, flash point and equiviscous temperature.

Qualifications of Applicator

Submit evidence of the roofing system manufacturer's approval.

SD-08 Manufacturer's Instructions

Felts

Flashings

Cap Sheet

Base Sheet attachment, including pattern and frequency of mechanical attachments required in field of roof, corners, and perimeters to provide for the specified wind resistance.

Asphalt

Primer

Roof Cement

Fasteners

SD-11 Closeout Submittals

Warranty

Information Card

1.5 QUALITY ASSURANCE

1.5.1 Qualifications of Applicator

The roofing system applicator must be approved, authorized, or licensed in

writing by the roofing system manufacturer and must have a minimum of 3 years experience as an approved, authorized, or licensed applicator with the manufacturer and be approved at a level capable of providing the specified warranty.

1.5.2 Fire Resistance

Complete roof covering assembly must:

a. Be Class A rated in accordance with ASTM E 108 , FM 4470, or UL 790; and

b. Be listed as part of Fire-Classified roof deck construction in UL RMSD, or Class I roof deck construction in FM APP GUIDE.

1.5.3 Wind Uplift Resistance

Rate complete roof covering assembly, including insulation, as Class 1 A with a wind uplift pressure rating of 90 psf in accordance with FM APP GUIDE. Do not install non-rated systems except as approved by the COR. Submit licensed engineer's wind uplift calculations and substantiating data to validate any non-rated roof system. Base wind uplift measurements on a design wind speed of 85 mphin accordance with ASCE 7-10 and/or other applicable building code requirements.

1.5.4 Preroofing Conference

After approval of submittals and before performing roofing and insulation if applicable, system installation work, hold a preroofing conference to review the following:

a. Drawings and specifications and submittals related to the roof work;

b. Roof system components installation;

c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representatives to roof manufacturer;

d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and

e. Quality control plan for the roof system installation;

f. Safety requirements.

Coordinate preroofing conference scheduling with the COR. The conference must be attended by the Contractor, the COR's designated personnel, and personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with the roof work, Fire Marshall, and representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Delivery

Deliver materials in manufacturers' original unopened containers and rolls with manufacturer's labels intact and legible. Mark and remove wet or damaged materials from site. Where materials are covered by a referenced specification, container must bear specification number, type, and class, as applicable. Indicate on labels or bill of lading for roofing asphalt the asphalt type, finished blowing temperature (FBT), flash point (FP), and equiviscous temperature (EVT), that is, the temperature at which the viscosity is either 125 centistokes when tested in accordance with ASTM D2170/D2170M or 75 centipoise when tested in accordance with ASTM D 4402. Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.6.2 Storage

Protect materials against moisture absorption, contamination, or other damage. Avoid crushing or crinkling of roll materials. Store roll materials on end on clean raised platforms in dry locations in enclosed buildings or trailers with adequate ventilation. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work are finished and dry. Do not store materials outdoors unless approved by the COR. Completely cover felts stored outdoors, on and off roof, with waterproof canvas protective covering. Do not use polyethylene sheet as a covering. Tie covering securely to pallets to make completely weatherproof and yet provide sufficient ventilation to prevent condensation. Maintain roll materials at temperature above 50 degrees F for a 24-hour period immediately prior to application. Keep aggregate dry as defined by ASTM D 1863. Place only those materials to be used during one day's work on the roof at one time. Remove unused materials from the roof at the end of each day's work. Immediately remove wet, contaminated or otherwise damaged or unsuitable materials from the site. Damaged materials may be marked by the COR.

1.6.3 Handling

Prevent damage to edges and ends of roll materials. Do not install damaged materials in the work. Select and operate material handling equipment so as not to damage materials or applied roofing.

1.7 ENVIRONMENTAL CONDITIONS

Do not install roofing during precipitation, or fog, or when air temperature is below 40 degrees F, or when there is ice, frost, moisture or visible dampness on roof deck.

1.8 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counterflashing are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials.

1.9 WARRANTY

Provide roof system material and workmanship warranties meeting specified

requirements. Provide revision or amendment to standard membrane manufacturer warranty to comply with the specified requirements.

1.9.1 Roof Membrane Manufacturer Warranty

Furnish the roof membrane manufacturer's 20-year no dollar limit roof system materials and installation workmanship warranty, including flashing, insulation, and accessories necessary for a watertight roof system construction. Write the warranty directly to the Government commencing at the time of Government's acceptance of the roof work. Provide the following statement for such warranty:

a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, blisters, splits, tears, delaminates, separates at the seams, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship are the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work are the responsibility of the roof membrane manufacturer.

b. The warranty must remain in full force and effect, including emergency temporary repairs performed by others, when the manufacturer or his approved applicator fail to perform the repairs within 72 hours of notification.

1.9.2 Roofing System Installer Warranty

The roof system installer must warrant for a minimum period of five years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, attachments, and sheet metal installation integral to a complete watertight roof system assembly. Write the warranty directly to the Government. The roof system installer is responsible for correction of defective workmanship and replacement of damaged or affected materials. The roof system installer is responsible for all costs associated with the repair or replacement work.

1.9.3 Continuance of Warranty

Approve repair or replacement work that becomes necessary within the warranty period and accomplished in a manner so as to restore the integrity of the roof system assembly and validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

1.10 CONFORMANCE AND COMPATIBILITY

The entire roofing and flashing system must be in accordance with specified and indicated requirements, including fire and wind resistance requirements. Work not specifically addressed and any deviation from specified requirements must be in general accordance with recommendations of the NRCA 0405, membrane manufacturer published recommendations and details, and compatible with surrounding components and construction. Submit any deviation from specified or indicated requirements to the COR for approval prior to installation.

PART 2 PRODUCTS

2.1 GENERAL

Furnish a combination of specified materials that comprise the membrane manufacturer's standard system of the number and type of plies specified. Materials provided must be approved by the roof membrane manufacturer and suitable for the service and climatic conditions of the installation.

2.2 FIBERGLASS FELT MATERIALS

a. Fiberglass Felt Base Sheet: ASTM D 4601, Type II, non-perforated, and as approved by the roof membrane manufacturer.

b. Ply Felt: ASTM D 2178, Type VI.

2.3 BASE FLASHING MEMBRANE

ASTM D 6163. Membrane manufacturer's standard, minimum two-ply modified bitumen membrane flashing system compatible with the built-up roof membrane and as recommended in membrane manufacturer's published literature. Provide a minimum base ply of flashing membrane of 70 mils thick. Provide a minimum granule surface modified bitumen flashing cap sheet of 120 mils thick on the selvage edge.

2.4 ASPHALT

ASTM D 312, Type III, in accordance with membrane manufacturer requirements and compatible with the slope conditions of the installation.

2.5 SURFACING MATERIAL

2.5.1 Granule Surface Cap Sheet

Mineral surface cap sheet produced for surfacing applications. Cap sheet shall conform to ASTM 3909.

2.6 PRIMER

ASTM D41/D41M for asphalt roofing systems and as approved by the membrane manufacturer.

2.7 ASPHALT ROOF CEMENT

ASTM D 4586 for use with asphalt roofing systems, Type II for vertical surfaces and built-up bituminous flashings; Type I for horizontal surfaces and as recommended by the membrane manufacturer.

2.8 CANT STRIPS

Standard cant strips shall be of perlite conforming to ASTM C 728 treated with bituminous impregnation, sizing, or waxing and fabricated to provide maximum 45 degree change in direction of membrane. Provide minimum 1-1/2 inch thick cant strips and provide for minimum 5 inch face and 3-1/2 inch vertical height when installed at 45 degree face angle, except where clearance restricts height to lesser dimension.

2.9 UNSATURATED FELT OR ROSIN-SIZED BUILDING PAPER

Provide rosin-sized sheathing paper weighing minimum 5 pounds per 100 square feet or unsaturated felt weighing approximately 7-1/2 pounds per 100 square feet.

2.10 FASTENERS AND PLATES

Coated, corrosion resistant fasteners compatible with components being attached and contact surfaces. Conform to FM 4470 for fasteners for attachment to deck substrate of Class I roof deck construction and FM APP GUIDEfor the wind resistance specified. Use hard copper fasteners in contact with copper; aluminum or stainless steel fasteners in contact with aluminum; and stainless steel fasteners in contact with stainless steel. For fastening only roofing felts, use fasteners driven through metal discs, or one-piece composite fasteners with heads not less than 1 inch in diameter or 1 inch square with rounded or 45-degree tapered corners.

2.10.1 Wood Substrates and Nailers

Provide 11 gage annular threaded shank nails with 7/16 to 5/8 inch diameter heads; or one-piece composite nails with annular threaded shanks not less than 11 gage for securing felts and metal items. Provide fasteners long enough to penetrate minimum 1 inch into or minimum 1/4 inch through wood substrate materials. Do not penetrate wood decking exposed to view on the underside.

2.10.2 Masonry or Concrete Walls and Vertical Surfaces

Provide hardened steel nails or screws with flat heads, diamond shaped points, and mechanically deformed shanks not less than 1 inch long for securing felts, metal items, and accessories. Use power-driven fasteners only when approved in writing by COR.

2.10.3 Metal Plates

Flat corrosion-resistant round stress plates as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM 4470; minimum 2 inch in diameter. Form discs to prevent dishing or cupping.

2.11 PRE-MANUFACTURED ACCESSORIES

Pre-manufactured accessories must be manufacturer's standard for intended purpose, compatible with the membrane roof system and approved for use by the roof membrane manufacturer.

2.12 WALKPADS

2.12.1 ROOF WALKWAYS

Provide 36 by 72 inch by 1/2 inch thick asphalt planks, consisting of a homogeneous core of asphalt, plasticizers, and fillers bonded between two saturated and coated facing sheets. Top side must be surfaced with ceramic granules. Conform to ASTM D 517, mineral-surfaced asphalt.

2.13 ROOF INSULATION BELOW BUILT-UP ROOF SYSTEM

Insulation must be compatible with the roof membrane, approved by the

membrane manufacturer.

2.14 MEMBRANE LINER

Self-adhering modified bitumen underlayment conforming to ASTM D 1970, EPDM membrane liner conforming to ASTM D4637/D4637M, or other waterproof membrane liner material conforming to ASTM D 4869, or ASTM D 6757, and as approved by the COR.

2.15 REFLECTIVE COATING

White elastomeric roof coating as specified by approved roof system manufacturer. Coating shall not contain asbestos or fibered aluminum.

2.16 ROOF DRAINS AND ACCESSORIES

Replace damaged or missing roof drains and their accessories. All new roof drain bowls, clamping rings and strainers shall match the existing drain bowl and leader size.

New drain bowls shall have no-hub connectors and an integral clamping ring, and deck clamp.

New drain bowls shall be Josam 2100 series or approved equal.

All connectors shall be with cast iron soil pipe and flex connectors in accordance with UPC and UBC

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Before applying roofing materials, ensure that the following exist:

a. Drains, curbs, cants, control joints, expansion joints, perimeter walls, roof penetrating components, and equipment supports are in place.

b. Surfaces are rigid, clean, dry, smooth, and free of cracks, holes, and sharp changes in elevation. Joints in substrate are sealed to prevent drippage of bitumen into building or down exterior walls. Inspect surfaces and approve immediately before application of roofing and flashings. Apply the roofing and flashings to a smooth and firm surface free from ice, frost, visible moisture, dirt, projections, and foreign materials.

c. The plane of the substrate does not vary more than 1/4 inch within an area 10 by 10 feet when checked with a 10 foot straight edge placed anywhere on the substrate.

d. Substrate is sloped as indicated to provide drainage.

e. Walls and vertical surfaces are constructed to receive counterflashing and will permit mechanical fastening of the base flashing materials.

f. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inch above finished roofing surface.

g. Treated wood nailers are fastened in place at eaves, gable ends,

openings, and intersections with vertical surfaces for securing of felts, edging strips, attachment flanges of sheet metal, and roof fixtures. Embedded nailers are flush with deck surfaces. Surface-applied nailers are same thickness as roof insulation.

h. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is approximately 45 degrees and the height of the vertical leg is not less than nominal 3-1/2 inch. Lay cants in a solid asphalt mopping or coat of asphalt cement just prior to laying the roofing plies.

i. Venting is provided in accordance with the following:

1. Edge Venting: Perimeter nailers are kerfed across width of the nailers to permit escape of gaseous pressure at roof edges.

2. Underside Venting: Vent openings are provided in steel form decking for cast-in-place concrete substrate.

3. Vapor pressure relief vents: Holes equal to the outside diameter of vents are provided through the insulation where vents are required. Space vents in accordance with membrane manufacturer's recommendations.

j. Exposed nail heads in wood substrates are properly set. Warped and split boards, sheets have been replaced. There are no cracks or end joints 1/4 inch in width or greater. Knot holes are covered with sheet metal and nailed in place. Wood or plywood decks are covered with rosin paper or unsaturated felt prior to base sheet or roof membrane application. Joints in plywood substrates are taped with 2 inch wide masking tape to prevent air leakage from the underside.

k. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 1/4 inch in width. Insulation is being roofed over on the same day the insulation is installed.

l. Cast-in-place concrete substrates have been allowed to cure and the surface dryness requirements specified under paragraph entitled "Field Quality Control" have been met.

m. Prior to application of primer on precast concrete decks, cover joints with a minimum 4 inch strip of felt or bituminous stripping membrane set in bituminous cement.

n. All drains, curbs, roof penetrating components and equipment supports shall be in place. The drain body must be recessed so that the clamping ring is flush with or below the roof surface.

Disconnect roof mounted mechanical equipment, such as fans, air conditioners, and HVAC units and remove curbs or other areas, for the proper installation of the roof system, prior to application of the new membrane. Qualified California State licensed people shall disconnect and re-connect the equipment after application of membrane. The Construction Manager shall be advised of the schedule of such disconnected equipment prior to removal and test after re-installation for proper function with the Construction Manager. The Contractor shall bring to the attention of the Construction Manager any defective equipment, prior to removal of the equipment. Failure to do so shall

indicate all equipment is functioning in a proper manner. Equipment damaged during roof operations shall be replaced under this contract with no increase in contract price.

After roof surface is completed, units shall be reset in proper locations, with all mechanical, electrical, and sheet metal connections completed by qualified personnel. Change in height of equipment may be required. All adjustments and their cost shall be included in bid price.

3.2 PREPARATION

Verify that work of other trades that penetrates the roof deck or requires men and equipment to traverse the roof deck is complete.

Examine deck surfaces for inadequate anchorage, foreign material, moisture, and unevenness which would prevent the execution and quality of application.

Proceed with the roofing application only after defects have been corrected.

Starting work designates acceptance of the surfaces by the Contractor.

3.2.1 Protection of Property

3.2.1.1 Protective Coverings

Install protective coverings at paving and building walls adjacent to hoists and kettles prior to starting the work. Lap protective coverings not less than six inch, secure against wind, and vent to prevent collection of moisture on covered surfaces. Keep protective coverings in place for the duration of the roofing work.

3.2.1.2 Bitumen Stops

Provide felt bitumen stops or other means to prevent bitumen drippage at roof edges, openings, and vertical projections before hot mopped application of the roofing membrane. Form felt bitumen stops with two 12 inch wide strips of organic ply felt. Laminate with and set strips into a coating of asphalt roof cement with one-half of the width overhanging the edge of the roof or opening. Where nailers are provided, nail the strips with roofing nails spaced 12 inch on center in addition to embedding in asphalt roof cement. Protect the free portion of each strip from damage throughout the roofing period. After the plies of felt are in place, fold free portion of the strips back over the roofing membrane and embed in a continuous coating of asphalt roof cement. Secure with roofing nails spaced 3 inch on center.

3.2.2 Equipment

3.2.2.1 Mechanical Application Devices

Provide and maintain mechanical application devices with pneumatic tires that operate without damaging the insulation, roofing membrane, or structural components.

3.2.2.2 Flame-Heated Equipment

Do not place flame-heated equipment on roof. Provide and maintain a fire extinguisher adjacent to flame-heated equipment and on the roof.

3.2.2.3 Open Flame Application Equipment

Use only open flame equipment recommended by the roofing materials manufacturer. Do not ignite open flame equipment when left unattended. Provide and maintain a fire extinguisher adjacent to open flame equipment on the roof.

3.2.3 Priming of Surfaces

Prime all surfaces to be in contact with adhered membrane materials. Apply primer at the rate of 3 liters per 0.75 gallon per 100 sq. ft.or as recommended by roof membrane manufacturer's printed instructions to promote adhesion of membrane materials. Allow primer to dry prior to application of membrane materials to primed surface. Avoid flammable primer material conditions in torch applied membrane base flashing applications.

3.2.3.1 Priming of Concrete and Masonry Surfaces

After surface dryness requirements have been met, coat concrete and masonry surfaces which are to receive roofing and base flashing uniformly with primer. Allow primer to dry before application of roofing and flashing materials.

3.2.3.2 Priming of Metal Surfaces

Prime flanges of metal components to be embedded into the roofing system prior to setting in bituminous materials or stripping into roofing system.

3.2.4 Covering of Wood Substrate

Cover wood substrate with a layer of unsaturated felt or rosin-sized building paper lapped 2 inch at sides and 4 inch at ends. Nail to hold in place prior to application of roofing system.

3.2.5 Heating of Asphalt

Break up solid asphalt on a surface free of dirt and debris. Heat asphalt in kettle designed to prevent contact of flame with surfaces in contact with the asphalt. Provide visible working thermometer and thermostatic controls set to the temperature limits. Keep controls in working order and calibrated. Use immersion thermometer, accurate within a tolerance of plus or minus 2 degrees F, to check temperatures of the asphalt frequently. When temperatures exceed maximum specified, remove asphalt from the site. Do no permit cutting back, adulterating, or fluxing of asphalt.

3.2.5.1 Temperature Limitations for Asphalt

Heat and apply asphalt at the temperatures specified below unless specified otherwise by manufacturer's printed application instructions. Use thermometer to check temperature during heating and application. Have kettle attended constantly during heating process to ensure specified temperatures are maintained. Do not heat asphalt above its finished blowing temperature (FBT). Do not heat asphalt between 500 and 525 degrees F for longer than four consecutive hours. Do not heat asphalt to the flash point (FP). Apply asphalt and embed membrane sheets when temperature of asphalt is within plus or minus 25 degrees F of the equiviscous temperature (EVT). Before heating and application of asphalt refer to the asphalt manufacturer's label or bill of lading for FP, FBT, and EVT of the asphalt

used.

3.3 APPLICATION

Apply roofing materials as specified unless approved otherwise by the COR. Keep roofing materials dry before and during application. Except for aggregate surfacing, complete application of roofing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day. Maintain specified temperature for asphalt. Provide temporary roofing and flashing as specified herein prior to application of permanent roofing system. Do not apply aggregate surfacing until the other roofing application procedures specified herein are completed.

3.3.1 Phased Membrane Construction

Phased application of membrane plies is prohibited. Any delay in cap sheet installation will result in thorough cleaning of the applied membrane material surface and drying immediately prior to cap sheet installation. Priming of the applied membrane surface may be required at the discretion of the COR prior to cap sheet installation.

3.3.2 Temporary Roofing and Flashing

Provide watertight temporary roofing and flashing where considerable work by other trades, such as installing cooling towers, antennas, pipes, ducts, is to be performed on the roof or where construction scheduling or weather conditions require protection of building interior before permanent roofing system can be installed. Do not install temporary roofing over permanently installed insulation. Provide rigid pads for traffic over temporary roofing.

3.3.2.1 Removal

Completely remove temporary roofing and flashing before continuing with application of permanent roofing system.

3.3.3 Base Sheet Application - General

Fully adhere base sheets in accordance with membrane manufacturer's printed instructions. Roll and broom in the base sheet to ensure full contract with the hot asphalt application. On nailable substrates, mechanically fasten base sheet in conformance with specified wind resistance requirements and membrane manufacturer's printed instructions, and to include increased fastening frequency in corner and perimeter areas. Drive fasteners flush with no dishing or cupping of fastener plate. Where applicable, base sheet may be mechanically fastened in conjunction with insulation to the substrate, in accordance with membrane manufacturers printed instructions. Apply sheets in a continuous operation. Apply sheets with side laps at a minimum of 2 inch unless greater side lap is recommended by the manufacturer's standard written application instructions. Provide end laps of not less than 6 inch and staggered a minimum of 36 inch. Apply sheets at right angles to the roof slope so that the direction of water flow is over and not against the laps. Extend base sheets approximately 2 inch above the top of cant strips at vertical surfaces and to the top of cant strips elsewhere. Trim base sheet to a neat fit around vent pipes, roof drains, and other projections through the roof. Retrofit roof drains must conform to ANSI/SPRI RD-1. Application must be free of ridges, wrinkles, and buckles.

3.3.3.1 Ventilating Base Sheets

Apply ventilating base sheet material recommended by the roof membrane manufacturer. Extend sheets over roof cants, up vertical surfaces, and terminate under cap flashing; at roof edges terminate sheets under outside edge of perimeter edge nailers or under gravel stop. Top mop perforated ventilating base sheet with a full, continuous mopping of hot asphalt.

3.3.4 Ply Felts

Ensure proper alignment of felts prior to installation starting at the low point. Apply ply felts shingle fashion perpendicular to slope of roof, including application on areas of tapered insulation that change slope direction. Bucking or backwater laps are prohibited. Apply felts in a continuous operation. Provide starter sheets of felt to maintain the specified number of plies throughout the roofing. Apply felts with side laps in accordance with the material manufacturer's printed instructions for the number of plies to be installed and in uniform alignment. Lap ends not less than 6 inch and stagger 36 inch minimum. Place the full width of each ply in hot bitumen immediately behind the bitumen applicator. Plies must be laid free of wrinkles, creases, ridges, or fishmouths. Extend felts approximately 2 inch above top of cant strips at vertical surfaces and to top of cant strips elsewhere. Trim felts to a neat fit around vent pipes, roof drains, and other projections. Avoid traffic on mopped surfaces when the bitumen is fluid and for a minimum of one hour after ply application.

3.3.4.1 Hot-Mopping of Ply Felts

Bond plies to each other and to the base sheets with hot asphalt. Apply felts immediately following application of asphalt. Do not work ahead with asphalt. At the instant felts come into contact with asphalt, asphalt must be completely fluid, with asphalt temperatures within specified EVT range. Apply asphalt uniformly in a full, continuous mopping and firmly bonding film. Apply asphalt at the rate of approximately 25 pounds per 100 sq. feet plus or minus 25 percent. Require application rate on the high end of the application range when mopping directly to absorptive insulation substrates of perlite and woodfiber. As felts are rolled into the hot asphalt, immediately squeegee, roll or broom down to eliminate trapped air and to provide tight, smooth laminations without wrinkles, buckles, kinks, or fish mouths. No more pressure is required than that exerted by the weight of the brooming tool. Do not allow felt to touch felt, even at roof edges or over cants. Bitumen must be visible beyond all edges of each ply as it is being installed. Individual ply installation and the completed roof membrane system must be free of air pockets, felt delaminations, ridges, creases, fishmouths, dry laps, or blisters. Remove and replace all sheets which are not fully and continuously bonded or which have inadequate mopping along end and side laps. Do not lay felts dry or turn back laps for mopping between plies.

3.3.4.2 Backnailing of Ply Felts

Unless otherwise recommended by the roof membrane manufacturer and approved by the COR, provide minimum 3-1/2 inch wide nailing strips matching insulation thickness and applied perpendicular to roof slope for backnailing of roof membrane. Space nailing strips as recommended by the membrane manufacturer, but not exceeding 16 feeton center unless approved otherwise by the COR. Coordinate the nailer installation with insulation

requirements. As the felt plies are installed, nail each ply 1 inch from the leading edge at each nailer line. Provide fasteners with a 1 inch diameter metal cap or fasten through 1 inch diameter caps. Set fasteners firm and flush without puncturing felt ply. Conceal fasteners with succeeding plies of felt.

3.3.4.3 Valleys and Ridges

Valleys: Apply roofing at valleys and waterways in the following manner:

Continue base sheets across valleys and terminate 18 inchfrom the valley.

Continue felt plies across valleys and terminate 12 inch from the valley. Terminate exposed laps on a line 12 inch from, and parallel to, the gutter valley. Provide two plies of felt, 9 and 12 inch wide, successively mop in over each felt line of the termination.

If the application can be completed without wrinkles, buckles, or fishmouths and if side laps do not face the direction of drainage, roofing felts and base sheets may be laid continuously across or parallel to shallow valleys such as those formed by reverse-slope roofs. For this application, reinforce valleys with one ply of felt, wide, center on the valley gutter and lay in a solid mopping of asphalt over the top ply of roofing. All unprotected base flashings and areas 3-coarsed shall receive two coats of the specified reflective coating at a rate of 1 gallon per 100 sq. ft.

3.3.5 Membrane Flashing

Provide two plies of modified bitumen membrane strip flashing and sheet flashing in the angles formed where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, and where necessary to make the work watertight. Top ply of flashing must be granule-surfaced modified bitumen membrane. Install flashing after plies of roof membrane felt have been applied but before aggregate surfacing is applied. Cut at a 45 degree angle across terminating end lap area of cap membrane prior to applying adjacent overlapping cap membrane. Press flashing into place to ensure full adhesion and avoid bridging. Ensure full lap seal in all lap areas. Mechanically fasten top edge of base flashing 6 inch on center through minimum 1 inch diameter tin caps with fasteners of sufficient length to embed minimum 1 inch into attachment substrate. Apply matching granules in any areas of asphalt bleed out while the asphalt is still hot. Apply membrane liner over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated to serve as waterproof lining under sheet metal flashing components.

3.3.5.1 Strip Flashing

Set primed flanges of sheet metal flashings to be incorporated into roofing system in a uniform coating of asphalt roof cement not less than 1/16 inch thick applied over the ply felts. Nail metal flanges 3 inches on center staggered. Apply two stripping plies over metal flange with hot asphalt. Extend first stripping ply not less than 4 inch beyond outer edge of flange onto roof membrane. Extend each additional ply 4 inch beyond the edge of the previous ply.

3.3.5.2 Membrane Flashing at Roof Drain

Apply a 30 inch square piece of 4 pound lead flashing set into a solid 1/4 inch thick bed of asphalt roof cement and centered onto the drain. Whenever drain and overflow are in close proximity, the lead flashing shall extend a minimum of 15 inches out from the center of the drain and overflow in all directions. Remove lead over center of drain. Cover the entire lead flashing, using one layer of ply sheet et in hot asphalt. Extend this layer a minimum of 4 inches beyond the lead flange. Apply a second layer of ply sheet set in hot asphalt to cover the first layover and extend beyond onto the roof membrane a minimum of 4 inches. Install the mineral cap sheet into the drain base. Tighten the bolts to hold all layers onto the outlet base, but not so as to cut any of the layers. If clamp ring is installed to cold roof system, warm roof to make pliable, then tighten clamp ring.

After 72 hours, re-tighten all bolts., Re-tighten all bolts once again in seven day. Clear drain plumbing from roof top to point where drain plumbing exits building.

3.3.5.3 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories are set on the membrane, adhere walkpad material to bottom of accessories prior to setting on roofing membrane. Specific method of installing set-on accessories must permit normal movement due to expansion, contraction, vibration, and similar occurrences without damaging roofing membrane. Do not mechanically secure set-on accessories through roofing membrane into roof deck substrate.

3.3.5.4 Lightning Protection

Flash or attach lightning protection system components to the roof membrane in a manner acceptable to the roof membrane manufacturer.

3.3.6 Roof Walkpads

Install walkpads at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the built-up roofing manufacturer's printed instructions. Provide minimum 6 inch separation between adjacent walkpads to accommodate drainage.

3.3.7 Granule-Surfaced Cap Sheet

Do not start cap sheet application until field inspection and testing has been completed and any directed repairs completed.

Inspect underlying applied membrane and repair free of damage, holes, puncture, gouges, abrasions, and any other defects, and free of moisture, loose materials, debris, sediments, dust, and any other conditions required by the membrane manufacturer prior to cap sheet installation. Provide cleaning and artificial drying with heated blowers or torches to ensure clean, dry surface prior to cap sheet application. When delays in cap sheet installation may have occurred, do not apply cap sheet if underlying materials have been exposed to rain or frozen precipitation within the previous 24 hours. Unroll cap sheet membrane and allow to relax a minimum of 1 hour prior to installation and as otherwise recommended by the membrane manufacturer starting at a low point. Apply cap sheet in same direction as the underlying felt plies. Align cap membrane and apply with

minimum 3 inch side laps and minimum 6 inch end laps and as otherwise required by membrane manufacturer. Set cap sheet in hot asphalt. Apply a solid even coat of asphalt at a rate of 30 pounds per 100 sq. ft. Cut at a 45 degree angle across selvage edge of cap membrane to be overlapped in end lap areas prior to applying overlapping cap membrane. Apply matching granules in any areas of bitumen bleed out while the bitumen is still hot. Minimize traffic on newly installed cap sheet membrane.

3.3.7.1 Backnailing of Cap Sheet Membrane

Unless otherwise recommended by the roof membrane manufacturer and approved by the COR, install the cap sheet to provide for end laps at nailer locations. Nail the cap sheet at the end lap area across the width of the sheet. Nail within 1 inch of each edge of the sheet and at 8 to 8-1/2 inch on center across the width of the sheet in a staggered fashion. Provide nails with a 1 inch diameter metal cap or nail through 1 inch diameter caps. Cover nails by overlapping adjacent aslope sheet at the end lap area.

3.3.8 Correction of Deficiencies

Where any form of deficiency is found, take additional measures to determine the extent of the deficiency and corrective actions must be as directed by the COR. Where interplay moppings are too light, apply additional two plies of felt in full moppings of asphalt. Apply with4 inch side and end laps. Where free water, skips, excessive voids, dry laps, desponding or any form of delamination are discovered between the plies, remove and rebuild affected area. Correction of inadequate number of plies, improper lap widths, or non-uniform or excessive asphalt mopping must be as directed by the COR. Where insulation is found to be wet, remove insulation and provide new built-up roofing and insulation.

3.3.9 Clean Up

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.4 PROTECTION OF APPLIED ROOFING

3.4.1 Protection Against Moisture Absorption

When precipitation is imminent and at the end of each day's work, protect applied roofing as follows:

3.4.2 Water Cutoffs

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of roofing system in an effective manner. Seal off flutes in metal decking along the cutoff edge. Remove the water cutoffs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

3.4.3 Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains, curbs, walls and other penetrations and terminations of roofing sheets until permanent flashings can be applied. Remove temporary flashing before applying permanent flashing.

3.4.4 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied roofing materials. Provide temporary walkways, runways, and platforms of smooth clean boards, mats or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.4.5 Glaze Coat

Use light glaze coating of bitumen to waterproof roof areas requiring extended time to complete. Glaze coating must be at the discretion of the COR. Apply bitumen glaze coat on exposed felts at a rate of 5 to 10 pounds per square. Lower application rates, in accordance with membrane manufacturer's recommendations, may be required when cap sheet surfacing is specified. Provide valleys and low areas that may pond water with glaze coating.

3.5 FIELD QUALITY CONTROL

Perform field tests in the presence of the COR. Notify the COR one day before performing tests.

3.5.1 Test for Surface Dryness

Before application of insulation or membrane materials and starting work on the area to be roofed, perform test for surface dryness in accordance with the following:

a. Foaming: When poured on the surface to which materials are to be applied, one pint of asphalt when heated in the range of 176 to 350 to 400 degrees F, must not foam upon contact.

b. Trainability: After asphalt used in the foaming test application has cooled to ambient temperatures, test coating for adherence. Should a portion of the sample be readily stripped clean from the surface, do not consider the surface to be dry and do not start application. Should rain occur during application, stop work and do not resume until surface has been tested by the method above and found dry.

3.5.2 Construction Monitoring

During progress of the roof work, Contractor is responsible for making visual inspections to ensure compliance with specified parameters. Additionally, verify the following:

a. Equipment is in working order. Metering devices are accurate.

b. Materials are not installed in adverse weather conditions.

c. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.

   Nailers and blocking are provided where and as needed.

   Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.

   The proper number, type, and spacing of fasteners are installed.

Materials comply with the specified requirements.

All materials are properly stored, handled and protected from moisture or other damages.

Asphalt is heated and applied within the specified temperature parameters.

Hot asphalt application is provided uniformly for voidless coverage and as necessary to ensure full adhesion of materials. Materials are set in place while asphalt is within the specified temperature range.

The proper number and types of plies are installed, with the specified overlaps.

Applied membrane surface is inspected, cleaned, dry, and repaired as necessary prior to cap sheet installation.

Membrane is without ridges, wrinkles, kinks, fishmouths, or other voids or delaminations.

Installer adheres to specified and detailed application parameters.

Associated flashings G and sheet metal are installed in a timely manner in accord with the specified requirements.

Temporary protection measures are in place at the end of each work shift.

3.5.2.1 Manufacturer's Inspection

Manufacturer's technical representative must visit the site a minimum of three times during the installation for purposes of reviewing materials installation practices and adequacy of work in place. Inspect during the first 20 squares of membrane installation, at mid-point of the installation, and at substantial completion prior to surfacing application, at a minimum. Additional inspections must not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors must be performed as requested by the COR. After each inspection, submit a report, signed by the manufacturer's technical representative to the COR within 3 working days. The report must note overall quality of work, deficiencies and any other concerns, and recommended corrective action.

3.5.3 Samples of Built-Up Roofing

After application of specified roofing felts and prior to applying surfacing, take field samples of built-up roofing as directed by the COR. Take and test samples in accordance with ASTM D 3617 and at locations selected by the COR immediately prior to cutting. Cut 4 inch by 40 inch samples across felt laps in a manner to expose the specified number of plies. The 4 inchedge must coincide with an edge lap of felt and not be positioned over an end lap. Use 4 inch by 40 inch samples for visual inspection. The COR will inspect the samples for the specified number of plies, bond between plies, skips in interplay moppings, uniform asphalt mopping, presence of excessive voids or large voids in the ply construction, presence of harmful foreign materials, visible presence of moisture in the sandwich and wet insulation. Use 300 mm by 12 inch by 12

inch cut samples to calculate bitumen quantities in accordance with ASTM D 3617 and directed by the COR. Do not proceed with surfacing until all deficiencies disclosed as a result of cut tests have been corrected and approved by the COR. Where cuts are not retained by the COR or disposed, set cut strip back in cut area and patch as specified.

3.5.3.1 Number of Cut Tests

Take cut samples as directed by the COR for quality assurance validation or as necessary to determine the extent of deficiencies discovered in the construction. Except where cut samples are taken to investigate deficiencies, provide no more than two cut samples per 100 squares or one cut sample from each day's work.

3.5.3.2 Sample Cutting Device

Provide a rectangular, 4 inch by 40 inch template and 12 inch by 12 inch template, of a type that will permit accurate cutting of samples with standard roofing knives. Keep cutting edge of knife clean by washing in solvent after each cut.

3.5.3.3 Patching Cut-Out Area

Immediately after inspection, replace cut-out sample. When sample is needed for laboratory analysis or other circumstance makes it unavailable, substitute a new section of equivalent size and structure. For non-nailable decks, replace sample in hot asphalt. For nailable decks, insert one ply of ply felt into opening from which sample was taken and sprinkle nail to hold in place; coat felt heavily with asphalt roof cement and press cutout sample firmly into asphalt roof cement. Repair area of cut with new patch of the same number of plies as the primary roof membrane. Extend the first ply minimum 6 inch all around the cut area. Extend each additional ply minimum 4 inch beyond the previous ply.

3.5.4 Roof Drain Test

After roofing system is complete except for surfacing, perform the following test of roof drains and adjacent roofing for watertight. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect the installation. Repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

3.6 INFRARED INSPECTION

Eight months after completion of the roofing system, the Contractor must inspect the roof surface using infrared (IRS) scanning as specified in ASTM C 1153. Where the IRS inspection indicates moisture intrusion, replace wet insulation and damaged or deficient materials or construction in a manner to provide watertight construction and maintain the specified roof system warranties.

3.7 INFORMATION CARD

For each roof, furnish a typewritten information card for facility records

and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.032 inch thick aluminum card for exterior display. Card must be 8-1/2 by 11 inch minimum. Information card must identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarded; date of completion; installing contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Provide minimum size information card of 8-1/2 by 11 inch. Install card at roof top or access location as directed by the COR and provide a paper copy to the COR.

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SECTION 07 54 19
POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for ENERGY STAR labeled reinforced polyvinyl chloride roofing membrane.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE/SEI 7-05	Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM D 4434/D 4434M	Poly(Vinyl Chloride) Sheet Roofing
ASTM D6754/D6754M	Standard Specification for Ketone Ethylene Ester Based Sheet Roofing
ASTM E 108	Fire Tests of Roof Coverings

FM GLOBAL (FM)

FM 4470	Single-Ply, Polymer-Modified Bitumen Sheet, Built-up Roof (BUR), and Liquid Applied Roof Assemblies for Use in Class 1 and Noncombustible Roof Deck Construction
FM APP GUIDE	Approval Guide http://www.approvalguide.com/

NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA 0405	Roofing and Waterproofing Manual

SINGLE PLY ROOFING INDUSTRY (SPRI)

SPRI RP-4	Wind Design Standard for Ballasted Single-Ply Roofing Systems

UNDERWRITERS LABORATORIES (UL)

UL 790	Standard Test Methods for Fire Tests of Roof Coverings
UL RMSD	Roofing Materials and Systems Directory

1.3 SYSTEM DESCRIPTION

Mechanically fastened PVC roof membrane system applied over insulation or recovery board substrate.

1.3.1 General

Roofing membrane sheet widths shall be consistent with membrane attachment methods and wind uplift requirements, and shall be as large as practical. In order to minimize joints and 3-way overlaps, prefabricated sheets are not accepted. Provide membrane which is free of defects and foreign material. Coordinate flashing work to permit continuous roof-surfacing operations. Insulation shall be applied and weatherproofed on the same day.

1.3.2 Fire Resistance

For this and the next paragraph submit roof system assembly wind uplift and fire rating classification listings. Complete roof system assembly shall be:

a. Class A rated in accordance with ASTM E 108, FM 4470, or UL 790.

b. Listed as part of Fire-Classified roof deck construction in the UL RMSD or Class I roof deck construction in the FM APP GUIDE or FM RoofNav (www.roofnav.com).

FM or UL approved components of the roof covering assembly shall bear the appropriate FM or UL label.

1.3.3 Wind Uplift Resistance

Complete roof covering assembly, including insulation, shall be rated Class 1-90 in accordance with FM RoofNav (www. roofnav.com) or FM APP GUIDE and capable of withstanding an uplift pressure of 90 psf. Non-rated systems shall not be installed, except as approved by the COR. Provide wind load calculations and submit engineering calculations and substantiating data to validate wind resistance of any non-rated roof system. Base wind uplift calculations on a design wind speed of 85 mph in accordance with ASCE/SEI 7-05 or applicable building code requirements. Submit engineering calculations validating the wind resistance of roof system.

1.4 PERFORMANCE REQUIREMENTS

a. All roofing shall meet the following criteria:

1. Initial Solar Reflectance equal to or greater than 0.83.

2. Solar Reflectance after 3 years equal to or greater than 0.70.

3. Initial Emissivity equal to or greater than 0.90.

b. Membrane shall be manufactured utilizing a spread coating process,

completely encapsulating the polyester reinforcement.

c. Membrane shall conform to ASTM D 4434-96, "Standard for Polyvinyl Chloride Sheet Roofing", Classification: Type III.

d. the membrane shall meet the following listed required physical properties when tested in accordance with the indicated test methods.

Parameters	ASTM Test Method	Required Physical Properties
Reinforcing Material	--	Polyester
Overall Thickness, min., inches	D751	0.060
Breaking Strength, min., lbf/in.	D751	230
Elongation at Break, min.	D751	20%
Seam strength, min. (% of breaking strength)*	D751	85
Retention of Properties After Heat Aging	D3045	--
Breaing Strength, min., (% of original)	D751	95
Elongation, min., (% or original)	D751	90
Tearing Strength, min., lbf	D1004	50
Low Temperature Bend, -40F	D2136	Pass
Accelerated Weathering Test (Xenson Arc)	D2565	10,000 Hours
Cracking (7x magnification)	--	None
Discoloration (by observation)	--	Negligible
Crazing (7x magnification)	--	None
Linear Dimensional Change	D1204	0.1%
Weight Change After Immersion in Water	D570	2.5%
Static Puncture Resistance, 33 lbf	D5602	Pass
Dynamic Puncture Resistance, 14.7 ft/lbf	D5635	Pass

*Failure occurs through membrane rupture not seam failure.

e. Manufacturer Qualifications: Membrane manufacturer shall have manufactured the PVC membrane successfully for a period of not less than 20 years.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

PVC Roofing Membrane
Bonding Adhesive
Flashing
Membrane Fasteners and Plates
Roof Insulation
Pre-manufactured accessories
Water Cutoffs
Information Card

SD-05 Design Data

Wind uplift calculations

SD-07 Certificates

Qualification of ENERGY STAR-labeled PVC
Qualifications of Applicator
Wind Uplift Resistance
Fire Resistance
Minimum Polymer Thickness
Warranty

SD-08 Manufacturer's Instructions

Application Method
Membrane Flashing
Perimeter Attachment
Auxiliary Fasteners
Pre-manufactured accessories
Cold weather

MSDSs need to be provided.

SD-10 Operation and Maintenance Data

Instructions to Government Personnel

1.6 QUALITY ASSURANCE

1.6.1 Qualification of ENERGY STAR-labeled PVC

ENERGY STAR labeled PVC membrane roofing product shall have at least 3 years of demonstrated performance experience. Submit certificate from PVC membrane roofing manufacturer certifying that the roof membrane, meets specified requirements.

1.6.2 Qualifications of Applicator

PVC membrane roofing system Applicator shall be approved, authorized, or licensed in writing by the PVC membrane roof manufacturer and shall have a minimum of three years experience as an approved, authorized, or licensed applicator with that manufacturer's PVC membrane roofing materials and be

approved at a level capable of providing the specified warranty. The applicator shall supply the names, locations and client contact information of 5 projects of similar size and scope that the applicator has constructed using the manufacturer's roofing products submitted for this project within the previous three years. Submit certificate stating that the applicator meets requirements specified.

1.6.3 Conformance and Compatibility

The entire roofing and flashing system (including edge metal) shall be in accordance with specified and indicated requirements, including fire and wind resistance requirements. Work not specifically addressed and any deviation from specified requirements shall be in general accordance with recommendations of the NRCA 0405, membrane manufacturer published recommendations and details and shall be compatible with surrounding components and construction. Any deviation from specified or indicated requirements shall be submitted to the COR and PVC roof membrane manufacturer for approval prior to installation.

1.6.4 Preroofing Conference

After approval of submittals and before performing roofing and insulation system installation work, hold a preroofing conference to review the following:

a. Drawings, specifications and submittals related to the roof work;

b. Roof system components installation;

c. Procedure for the roof manufacturer's technical representative's onsite inspection and acceptance of the roofing substrate, the name of the manufacturer's technical representatives, the frequency of the onsite visits, distribution of copies of the inspection reports from the manufacturer's technical representative;

d. Contractor's plan for coordination of the work of the various trades involved in providing the roofing system and other components secured to the roofing; and

e. Quality control plan for the roof system installation;

f. Safety requirements.

Preroofing conference scheduling shall be coordinated with the COR. The conference shall be attended by the Contractor, the COR's designated personnel, personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, other trades interfacing with the roof work, and a representative of the roofing materials manufacturer. Before beginning roofing work, provide a copy of meeting notes and action items to all attending parties. Note action items requiring resolution prior to start of roof work.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Delivery

Deliver materials in their original, unopened containers or wrappings with labels intact and legible. Where materials are covered by a referenced specification number, the labels shall bear the specification number, type,

class, and shelf life expiration date where applicable. Deliver materials in sufficient quantity to allow continuity of work.

1.7.2 Storage

Store and protect materials from damage and weather in accordance with manufacturer's instructions, except as specified otherwise. Keep materials clean and dry. Store and maintain adhesives, sealants, primers and other liquid materials above 60 degrees F. Insulated hot boxes or other enclosed warming devices may be required in cold weather subject to PVC membrane roofing manufacturer's printed instruction. Submit detailed application instructions and standard manufacturer drawings altered as required by these specifications. Explicitly identify in writing, differences between manufacturer's instructions and the specified requirements. Mark and remove damaged materials from the site. Use pallets to support and canvas tarpaulins to completely cover material materials stored outdoors. Do not use polyethylene as a covering. Locate materials temporarily stored on the roof in approved areas, and distribute the load to stay within the live load limits of the roof construction. Remove unused materials from the roof at the end of each days work.

1.7.3 Handling

Prevent damage to roll materials. Damaged materials shall not be installed in the work. Select and operate material handling equipment so as not to damage materials or applied roofing. Do not use materials contaminated by exposure, incompatible materials or moisture. Remove contaminated materials from the site. When hazardous materials are involved, conform with the special precautions of the manufacturer. Adhesives may contain petroleum distillates and may be extremely flammable; prevent personnel from breathing vapors, and do not use near sparks or open flame.

1.8 ENVIRONMENTAL REQUIREMENTS

Follow manufacturer's printed instructions for installation during cold weather conditions.

1.9 SEQUENCING

Coordinate the work with other trades to ensure that components which are to be secured to or stripped into the roofing system are available and that permanent flashing and counterflashing are installed as the work progresses. Ensure temporary protection measures are in place to preclude moisture intrusion or damage to installed materials. Application of roofing shall immediately follow application of insulation as a continuous operation. Roofing operations shall be coordinated with insulation work so that all roof insulation applied each day is covered with roof membrane installation the same day.

1.10 WARRANTY

Provide a Full System Roof Warranty covering all PVC membrane roof system components as well as their installation workmanship and meeting all specified requirements. Revision or amendment to standard full system PVC membrane manufacturer warranty shall be provided as required to comply with the specified requirements. Submit sample certificate.

1.10.1 PVC Membrane Manufacturer's Full Roof System Warranty

Furnish roof membrane manufacturer's 20-year, no dollar limit, full roof system materials and installation workmanship warranty, including all flashing, insulation, and accessory materials necessary to construct a complete, watertight roof system. The warranty shall run directly from the roof system manufacturer to the Government and commence at time of Government's acceptance of the roof work. The warranty shall state that:

a. If within the warranty period the roof system, as installed for its intended use in the normal climatic and environmental conditions of the facility, becomes non-watertight, shows evidence of moisture intrusion within the assembly, splits, tears, cracks, delaminates, separates at the seams, shrinks to the point of significant bridging or tenting membrane at transitions, or shows evidence of excessive weathering due to defective materials or installation workmanship, the repair or replacement of the defective and damaged materials of the roof system assembly and correction of defective workmanship shall be the responsibility of the roof membrane manufacturer. All costs associated with the repair or replacement work shall be the responsibility of the roof membrane manufacturer.

b. When the manufacturer and his approved applicator fail to perform the repairs within 72 hours of notification, emergency temporary repairs performed by others shall not void the warranty.

1.10.2 Roofing System Installer Warranty

The roof system installer shall warrant for a period of not less than five (5) years that the roof system, as installed, is free from defects in installation workmanship, to include the roof membrane, flashing, insulation, accessories, all attachments, including installation of all PVC membrane manufacturer-supplied edge metal which is always integral to a complete watertight roof system assembly. The warranty shall run directly to the Government. Correction of defective workmanship and replacement of damaged or affected materials shall be the responsibility of the roof system installer. All costs associated with the repair or replacement work shall be the responsibility of the installer.

1.10.3 Continuance of Warranty

Any repair or replacement work that becomes necessary within the warranty period shall be approved by the roof membrane manufacturer and accomplished in a manner so as to restore the integrity of the roof system assembly and the validity of the roof membrane manufacturer warranty for the remainder of the manufacturer warranty period.

1.10.4 Single-Source Contract Liability Warranty

The specified, single-source contract liability warranty of a PVC membrane roofing system manufacturer shall be furnished to the Government upon project completion. The single-source contract liability warranty shall encompass all roof system components' warranty performance coverage's, including all performance guarantees for roof system materials, roof system design and all roof system installation labor and workmanship. The single-source contract liability warranty shall be a Full Roof System Warranty that is issued by either the PVC membrane roof system manufacturer, or by a direct affiliate of the PVC membrane roof system manufacturer (100 percent owned affiliate), or by an agent of the PVC

membrane roof system manufacturer possessing the authority to contractually bind the PVC membrane roof system manufacturer (manufacturer, affiliate and agent are collectively referred to as "Roofing System Supplier") and to, at said agent's discretion, underwrite and/or provide for insurance covering all of the respective warranty obligations of the PVC membrane manufacturer's Full Roof System Warranty.

a. The Government intends to sign a contract binding all warranty and associated roof system performance guarantees of the roofing system directly with the PVC membrane roofing manufacturer, or it's subsidiary, or an exclusive agent capable of enjoining said PVC membrane manufacturer; and

b. This roofing system shall be applied only by a roofing system Applicator authorized by the PVC membrane roofing manufacturer prior to bid; and

c. The roofing system Applicator shall arrange with, and make arrangements to the satisfaction and discretion of the PVC Roofing System Supplier, to have the services of a Technical Field Representative on site full time to observe the total roof application, including removal of pre-existing roofing (if applicable). The Technical Field Representative shall provide written daily reports to the Roofing System Supplier and Applicator. The roofing system Applicator shall include the cost of the full-time Technical Field Representative in his/her bid price; and

d. Submit roof plan depicting wind loads and boundaries of enhanced perimeter and corner attachments of roof system components, spacing of perimeter, corner, and infield fasteners, as applicable. The drawing shall reflect the project roof plan of each roof level and conditions indicated. Submit bids with approved detail drawings and specifications approved and furnished by the PVC membrane manufacturer, and

e. There shall be no deviation made from the contract specification or the approved shop/detail drawings without prior written approval by the both PVC membrane roofing material manufacturer/subsidiary and by the Government; and

f. Complete all work by personnel trained and authorized by the PVC membrane roof manufacturer.

PART 2 PRODUCTS

2.1 MATERIALS

Submit Data as required by Section 07 22 00 ROOF AND DECK INSULATION together with requirements of this section. Data shall include written acceptance by the roof membrane manufacturer of the insulation and other products and accessories to be provided by and warranted under the full system guarantee of the roof membrane manufacturer. Provide products as listed in the applicable wind uplift and fire rating classification listings, unless approved otherwise by the COR.

a. Coordinate with other specification sections related to the roof work. Furnish a combination of specified materials that comprise a roof system acceptable to the roof membrane manufacturer and meeting specified requirements. Provide materials free of defects and suitable

for the service and climatic conditions of the installation. All warranted roof system components shall be sourced from the PVC roof membrane manufacturer, including but not limited to all insulation, coverboards, accessories, adhesives and edge metal.

b. For each roof, furnish a typewritten information card for facility records and a card laminated in plastic and framed for exterior display at roof access point. Card shall be 8 1/2 by 11 inches minimum. Information card shall identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarder; date of completion; installing Contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, contact information, and a copy should be filed with the as-builts and entered in the EDC database in the basement of N213. Install card at roof top or access location as directed by the COR and provide a paper copy to the COR.

c. Provide "Slip Hazard" sign for posting at underside of roof hatch lid. Signs shall be 8-1/2 x 11 inches, yellow, weather resistant and shall state the following:

CAUTION: Roof and Walkways may be slippery when icy, snow-covered, or wet.

When these conditions exist:

- Notify supervisory personnel.
- Limit roof-top traffic to emergencies.
- Proceed with extreme caution.
- Protect the roof!
- This roof membrane can be damaged by:

  * Asphalt and tar products
  * Oils and grease
  * Chemical spills
  * Sharp objects

- Confine roof-top traffic to walkways. If damage or contamination occurs, immediately contact the Plant Engineering Branch.

2.1.1 Bonding Adhesive

Provide PVC membrane manufacturer's membrane adhesive, as supplied by roof membrane manufacturer, and recommended by the manufacturer's printed data for bonding of PVC membrane materials to acceptable insulation, wood, metal, concrete or other acceptable substrate materials. Bonding adhesive shall not be used to bond membrane materials to each other.

Basis of Design: Sika Sarnafil, Sarnacol 2121 Adhesive or approved equal. A water-based adhesive used to attach the membrane to horizontal or near- horizontal substrates.

Use low VOC reactivating-type adhesive used to attach membrane to flashing substrate. Basis of Design: Sika Sarnafil, Sarnacol 2170 Adhesive or approval equal.

At tube steel and plate on roof screen, use Sarnafil 11FC adhesive or approved equal.

2.1.2 Water Cutoff Mastic/Water Block

As supplied by the roof membrane manufacturer and recommended by the manufacturer's printed data.

2.1.3 Membrane Flashing

Membrane flashing, including self-adhering membrane flashing, perimeter flashing, flashing around roof penetrations and prefabricated pipe seals, shall be minimum polymer thickness 0.060 inch reinforced PVC for 20 year warranties, and shall be utilized as recommended and supplied by the roof membrane manufacturer. Submit certification from PVC membrane manufacturer that the proposed PVC membrane roofing product meets the minimum polymer thickness specified.

a. Flashing Membrane - Flashing Membrane shall conform to ASTM D 4434 (latest version), "Standard for Polyvinyl Chloride Sheet Roofing", Classification: Type II Grade I.

Basis of Design: Sika Sarnafil, G459-15 Glass Fiber Reinforced PVC or approved equal, 58 mils minimum thickness with fiberglass reinforcement. Membrane weight minimum 0.36 pounds per squire foot. Color to match main field sheet.

Basis of Design: Sika Sarnafil, Sarnaclad or approved equal. A PVC-coated, heat-weldable sheet metal capable of being formed into a variety of shapes and profiles. Sarnaclad is a 25 gauge, G90 galvanized metal sheet with a 20 mil Unsupported Sarnafil membrane laminated on one side. The dimensions of Sarnaclad are 4 ft x 8 ft or 4 ft x 10 ft.

Bonding Adhesive (Flashing): Basis of Design: Sika Sarnafil, Stabond U148A Adhesive or approved equal. A low VOC reactivating-type adhesive used to attach membrane to flashing substrate.

2.1.4 Membrane Fasteners and Plates

Coated, corrosion-resistant fasteners as recommended and supplied by the PVC roof membrane manufacturer and meeting the requirements of FM 4470 and FM RoofNav (www. roofnav.com) or FM APP GUIDE for Class I roof deck construction and the wind uplift resistance specified. Fasteners and Plates to be supplied and warranted for the substrate type(s) by PVC membrane manufacturer and recommended by PVC membrane manufacturer's printed data.

Basis of Design: Sika Sarnafil, Sarnafastener-XP or approval equal. #15, heavy-duty, corrosion-resistant fastener used with Sarnaplate to attach insulation or Sarnastop and Sarnabar to attach Sarnafil G410 roof membrane to steel or wood roof decks. Saranfastener-XP has a shank diameter of approximately 0.21 inch and the thread diameter is approximately 0.26 inch. The driving head has a diameter has a diameter of approximately 0.435 inch with a #3 Phillips recess for positive engagement. Consult Product Data Sheet for additional information.

Stress Plates for Fasteners: Basis of Design: Sika Sarnafil, Sarnadisc-XPN or approval equal. A high strength linear plate used with a Sarnafastener to attach Sarnafil S327 roof membrane to steel, wood or concrete roof decks. Sarnadisc-XPN is an 18 gauge, 1-1/2 inch by 3-3/4 inch corrosion resistant steel plate. Consult Product Data Sheet for additional information.

Auxiliary Fasteners: All fasteners, anchors, nails, straps, bars, etc., shall be post-galvanized steel, aluminum or stainless steel. Mixing metal types and methods of contact shall be assembled in such a manner as to avoid galvanic corrosion. Fasteners for such a manner as to avoid galvanic corrosion. Fasteners for attachment of metal to masonry shall be expansion type fasteners with stainless steel pins. All concrete fasteners and anchors shall have a minimum embedment of 1-1/4 inch and shall be approved for such sue by the fastener manufacturer. All miscellaneous wood fasteners and anchors used for flashings shall have a minimum embedment of 1 inch and shall be approved for such use by the fastener manufacturer.

2.1.4.1 Stress Plates, Bar or Rail for Fasteners

Corrosion-resistant stress plates as recommended by the roof membrane manufacturer's printed instructions and meeting the requirements of FM 4470 must be utilized and must be supplied by PVC roof membrane manufacturer. Stress plates shall be formed to prevent dishing or cupping. Manufacturer-supplied anchoring bar or rails may be utilized for high wind conditions.

2.1.4.2 Auxiliary Fasteners

Corrosion resistance screws, nails, or anchors must be suitable for intended attachment purpose and be recommended and supplied for use by the PVC roof membrane manufacturer.

2.1.5 Pre-manufactured Accessories

Pre-manufactured accessories shall be manufacturer's standard for intended purpose, must comply with applicable specification section, be compatible with the membrane roof system and approved for use and supplied by the PVC roof membrane manufacturer.

Sarnareglet or approval equal: A heavy-duty, extruded aluminum flashing termination reglet used at walls and large curbs. Sarnareglet is produced from 6063-T5, 0.10 inch - 0.12 inch thick extruded aluminum. Sarnareglet has a 2-1/4 inch deep profile, and is provided in 10 foot lengths. Use prefabricated Sarnareglet mitered inside and outside corners where walls intersect. Consult Product Data Sheet for additional information.

Sarnastack or approved equal: A prefabricated vent pipe flashing made from 0.048 inch thick Sarnafil G410 membrane. Available in five different sizes. Consult Product Data Sheet for sizes and additional information.

Sarnacorners - Universal or approved equal: Prefabricated outside and inside flashing corners made of 0.060 inch thick membrane that are heat-welded to membrane or Sarnaclad base flashings. Available in one

size, which accommodates both inside and outside corners. Can be cut into one inside or one outside corner. Consult product Data Sheet for additional information.

Sarnacircle - "G" or approval equal: Circular 0.048-inch thick G410 membrane patch welded over T-joints formed by overlapping thick membranes.

Aluminum Tape: A 2 inch wide pressure-sensitive aluminum tape used as a separation layer between small areas of asphalt contamination and the membrane and as a bond-breaker under the coverstrip at Sarnaclad joints.

Multi-Purpose Tape: A high performance sealant tape used with metal flashings as a preventive measure against air and wind blown moisture entry.

Sarnasolv or approved equal: A high quality solvent, cleaner used for the general cleaning of residual asphalt, scuff marks, etc., from the membrane surface. Sarnasolv is also used daily to clean seam areas prior to hot-air welding in tear off or dirty conditions or if the membrane is not welded the same day it is unrolled. Consult Product Data Sheet for additional information.

2.1.6 PVC Walk Tread

Provide the following:

2.1.6.1 Sand-coated Walkway

Fiberglass reinforced, 60 mil, weldable membrane with a thick sand-based coating on top., Net dimensions are approximately 150 mil thick by 39 inches wide with varying lengths. The standard length is 32 feet.

2.1.7 Roof Insulation

Insulation system and facer material shall be compatible with membrane application specified and be approved and supplied by the PVC membrane roof manufacturer and as specified in Section 07 22 00 ROOF AND DECK INSULATION.

2.2 ENERGY STAR-Labeled, Reinforced, PVC Membrane

Reinforced polyvinyl chloride (PVC) membrane shall contain fibers or scrim, and shall comply with ASTM D 4434/D 4434M, Type III or ASTM D6754/D6754M, and in all cases shall provide 77 mils minimum thickness for mechanically fastened application. Not withstanding the ASTM standards referenced, reinforced PVC roof membranes provided under this section shall have the minimum, labeled thickness specified. PVC membrane thickness specified herein is exclusive of backing material on the bottom of fleece-backed membrane. Principal polymer used in manufacture of the membrane sheet shall be PVC. Width and length of PVC membrane roofing sheet shall be consistent with membrane attachment methods and wind uplift requirements, and shall be as large as practical. In order to minimize joints and 3-way overlaps, prefabricated sheets are not accepted. Maximum reinforced PVC membrane roofing sheet dimensions to be the maximum width obtainable from PVC membrane roof manufacturer in order to minimize seams in the field of the roof.

Basis of Design: Sika Sarnafil S327-20 Polyester Reinforced PVC membrane or approved equal. Minimum weight shall be 0.50 pounds per

square foot. White shall be California Title 24 compliant white.

PART 3 EXECUTION

3.1 EXAMINATION

Ensure that the following conditions exist prior to application of the roofing materials:

a. Drains, curbs, control joints, expansion joints, perimeter walls, roof penetrating components, and equipment supports are in place.

b. Surfaces are rigid, clean, dry, smooth, and free from cracks, holes, and sharp changes in elevation.

c. Substrate is sloped to provide positive drainage.

d. Walls and vertical surfaces are constructed to receive counterflashing, and will permit mechanical fastening of the base flashing materials.

e. Treated wood nailers are in place on non-nailable surfaces, to permit nailing of base flashing at minimum height of 8 inches above finished roofing surface.

f. PVC materials are not in contact with fire retardant treated wood, except as approved by the PVC membrane roof manufacturer and COR.

g. Exposed nail heads in wood substrates are properly set. Warped and split sheets have been replaced. There are no cracks or end joints 1/4 inch in width or greater. Joints in plywood substrates are taped or otherwise sealed to prevent air leakage from the underside.

h. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. There are no gaps in insulation board joints exceeding 1/4 inch in width. Insulation is attached as specified in Section 07 22 00 ROOF AND DECK INSULATION. Insulation is being roofed over on the same day the insulation is installed.

3.2 APPLICATION METHOD

Apply entire PVC membrane roofing utilizing mechanically fastened application method. Apply roofing materials as specified herein unless approved otherwise by the COR. Submit instructions including pattern and frequency of mechanical attachments required in the field for roof, corners, and perimeters to provide for the specified wind resistance

3.2.1 Special Precautions

a. Do not dilute coatings or sealants unless specifically recommended by the material manufacturer's printed application instructions. Do not thin liquid materials or cleaners used for cleaning PVC sheet.

b. Keep liquids in airtight containers, and keep containers closed except when removing materials.

c. Use liquid components, including adhesives, within their shelf life period. Store adhesives at 60 to 80 degrees F prior to use. Avoid excessive adhesive application and adhesive spills, as they can be destructive to some thermoplastic sheets and insulations; follow

adhesive manufacturer's printed application instructions. Mix and use liquid components in accordance with label directions and manufacturer's printed instructions.

d. Provide clean, dry cloths or pads for applying membrane cleaners and cleaning of membrane.

e. Do not use heat guns or open flame to expedite drying of adhesives or primers.

f. Require workmen and others who walk on the membrane to wear clean, soft-soled safety shoes to avoid damage to roofing materials.

g. Do not use equipment with sharp edges which could puncture the PVC membrane roofing sheet.

h. Shut down air intakes and any related mechanical systems and seal open vents and air intakes when applying solvent-based materials in the area of the opening or intake. Coordinate shutdowns with the COR.

3.2.2 PVC Roofing Membrane

Only felt-backed membrane shall be placed directly on concrete deck or other hard surface which may otherwise damage the membrane, absent the felt backing. Non-felt-backed PVC membrane roofing sheet shall not be placed directly on concrete deck or other hard surface which may damage the membrane. Membrane shall be overlapped a minimum of 3 inches at sides for adhered applications and 5.5-7 inchesfor mechanically fastened applications and minimum 4 inches at ends. Where possible, direction of laps shall allow water to flow over and not into the lap. Membrane joints shall be free of wrinkles and fishmouths. The entire length of hot-air-welded seams shall be probe-tested and corrected during the day of installation. Defective areas shall be re-welded. Wrinkles, fishmouths, or damaged areas shall be cut out and the area covered with membrane using a continuous hot-air-welded seam on all sides. Repairs shall be probe-tested for continuity. Hot-air-welded seams are to be accomplished in accordance with the PVC membrane roofing manufacturer's published requirements.

3.2.2.1 Nailing

Membrane shall be fastened to nailers in accordance with the membrane manufacturer's approved instructions. Unless otherwise specified, nails shall be staggered on 4 inch centers maximum; screws for sheet metal shall be staggered on 8 inch centers maximum; and a row of fasteners shall be at least 1/2 inch from edges of sheet metal.

3.2.2.2 Flashing

Roof edges, projections through the roof and changes in roof planes shall be flashed. The seam shall be sealed a minimum of 3 inches beyond the fasteners which attach the membrane to nailers. The installed flashing's shall be secured at the top of the flashing a maximum of12 inches on centers under the counterflashing or cap. Where possible, prefabricated components shall be used for pipe seals and flashing accessories.

3.2.2.3 Cutoffs

If work is terminated prior to weatherproofing the entire roof, the membrane shall be sealed to the roof deck. Flutes in metal decking shall

be sealed off along the cutoff edge. Membrane shall be pulled free or cut to expose the insulation when resuming work and cut insulation sheets used for fill-in shall be removed. Asphalt or coal-tar products shall not be used for sealing.

3.2.2.4 Walkways

Walkways shall be installed on a loose-laid pad of the membrane material extending at least 1 inch beyond the walkway material, and as specified by the manufacturer. Stone ballast shall not be placed below or above walkways.

3.2.3 Mechanically Fastened Membrane Application

Layout membrane and lap adjoining sheets in accordance with membrane manufacturer's printed instructions such that the minimum recommended seam width is maintained and to ensure that seam width is as required by tested assembly meeting specified wind resistance requirements. Account for additional overlap required for placement of fasteners and plates or battens beyond the closed seam. Allow for sufficient membrane to form proper membrane terminations. Ensure membrane is free of wrinkles and ridges in the installation. Mechanically secure the membrane sheet with specified fasteners in the lap area. Space fasteners as required to provide the wind uplift resistance specified and in accordance with submitted fastener patterns for the field, corner, and perimeter roof areas. Set fasteners firm to plate or batten. Form field hot-air-welded seams and laps and/or coverstrips, as specified. Check all seams and ensure full/continuous lap seal.

3.2.4 Perimeter Attachment

Adhesive bond or mechanically secure roof membrane sheet at roof perimeter in a manner to comply with wind resistance requirements and in accordance with membrane manufacturer's printed application instructions. When adhesively bonding a mechanically fastened system in perimeter areas, the perimeter boundary of the adhesive bond shall be the same as the boundary required for additional perimeter mechanical fastening to meet wind resistance requirements.

3.2.5 Securement at Base Tie-In Conditions

Mechanically fasten the roof membrane at penetrations, at base of curbs and walls, and at all locations where the membrane turns and angles greater than 4 degrees (1:12). Space fasteners a maximum of 12 inches on center, except where more frequent attachment is required to meet specified wind resistance or where recommended by the roof membrane manufacturer. Cover over fasteners with a layer of flashing material. Hot-air-weld all seams of flashing material as recommended by the roof membrane manufacturer's printed data.

3.2.6 Membrane Flashing

a. Install flashing and flashing accessories as the roof membrane is installed. Apply flashing to cleaned surfaces and as recommended by the roof membrane manufacturer and as specified. Utilize reinforced PVC membrane flashing and prefabricated accessory flashing's as recommended by the roof membrane manufacturer.

b. Completely adhere flashing sheets in place. Hot-air-weld the seams of

flashing membrane in the same manner as roof membrane, except as otherwise recommended by the membrane manufacturer's printed instructions and approved by the COR. Mechanically fasten top edge of base flashing with manufacturer recommended termination bar fastened at maximum 12 inches on center. Sheet metal counter-flashing shall be installed over the termination bar in the completed work. Mechanically fasten top edge of base flashing for all other terminations in a manner recommended by the roof membrane manufacturer. Apply reinforced PVC flashing membrane over top of exposed nailers and blocking and to overlap top edge of base flashing installation at curbs, parapet walls, expansion joints and as otherwise indicated. Metal flashing's are specified under Section 07 60 00 FLASHING AND SHEET METAL.

c. Flashing for roof drains, are specified in Section 07 60 00 FLASHING AND SHEET METAL. Provide a tapered insulation sump into the drain bowl area. Tapered slope shall not exceed 15 degrees (3:12) for fiberglass reinforced PVC membrane. Tapered insulation shall have surface suitable for adhering membrane in the drain sump area. Avoid field seams running through or within 24 inches of roof drain, or as otherwise recommended by the roof membrane manufacturer.

d. Adhere the membrane to the tapered insulation in the drain sump area. Apply PVC membrane manufacturer's compatible sealant and extend membrane sheets over edge of drain bowl opening at the roof drain deck flange in accordance with membrane manufacturer's printed application instructions. Membrane shall be free of wrinkles and folds in the drain area. Securely clamp membrane in the flashing clamping ring. Ensure membrane is cut to within 3/4 inch of inside rim of clamping ring to maintain drainage capacity. Do not cut back to bolt holes.

3.2.7 Set-On Accessories

Where pipe or conduit blocking, supports and similar roof accessories, or isolated paver block, are set on the membrane, adhere reinforced membrane or walkpad material, as recommended by the roof membrane manufacturer, to bottom of accessories prior to setting on roofing membrane. Specific method of installing set-on accessories must permit normal movement due to expansion, contraction, vibration, and similar occurrences without damaging roofing membrane. Do not mechanically secure set-on accessories through roofing membrane into roof deck substrate.

3.2.8 Roof Walkways

Install walkways at roof access points and where otherwise indicated for traffic areas and for access to mechanical equipment, in accordance with the PVC membrane roof manufacturer's printed instructions.

3.2.9 Correction of Deficiencies

Where any form of deficiency is found, additional measures shall be taken as deemed necessary by the COR to determine the extent of the deficiency and corrective actions shall be as directed by the COR.

3.2.10 Clean Up

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.3 PROTECTION OF APPLIED ROOFING

At the end of the day's work and when precipitation is imminent, protect applied membrane roofing system from water intrusion.

3.3.1 Water Cutoffs

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of the roof membrane system in an effective manner. Remove the water cut-offs to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

3.3.2 Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains, curbs, walls and other penetrations and terminations of roofing sheets until permanent flashings can be applied. Remove temporary flashing before applying permanent flashing.

3.3.3 Temporary Walkways, Runways, and Platforms

Do not permit storing, walking, wheeling, and trucking directly on applied roofing system. Provide temporary walkways, runways, and platforms of smooth clean boards, mats or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.4 FIELD QUALITY CONTROL

3.4.1 Construction Monitoring

During progress of the roof work, make visual inspections as necessary to ensure compliance with specified parameters. Additionally, verify the following:

a. Equipment is in working order. Metering devices are accurate.

b. Materials are not installed in adverse weather conditions.

c. Substrates are in acceptable condition, in compliance with specification, prior to application of subsequent materials.

   1. Nailers and blocking are provided where and as needed.

   2. Insulation substrate is smooth, properly secured to its substrate, and without excessive gaps prior to membrane application.

   3. The proper number, type, and spacing of fasteners are installed.

   4. Materials comply with the specified requirements.

   5. All materials are properly stored, handled and protected from moisture or other damages. Liquid components are properly mixed prior to application.

   6. Adhesives are applied uniformly to both mating surfaces and checked for proper set prior to bonding mating materials. Mechanical attachments are spaced as required, including additional fastening of membrane in corner and perimeter areas as required.

7. Membrane is properly overlapped.

8. Membrane seaming is as specified by PVC membrane manufacturer. All seams are checked at the end of each work day.

9. Applied membrane is inspected and repaired as necessary prior to paver installation.

10. Membrane is adhered without ridges, wrinkles, kinks, fishmouths.

11. Installer adheres to specified and detailed application parameters.

12. Associated flashing's and sheet metal are installed in a timely manner in accord with the specified requirements.

13. Temporary protection measures are in place at the end of each work shift.

3.4.2 Manufacturer's Inspection

Manufacturer's technical representative shall visit the site a minimum of 3 times during the installation for purposes of reviewing materials installation practices and adequacy of work in place. Inspections shall occur during the first 20 squares of membrane installation, at mid-point of the installation, and at substantial completion, at a minimum. Additional inspections need not exceed one for each 100 squares of total roof area with the exception that follow-up inspections of previously noted deficiencies or application errors shall be performed as requested by the COR. After each inspection, a report, signed by the manufacturer's technical representative shall be submitted by the roofing Contractor to the COR within 3 working days. The report shall note overall quality of work, deficiencies and any other concerns, and recommended corrective action.

3.5 INSTRUCTIONS TO GOVERNMENT PERSONNEL

Furnish written and verbal instructions on proper maintenance procedures to designated Government personnel. Furnish instructions by a competent representative of the roof membrane manufacturer and include a minimum of 4 hours on maintenance and emergency repair of the membrane. Include a demonstration of membrane repair, and give sources of required special tools. Furnish information on safety requirements during maintenance and emergency repair operations. Submit copies of Material Safety Data Sheets for maintenance/repair materials.

3.6 ROOF DRAIN TEST

After completing roofing but prior to Government acceptance, perform the following test for watertightness. Plug roof drains and fill with water to edge of drain sump for 8 hours. Do not plug secondary overflow drains at the same time as adjacent primary drain. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the test period. When precipitation occurs during test period, repeat test. When water level falls, remove water, thoroughly dry, and inspect installation; repair or replace roofing at drain to provide for a properly installed watertight flashing seal. Repeat test until there is no water leakage.

3.7 INFRARED INSPECTION

Eight months after completion of the roofing system, the Contractor must inspect the roof surface using infrared (IRS) scanning as specified in ASTM C 1153. Where the IRS inspection indicates moisture intrusion, replace wet insulation and damaged or deficient materials or construction in a manner to provide watertight construction and maintain the specified roof system warranties.

3.8 INFORMATION CARD

For each roof, furnish a typewritten information card for facility records and a card laminated in plastic and framed for interior display at roof access point, or a photoengraved 0.032 inch thick aluminum card for exterior display. Card must be 8-1/2 by 11 inch minimum. Information card must identify facility name and number; location; contract number; approximate roof area; detailed roof system description, including deck type, membrane, number of plies, method of application, manufacturer, insulation and cover board system and thickness; presence of tapered insulation for primary drainage, presence of vapor retarded; date of completion; installing contractor identification and contact information; membrane manufacturer warranty expiration, warranty reference number, and contact information. Provide minimum size information card of 8-1/2 by 11 inch. Install card at roof top or access location as directed by the COR and provide a paper copy to the COR.

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SECTION 07 60 00

FLASHING AND SHEET METAL

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for flashing and sheet metal work including gutters and downspouts, scuppers, splash pans, and sheet metal roofing.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/SPRI RD-1	Performance Standard for Retrofit Drains

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M	Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A256M	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM A308/A308M	Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot Dip Process
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 101	Standard Specification for Lead-Coated Copper Sheet and Strip for Building Construction
ASTM B 209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B 209M	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 224	Classification of Coppers
ASTM B 32	Standard Specification for Solder Metal
ASTM B 370	Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B 69	Standard Specification for Rolled Zinc
ASTM D 1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 226/D 226M	Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 4586	Asphalt Roof Cement, Asbestos-Free
ASTM D41/D41M	Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	Architectural Sheet Metal Manual, 6th Edition

1.3 GENERAL REQUIREMENTS

Finished sheet metalwork will form a weathertight construction without waves, warps, buckles, fastening stresses or distortion, which allows for expansion and contraction. Sheet metal mechanic is responsible for cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades. Coordinate installation of sheet metal items used in conjunction with roofing with roofing work to permit continuous roofing operations.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Covering on flat, sloped, or curved surfaces

Gutters
Downspouts

Expansion joints

Gravel stops and fascias

Splash pans

Flashing for roof drains

Base flashing

Counterflashing

Flashing at roof penetrations

Reglets

Scuppers

Copings

Drip edge

Conductor heads

Open valley flashing

Eave flashing

Indicate thicknesses, dimensions, fastenings and anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

SD-11 Closeout Submittals

Quality Control Plan

Submit for sheet metal work in accordance with paragraph entitled "Field Quality Control."

1.5 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until immediately before installation.

PART 2 PRODUCTS

2.1 MATERIALS

Use any metal listed by SMACNA Arch. Manual for a particular item, unless otherwise specified or indicated. Conform to the requirements specified

and to the thicknesses and configurations established in SMACNA Arch. Manual for the materials. Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items must be copper.

Furnish sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 12 inch legs. Provide accessories and other items essential to complete the sheet metal installation. Provide accessories made of the same or compatible materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I at the end of this section. Provide sheet metal items with mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used except as follows:

2.1.1 Exposed Sheet Metal Items

Must be of the same material. Consider the following as exposed sheet metal: gutters, including hangers; downspouts; gravel stops and fascias; cap, valley, steeped, base, and eave flashings and related accessories.

2.1.2 Drainage

Do not use copper for an exposed item if drainage from that item will pass over exposed masonry, stonework or other metal surfaces. In addition to the metals listed in Table I, lead-coated copper may be used for such items.

2.1.3 Copper, Sheet and Strip

ASTM B 370, cold-rolled temper, H 00 (standard). Copper - Standard electrolytic tough-pitch copper, Type ETP, or fire-refined tough-pitch copper, type FRTP, as classified in ASTM B224 and conforming to ASTM B 370, light cold-rolled temper, H00 Standard.

2.1.4 Lead-Coated Copper Sheet

ASTM B 101.

2.1.5 Lead Sheet

Lead Flashing and Lead Washers: 4 lbs/ft^2, 0.06 inch thick.

2.1.6 Steel Sheet, Zinc-Coated (Galvanized)

ASTM A 256M, Regular Coating, Designation Z90.

ASTM A653/A653M.

2.1.6.1 Finish

Exposed exterior items of zinc-coated steel sheet must have a baked-on, factory-applied color coating of polyvinylidene fluoride or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Provide finish coating dry-film thickness of 0.8 to 1.3 mils and color to be selected by the Architect.

2.1.7 Zinc Sheet and Strip

ASTM B 69, Type I, a minimum of 0.024 inch thick.

2.1.8 Stainless Steel

ASTM A167, Type 302 or 304, 2D Finish, fully annealed, dead-soft temper.

2.1.9 Terne-Coated Steel

Minimum of 14 by 20 inch with minimum of 40 pound coating per double base box. ASTM A308/A308M.

2.1.10 Aluminum Alloy Sheet and Plate

ASTM B 209 anodized clear form alloy, and temper appropriate for use.

2.1.10.1 Alclad

When fabricated of aluminum, fabricate the items Alclad 3003, Alclad 3004, Alclad 3005, clad on one side unless otherwise indicated.

a. Gutters, downspouts, and hangers

b. Gravel stops and fascias

c. Flashing

d. ASTM B209M, embossed finish, clad one side and of specified temper. Minimum tensile strength: 23,060 psi.

2.1.10.2 Finish

Exposed exterior sheet metal items of aluminum must have a baked-on, factory-applied color coating of polyvinylidene fluoride (PVF2) or other equivalent fluorocarbon coating applied after metal substrates have been cleaned and pretreated. Provide finish coating dry-film thickness of 0.8 to 1.3 mils and color to be selected by the Architect.

2.1.11 Aluminum Alloy, Extruded Bars, Rods, Shapes, and Tubes

ASTM B 221.

2.1.12 Solder

ASTM B 32, 95-5 tin-antimony.

2.1.13 Polyvinyl Chloride Reglet

ASTM D 1784, Type II, Grade 1, Class 14333-D, 0.075 inch minimum thickness.

2.1.14 Bituminous Plastic Cement

Asphaltic-base non-asbestos containing material conforming to ASTM D 4586, Type I, compatible with roofing asphalts and asphalt primer..

2.1.15 Roofing Felt

ASTM D 226/D 226M Type I.

2.1.16 Asphalt Primer

ASTM D41/D41M.

2.1.17 Fasteners

Use the same metal or a metal compatible with the item fastened. Use stainless steel fasteners to fasten dissimilar materials.

2.1.18 Sealing Compound

Gun grade, one-component, nonsag, elastomeric, conforming to ASTM C 920. Base material - polyurethane, resistant to 50 percent joint movement.

2.1.19 Aluminum-Seam Sealant

As recommended by aluminum manufacturer.

2.1.20 Endlap Sealant Tape

Endlap sealant tape (gasket material) shall be a 1 inch wide isobutylene-isoprene copolymer tape. Sealant tape shall release cleanly in the hot and cold weather from the backing paper at temperatures ranging from -10°F to 140°F. Sealant tape shall have the following minimum properties:

a. Sealant tape shall not sag more than 0.05 inch after hanging in the vertical position for 48 hours.

b. Penetration limits (degrees of hardness) determined in accordance with ASTM D 217, 300 gram cone:

At 0°F +/- 2°F	45 +/- minimum
At 77°F +/- 2°F	100 +/- minimum
At 120°F +/- 2°F	135 +/- minimum

c. Composition shall be isobutylene-isoprene rubber and fine inert silica fillers. Asbestos fillers are not acceptable.

d. Thickness shall be 0.125 inch.

e. Flexibility per ASTM C 765 - no cracking at -60°F.

f. Webbing and elongation - at 0°f, minimum 500%; at 77°F, minimum 1000%.

g. Cohesive Tensile Strength per ASTM D897 metal - 25 psi minimum.

PART 3 EXECUTION

3.1 GENERAL

a. Sheetmetal Work -- Conform to drawing details and to applicable plate number and design and installation recommendations of SMACNA-93. Ensure that finished sheetmetal installation is free from water leakage.

b. Ensure that surfaces to receive sheetmetal work are clean, smooth, dry, and free from defects and projections that might affect work. Make surfaces plumb and true to a maximum tolerance of 1:1000, with no dips, waves, or uneven surfaces exceeding 1:1000 in any direction. Make lines, arises, and angles sharp and uniform. Fold back exposed edges of sheetmetal to from a 1/2 inch wide hem on concealed side.

3.2 INSTALLATION

3.2.1 Workmanship

Make lines and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

3.2.2 Nailing

Use concealed fasteners. Confine nailing of sheet metal generally to sheet metal having a maximum width of 18 inch. Confine nailing of flashing to one edge only. Space nails evenly not over 3 inch on center and approximately 1/2 inch from edge unless otherwise specified or indicated. Face nailing will not be permitted. Where sheet metal is applied to other than wood surfaces, include in shop drawings, the locations for sleepers and nailing strips required to secure the work. Ensure nails penetrate backing by 1 inch minimum.

3.2.3 Cleats

Provide cleats for sheet metal 12 inches and over in width and other designated locations. Space cleats evenly not over 12 inch on center unless otherwise specified or indicated. Unless otherwise specified, provide cleats of 2 inch wide by 3 inch long and of the same material and thickness as the sheet metal being installed. Secure one end of the cleat with two nails and the cleat folded back over the nailheads. Lock the other end into the seam. Where the fastening is to be made to concrete or masonry, use screws and drive in expansion shields set in concrete or masonry. Pretin cleats for soldered seams.

3.2.4 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide neoprene or lead washers where required to protect surface of sheet metal and to provide a watertight connection. Provide mechanically formed joints in aluminum sheets 0.040 inch or less in thickness.

3.2.5 Seams & Lock Joint Construction

Conform to SMACNA-1793, Plate 131. Straight and uniform in width and height and finish with no solder showing on the face.

3.2.5.1 Flat-lock Seams

Finish not less than 3/4 inch wide.

3.2.5.2 Lap Seams

Finish soldered seams not less than one inch wide. Overlap seams not soldered, not less than 3 inch.

3.2.5.3 Loose-Lock Expansion Seams

Not less than 3 inch wide; provide minimum one inch movement within the joint. Completely fill the joints with the specified sealant, applied at not less than 1/8 inch thick bed.

3.2.5.4 Standing Seams

Not less than one inch high, double locked without solder.

3.2.5.5 Flat Seams

Make seams in the direction of the flow. Seams that are not soldered should be completely filled with approved sealant.

3.2.6 Soldering

Where soldering is specified, apply to copper, terne-coated stainless steel, zinc-coated steel, and stainless steel items. Pretin edges of sheet metal before soldering is begun. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

3.2.6.1 Edges

Scrape or wire-brush the edges of lead-coated material to be soldered to produce a bright surface. Flux brush the seams in before soldering. Treat with soldering acid flux the edges of stainless steel to be pretinned. Seal the joints in aluminum sheets of 0.040 inch or less in thickness with specified sealants. Do not solder aluminum.

3.2.7 Welding and Mechanical Fastening

Use welding for aluminum of thickness greater than 0.040 inch. Aluminum 0.040 inch or less in thickness must be butted and the space backed with formed flashing plate; or lock joined, mechanically fastened, and filled with sealant as recommended by the aluminum manufacturer.

3.2.7.1 Welding of Aluminum

Use welding of the inert gas, shield-arc type. For procedures, appearance and quality of welds, and the methods used in correcting welding work, conform to AWS D1.2/D1.2M.

3.2.7.2 Mechanical Fastening of Aluminum

Use No. 12, aluminum alloy, sheet metal screws or other suitable aluminum alloy or stainless steel fasteners. Drive fasteners in holes made with a No. 26 drill in securing side laps, end laps, and flashings. Space

fasteners 12 inch maximum on center. Where end lap fasteners are required to improve closure, locate the end lap fasteners not more than 2 inch from the end of the overlapping sheet.

3.2.8 Protection from Contact with Dissimilar Materials

3.2.8.1 Copper or Copper-bearing Alloys

Paint with heavy-bodied bituminous paint surfaces in contact with dissimilar metal, or separate the surfaces by means of moistureproof building felts.

3.2.8.2 Aluminum

Do not allow aluminum surfaces in direct contact with other metals except stainless steel, zinc, or zinc coating. Where aluminum contacts another metal, paint the dissimilar metal with a primer followed by two coats of aluminum paint. Where drainage from a dissimilar metal passes over aluminum, paint the dissimilar metal with a non-lead pigmented paint.

3.2.8.3 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.2.8.4 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with a coat of heavy-bodied bituminous paint.

3.2.9 Expansion and Contraction

Provide expansion and contraction joints at not more than 32 foot intervals for aluminum and at not more than 40 foot intervals for other metals. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval. Space joints evenly. Join extruded aluminum gravel stops and fascias by expansion and contraction joints spaced not more than 12 feet apart.

3.2.10 Base Flashing

Install metal base flashing where roof abuts vertical surfaces, in valleys, at ridges, and where roof slop changes. Configuration -- conform to SMACNA-93. Extend up vertical surfaces of the flashing not less than 8 inches. Where finish wall coverings form a counterflashing, extend the vertical leg of the flashing up behind the applied wall covering not less than 6 inch. Overlap the flashing strips with the previously laid flashing not less than 3 inch. Fasten the strips at their upper edge to the deck. Horizontal flashing at vertical surfaces must extend vertically above the roof surface and fastened at their upper edge to the deck a minimum of 6 inch on center with hex headed, galvanized shielded screws a minimum of 2-inch lap of any surface. Solder end laps and provide for expansion and contraction. Extend the metal flashing over crickets at the up-slope side of curbs and similar vertical surfaces extending through sloping roofs, the metal flashings. Extend the metal flashings onto the roof covering not less than 4.5 inch at the lower side of vertical surfaces extending through the roof decks. Install and fit the flashings so as to be completely weathertight. Provide factory-fabricated base flashing for interior and

exterior corners. Do not use metal base flashing on built-up roofing.

3.2.11 Cap and Counter Flashing

a. Install metal cap or counter flashing where horizontal roof surfaces abut vertical wall surfaces, at copings, at joints between existing and new construction, at penetrations of roof surfaces, and at equipment supports. Configuration -- conform to SMACNA-93.

b. Form flashing in 10 foot lengths, except where shorter pieces are required; lap end joints 3 inches minimum; do not solder joints.

Except where indicated or specified otherwise, insert counterflashing in reglets located from 9 to 10 inch above roof decks, extend down vertical surfaces over upturned vertical leg of base flashings not less than 3 inch. Fold the exposed edges of counterflashings 1/2 inch. Where stepped counterflashings are required, they may be installed in short lengths a minimum 8 inches by 10 inches or may be of the preformed one-piece type. Provide end laps in counterflashings not less than 3 inch and make it weathertight with plastic cement. Form the flashings to the required shapes before installation. Factory-form the corners not less than 12 inch from the angle. Secure the flashings in the reglets with lead wedges and space not more than 18 inch apart; on short runs, place wedges closer together. Fill caulked-type reglets or raked joints which receive counterflashing with caulking compound. Turn up the concealed edge of counterflashings built into masonry or concrete walls not less than 1/4 inch and extend not less than 2 inch into the walls. Install counterflashing to provide a spring action against base flashing. Where bituminous base flashings are provided, extend down the counter flashing as close as practicable to within 1 inch above the top of the cant strip. Factory form counter flashing to provide spring action against the base flashing.

3.2.12 Metal Reglets

Provide factory fabricated caulked type or friction type reglets with a minimum opening of 1/4 inch and a depth of 1 1/4 inch, as approved.

Reglets and Flashing Receivers - conform to SMACNA-93. Cut masonry joints or concrete to form a saw-cut reglet. Cut slots to a minimum depth of 1.5 inches and approximately 0.2 inch thick.

3.2.12.1 Caulked Reglets

Provide with rounded edges and metal strap brackets or other anchors for securing to the concrete forms. Provide reglets with a core to protect them from injury during the installation. Provide built-up mitered corner pieces for internal and external angles. Wedge the flashing in the reglets with lead wedges every 18 inch, caulked full and solid with an approved compound.

3.2.12.2 Friction Reglets

Provide with flashing receiving slots not less than 5/8 inch deep, one inch jointing tongues, and upper and lower anchoring flanges installed at 24 inch maximum snaplock receiver. Insert the flashing the full depth of the slot and lock by indentations made with a dull-pointed tool, wedges, and filled with a sealant. For friction reglets, install flashing snaplock receivers at 24 inch on center maximum. When the flashing has been inserted the full depth, caulk the slot and lock with wedges and fill with

sealant.

3.2.13 Gravel Stops and Fascias

Install gravel-stop fascias at exposed edges of built-up roofs. Configuration - conform to SMACNA-93. Secure in place lower edge of each gravel-stop fascia section by hooking over a continuous edge strip or cleat. Prefabricate in the shapes and sizes indicated and in lengths not less that 8 feet. Extend flange at least 4 inch onto roofing. Provide prefabricated, mitered corners internal and external corners. Install gravel stops and fascias after all plies of the roofing membrane have been applied, but before the flood coat of bitumen is applied. Prime roof flange of gravel stops and fascias on both sides with an asphalt primer. After primer has dried, set flange on roofing membrane and strip-in.Nail flange securely to wood nailer with large-head, barbed-shank roofing nails 1.5 inch long spaced not more than 3 inch on center, in two staggered rows.

3.2.13.1 Edge Strip

Hook the lower edge of fascias at least 3/4 inch over a continuous strip of the same material bent outward at an angle not more than 45 degrees to form a drip. Nail hook strip to a wood nailer at 6 inchmaximum on center. Where fastening is made to concrete or masonry, use screws spaced 12 inch on center driven in expansion shields set in the concrete or masonry. Where horizontal wood nailers are slotted to provide for insulation venting, install strips to prevent obstruction of vent slots. Where necessary, install strips over 1/16 inch thick compatible spacer or washers.

3.2.13.2 Joints

Provide 1/8 inch open joint between each gravel-stop fascia section, with a 12 inch wide plate centered on joint. Install system in conformance with SMACNA-93, Plate 38. Face nailing will not be permitted. Install prefabricated aluminum gravel stops and fascias in accordance with the manufacturer's printed instructions and details.

3.2.14 Metal Drip Edge

Provide a metal drip edge, designed to allow water run-off to drip free of underlying construction, at eaves and rakes prior to the application of roofing shingles. Apply directly on the wood deck at the eaves and over the underlay along the rakes. Extend back from the edge of the deck not more than 3 inch and secure with compatible nails spaced not more than 10 inch on center along upper edge.

3.2.15 Gutters

Gutter design and supports - in accordance with SMACNA-1793. The hung type of shape indicated and supported on underside by brackets that permit free thermal movement of the gutter. Provide gutters in sizes indicated complete with mitered corners, end caps, outlets, brackets, and other accessories necessary for installation. Bead with hemmed edge or reinforce the outer edge of gutter with a stiffening bar not less than 3/4 by 3/16 inch of material compatible with gutter. Fabricate gutters in sections not less than 8 feet. Lap the sections a minimum of one inch in the direction of flow or provide with concealed splice plate 6 inch minimum. Join the gutters, other than aluminum, by riveted and soldered joints. Join aluminum gutters with riveted sealed joints. Provide expansion-type slip joints midway between outlets. Support gutters on as indicated. Adjust

gutters to slope uniformly to outlets, with high points occurring midway between outlets. Fabricate hangers and fastenings from metals.

3.2.15.1 Pitch

Gutters to drain 1:200 maximum.

3.2.15.2 Outlet Tubes with Flanges

Riveted and soldered to gutters; extend tubes 3 inches into downspouts. Insert downspout strainer into each outlet tube.

3.2.15.3 Gutter Expansion Joints

Provide gutter expansion joints at 32 feet on center maximum, in accordance with SMACNA-93, Plate 6.

3.2.16 Downspouts

Space supports for downspouts according to the manufacturer's recommendation for the wood, masonry, or steel substrate. Types, shapes and sizes are indicated. Provide complete including elbows and offsets. Provide downspouts in approximately 10 foot lengths. Provide end joints to telescope not less than 1/2 inch and lock longitudinal joints. Provide gutter outlets with wire ball strainers for each outlet. Provide strainers to fit tightly into outlets and be of the same material used for gutters. Keep downspouts not less than one inch away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 5 feet on center with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

a. Provide downspouts on outside walls from gutters, conductor heads, and scuppers.

b. Join downspouts to gutters at outlet tubes, and join to each other by telescoping end joints 1.5 inches into lower section.

c. Fabricate downspout hangers of same material as downspouts. Provide one hanger at top and bottom of each downspout section.

d. Install elbows where downspouts terminate on splash blocks or roof pans. Fit downspouts neatly into cast-iron boots or drain pipes where downspouts terminate in drainage lines; fill joints to full height of bell with Portland cement mortar caps.

3.2.16.1 Terminations

Neatly fit into the drainage connection the downspouts terminating in drainage lines and fill the joints with a portland cement mortar cap sloped away from the downspout. Provide downspouts terminating in splash blocks with elbow-type fittings. Provide splash pans as specified.

3.2.17 Flashing for Roof Drains

Provide a 30 inch square sheet indicated. Taper insulation to drain from 24 inch out. Set flashing on finished felts in a full bed of asphalt roof cement, ASTM D 4586. Heavily coat the drain flashing ring with asphalt roof cement. Clamp the roof membrane, flashing sheet, and stripping felt in the drain clamping ring. Secure clamps so that felts and drain flashing

are free of wrinkles and folds. Retrofit roof drains must conform to ANSI/SPRI RD-1.

3.2.18 Scuppers

Line interior of scupper openings with sheet metal conforming to SMACNA-1793, Plate 30, through wall and roof openings. Extend the lining through and project outside of the wall or fascias, to form a drip on the bottom edge and form to return not less than one inch against the face of the outside wall at the top and sides. Terminate scupper projections in conductor heads, spouts, or overflow openings. Fold outside edges under 1/2 inch on all sides. Provide the perimeter of the lining approximately 1/2 inch less than the perimeter of the scupper. Join the top and sides of the lining on the roof deck side to a closure flange by a locked and soldered joint. Join the bottom edge by a locked and soldered joint to the closure flange, where required, form with a ridge to act as a gravel stop around the scupper inlet. Provide surfaces to receive the scupper lining and coat with bituminous plastic cement.

3.2.19 Conductor Heads

Conform to SMACNA-1793, Plate 25. Type indicated and fabricated of the same material as the downspouts. Set the depth of top opening equal to two-thirds of the width. Provide outlet tubes not less than 4 inch long. Flat-lock solder the seams. Where conductor heads are used in conjunction with scuppers, set the conductor a minimum of 2 inch wider than the scupper. Attach conductor heads to the wall with masonry fasteners, and loose-lock to provide conductor heads with screens of the same material. Securely fasten screens to the heads. Installation - conform to SMACNA-1793.

3.2.20 Splash Pans

Provide metal splash pans conforming to SMACNA-1793, Plate 35, Alternate Section 2. Install splash pans where downspouts discharge on roof surfaces and at other locations as indicated. Unless otherwise shown, provide pans not less than 24 inch long by 18 inch wide with metal ribs across the bottom of the pan. Form the sides of the pan with vertical baffles not less than one inch high in the front, and 4 inch high in the back doubled over and formed continuous with horizontal roof flanges not less than 4 inch wide. Bend the rear flange of the pan to contour of cant strip and extend up 6 inch under the side wall covering or to height of base flashing under counterflashing. Bed the pans and roof flanges in plastic bituminous cement and strip-flash as specified.

3.2.21 Open Valley Flashing

Provide valley flashing free of longitudinal seams, of width sufficient to extend not less than 6 inch under the roof covering on each side. Provide a 1/2 inch fold on each side of the valley flashing. Lap the sheets not less than 6 inch in the direction of flow and secure to roofing construction with cleats attached to the fold on each side. Nail the tops of sheets to roof sheathing. Space the cleats not more than 12 inch on center. Provide exposed flashing not less than 4 inch in width at the top and increase one inch in width for each additional 8 feet in length. Where the slope of the valley is 4.5 inch or less per foot, or the intersecting roofs are on different slopes, provide an inverted V-joint, one inch high, along the centerline of the valley; and extend the edge of the valley sheets 8 inch under the roof covering on each side.

3.2.22 Eave Flashing

One piece in width, applied in 8 to 10 foot lengths with expansion joints spaced as specified in paragraph entitled "Expansion and Contraction." Provide a 3/4 inch continuous fold in the upper edge of the sheet to engage cleats spaced not more than 10 inch on center. Locate the upper edge of flashing not less than 18 inch from the outside face of the building, measured along the roof slope. Fold lower edge of the flashing over and loose-lock into a continuous edge strip on the fascia. Where eave flashing intersects metal valley flashing, secure with one inch flat locked joints with cleats that are 10 inch on center.

3.2.23 Sheet Metal Covering on Flat, Sloped, or Curved Surfaces

Except as specified or indicated otherwise, cover and flash all minor flat, sloped, or curved surfaces such as crickets, bulkheads, dormers and small decks with metal sheets of the material used for flashing; maximum size of sheets, 16 by 18 inch. Fasten sheets to sheathing with metal cleats. Lock seams and solder. Lock aluminum seams as recommended by aluminum manufacturer. Provide an underlayment of roofing felt for all sheet metal covering.

3.2.24 Expansion Joints

Provide expansion joints for roofs, walls, and floors as indicated. Provide expansion joints in continuous sheet metal at 40 foot intervals for copper and stainless steel and at 32 foot intervals for aluminum, aluminum gravel stops and fascias which must have expansion joints at not more than 12 foot spacing. Provide evenly spaced joints. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing. Conform to the requirements of Table I.

a. Expansion-joint configuration - conform to drawing details and to SMACNA-93.

b. Expansion joints in concrete walls - conform to SMACNA-93, Plate 82, Figure B. Ensure that each member does snot exceed 10 feet in length and runs continuously from top of footing to top of wall.

c. Floor slab expansion joints - conform to SMACNA-93, Plate 83. Lap joints 0.75 inch and solder before installing in concrete floor slab.

3.2.24.1 Roof Expansion Joints

Consist of curb with wood nailing members on each side of joint, bituminous base flashing, metal counterflashing, and metal joint cover. Bituminous base flashing is specified in Roofing Section. Provide counterflashing as specified in paragraph "Counterflashing," except as follows: Provide counterflashing with vertical leg of suitable depth to enable forming into a horizontal continuous cleat. Secure the inner edge to the nailing member. Make the outer edge projection not less than one inch for flashing on one side of the expansion joint and be less than the width of the expansion joint plus one inch for flashing on the other side of the joint. Hook the expansion joint cover over the projecting outer edges of counterflashing. Provide roof joint with a joint cover of the width indicated. Hook and lock one edge of the joint cover over the shorter projecting flange of the continuous cleat, and the other edge hooked over and loose locked with the longer projecting flange. . Joints are specified

in Table II.

3.2.24.2 Floor and Wall Expansion Joints

Provide U-shape with extended flanges for expansion joints in concrete and masonry walls and in floor slabs.

3.2.25 Flashing at Roof Penetrations and Equipment Supports

Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck.

3.2.26 Single Pipe Vents

Single-pipe ents - flashed with lead flashing or a two-piece formed-metal housing of specified sheetmetal, installed in accordance with SMACNA-93, Plate 59, Figures B and C. See Table I, footnote (d). Set flange of sleeve in bituminous plastic cement and nail 3 inch on center. Bend the top of sleeve over and extend down into the vent pipe a minimum of 2 inch. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed metal housing. Set metal housing with a metal sleeve having a 4 inch roof flange in bituminous plastic cement and nailed 3 inch on center. Extend sleeve a minimum of8 inch above the roof deck and lapped a minimum of 3 inch by a metal hood secured to the vent pipe by a draw band. Seal the area of hood in contact with vent pipe with an approved sealant.

3.2.27 Stepped Flashing

Stepped flashing shall be installed where sloping roofs surfaced with shingles abut vertical surfaces. Separate pieces of base flashing shall be placed in alternate shingle courses.

3.2.28 Copings

Provide coping using copper sheets 8 or 10 feet long joined by a 3/4 inch locked and soldered seam. Terminate outer edges in edge strips. Install with sealed cover plate joints as indicated.

3.3 PAINTING

Dissimilar Metals - isolate from each other by painting with bituminous paint.

3.3.1 Aluminum Surfaces

Shall be solvent cleaned and given one coat of zinc-molybdate primer and one coat of aluminum paint.

3.4 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.5 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

3.6 FIELD QUALITY CONTROL

Establish and maintain a Quality Control Plan for sheet metal used in conjunction with roofing to assure compliance of the installed sheet metalwork with the contract requirements. Remove work that is not in compliance with the contract and replace or correct. Include quality control, but not be limited to, the following:

a. Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.

b. Verification that specified material is provided and installed.

c. Inspection of sheet metalwork, for proper size(s) and thickness(es), fastening and joining, and proper installation.

3.6.1 Procedure

Submit for approval prior to start of roofing work. Include a checklist of points to be observed. Document the actual quality control observations and inspections. Furnish a copy of the documentation to the COR at the end of each day.

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES
(General Table and not all items may be used or specified)

Sheet Metal Items	Copper, Ounces Per Square Foot	Aluminum, Inch	Stainless Steel, Inch	Terne-Coated Steel, Inch	Zinc-Coated Steel, U.S. Std. Gage
Building Expansion Joints					
Cover	16	.032	.02(28)	.015	24
Waterstop-bellows or flanged, U-type.	16	-		.02(28)	.015
Covering on minor flat, pitched or curved surfaces	20	.040	.018	.018	-
Downspouts and leaders	16	.032	.012(3)	.015	24
Downspout clips and anchors	-	.040 clip	-	-	-
	-	.125 anchor	-	-	-
Downspout straps, 2-inch	48(a)	.13	.047(18)	-	-
Conductor heads	16	.032	.016(28)	.015	-
Scupper lining	20	.032	.016(28)	.015	-
Strainers, wire					

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES
(General Table and not all items may be used or specified)

Sheet Metal Items	Copper, Ounces Per Square Foot	Aluminum, Inch	Stainless Steel, Inch	Terne-Coated Steel, Inch	Zinc-Coated Steel, U.S. Std. Gage
diameter or gage	No. 9 gage	.144 diameter	.11 diameter		-
Flashings:					
Base	20	.040	.02(28)	.018	24
Cap (Counter-flashing)	16	.032	.015	.015	26
Eave	16	-	.015	.015	24
Spandrel beam	10	-	.010	.010	-
Bond barrier	16	-	.015	.015	-
Stepped	16	.032	.015	.015	-
Valley	16	.032	.015	.015	-
Roof drain	16(b)				
Pipe vent sleeve(d)					
Coping	16	-	-	-	-
Gravel stops and fascias:					
Extrusions	-	.075	-	-	-
Sheets, corrugated	16	.032	.016(28)	.015	-
Sheets, smooth	20	.050	.018	.018	24
Edge strip	24	.050	.025	-	-
Gutters:					
Gutter section.....	16	.032	.016(28)	.015	24
Continuous cleat.....	16	.032	.016(28)	.015	24
Hangers, dimensions	1 inch by 1/8 inch (a)	1 inch by .080 inch (c)	1 inch by .037 inch	-	-
Joint Cover plates... (See Table II)	16	.032	.016(28)	.015	24
Reglets (c)	10	-	.010(30)	.010	-
Splash pans	16	.040	.018	.018	-

(a) Brass.

(b) May be lead weighing 4 pounds per square foot.

(c) May be polyvinyl chloride.

(d) 2.5 pound minimum lead sleeve with 4 inch flange. Where lead sleeve is impractical, refer to paragraph entitled "Single Pipe Vents" for optional material.

TABLE II. SHEET METAL JOINTS
(General Table and not all items may be used or specified)

Item Designation	Copper, Terne-Coated Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Joint cap for building expansion seam, cleated joint at roof	1.25 inch single lock, standing seam, cleated	1.25 inch single lock, standing	- - -
Flashings			
Base	One inch 3 inch lap for expansion joint	One inch flat locked, soldered; sealed; 3 inch lap for expansion joint	Aluminum producer's recommended hard setting sealant for locked aluminum joints. Fill each metal expansion joint with a joint sealing compound compound.
Cap-in reglet	3 inch lap	3 inch lap	Seal groove with joint sealing compound.
Reglets	Butt joint	- - -	Seal reglet groove with joint sealing compound.
Eave	One inch flat locked, cleated One inch loose locked, expansion joint cleated	One inch flat locked, locked, cleated one inch loose locked, sealed expansion joints, cleated	Same as base flashing.
Stepped	3 inch lap	3 inch lap	- - -
Valley.	6 inch lap cleated	6 inch lap cleated	- - -
Edge strip	Butt	Butt	- - -
Gravel stops:			
Extrusions	- - -	Butt with 1/2 inch	Use sheet flashing

TABLE II. SHEET METAL JOINTS
(General Table and not all items may be used or specified)

Item Designation	Copper, Terne-Coated Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
		space	beneath and a cover plate.
Sheet, smooth	Butt with 1/4 inch space	Butt with 1/4 inch space	Use sheet flashing backup plate.
Sheet corrugated	Butt with 1/4 inch space	Butt with 1/4 inch space	Use sheet flashing beneath and a cover plate or a combination unit
Gutters	1.5 inch lap, riveted and soldered	One inch flat locked, riveted, and sealed	Aluminum producers recommended hard setting sealant for locked aluminum joints.

(a) Provide a 3 inch lap elastomeric flashing with manufacturer's recommended sealant.

(b) Seal polyvinyl chloride reglet with manufacturer's recommended sealant.

-- End of Section --

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SECTION 07 84 00

FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for firestopping using tested and listed firestop systems to form an effective barrier against the spread of fire, smoke and gases, and to maintain the integrity of fire resistance rated construction.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM E 119	Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 1399	Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
ASTM E 1966	Fire-Resistive Joint Systems
ASTM E 2174	Standard Practice for On-Site Inspection of Installed Fire Stops
ASTM E 2307	Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus
ASTM E 2393	Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers
ASTM E 814	Standard Test Method for Fire Tests of Through-Penetration Fire Stops
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials

FM GLOBAL (FM)

FM APP GUIDE	Approval Guide http://www.approvalguide.com/
FM AS 4991	Approval of Firestop Contractors

UNDERWRITERS LABORATORIES (UL)

UL 1479	Fire Tests of Through-Penetration Firestops
UL 2079	Tests for Fire Resistance of Building Joint Systems
UL 723	Test for Surface Burning Characteristics of Building Materials
UL Fire Resistance	Fire Resistance Directory

1.3 SYSTEM DESCRIPTION

1.3.1 General

Furnish and install tested and listed firestopping systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps.

a. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents.

b. Construction joints include those used to accommodate expansion, contraction, wind, or seismic movement; firestopping material shall not interfere with the required movement of the joint.

   Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above and at the intersection of shaft assemblies and adjoining fire resistance rated assemblies.

1.3.2 Sequencing

Coordinate the specified work with other trades. Apply firestopping materials, at penetrations of pipes and ducts, prior to insulating, unless insulation meets requirements specified for firestopping. Apply firestopping materials. at building joints and construction gaps, prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible. Firestop material shall be inspected and approved prior to final completion and enclosing of any assemblies that may conceal installed firestop.

1.3.3 Submittals Requirements

a. Submit detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance or other details

certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal shall indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" "T" and "L" ratings, and type of application.

b. Submit certificates attesting that firestopping material complies with the specified requirements. For all intumescent firestop materials used in through penetration systems, manufacturer shall provide certification from UL of passing the "Aging and Environmental Exposure Testing " portion of UL 1479.

c. Submit documentation of training and experience for Installer.

d. Submit manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Firestopping Materials

SD-07 Certificates

Manufacturer's Technical Representative
Firestopping Materials.
Installer Qualifications.
Inspection.

1.5 QUALITY ASSURANCE

1.5.1 Installer

Engage an experienced Installer who is:

a. FM Research approved in accordance with FM AS 4991, operating as a UL Certified Firestop Contractor, or

b. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products in accordance with specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer installer qualifications on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures. The installer shall obtain from the manufacturer written certification of training,

and retain proof of certification for duration of firestop installation.

1.5.2 Manufacturer's Technical Representative

The manufacturer's technical representative shall be a direct representative of the manufacturer (not a distributor or an agent). Provide current documentation from the manufacturer that he or she is a direct representative of the manufacturer and is qualified to preform the specified inspections and certify the firestopping installation.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the original unopened packages or containers showing name of the manufacturer and the brand name. Store materials off the ground, protected from damage and exposure to elements. Remove damaged or deteriorated materials from the site.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Provide firestopping materials, supplied from a single domestic manufacturer, consisting of commercially manufactured, asbestos-free, nontoxic, water-based, noncombustible products FM APP GUIDE approved, or UL listed, for use with applicable construction and penetrating items, complying with the following minimum requirements:

2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resistance or by a nationally recognized testing laboratory.

2.1.2 Toxicity

Material shall be nontoxic and carcinogen free to humans at all stages of application or during fire conditions and shall not contain hazardous chemicals or require harmful chemicals to clean material or equipment. Firestop material must be free from Ethylene Glycol, PCB, MEK, or other types of hazardous chemicals.

2.1.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resistance listed or FM APP GUIDE approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected. Where required, firestop systems shall also have "T" rating at least equal to the fire-rated floor in which the openings are to be protected.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph SYSTEM DESCRIPTION, shall provide "F", "T" and "L" fire resistance ratings in accordance with ASTM E 814 or UL 1479. Fire resistance ratings shall be as follows:

a. Penetrations of Fire Resistance Rated Walls and Partitions: F Rating = Rating of wall or partition being penetrated.

b. Penetrations of Fire Resistance Rated Floors, Floor-Ceiling Assemblies and the ceiling membrane of Roof-Ceiling Assemblies: F Rating = Rating of wall or partition being penetrated, T Rating = Rating of wall or partition being penetrated. Where the penetrating item is outside of a wall cavity the F rating and T rating must be equal to the fire resistance rating of the floor penetrated.

c. Penetrations of Fire and Smoke Resistance Rated Walls, Floors, Floor-Ceiling Assemblies, and the ceiling membrane of Roof-Ceiling Assemblies: F Rating = Rating of wall or partition being penetrated, T Rating = Rating of wall or partition being penetrated and L Rating = <5 cfm/sf Where L rating is required.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph SYSTEM DESCRIPTION, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E 119, ASTM E 1966 or UL 2079 to meet the required fire resistance rating. Curtain wall joints shall be provided with firestopping materials and systems that have been tested in accordance with ASTM E 2307 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079. All joints at the intersection of the top of a fire resistance rated wall and the underside of a fire-rated floor, floor ceiling, or roof ceiling assembly shall provide a minimum class II movement capability.

2.1.4 Material Performance

All firestop materials are subject to these minimum standards of performance.

a. Firestop material shall be capable of installation at temperatures of 35 to 120 degrees F.

b. Material must be able to be frozen, thawed and still maintain manufacturer approval for installation.

c. Firestop material must convey a manufacturer's written warranty guaranteeing the performance of the material for the sustainable lifetime of the structure.

d. Material must maintain a shelf life of no less than 2 years form date of manufacturing.

e. Acceptable firestop cast-in-place devices are factory assembled intumescent lined round or oval plastic cylinders capable of protecting plastic, metallic, cable, and blank openings through the cast-in-place device equal to the fire-resistance rating of the floor.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the

firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement shall be sound and capable of supporting device. Prepare surfaces as recommended by the manufacturer.

3.2 INSTALLATION

Completely fill void spaces with firestopping material regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 4 inches or more in any direction shall be capable of supporting the same load as the floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Install firestopping in accordance with manufacturer's written instructions. Provide tested and listed firestop systems in the following locations, except in floor slabs on grade:

a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.

b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.

c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.

d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

e. Construction joints in floors and fire rated walls and partitions.

f. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Replace thermal insulation with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Fire Dampers

Install and firestop fire dampers in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM. Firestop installed with fire damper must be tested and approved for use in fire damper system. Firestop installed with fire damper must be tested and approved for use in fire damper system.

3.2.3 Data and Communication Cabling

Cabling for data and communication applications shall be sealed with re-enterable firestopping products. Firestopping devices shall be pre-manufactured modular devices, containing built-in self-sealing intumescent inserts. Firestopping devices shall allow for cable moves, additions or changes without the need to remove or replace any firestop materials. Devices must be capable of maintaining the fire resistance rating of the penetrated membrane at 0% to 100% visual fill of penetrants;

while maintaining "L" rating of <5 cfm/sf measured at ambient temperature and 400* F at 0% to 100% visual fill. Each device must be capable of retrofit applications and be available in square and round configurations, with single, double, triple and six-plex bracket systems provided. Firestop devices must also allow for plastic pipe, metallic pipe, and mixed multiple penetrations plastic, metallic, insulated metallic, and cable through a single device.

3.3 INSPECTION

3.3.1 General Requirements

For all projects, the firestopped areas shall not be covered or enclosed until inspection is complete and approved by the manufacturer's technical representative. The manufacturer's representative shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements. Submit written reports indicating locations of and types of penetrations and types of firestopping used at each location; type shall be recorded by UL listed printed numbers.

3.3.2 Inspection Standards

Inspect all firestopping in accordance to ASTM standards for firestop inspection, and document inspection results to be submitted to GC, Architect and Owner.

a. ASTM E 2393

b. ASTM E 2174

-- End of Section --

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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07 92 00

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SECTION 07 92 00

JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for sealants for normal building construction.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM C 1311	Standard Specification for Solvent Release Agents
ASTM C 509	Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 734	Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C 834	Latex Sealants
ASTM C 919	Use of Sealants in Acoustical Applications
ASTM C 920	Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1667	Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D 217	Cone Penetration of Lubricating Grease
ASTM D 2452	Standard Test Method for Extrudability of Oil- and Resin-Base Caulking Compounds
ASTM D 2453	Standard Test Method for Shrinkage and Tenacity of Oil- and Resin-Base Caulking Compounds

ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sealants

Primers

Bond breakers

Backstops

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). Provide a copy of the Material Safety Data Sheet for each solvent, primer or sealant material.

SD-07 Certificates

Sealant

Certificates of compliance stating that the materials conform to the specified requirements.

1.4 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 40 and 90 degrees F.

1.5 DELIVERY AND STORAGE

Deliver materials to the job site in unopened manufacturers' external shipping containers, with brand names, date of manufacture, color, and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Carefully handle and store materials to prevent inclusion of foreign materials or subjection to sustained temperatures exceeding 90 degrees F or less than 0 degrees F.

1.6 QUALITY ASSURANCE

1.6.1 Compatibility with Substrate

Verify that each of the sealants are compatible for use with joint substrates.

1.6.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant that has been tested and found suitable for the substrates to which it will be applied. Comply with applicable regulations regarding toxic and hazardous materials, and as specified. Sealants containing asbestos, aromatic solvents, fibrous talc, formaldehyde, halogenated solvents, mercury, lead, cadmium, chromium and their compounds, are not permitted. Sealants, primers, and cleaners required for sealant installation must also comply with all local regulations controlling VOC content.

2.1.1 Interior Sealant

One-part mildew resistant, silicone rubber conforming to ASTM C 920, Type S, Grade NS, Class 2.5, Use NT. Color shall match surrounding material unless indicated otherwise. Location(s) and color(s) of sealant for the following:

LOCATION

a. Small voids between walls or partitions and adjacent lockers, casework, shelving, door frames, built-in or surface-mounted equipment and fixtures, and similar items.

b. Perimeter of frames at doors, windows, and access panels which adjoin exposed interior concrete and masonry surfaces.

c. Joints of interior masonry walls and partitions which adjoin columns, pilasters, concrete walls, and exterior walls unless otherwise detailed.

d. Joints between edge members for acoustical tile and adjoining vertical surfaces.

e. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.

f. Joints between bathtubs and ceramic tile; joints between shower receptors and ceramic tile; joints formed where nonplaner tile surfaces meet.

g. Joints formed between tile floors and tile base cove; joints between tile and dissimilar materials; joints occurring where substrates change.

h. Behind escutcheon plates at valve pipe penetrations and showerheads in showers.

2.1.2 Exterior Sealant

For joints in vertical surfaces, provide single component polyurethane conforming to ASTM C 920, Type S, Grade NS, Class 25, Use NT. For joints

in horizontal surfaces, provide ASTM C 920, Type S, Grade P, Class 25, Use T. For exterior concealed joints and under thresholds, provide one-part butyl rubber caulk conforming to FS TT-S-001647, Type I. For exterior concealed joints between two assembled rigid surfaces in compression, provide polyisobutylene sealant tape conforming to AAMA 804.1. Color shall match surrounding material unless indicated otherwise. Provide location(s) and color(s) of sealant as follows:

LOCATION

a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.

b. Voids where items pass through exterior walls.

c. Masonry joints where shelf angles occur.

d. Joints in wash surfaces of stonework.

e. Expansion and control joints.

f. Interior face of expansion joints in exterior concrete or masonry walls where metal expansion joint covers are not required.

g. Voids where items pass through exterior walls.

h. Metal reglets, where flashing is inserted into masonry joints, and where flashing is penetrated by coping dowels.

i. Metal-to-metal joints where sealant is indicated or specified.

j. Joints between ends of gravel stops, fascias, copings, and adjacent walls.

2.1.3 Floor Joint Sealant

Two-part polyurethane conforming to ASTM C 920, Type , Grade P, Class 25, Use T self leveling. Color shall match surrounding material unless indicated otherwise. Provide location(s) and color(s) of sealant as follows:

LOCATION

a. Seats of metal thresholds for exterior doors.

b. Control and expansion joints in floors, slabs, ceramic tile, and walkways.

2.2 PRIMERS

Provide a nonstaining, quick-drying type and consistency recommended by the sealant manufacturer for the particular application.

2.3 BOND BREAKERS

Provide the type and consistency recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.4 BACKSTOPS

Provide glass fiber roving or neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Make backstop material compatible with sealant. Do not use oakum and other types of absorptive materials as backstops.

2.4.1 Rubber

Conform to ASTM D 1056, Type 2, closed cell, Class A or B foil oil or fuel resistance, cross section as required for the application.

2.4.2 PVC

Conform to ASTM D 1667, Grade VO 12, open-cell foam, cross-section as required for the application.

2.4.3 Synthetic Rubber

Conform to ASTM C 509, Option I, Type I preformed rods or tubes.

2.4.4 Neoprene

Conform to ASTM D 1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2 or open cell neoprene sponge Type 1, Class C, Grade 1C3.

2.5 CAULKING

Conform to ASTM D 2452 and ASTM D 2453, for Oil- and resin-based caulking.

2.6 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer except for aluminum and bronze surfaces that will be in contact with sealant.

PART 3 EXECUTION

3.1 GENERAL

a. Install caulking and sealing materials in accordance with approved catalog data and as specified.

b. Use components of each formula only with that formula; do not intermix components of different formulas. Do not use thinners or other additives to modify formula.

c. Do not install caulking and sealing compounds when ambient temperature is below 39°F or above 100°F. Do not apply exterior caulking and sealing compounds in damp or rainy weather; ensure that surfaces of joints to be sealed have dried from effects of such weather.

d. Do not allow condensation to form on joint surfaces that will receive caulking or sealing compounds. Provide ventilation as required to prevent formation of condensation on such surfaces.

3.2 SURFACE PREPARATION

Clean surfaces from dirt, frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would tend to destroy or impair adhesion. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant. For surface types not listed below, contact sealant manufacturer for specific recommendations.

3.2.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finish work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue-free solvent.

3.2.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive just prior to sealant application. For removing protective coatings and final cleaning, use nonstaining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.2.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity.

3.2.4 Wood Surfaces

Keep wood surfaces to be in contact with sealants free of splinters and sawdust or other loose particles.

3.3 SEALANT PREPARATION

Do not add liquids, solvents, or powders to the sealant. Mix multicomponent elastomeric sealants in accordance with manufacturer's instructions.

3.4 APPLICATION

3.4.1 Gun-Apply Caulking Compound

Gun-apply caulking compound with a nozzle of proper size to fit joint width, and solidly force compound into joint cavity. Ensure that finished exposed surfaces of caulking compound are sufficiently convex to result in a flush joint when caulking compound has dried, and are uniformly smooth and free from wrinkles.

3.4.2 Gun-Apply Elastomeric Sealing Compound

Gun-apply elastomeric sealing compound with a nozzle of proper size to fit joint width, and force compound into joint cavity with sufficient pressure to expel air and to solidly fill joint cavity. Firmly tool surface of sealing compound in place using wetting agent recommended by manufacturer of sealing compound. Ensure that finished exposed surfaces of sealing compound are slightly concave, uniformly smooth, and free from cracking and air bubbles.

3.4.3 Joint-Sealant Tape

Ensure that metal and other surfaces to receive joint-sealant tape are clean and dry. Place tape on one surface with removable backing exposed. Remove backing immediately before placing next plate. After plates are placed and lapped and holes in plates are match, cold-punch holes for bolts through tape, or pierce tape through bolt holes with a X-shaped cut without deforming tape adjacent to bolt holes. Do no stretch tape; lap tape 1 inch minimum at splices. At corner laps of plates and at other laps requiring additional sealant material to make waterproof joints, place as many thicknesses of tape as required to fill voids. Store tape at ambient temperatures of less than 100°F, and handle and store so as to not deform tape from its original shape.

3.4.4 Joint Width-To-Depth Ratios

a. Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH Minimum	JOINT DEPTH Maximum
For metal, glass, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For wood, concrete, masonry, stone:		
1/4 inch (minimum)	1/4 inch	1/4 inch
Over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
Over 1/2 inch to 2 inch	1/2 inch	5/8 inch
Over 2 inch.	(As recommended by sealant manufacturer)	

b. Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is not required on metal surfaces.

3.4.5 Masking Tape

Place masking tape on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears.

Remove masking tape within 10 minutes after joint has been filled and tooled.

3.4.6 Backstops

Install backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide a joint of the depth specified. Install backstops in the following locations:

a. Where indicated.

b. Where backstop is not indicated but joint cavities exceed the acceptable maximum depths specified in paragraph entitled, "Joint Width-to-Depth Ratios".

3.4.7 Primer

Immediately prior to application of the sealant, clean out loose particles from joints. Where recommended by sealant manufacturer, apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's instructions. Do not apply primer to exposed finish surfaces.

3.4.8 Bond Breaker

Provide bond breakers to the back or bottom of joint cavities, as recommended by the sealant manufacturer for each type of joint and sealant used, to prevent sealant from adhering to these surfaces. Carefully apply the bond breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the bond breaker.

3.4.9 Sealants

Provide a sealant compatible with the material(s) to which it is applied. Do not use a sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the gun. Apply the sealant in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Force sealant into joints to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Make sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply sealant, and tool smooth as specified. Apply sealer over the sealant when and as specified by the sealant manufacturer.

3.5 PROTECTION AND CLEANING

3.5.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled.

3.5.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces: Immediately scrape off fresh sealant that has been smeared on masonry and rub clean with a solvent

as recommended by the sealant manufacturer. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent-moistened cloth.

3.6 INSPECTION AND ACCEPTANCE PROVISIONS

a. Caulking and sealing work will be rejected if color does not match that of approved sample, if finished surface does not conform to requirements, or if compound fails to adhere to joint surfaces at sides of joint.

b. Remove defective work and replace with new acceptable work.

-- End of Section --

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SECTION 08 11 13

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SECTION 08 11 13

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for steel doors and frames.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code - Steel

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A879/A879M	Standard Specification for Steel Sheet, zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
ASTM A924/A924M	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C578	Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
ASTM C591	Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C612	Mineral Fiber Block and Board Thermal Insulation
ASTM D2863	Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)

ASTM E1300	Determining Load Resistance of Glass in Buildings
ASTM E283	Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM F 2248	Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.115	Hardware Preparation in Steel Doors and Steel Frames

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM HMMA HMM	Hollow Metal Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 105	Standard for Installation of Smoke Door Assemblies and Other Opening Protectives
NFPA 252	Standard Methods of Fire Tests of Door Assemblies
NFPA 80	Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR 111	Recommended Selection and Usage Guide for Standard Steel Doors, Frames and Accessories
SDI/DOOR 113	Standard Practice for Determining the Steady State Thermal Transmittance of Steel Door and Frame Assemblies
SDI/DOOR A250.11	Recommended Erection Instructions for Steel Frames
SDI/DOOR A250.3	Test Procedure and Acceptance Criteria for Factory Applied Finish Painted Steel Surfaces for Steel Doors and Frames
SDI/DOOR A250.4	Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcing
SDI/DOOR A250.6	Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames
SDI/DOOR A250.8	Recommended Specifications for Standard

UNDERWRITERS LABORATORIES (UL)

UL 10C Standard for Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors

Frames

Accessories

Weatherstripping

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors

Schedule of frames

Submit door and frame locations.

SD-03 Product Data

Doors

Frames

Accessories

Weatherstripping

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to SDI/DOOR A250.8 requirements.

SD-04 Samples

Factory-applied enamel finish

Where colors are not indicated, submit manufacturer's standard colors and patterns for selection.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Strap knock-down frames in bundles. Provide

temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 1/4 inch airspace between doors. Remove damp or wet packaging immediately and wipe affected surfaces dry. Replace damaged materials with new.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

SDI/DOOR A250.8, except as specified otherwise. Prepare doors to receive door hardware as specified in Section 08 71 00. Undercut where indicated. Exterior doors shall have top edge closed flush and sealed to prevent water intrusion. Doors shall be 1-3/4 inch thick, unless otherwise indicated. Provide exterior glazing in accordance with ASTM F 2248 and ASTM E1300.

2.1.1 Classification - Level, Performance, Model

2.1.1.1 Standard Duty Doors

SDI/DOOR A250.8, Level 1, physical performance Level C, Model 2, of size(s) and design(s) indicated and core construction as required by the manufacturer. Provide level doors where indicated.

2.1.1.2 Heavy Duty Doors

SDI/DOOR A250.8, Level 2, physical performance Level B, Model 2, with core construction as required by the manufacturer for interior doors and for exterior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation. Provide Level 2 where indicated.

2.1.1.3 Extra Heavy Duty Doors

SDI/DOOR A250.8, Level 3, physical performance Level A, Model 2 with core construction as required by the manufacturer for interior doors and for indicated exterior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation. Provide Level 3 where indicated.

2.1.1.4 Maximum Duty Doors

SDI/DOOR A250.8, Level 4, physical performance Level A, Model 2 with core construction as required by the manufacturer for interior doors and for indicated exterior doors, of size(s) and design(s) indicated. Where vertical stiffener cores are required, the space between the stiffeners shall be filled with mineral board insulation. Provide Level 4 where indicated.

2.2 SOUND RATED STEEL DOORS

Doors shall have a Sound Transmission Class (STC) as indicated on the drawings.

2.3 ACCESSORIES

2.3.1 Louvers

2.3.1.1 Interior Louvers

SDI/DOOR 111, Louvers shall be stationary sightproof and lightproof type where scheduled. Louvers for lightproof doors shall not transmit light. Detachable moldings on room or non security side of door; on security side of door, moldings to be integral part of louver. Form louver frames of 20 gage steel and louver blades of a minimum 24 gage. Louvers for lightproof doors shall have minimum of 20 percent net-free opening. Sightproof louvers to be inverted "V" blade design with minimum 55.

2.3.1.2 Exterior Louvers

Louvers shall be inverted "V" type with minimum of 35 percent net-free opening. Weld or tenon louver blades to continuous channel frame and weld assembly to door to form watertight assembly. Form louvers of hot-dip galvanized steel of same gage as door facings. Louvers shall have steel-framed insect screens secured to room side and readily removable. Provide aluminum wire cloth, 18 by 18 or 18 by 16 inch mesh, for insect screens. Net-free louver area to be before screening.

2.3.2 Astragals

For pairs of exterior steel doors which will not have aluminum astragals or removable mullions, as specified in Section 08 71 00 DOOR HARDWARE provide overlapping steel astragals with the doors. For interior pairs of fire rated and smoke control doors, provide stainless steel astragals complying with NFPA 80 for fire rated assemblies and NFPA 105 for smoke control assemblies.

2.3.3 Moldings

Provide moldings around glass of interior and exterior doors and louvers of interior doors. Provide nonremovable moldings on outside of exterior doors and on corridor side of interior doors. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings. Muntins shall interlock at intersections and shall be fitted and welded to stationary moldings.

2.4 STANDARD STEEL FRAMES

SDI/DOOR A250.8, Level 1, 2, 3, 4, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners or knock-down field-assembled corners. Provide steel frames for doors, transoms, sidelights, mullions, cased openings, and interior glazed panels, unless otherwise indicated.

2.4.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth.

Weld frames in accordance with the recommended practice of the Structural Welding Code Sections 1 through 6, AWS D1.1/D1.1M and in accordance with the practice specified by the producer of the metal being welded.

2.4.2 Knock-Down Frames

Design corners for simple field assembly by concealed tenons, splice plates, or interlocking joints that produce square, rigid corners and a tight fit and maintain the alignment of adjoining members. Provide locknuts for bolted connections.

2.4.3 Mullions and Transom Bars

Mullions and transom bars shall be closed or tubular construction and be a member with heads and jambs butt-welded thereto or knock-down for field assembly. Bottom of door mullions shall have adjustable floor anchors and spreader connections.

2.4.4 Stops and Beads

Form stops and beads from 20 gage steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 12 to 16 inch on center. Miter molded shapes at corners. Butt or miter square or rectangular beads at corners.

2.4.5 Cased Openings

Fabricate frames for cased openings of same material, gage, and assembly as specified for metal door frames, except omit door stops and preparation for hardware.

2.4.6 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 18 gage.

2.4.6.1 Wall Anchors

Provide at least three anchors for each jamb. For frames which are more than 7.5 feet in height, provide one additional anchor for each jamb for each additional 2.5 feet or fraction thereof.

a. Masonry: Provide anchors of corrugated or perforated steel straps or 3/16 inch diameter steel wire, adjustable or T-shaped;

b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to wood studs with nails, to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;

c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI/DOOR 111; and

d. Solid plaster partitions: Secure anchors solidly to back of frames and tie into the lath. Provide adjustable top strut anchors on each side of frame for fastening to structural members or ceiling construction above. Size and type of strut anchors shall be as recommended by the frame manufacturer.

2.4.6.2 Floor Anchors

Provide floor anchors drilled for 3/8 inch anchor bolts at bottom of each jamb member.

2.5 FIRE AND SMOKE DOORS AND FRAMES

NFPA 80 and NFPA 105 and this specification. The requirements of NFPA 80 and NFPA 105 shall take precedence over details indicated or specified.

2.5.1 Labels

Fire doors and frames shall bear the label of Underwriters Laboratories (UL), Factory Mutual Engineering and Research (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10C. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted.

2.5.2 Oversized Doors

For fire doors and frames which exceed the size for which testing and labeling are available, furnish certificates stating that the doors and frames are identical in design, materials, and construction to a door which has been tested and meets the requirements for the class indicated.

2.5.3 Astragal on Fire and Smoke Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements. On smoke control doors, conform to NFPA 105.

2.6 WEATHERSTRIPPING

2.6.1 Integral Gasket

Black synthetic rubber gasket with tabs for factory fitting into factory slotted frames, or extruded neoprene foam gasket made to fit into a continuous groove formed in the frame, may be provided in lieu of head and jamb seals specified in Section 08 71 00 DOOR HARDWARE. Insert gasket in groove after frame is finish painted. Air leakage of weatherstripped doors shall not exceed 1.25 cubic feet per minute of air per square foot of door area when tested in accordance with ASTM E283.

2.7 HARDWARE PREPARATION

Provide minimum hardware reinforcing gages as specified in SDI/DOOR A250.6. Drill and tap doors and frames to receive finish hardware. Prepare doors and frames for hardware in accordance with the applicable requirements of SDI/DOOR A250.8 and SDI/DOOR A250.6. For additional requirements refer to ANSI/BHMA A156.115. Drill and tap for surface-applied hardware at the project site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of SDI/DOOR A250.8, as applicable. Punch door frames, with the exception of frames that will have weatherstripping or lightproof or soundproof gasketing, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and one silencer for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.8 FINISHES

2.8.1 Factory-Primed Finish

All surfaces of doors and frames shall be thoroughly cleaned, chemically treated and factory primed with a rust inhibiting coating as specified in SDI/DOOR A250.8, or paintable A25 galvannealed steel without primer. Where coating is removed by welding, apply touchup of factory primer.

2.8.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate scheduled doors and frames from hot dipped zinc coated steel, alloyed type, that complies with ASTM A924/A924Mand ASTM A653/A653M. The coating weight shall meet or exceed the minimum requirements for coatings having 0.4 ounces per square foot, total both sides, i.e., A40. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Thoroughly clean and chemically treat to insure maximum paint adhesion. Factory prime as specified in SDI/DOOR A250.8.

2.8.3 Electrolytic Zinc-Coated Anchors and Accessories

Provide electrolytically deposited zinc-coated steel in accordance with ASTM A879/A879M, Commercial Quality, Coating Class A. Phosphate treat and factory prime zinc-coated surfaces as specified in SDI/DOOR A250.8.

2.9 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. Frames for use in solid plaster partitions shall be welded construction. On wraparound frames for masonry partitions, provide a throat opening 1/8 inch larger than the actual masonry thickness. Design other frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive calking compound.

2.9.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

2.10 PROVISIONS FOR GLAZING

Materials are specified in Section 08 81 00, GLAZING.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI/DOOR A250.11. Plumb, align, and brace

securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. Where frames require ceiling struts or overhead bracing, anchor frames to the struts or bracing. Backfill frames with mortar. Coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

3.1.2 Doors

Hang doors in accordance with clearances specified in SDI/DOOR A250.8. After erection and glazing, clean and adjust hardware.

3.1.3 Fire and Smoke Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80. Install fire rated smoke doors and frames in accordance with NFPA 80 and NFPA 105.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

3.4 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements are as follows:

PRODUCTS	INCH-POUND
Door thickness	1-3/4 inch
Steel channels	16 gage
Steel Sheet	23 gage
Anchor bolts	3/8 inch

-- End of Section --

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-- End of Section Table of Contents --

SECTION 08 14 00

WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for wood doors.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual Stds	AWI Quality Standards

ASTM INTERNATIONAL (ASTM)

ASTM E2074	Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies
ASTM E283	Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E90	Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI/NEMA LD 3	Standard for High-Pressure Decorative Laminates

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 252	Standard Methods of Fire Tests of Door

	Assemblies
NFPA 80	Standard for Fire Doors and Other Opening Protectives

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

WINDOW AND DOOR MANUFACTURERS ASSOCIATION (WDMA)

WDMA I.S. 1-A	Architectural Wood Flush Doors
WDMA I.S. 4	Water-Repellent Preservative Non-Pressure Treatment for Millwork
WDMA I.S. 6	Wood Stile and Rail Doors
WDMA TM-5	Split Resistance Test Method
WDMA TM-7	Cycle Slam Test Method
WDMA TM-8	Hinge Loading Test Method

UNDERWRITERS LABORATORIES (UL)

UL 10B	Fire Tests of Door Assemblies

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Doors

Submit drawings or catalog data showing each type of door unit; descriptive data of head and jamb weatherstripping with installation instructions shall be included. Drawings and data shall indicate door type and construction, sizes, thickness, methods of assembly, door louvers, and glazing.

SD-03 Product Data

Doors

Accessories

Water-resistant sealer

Sample warranty

Sound transmission class rating

Fire resistance rating

SD-04 Samples

Doors

Prior to the delivery of wood doors, submit a sample section of each type of door which shows the stile, rail, veneer, finish, and core construction.

Door finish colors

Submit a minimum of three color selection samples, minimum 3 by 5 inches in size representing wood stain for selection by the COR.

SD-06 Test Reports

Split resistance

Cycle-slam

Hinge loading resistance

Submit split resistance test report for doors tested in accordance with WDMA TM-7, cycle-slam test report for doors tested in accordance with WDMA TM-7, and hinge loading resistance test report for doors tested in accordance with WDMA TM-8.

1.4 SUSTAINABLE DESIGN CERTIFICATION

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 4 inch thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Do not store in a building under construction until concrete, masonry work, and plaster are dry. Replace defective or damaged doors with new ones.

1.6 WARRANTY

Warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

1.7 RELATED SECTIONS

Section 08 71 00 DOOR HARDWARE.

PART 2 PRODUCTS

2.1 DOORS

Provide doors of the types, sizes, and designs indicated on the drawings.

2.1.1 Flush Doors

Conform to WDMA I.S. 1-A for flush doors. Provide hollow core doors with lock blocks and 1 inch minimum thickness hinge stile. Hardwood stile edge bands of doors receives a natural finish, compatible with face veneer. Provide mill option for stile edge of doors scheduled to be painted. No visible finger joints will be accepted in stile edge bands. When used, locate finger-joints under hardware.

2.1.1.1 Interior Flush Doors

Provide agrifiber core, Type II flush doors conforming to WDMA I.S. 1-A with faces of premium grade natural birch. Hardwood veneers shall be plain sliced.

2.1.2 Acoustical Doors

WDMA I.S. 1-A, solid core, constructed to provide Sound Transmission Class rating as indicated on the door schedule, when tested in accordance with ASTM E90.

2.1.3 Composite Type Fire Doors

Provide doors specified or indicated to have a fire resistance rating conforming to the requirements of UL 10B, ASTM E2074, or NFPA 252 for the class of door indicated. Affix a permanent metal label with raised or incised markings indicting testing agency's name and approved hourly fire rating to hinged edge of each door.

2.1.4 Door Frames

a. Door frames for flush doors - steel channel frames, size as indicated, hot-dop galvanized Z275 after fabrication, furnished as part of door assembly by door manufacturer.

b. Frames for fire rated doors - rated and labeled as required for door.

c. Frames plumb and straight, with joints continuous welded and ground smooth. Provide a continuous steel bar stop, 0.75 inch x 0.75 inch, welded to frame; hinge pintles and latch keepers welded to jambs in factory; holes for other hardware items drilled and tapped in factory.

2.2 ACCESSORIES

2.2.1 Door Light Openings

Provide glazed openings with the manufacturer's standard steel frame. Provide moldings for doors to receive natural finish of the same wood species and color as the wood face veneers.

2.2.2 Additional Hardware Reinforcement

Provide the minimum lock blocks to secure the specified hardware. The measurement of top, bottom, and intermediate rail blocks are a minimum 5 inches by full core width. Comply with the manufacturer's labeling requirements for reinforcement blocking, but not mineral material similar to the core.

2.3 FABRICATION

2.3.1 Marking

Stamp each door with a brand, stamp, or other identifying mark indicating quality and construction of the door.

2.3.2 Quality and Construction

Identify the standard on which the construction of the door was based and identify doors having a Type I glue bond.

2.3.3 Preservative Treatment

Treat doors scheduled for restrooms, janitor closets and other possible wet locations including exterior doors with a water-repellent preservative treatment and so marketed at the manufacturer's plant in accordance with WDMA I.S. 4.

2.3.4 Adhesives and Bonds

WDMA I.S. 1-A. Use Type II bond for interior doors. Provide a nonstaining adhesive on doors with a natural finish.

2.3.5 Prefitting

Provide factory prefinished and factory prefitted doors for the specified hardware, door frame and door-swing indicated. Machine and size doors at the factory by the door manufacturer in accordance with the standards under which the doors are produced and manufactured. The work includes sizing, beveling edges, mortising, and drilling for hardware and providing necessary beaded openings for glass and louvers. Provide the door manufacturer with the necessary hardware samples, and frame and hardware schedules to coordinate the work.

2.3.6 Finishes

2.3.6.1 Field Painting

Factory prime or seal doors and field painting by others.

2.3.6.2 Factory Finish

Provide doors finished at the factory by the door manufacturer as follows: AWI Qual Stds Section 1500, specification for System No. 4 Conversion varnish alkyd urea or System No. 5 Vinyl catalyzed. The coating is AWI Qual Stds premium, medium rubbed sheen, open grain effect. Use stain when required to produce the finish specified for color. Seal edges, cutouts, trim, and wood accessories, and apply two coats of finish compatible with the door face finish. Touch-up finishes that are scratched or marred, or where exposed fastener holes are filled, in accordance with the door manufacturer's instructions. Match color and sheen of factory finish using materials compatible for field application.

2.3.6.3 Color

Provide door finish colors as indicated or as selected by the COR from the color selection samples.

2.3.7 Water-Resistant Sealer

Provide manufacturer's standard water-resistant sealer compatible with the specified finish.

2.4 SOURCE QUALITY CONTROL

Meet or exceed the following minimum performance criteria of stiles of "B" and "C" label fire doors utilizing standard mortise leaf hinges:

a. Cycle-slam: 200,000 cycles with no loose hinge screws or other visible signs of failure when tested in accordance with the requirements of WDMA TM-7.

b. Hinge loading resistance: Averages of ten test samples not less than 700 pounds load when tested for direct screw withdrawal in accordance with WDMA TM-8 using a No. 12, 1-1/4 inch long, steel, fully threaded wood screw. Drill 5/32 inch pilot hole, use 1-1/2 inch opening around screw for bearing surface, and engage screw full, except for last 1/8 inch. Do not use a steel plate to reinforce screw area.

PART 3 EXECUTION

3.1 INSTALLATION

Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with a 1/16 inch minimum, 1/8 inch maximum clearance at sides and top, and a 3/16 inch minimum, 1/4 inch maximum clearance over thresholds. Provide 3/8 inch minimum, 7/16 inch maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 1/8 inch in 2 inch. Door warp shall not exceed 1/4 inch when measured in accordance with WDMA I.S. 1-A.

3.1.1 Fire Doors

Install fire doors in accordance with NFPA 80. Install smoke doors in accordance with NFPA 105. Do not paint over labels.

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SECTION 08 51 13

ALUMINUM WINDOWS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for R, LC, CW and aW performance class aluminum windows.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 1302.5	Voluntary Specifications for Forced-Entry Resistant Aluminum Prime Windows
AAMA 1503	Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections
AAMA 2603	Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
AAMA 2604	Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
AAMA 2605	Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels
AAMA 611	Voluntary Specification for Anodized Architectural Aluminum
AAMA 701/702	Voluntary Specification for Pile Weatherstripping and Replaceable

	Fenestration Weatherseals
AAMA 902	Voluntary Specification for Sash Balances
AAMA WSG.1	Window Selection Guide
AAMA/WDMA/CSA 101/I.S.2/A440	North American Fenestration Standard/ Specification for Windows, Doors, and Skylights

ASTM INTERNATIONAL (ASTM)

ASTM A276	Standard Specification for Stainless Steel Bars and Shapes
ASTM D 1972	Standard Practice for Generic Marking of Plastic Products
ASTM E 1300	Determining Load Resistance of Glass in Buildings
ASTM E 2129	Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM F 1642	Standard Test Method for Glazing and Glazing Systems Subject to Airblast Loadings
ASTM F 2248	Standard Practice for Specifying an Equivalent 3-Second Duration Design Loading for Blast Resistant Glazing Fabricated with Laminated Glass

GREEN SEAL (GS)

GS-36	Commercial Adhesives

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	Procedure for Determining Fenestration Product U-Factors
NFRC 200	Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	Life Safety Code

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	Adhesive and Sealant Applications

1.3 CERTIFICATION

Each prime window unit must bear the AAMA Label warranting that the product complies with AAMA/WDMA/CSA 101/I.S.2/A440. Certified test reports

attesting that the prime window units meet the requirements of AAMA/WDMA/CSA 101/I.S.2/A440, including test size, will be acceptable in lieu of product labeling.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Windows

Fabrication Drawings

SD-03 Product Data

Windows

Hardware

Fasteners

Window performance

Screens

Weatherstripping

Accessories

Adhesives

Submit manufacturer's product data, indicating VOC content.

Thermal performance

Submit documentation for Energy Star qualifications.

SD-04 Samples

Finish Sample

Window Sample

SD-05 Design Data

Structural calculations for deflection

SD-06 Test Reports

Minimum condensation resistance factor

SD-10 Operation and Maintenance Data

Windows, Data Package 1

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

Plastic Identification

When not labeled, identify types in Operation and Maintenance Manual.

1.5 QUALITY ASSURANCE

1.5.1 Shop Drawing Requirements

Provide drawings that indicate elevations of windows, full-size sections, thickness and gages of metal, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, method of glazing, details of operating hardware, mullion details, method and materials for weatherstripping, method of attaching screens, material and method of attaching subframes, stools, casings, sills, trim, installation details, and other related items.

1.5.2 Sample Requirements

1.5.2.1 Finish Sample Requirements

Submit color chart of standard factory color coatings when factory-finish color coating is to be provided.

1.5.2.2 Window Sample Requirements

Submit one full-size corner of each window type proposed for use. Where screens or weatherstripping is required, fit sample with such items that are to be used.

1.5.3 Design Data Requirements

Submit calculations to substantiate compliance with deflection requirements. A registered Professional Engineer must provide calculations.

Calculations verifying the structural performance of each window proposed for use, under the given loads, must be prepared and signed by a registered professional engineer. Reflect the window components and anchorage devices to the structure, as determined by the design analysis, in the shop drawings.

1.5.4 Test Report Requirements

Submit test reports for each type of window attesting that identical windows have been tested and meet the requirements specified herein for conformance to AAMA/WDMA/CSA 101/I.S.2/A440 including test size, and minimum condensation resistance factor (CRF).

1.6 DELIVERY AND STORAGE

Deliver windows to project site in an undamaged condition. Use care in handling and hoisting windows during transportation and at the jobsite. Store windows and components out of contact with the ground, under a weathertight covering, so as to prevent bending, warping, or otherwise damaging the windows. Repair damaged windows to an "as new" condition as approved. If windows can not be repaired, provide a new unit.

1.7 PROTECTION

Protect finished surfaces during shipping and handling using the manufacturer's standard method. Do not apply coatings or lacquers to surfaces to which calking and glazing compounds must adhere.

1.8 SUSTAINABLE DESIGN REQUIREMENTS

1.8.1 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: aluminum windows.

1.8.2 Plastic Identification

Verify that plastic products to be incorporated into the project are labeled in accordance with ASTM D 1972. Where products are not labeled, provide product data indicating polymeric information in the Operation and Maintenance Manual.

a. Type 1: Polyethylene Terephthalate (PET, PETE).

b. Type 2: High Density Polyethylene (HDPE).

c. Type 3: Vinyl (Polyvinyl Chloride or PVC).

d. Type 4: Low Density Polyethylene (LDPE).

e. Type 5: Polypropylene (PP).

f. Type 6: Polystyrene (PS).

g. Type 7: Other. Use of this code indicates that the package in question is made with a resin other than the six listed above, or is made of more than one resin listed above, and used in a multi-layer combination.

1.9 FIELD MEASUREMENTS

Take field measurements prior to preparation of the drawings and fabrication.

1.10 PERFORMANCE REQUIREMENTS

1.10.1 Wind Loading Design Pressure

Design window components, including mullions, hardware, and anchors, to withstand a wind-loading design pressure of at least 20 pounds per square foot (psf).

1.10.2 Tests

Test windows proposed for use in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 for the particular type and quality window specified.

Perform tests by a nationally recognized independent testing laboratory equipped and capable of performing the required tests. Submit the results of the tests as certified laboratory reports required herein.

Minimum design load for a uniform-load structural test must be 50 psf.

1.11 DRAWINGS

Submit the Fabrication Drawings for aluminum window units showing complete window assembly including hardware, weatherstripping, and subframe assembly details.

1.12 WINDOW PERFORMANCE

Aluminum windows must meet the following performance requirements. Perform testing requirements by an independent testing laboratory or agency.

1.12.1 Structural Performance

Structural test pressures on window units must be for positive load (inward) and negative load (outward). After testing, there will be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage which could cause window to be inoperable. There must be no permanent deformation of any main frame, sash or ventilator member in excess of the requirements established by AAMA/WDMA/CSA 101/I.S.2/A440 for the window types and classification specified in this section.

1.12.2 Air Infiltration

Air infiltration must not exceed the amount established by AAMA/WDMA/CSA 101/I.S.2/A440 for each window type.

1.12.3 Water Penetration

Water penetration must not exceed the amount established by AAMA/WDMA/CSA 101/I.S.2/A440 for each window type.

1.12.4 Thermal Performance

Non-residential aluminum windows (including frames and glass) shall be certified by the National Fenestration Rating Council with a whole-window Solar Heat Gain Coefficient (SHGC) maximum of 0.30 determined according to NFRC 200 procedures and a U-factor maximum of 0.35 Btu/hr-ft^2-F in accordance with NFRC 100.

1.12.5 Life Safety Criteria

Provide windows that conform to NFPA 101 Life Safety Code when rescue and/or second means of escape are indicated.

1.13 QUALIFICATION

Window manufacturer must specialize in designing and manufacturing the type of aluminum windows specified in this section, and have a minimum of 10 years of documented successful experience. Manufacturer must have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

1.14 WARRANTY

Provide Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 WINDOWS

Provide prime windows that comply with AAMA/WDMA/CSA 101/I.S.2/A440 and the requirements specified herein. In addition to compliance with AAMA/WDMA/CSA 101/I.S.2/A440, window framing members for each individual light of glass must not deflect to the extent that deflection perpendicular to the glass light exceeds L/175 of the glass edge length when subjected to uniform loads at specified design pressures. Provide Structural calculations for deflection to substantiate compliance with deflection requirements. Provide windows of types, performance classes, performance grades, combinations, and sizes indicated or specified. Design windows to accommodate hardware, glass, weatherstripping, screens, and accessories to be furnished. Each window must be a complete factory assembled unit with or without glass installed. Dimensions shown are minimum. Provide windows with insulating glass and thermal break necessary to achieve a minimum Condensation Resistance Factor (CRF) of 50 when tested in accordance with AAMA 1503.

2.1.1 Awning Windows (AP)

Type AP-LC25. Conceal operating mechanism within the frame members or enclose within a metal casing not less than 0.0625 inch thick sheet aluminum.

2.1.2 Horizontal Sliding Windows (HS)

Type HS LC25.

2.1.3 Fixed Windows (F)

Type F-LC25.

2.1.4 Glass and Glazing

Materials are specified in Section 08 81 00 GLAZING.

2.1.5 Calking and Sealing

Are specified in Section 07 92 00 JOINT SEALANTS.

2.1.6 Weatherstripping

AAMA/WDMA/CSA 101/I.S.2/A440.

2.1.7 Sash Poles

Seamless aluminum tube, 0.0625 inch minimum wall thickness, one inch diameter, 6 feet long, with cast aluminum hook and protective cover or tip on the lower end. Finish must match windows.

2.2 FABRICATION

Fabrication of window units must comply with AAMA/WDMA/CSA 101/I.S.2/A440.

2.2.1 Provisions for Glazing

Design windows and rabbets suitable for glass thickness shown or specified.

Design sash for inside double glazing and for securing glass with metal beads, glazing channels, or glazing compound.

2.2.2 Weatherstripping

Provide for ventilating sections of all windows to ensure a weather-tight seal meeting the infiltration requirements specified in AAMA/WDMA/CSA 101/I.S.2/A440. Provide easily replaceable factory-applied weatherstripping. Use molded vinyl, molded or molded-expanded neoprene or molded or expanded Ethylene Propylene Diene Terpolymer (EPDM) compression-type weatherstripping for compression contact surfaces. Use treated woven pile or wool, or polypropylene or nylon pile bonded to nylon fabric and metal or plastic backing strip weatherstripping for sliding surfaces. Do no use neoprene or polyvinylchloride weatherstripping where they will be exposed to direct sunlight.

2.2.3 Fasteners

Fabricated from 100 percent re-melted steel. Use fasteners as standard with the window manufacturer for windows, trim, and accessories. Self-tapping sheet-metal screws are not acceptable for material more than 1/16 inch thick.

2.2.4 Adhesives

Comply with applicable regulations regarding toxic and hazardous materials, GS-36, SCAQMD Rule 1168, and as specified in Section 07 92 00 JOINT SEALANTS.

2.2.5 Drips and Weep Holes

Provide continuous drips over heads of top ventilators. Where fixed windows adjoin ventilators, drips must be continuous across tops of fixed windows. Provide drips and weep holes as required to return water to the outside.

2.2.6 Combination Windows

Windows used in combination must be the same class and grade and will be factory assembled. Where factory assembly of individual windows into larger units is limited by transportation considerations, prefabricate, match mark, transport, and field assemble.

2.2.7 Mullions and Transom Bars

Provide mullions between multiple window units to resist two times (2X) glazing resistance in accordance with ASTM F 2248 and ASTM E 1300. Provide mullions with a thermal break. Secure mullions and transom bars to adjoining construction and window units in such a manner as to permit expansion and contraction and to form a weathertight joint. Provide mullion covers on the interior and exterior to completely close exposed joints and recesses between window units and to present a neat appearance. Provide special covers over structural support at mullions as indicated.

2.2.8 Accessories

Provide windows complete with necessary hardware, fastenings, clips, fins, anchors, glazing beads, and other appurtenances necessary for complete installation and proper operation.

2.2.8.1 Hardware

AAMA/WDMA/CSA 101/I.S.2/A440. The item, type, and functional characteristics must be the manufacturer's standard for the particular window type. Provide hardware of suitable design and of sufficient strength to perform the function for which it is used. Equip all operating ventilators with a lock or latching device which can be secured from the inside.

2.2.8.2 Fasteners

Provide concealed anchors of the type recommended by the window manufacturer for the specific type of construction. Anchors and fasteners must be compatible with the window and the adjoining construction. Provide a minimum of three anchors for each jamb located approximately 6 inches from each end and at midpoint.

2.2.8.3 Window Anchors

Anchoring devices for installing windows must be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA/WDMA/CSA 101/I.S.2/A440.

2.2.9 Finishes

Exposed aluminum surfaces must be factory finished with an anodic coating. Color must be as indicated. All windows will have the same finish.

2.2.9.1 Anodic Coating

Clean exposed aluminum surfaces and provide an anodized finish conforming to AA DAF-45 and AAMA 611. Finish must be:

a. Architectural Class I (0.7 mil or thicker), designation AA-M10-C22-A44, electrolytically deposited color anodized.

2.2.10 Screens

AAMA/WDMA/CSA 101/I.S.2/A440. Provide one insect screen for each operable exterior sash or ventilator. Design screens to be rewirable, easily removable from inside the building, and to permit easy access to operating hardware.

2.3 SPECIAL OPERATORS

For windows having operating hardware or locking or latching devices located more than 6 feet above the floor, provide suitably designed operators or locking or latching devices necessary for convenient and proper window operation.

2.3.1 Pole Operators

Poles must be of proper length to permit window operation from 5 feet above the floor. Provide one pole operator for each room, and one pole hanger for each pole. Locate hangers where directed.

2.3.2 Extension Crank Operators

Provide removable handles for crank-operated rotary-type operators located more than 6 feet above the floor. Provide one removable handle for each room.

2.4 THERMAL-BARRIER WINDOWS

Provide thermal-barrier windows, complete with accessories and fittings, where indicated.

Specify material and construction except as follows:

a. Aluminum alloy must be 6063-T6.

b. Frame construction, including operable sash, must be factory-assembled and factory-sealed inner and outer aluminum completely separated from metal-to-metal contact. Join assembly by a continuous, concealed, low conductance divider housed in an interlocking extrusion of the inner frame. Metal fasteners, straps, or anchors will not bridge the connection between the inner and outer frame.

c. Operating hardware for each sash must consist of spring-loaded nylon cushion blocks and pin locks designed to lock in predetermined locations.

d. Sash must be completely separated from metal-to-metal contact by means of woven-pile weatherstripping, plastic, or elastomeric separation members.

e. Operating and storm sash will be factory-glazed with the type of glass indicated and of the quality specified in Section 08 81 00 GLAZING.

2.5 MULLIONS

Provide mullions between multiple-window units where indicated.

Mullions and mullion covers must be the profile indicated, reinforced as required for the specified wind loading, and securely anchored to the adjoining construction. Mullion extrusion will include serrations or pockets to receive weatherstripping, sealant, or tape at the point of contact with each window flange.

Mullion assembly must include aluminum window clamps or brackets screwed or bolted to the mullion and the mullion cover.

Mullion cover must be screw-fastened to the mullion unless otherwise indicated.

Mullion reinforcing members shall be fabricated of the materials specified in AAMA/WDMA/CSA 101/I.S.2/A440 and meet the specified design loading.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Method of Installation

Install in accordance with the window manufacturer's printed instructions

and details. Build in windows as the work progresses or install without forcing into prepared window openings. Set windows at proper elevation, location, and reveal; plumb, square, level, and in alignment; and brace, strut, and stay properly to prevent distortion and misalignment. Protect ventilators and operating parts against accumulation of dirt and building materials by keeping ventilators tightly closed and locked to frame. Bed screws or bolts in sill members, joints at mullions, contacts of windows with sills, built-in fins, and subframes in mastic sealant of a type recommended by the window manufacturer. Install and caulk windows in a manner that will prevent entrance of water and wind. Fasten insect screens securely in place.

3.1.2 Dissimilar Materials

Where aluminum surfaces are in contact with, or fastened to masonry, concrete, wood, or dissimilar metals, except stainless steel or zinc, protect the aluminum surface from dissimilar materials as recommended in the Appendix to AAMA/WDMA/CSA 101/I.S.2/A440. Do not coat surfaces in contact with sealants after installation with any type of protective material.

3.1.3 Anchors and Fastenings

Make provision for securing units to each other, to masonry, and to other adjoining construction. Windows installed in masonry walls must have head and jamb members designed to recess into masonry wall not less than 7/16 inch.

3.1.4 Adjustments After Installation

After installation of windows and completion of glazing and field painting, adjust all ventilators and hardware to operate smoothly and to provide weathertight sealing when ventilators are closed and locked. Lubricate hardware and operating parts as necessary. Verify that products are properly installed, connected, and adjusted.

3.2 CLEANING

Clean interior and exterior surfaces of window units of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance, to prevent fouling of weathering surfaces and weather-stripping, and to prevent interference with the operation of hardware. Replace all stained, discolored, or abraded windows that cannot be restored to their original condition with new windows.

3.3 WASTE MANAGEMENT

Separate corrugated cardboard and protective materials in accordance with the Waste Management Plan and place in designated areas for reuse or recycling. Place materials defined as hazardous or toxic waste in designated containers. Close and seal tightly all partly used sealant containers and store protected in well ventilated fire-safe area at moderate temperature. Place used sealant tubes and containers in areas designated for hazardous materials.

-- End of Section --

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SECTION 08 51 23

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-- End of Section Table of Contents --

SECTION 08 51 23

STEEL WINDOWS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for stndard steel windows.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASME INTERNATIONAL (ASME)

ASME A39.1	Safety Requirements for Window Cleaning
ASME B18.6.3	Machine Screws and Machine Screw Nuts
ASME B18.6.4	Thread Forming and Threaded Cutting Tapping Screws and Metallic Drive Screws (Inch Series)

ASTM INTERNATIONAL (ASTM)

ASTM A1011/A1011M	Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability and Ultra-High Strength
ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM D 3656	Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns

ASTM E 2129	Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 283	Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330	Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
ASTM E 331	Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	Procedure for Determining Fenestration Product U-Factors
NFRC 200	Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	Life Safety Code
NFPA 80	Standard for Fire Doors and Other Opening Protectives

STEEL WINDOW INSTITUTE (SWI)

SWI SWS	Steel Window Specifications

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	Energy Star Energy Efficiency Labeling System

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Windows

Indicate elevations of windows, full-size sections, thicknesses and gages of metal, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, method of glazing, details of operating hardware, mullion details, method and materials for weatherstripping, method of attachment of screens, metal subframes, stools, casings, sills, trim, other related items, and installation details.

SD-03 Product Data

Hardware

Accessories

Operators

Screens

Environmental Data

SD-04 Samples

Color coating

Submit chart of manufacturer's color coatings if factory finish is to be provided in lieu of field painting.

SD-06 Test Reports

Air infiltration

Water infiltration

Mullion and transom bar wind load

SD-10 Operation and Maintenance Data

Windows, Data Package 1

Submit in accordance with the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

1.4 TEST REPORT REQUIREMENTS

1.4.1 Air and Water Infiltration

ASTM E 283 and ASTM E 331. Do not exceed maximum air infiltration of one-half cubic foot per minute per foot of crack length when subjected to a static pressure of 1.56 pounds per square foot (equivalent to a wind velocity of 25 miles per hour (mph)). Water infiltration shall be "zero."

1.4.2 Mullion and Transom Bar Wind Load Tests

ASTM E 330. Members shall withstand a uniform wind load of 20 pounds per square foot of window area without deflecting more than 1/175 of the span.

1.5 DELIVERY AND STORAGE

Deliver to project site in undamaged condition. Store windows and components on edge, out of contact with the ground, under weathertight covering, and arranged to avoid bending, warping, or other damage.

1.6 SUSTAINABLE DESIGN REQUIREMENTS

1.6.1 Environmental Data

Submit Table 1 of ASTM E 2129 for the following products: steel windows.

PART 2 PRODUCTS

2.1 MATERIALS

Metal materials listed below shall contain a minimum of 10 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content. Metal materials may contain post-consumer or post-industrial recycled content.

Non-residential glazed systems (including frames and glass) shall be certified by the National Fenestration Rating Council with a whole-window Solar Heat Gain Coefficient (SHGC) maximum of 0.30 determined according to NFRC 200 procedures and a U-factor maximum of 0.35 Btu per square foot by hr by degree F in accordance with NFRC 100.

2.1.1 Steel Bars

SWI SWS.

2.1.2 Sheet Steel

ASTM A1011/A1011M.

2.1.3 Zinc-Coated Sheet Steel

ASTM A653/A653M.

2.1.4 Zinc Coating

ASTM A123/A123M.

2.1.5 Corrosion Resisting Sheet Steel

ASTM A167.

2.1.6 Screws and Bolts

ASME B18.6.3 or ASME B18.6.4 as applicable.

2.2 FABRICATION OF WINDOWS

Form permanent joints by welding as specified for each type window. Weld joints solid, remove excess metal, and dress smooth on exposed and contact surfaces. Assemble frames and sash, including ventilators and thermal breaks, at the plant and ship as a unit with hardware unattached. Provide the following construction:

a. Where fixed window sections adjoin ventilator sections, provide fixed sash, fabricated from similar frame members, and of manufacturer's standard type suitable for the purpose.

b. Roll weathering surfaces integrally to provide two-point parallel-surface contact with overlap at both inside and outside points

of closure.

c. Provide drips and weep holes as required to return water to outside.

d. Design glazed windows and rabbets suitable for glass thickness shown on drawings, or specified.

e. Use flathead, cross recessed type, exposed head screws and bolts with standard threads on windows, trim and accessories. Screw heads shall finish flush with adjoining surfaces. Self tapping sheet-metal screws are not acceptable.

f. For hot-dipped galvanized windows, use stainless steel or hot-spun galvanized steel fasteners. For windows with painted finish use cadmium plated or electro-galvanized fasteners. Finish exposed heads to match finish of windows.

2.3 FIRE RATED WINDOWS

Provide sash and frame with necessary hardware to conform to the requirements of Underwriters Laboratories Inc. (UL), for class of window indicated. Submit proof of conformance. UL label will be accepted as proof. Labeled window details take precedence over details indicated or specified for nonlabeled windows, except when sections required for nonlabeled windows are heavier than those required by UL. In lieu of UL label, written certification by approved nationally recognized testing agency may be submitted. Certification must state that complete window unit of type provided has been tested and conforms to published standards, including methods of tests, of UL.

2.4 PROVISIONS FOR GLAZING

Design sash for inside glazing and for securing glass with metal beads and glazing compound. Where insulating glass is indicated, use rabbets of adequate weight and depth to receive and properly support glass and glazing accessories.

2.5 MULLIONS AND TRANSOM BARS

Provide mullions between multiple window units designed to withstand specified wind load requirements. Provide mullions with a thermal break. Secure mullions and transom bars to adjoining construction and window units in such a manner as to permit expansion and contraction and to form weathertight joint. Provide mullion covers of manufacturer's stock design on the interior and exterior to completely cover exposed joints and recesses between window units and for neat appearance. Provide special covers over structural supports at mullions as indicated.

2.6 METAL-TO-METAL JOINTS

Set in mastic, using type recommended by window manufacturer to provide weathertight joints. Remove excess mastic before it hardens.

2.7 ACCESSORIES

Provide windows with hardware, clips, fins, anchors, glazing beads, and fastenings, necessary for complete installation and operation of ventilators.

2.7.1 Anchors

Use hot-dip galvanized steel anchors. Secure anchors and fastenings to heads, jambs, and sills of openings, and fasten securely to windows or frames. Use anchors recommended by window manufacturer for specific type of construction and conceal. Anchor each frame at jambs with minimum of three adjustable steel anchors. For anchorage at concrete walls and prepared openings, equip frames with manufacturer's standard bent-clips located approximately 6 inches from each end and at midpoint.

2.7.2 Weatherstripping

Provide on all operable windows so that, when tested before leaving factory, in accordance with ASTM E 283, do not exceed a maximum air infiltration of one half cubic foot per minute per foot of crack length when subjected to static pressure of 1.56 pounds per square foot equivalent to wind velocity of 25 mph.

2.7.3 Hardware

Equip all operable sash with latching device which can be secured from inside. The item, type, and function of hardware required is specified under individual window type. Attach hardware securely to windows with corrosion resisting bolts or machine screws; do not use sheet metal screws. At fixed screens, adapt hardware to permit operation of ventilators. Fit and test hardware for each window at factory to ensure satisfactory operation and security.

2.7.3.1 Material and Finish

Provide non-magnetic type stainless steel exposed hardware with satin finish; white bronze with satin finish; yellow bronze with dull (oxidized) finish. Use steel or malleable iron hinges, with nonferrous pins, or with steel pins and non-ferrous bushings or washers.

2.7.4 Fasteners

Prime exposed heads of coated or plated fasteners and finish to match adjacent material.

2.7.5 Metal Sub-frames and Stools

Manufacturer's standard type designed to suit the particular window. Match exposed surfaces to windows.

2.8 WINDOW FINISH

2.8.1 Shop Primed Finish

After fabrication, clean all surfaces of windows, fins, mullions, cover plates, and screen frames and provide a hot-dip galvanized, phosphate-treated and shop primed finish. Conform to SWI SWS for the methods of cleaning, chemical treatment, galvanizing, and painting.

2.8.2 Factory Finish

In lieu of shop primed finish, factory finish may be provided using the following method, in which case finish field painting will not be required:

a. Chemically clean and bonderize windows. Apply dip coat of epoxy primer baked on for not less than 15 minutes at not less than 300 degrees F, followed by finish coat of alkyd-amine enamel of not less than one mil thickness, baked on for 15 minutes at not less than 300 degrees F.

b. Finish color coating to be selected from manufacturer's standard color chart.

c. Touch up abraded surfaces with enamel as specified for factory finish.

2.9 WINDOW TYPES

Conform to SWI SWS. Provide combinations, types and sizes indicated. Each window shall consist of a unit including subframe, frame, sash, hardware, mullions, trim, casing, insect screen, and anchors. Design windows indicated to have screen to accommodate items to be furnished.

2.9.1 Awning Windows

Provide compression-type weatherstripping. Heavy Intermediate materials in group of top-hinged or projected out-swinging ventilators:

2.9.1.1 Operators

Control shall be simultaneous by means of cam-type lever handle fastener for hand push-pull operation. For windows with screens, provide with underscreen push bar operators. For operators more than 6 feet above floor, provide with hardware designed for pole operation.

2.9.1.2 Ventilators

Support on two hinges and two arms, or on two steel slide arms pivoted to vent and to principal frame member. Provide bronze-brushed pivots and hinges with bronze pins. Design ventilators to close and weather on each other, or on independent meeting rails assembled as part of window frame. Provide for positive adjustment of individual vents to ensure positive contact between sash and frame when closed.

2.9.2 Fixed Windows

Standard Intermediate windows.

2.9.3 Security Windows

SWI SWS. Provide ventilators with manufacturer's standard hardware of iron, steel or zinc. Equip ventilators having locking rails more than 6 feet above floor with hardware designed for pole operation.

2.10 SCREENS

Provide one insect screen for each operable exterior sash or ventilator. Locate screen units either inside or outside, depending upon window type and method of operation. Design screens to fit closely around entire perimeter of ventilator or opening, to be rewirable, easily removable from inside building, and interchangeable for same size ventilators of similar type windows, with minimum of exposed fasteners and latches. Provide all guides, stops, clips, bolts, and screws, as necessary, for a secure and insect-tight attachment to window. Where wickets are necessary, use sliding or hinged type, with friction catches, framed and trimmed for

durability and tight fit. Provide wicket opening frames of similar material and cross-section as screen frames. Provide continuous framing bar between the two sides of screen frames.

2.10.1 Construction

Provide screen frames of steel with finish matching that of windows. Equip frames with removable splines of steel or vinyl. Form groove in frame for holding screen cloth in place with noncylindrical splines. Make spline and groove assembly so that cloth cannot be removed from groove by pressure on cloth. Make splines of such size and shape that rotation of spline in groove will be prevented and spline will tightly hold cloth in place.

2.10.2 Insect Screening

ASTM D 3656, Class 2, 18 by 14 mesh, color charcoal. Install with weave parallel to frames. Stretch tight for smooth appearance. Conceal edges in spline channels.

2.11 SPECIAL OPERATORS

2.11.1 Pole Operators

Provide for windows having operating hardware or locking rails more than 6 feet above floor. Provide window manufacturer's standard pole design of length to provide operation from 5 feet above floor, and with push-pull hooks of proper shape and length. Provide one pole operator for each room, and one pole hanger for each pole in location as directed.

PART 3 EXECUTION

3.1 INSTALLATION

Install in accordance with window manufacturer's printed instructions and details. Install fire rated windows in accordance with NFPA 80 and NFPA 101. Build in windows as work progresses or install without forcing into prepared window openings. Set at proper elevation, location, and reveal; plumb, square, level, and in alignment. Brace and stay to prevent distortion and misalignment. Protect ventilators and operating parts against dirt and building materials by keeping closed and locked to frame. Bed screws or bolts in sill members, joints at mullions, contacts of windows with sills, built-in fins, and subframes in mastic sealant recommended by window manufacturer. Install and seal windows in a manner that will prevent entrance of water and wind. Fasten insect screens securely in place.

3.2 ANCHORS AND FASTENINGS

Make provision for securing units to each other and to adjoining construction. Design head and jamb members to enter into masonry not less than 7/16 inch where windows are installed in direct contact with masonry. Where windows are set in prepared masonry openings, build in anchors and fastenings to jambs of openings and fasten securely to windows or frames and to adjoining construction. Space anchors not more than 18 inches apart on jambs and sills, and install a minimum of three anchors on each side of each opening. Anchors and fastenings shall have sufficient strength to hold member firmly in position. Where type, size, or spacing of anchors is not shown or specified, use expansion or toggle bolts or screws as best suited to construction material. Provide expansion shield and bolt

assemblies of type designed to give holding power beyond tensile and shearing strength of bolt. Minimum fastener penetration shall be not less than that recommended by manufacturer for type fastener and wall material involved.

3.3 OPERATORS

Install operators before glazing. Plumb and level shaft risers and runs. Adjust ventilators for free opening and tight closing. Secure housings and adjustable supports to wall. Anchor operator parts to steel window mullions with 1/2 inch bolts. Couple individual lengths of shafting with steel rivets or bolts. Leave mechanical equipment and ventilators in proper operating condition.

3.4 WEATHERSTRIPPING

Use bronze, spring-brass, or stainless steel and secure with non-ferrous screws. Secure weatherstripping or rubbing-blocks to parting-strip and each end of meeting-rails. For solid bar stock windows, use manufacturer's standard weatherstripping inserted into groove.

3.5 ADJUSTMENTS AFTER INSTALLATION

After installation of windows and completion of glazing and field painting, adjust all ventilators and hardware to operate smoothly and to provide weathertight sealing when ventilators are closed and locked. Lubricate hardware and operating parts. Adjust weatherstripping to assure weathertight contact with frames when ventilators are closed and locked. Weatherstripping shall not cause binding of sash, or prevent closing and locking of ventilator. Verify products are properly installed, connected, and adjusted.

3.6 CLEANING

Clean interior and exterior surfaces of window units of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance and to prevent fouling of weathering surfaces and weatherstripping, or interference with operation of hardware. Clean and touch up abraded surfaces. Replace with new windows any stained, discolored, or abraded windows that cannot be restored to original condition.

3.7 WASTE MANAGEMENT

Separate protective materials and corrugated cardboard in accordance with the Waste Management Plan and place in designated areas for reuse or recycling. Place materials defined as hazardous or toxic waste in designated containers. Close and seal tightly all partly used sealant containers and store protected in well ventilated fire-safe area at moderate temperature. Place used sealant tubes and containers in areas designated for hazardous materials.

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SECTION 08 71 00

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for finish hardware for permanent structures.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM E 283	Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM F 883	Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1	Butts and Hinges
ANSI/BHMA A156.12	Interconnected Locks & Latches
ANSI/BHMA A156.13	Mortise Locks & Latches Series 1000
ANSI/BHMA A156.15	Release Devices Closer Holder, Electromagnetic and Electromechanical
ANSI/BHMA A156.16	Auxiliary Hardware
ANSI/BHMA A156.17	Self Closing Hinges & Pivots
ANSI/BHMA A156.18	Materials and Finishes
ANSI/BHMA A156.2	Bored and Preassembled Locks and Latches
ANSI/BHMA A156.21	Thresholds
ANSI/BHMA A156.22	Door Gasketing and Edge Seal Systems
ANSI/BHMA A156.3	Exit Devices

ANSI/BHMA A156.4	Door Controls - Closers
ANSI/BHMA A156.5	Auxiliary Locks and Associated Products
ANSI/BHMA A156.6	Architectural Door Trim
ANSI/BHMA A156.7	Template Hinge Dimensions
ANSI/BHMA A156.8	Door Controls - Overhead Stops and Holders

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	Life Safety Code
NFPA 80	Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8	Recommended Specifications for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	Building Materials Directory

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Hardware schedule

Keying system

SD-03 Product Data

Hardware items

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Key Bitting

1.4 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (If fire rated and listed)	BHMA Finish Designation

1.5 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the COR prior to completion of the work. Include:

a. Complete listing of all keys (AA1, AA2, etc.).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.

1.6 QUALITY ASSURANCE

1.6.1 Key Shop Drawings Coordination Meeting

Prior to the submission of the key shop drawing, the COR, Contractor, Door Hardware subcontractor, using Activity and Base Locksmith shall meet to discuss key requirements for the facility.

1.7 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the COR, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Provide hardware to be applied to metal or to prefinished doors manufactured to template. Promptly furnish template information or templates to door and frame manufacturers. Conform to ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors, as well as to other requirements indicated, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." Provide the label of Underwriters

Laboratories, Inc. for such hardware listed in UL Bld Mat Dir or labeled and listed by another testing laboratory acceptable to the COR.

2.3 ACCEPTABLE MANUFACTURERS

Acceptable manufacturers or pre-approved equal meeting or exceeding salient product features listed below, except Locksets, Latchsets, and Cylinders (Item B) shall be Best 9K only. Numbers in Hardware Schedule refer to those of the first names manufacturer below.

a. Hinges - Hager, Stanley, Lawrence, or McKinney.

b. Locksets, Latchsets, and Cylinders - Best 9K (Ames Research Center Standard).

c. Exit Devices - Von Duprin.

d. Overhead Closers -- LCN or Sargent.

e. Manual Bolts - Glynn Johnson, Builders Brass, or Ives.

f. Gasketing, Astragals, and Thresholds - Pemko, Zero, NGP.

g. Stops, Holders - Glynn Johnson, Ives, Quality.

2.4 FASTENERS

Fasteners of the proper type, size, quantity, and finish for each hardware item shall be provided. Visible fasteners shall be Phillips-head, bronze or stainless steel finished to match specified hardware.

2.5 HINGES

Hinges shall be full mortise, heavy weight, ball bearing, button tip, template type conforming to ANSI A156.1, Grade 1. Size shall be 4.5 inches x 4.5 inches.

2.6 LOCKSETS

a. Cylinder bored locksets and latchsets shall conform to ANSI A156.2, plain design and wrought trim.

b. Cylinder bored locksets and latchsets for fire-rated doors shall be UL listed and labeled, heavy duty, Series 4000, Grade 1.

c. Heavy duty usage cylinder bored locksets and latchsets shall be Series 4000, Grade 1.

d. Locksets and latchsets shall have standardized fronts, cases, and strikes so that varying functions will be interchangeable and will require only one mortise for their installation. Locks and latches shall have beveled bronze fronts, bronze bolts and strikes, brass hubs, and cases with specified finish. Locks shall have Best cylinders conforming to ANSI A156.5, with seven-pin tumblers, steel cylindrical cases, and interior non-corrosive parts.

e. All locksets shall be furnished with "Best" 7-pin green construction cores. Temporary construction cores shall be furnished, installed, and maintained in locks during the construction and shall be left in place

and shall become the property of the Government. All excess lock parts (throw members, strikes, screws, etc.) from new locksets shall be turned over to the Government.

f. Where existing door hardware is removed, locksets and lockset cores shall be turned over to the Government.

2.7 THRESHOLDS

a. Thresholds shall be extruded bronze anodized aluminum 6063-alloy.

b. Thresholds shall be provided for the full width of the opening at exterior doors.

2.8 FLUSH BOLTS

a. Flush bolts shall be aluminum, specified finish, conforming to ANSI A156.16, with 12.008 in. lever extensions.

b. Flush bolts shall be a type listed in UL for fire-rated doors.

2.9 CLOSERS

a. Closers shall conform to ANSI A156.4, and shall be provided on emergency fire exits UL labeled, exterior doors, restrooms and general office doors, and where specified in the hardware schedule.

b. Closers shall be the surface mounted heavy duty, parallel arm type, Grade 1. Style shall be traditional or modern.

c. Brackets, reinforcing plates, and accessory fittings shall be provided as required.

2.10 ASTRAGALS

Astragals shall be prime steel, 13 ga minimum by 1.6 in. side minimum.

2.11 EXIT DEVICES

Provide exit devices as required to fulfill all requirements of NFPA 80, NFPA 100, UL and California Building Code. Provide levers and other trim compatible with other hardware, drop forged trim with solid lever handle, and cylinders of proper size and finishes for smooth operation of exit devices. All lock cylinders in exit devices shall be "Best" 7-pin mortise or rim cylinders with green construction core.

2.12 MISCELLANEOUS AND SHELF HARDWARE

a. Door Holders - Floor holder, type L11241, conforming to ANSI A156.16.

b. Door Stops

1. Door stops or bumpers conforming to ANSI A156.16 shall be provided for all doors to protect the hardware and prevent doors from striking walls and fixtures.

2. Floor mounted stops, Type L02141 (dome type) or Type L02161 (dome type for door with thresholds) shall be provided.

c. Door Silencers

1. Door silencers conforming to ANSI A156.16 shall be provided except on fire-rated door frames.

2. Door silencers shall be Type L03011 for metal frames.

3. Three silencers shall be provided for single doors. Two silencers shall be provided for each leaf of pairs of doors for installation in the head rail of the door frame.

2.13 KEYING SYSTEM

Provide an extension of the existing keying system. Existing locks were manufactured by Best 9K; do not have interchangeable cores.

2.14 LEVER HANDLES

Provide lever handles. Conform to the minimum requirements of ANSI/BHMA A156.13 for mortise locks of lever handles for exit devices. Provide lever handle locks with a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when force in excess of that specified in ANSI/BHMA A156.13 is applied to the lever handle. Provide lever handles return to within 1/2 inch of the door face.

2.15 KEYS

Furnish one file key, one duplicate key, and one working key for each key change and for each master and grand master keying system. Furnish one additional working key for each lock of each keyed-alike group. Coordinate quantity of great grand master keys, quantity of construction master keys, and quantity of control keys for removable cores with COR. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - Do no duplicate." Do not place room number on keys.

2.16 DOOR PROTECTION PLATES

ANSI/BHMA A156.6.

2.16.1 Sizes of Armor, Mop, and Kick Plates

Two inches less than door width for single doors; one inch less than door width for pairs of doors. Provide 10 inch kick plates for flush doors and 1 inch less than height of bottom rail for panel doors. Provide minimum 48 inch armor plates for flush doors and completely cover lower panels of panel doors, except 16 inch high armor plates on fire doors. Provide 6 inch mop plates.

2.17 SPECIAL TOOLS

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.18 FINISHES

Provide hardware with the following finishes conforming to ANSI A156.18:

a. Hinges, Locksets and Latchsets - Satin stainless steel, BHMA Code 630, unless otherwise indicated.

b. Hinges at Labeled Openings - Satin chromium plated on steel, BHMA Code 652.

c. Panic Hardware - Satin chrome, clear anodized, BHMA Code 626 at interior; dull bronze, BHMA Code 612 at exterior.

d. Astragals - Primed for painting, steel, BHMA Code 600.

e. Closures - Sprayed, matching locksets and latchsets.

f. Door Stops, Finish Bolts - Match locksets and latchsets.

g. Door Holders - Match new exterior hardware finish.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed installation instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

3.2 FIRE DOORS AND EXIT DOORS

Install hardware in accordance with NFPA 80 for fire doors, NFPA 101 for exit doors.

3.3 HARDWARE LOCATIONS

SDI/DOOR A250.8, unless indicated or specified otherwise.

a. Kick and Armor Plates: Push side of single-acting doors. Both sides of double-acting doors.

b. Mop Plates: Bottom flush with bottom of door.

3.4 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the COR. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the COR. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.5 HARDWARE SCHEDULE

a. Group 1 - Standard Doors (non-rated)
1.5 pr Butts 4.4 in. x 4.4 in., Hager BB1279
1 Lockset, Best 93K7AB15D626
1 Doorstop, Glynn Johnson FB19X
Silencers

b. Group 2 - Standard Double Doors (non-rated)
3 pr Butts 4.4 in. x 4.4 in., Hager BB1279
1 pr Flush bolts Glynn Johnson FB6W, DP2
1 Lockset, Best 93K7AB15D626
1 Doorstop, Glynn Johnson FH19X
Silencers

c. Group 3 - Standard Office Door (fire-rated)
1.5 pr Butts 4.4 in. x 4.4 in., Hager BB1279
1 Door closer, LCN 4011
1 Lockset, Best 93K7AB15D626
1 Doorstop, Glynn Johnson GB19X
Door seals, Pemko S88D17

d. Group 4 - Strandard Double Doors (fire-rated)
3 pr Butts 4.4 in. x 4.4 in., Hager BB1279
1 pr Flush bolts Glynn Johnson FB6W, DP2
1 Lockset, Best 93K7AB15D626
1 Door closer, LCN 4011
1 Doorstop, Glynn Johnson FH19X
Door seals, Pemko S88D20
1 Astragal, Pemko 357SP

e. Group 5 - Single Doors with Panic Hardware
1.5 pr Butts 4.4 in. x 4.4 in., Hager BB1168
1 Door closer, LCN 4011
1 Exit device, Von Duprin 98L-F
1 Door stop, Glynn Johnson FH19X
Door seals, Pemko S88D17
1 Best 1E, 7-pin, cylinder housing(s)

f. Group 6 - Double Doors with Panic Hardware
3 pr Butts 4.4 in. x 4.4 in., Hager BB1168
1 pr Door closers, LCN 4011
1 Exit device, Von Duprin 9927L
2 Door stops, Glynn Johnson FH19X
1 Astragal, Pemko 357SP
Door seals, Pemko S88D20
1 Best 1E, 7-pin, cylinder housing(s)

-- End of Section --

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SECTION 08 81 00

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SECTION 08 81 00

GLAZING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for normal glazing.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7-10	Minimum Design Loads for Buildings and Other Structures

ASTM INTERNATIONAL (ASTM)

ASTM C1036	Standard Specification for Flat Glass
ASTM C1048	Standard Specification for Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM C1172	Standard Specification for Laminated Architectural Flat Glass
ASTM C1184	Standard Specification for Structural Silicone Sealants
ASTM C509	Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C864	Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C920	Standard Specification for Elastomeric Joint Sealants

ASTM D 2287	Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM D 395	Standard Test Methods for Rubber Property - Compression Set
ASTM D 4802	Poly(Methyl Methacrylate) Acrylic Plastic Sheet
ASTM E 119	Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 1300	Determining Load Resistance of Glass in Buildings
ASTM E 2129	Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 413	Rating Sound Insulation
ASTM E 90	Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM E2226	Standard Practice for Application of Hose Stream

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual	Glazing Manual
GANA Sealant Manual	Sealant Manual
GANA Standards Manual	Tempering Division's Engineering Standards Manual

INSULATING GLASS MANUFACTURERS ALLIANCE (IGMA)

IGMA TB-3001	Guidelines for Sloped Glazing
IGMA TM-3000	Glazing Guidelines for Sealed Insulating Glass Units
IGMA TR-1200	Commercial Insulating Glass Dimensional Tolerances

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	Procedure for Determining Fenestration Product U-Factors
NFRC 200	Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 252	Standard Methods of Fire Tests of Door

	Assemblies
NFPA 257	Standard on Fire Test for Window and Glass Block Assemblies
NFPA 80	Standard for Fire Doors and Other Opening Protectives

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	Energy Star Energy Efficiency Labeling System

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1201	Safety Standard for Architectural Glazing Materials

UNDERWRITERS LABORATORIES (UL)

UL 752	Standard for Bullet-Resisting Equipment
UL MEAPD	Mechanical Equipment and Associated Products Directory (online version is listed under Certifications at www.ul.com)

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

SD-03 Product Data

Insulating Glass

Documentation for Energy Star qualifications.

Plastic Glazing

Glazing Accessories

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

Environmental Data

SD-04 Samples

Insulating Glass

Glazing Compound

Glazing Tape

Sealant

Two 8 by 10 inch samples of each of the following: tinted glass, patterned glass, heat-absorbing glass, and insulating glass units.

SD-07 Certificates

Insulating Glass

Certificates stating that the glass meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

Certificates from the manufacturer attesting that the units meet the luminous and solar radiant transmission requirements for heat absorbing glass.

SD-08 Manufacturer's Instructions

Setting and sealing materials

Glass setting

Submit glass manufacturer's recommendations for setting and sealing materials and for installation of each type of glazing material specified.

1.4 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind/snow loading in accordance with ASTM E 1300.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver products to the site in unopened containers, labeled plainly with manufacturers' names and brands. Store glass and setting materials in safe, enclosed dry locations and do not unpack until needed for installation. Handle and install materials in a manner that will protect them from damage.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not start glazing work until the outdoor temperature is above 40 degrees F and rising, unless procedures recommended by the glass manufacturer and approved by the COR are made to warm the glass and rabbet surfaces. Provide ventilation to prevent condensation of moisture on glazing work during installation. Do not perform glazing work during damp or rainy

weather.

1.7 WARRANTY

1.7.1 Warranty for Insulating Glass Units

Warranty insulating glass units against development of material obstruction to vision (such as dust, fogging, or film formation on the inner glass surfaces) caused by failure of the hermetic seal, other than through glass breakage, for a 10-year period following acceptance of the work. Provide new units for any units failing to comply with terms of this warranty within 45 working days after receipt of notice from the Government.

PART 2 PRODUCTS

2.1 GLASS

ASTM C1036, unless specified otherwise. In doors and sidelights, provide safety glazing material conforming to 16 CFR 1201.

2.1.1 Clear Glass

Type I, Class 1 (clear), Quality 83(A). Provide for glazing openings not indicated or specified otherwise. Use double-strength sheet glass or 1/8 inch float glass for openings up to and including 15 square feet, 3/16 inch for glazing openings over 15 square feet but not over 30 square feet, and 1/4 inch for glazing openings over 30 square feet but not over 45 square feet.

2.1.2 Mirrors

2.1.2.1 Glass Mirrors

Glass for mirrors shall be Type I transparent flat type, Class 1-clear, Glazing Quality q1 1/4 inch thick conforming to ASTM C1036. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint , and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.1.3 Tempered Glass

ASTM C1048, Kind FT (fully tempered), Condition A (uncoated), Type I, Class 1 (transparent), Quality q3, 1/4 inch thick, conforming to ASTM C1048 and GANA Standards Manual. Color shall be clear. Provide wherever safety glazing material is indicated or specified.

2.1.4 Fire/Safety Rated Glass

Fire/safety rated glass shall be laminated Type I transparent flat type, Class 1-clear. Glass shall have a 20, 45, or 60 minute rating when tested in accordance with ASTM E 119. Glass shall be permanently labeled with

appropriate markings. Rating of glass dependent on rating of opering. Rating of opening shall be indicated on drawings.

2.2 INSULATING GLASS UNITS

Two panes of glass separated by a dehydrated 1/2 inch airspace, filled with argon gas, and hermetically sealed. Non-residential glazed systems (including frames and glass) shall be certified by the National Fenestration Rating Council with a whole-window Solar Heat Gain Coefficient (SHGC) maximum of .30 determined according to NFRC 200 procedures and a U-factor maximum of .35 Btu/hr-ft2-F in accordance with NFRC 100. Spacer shall be black, roll-formed, thin-gauge, C-section steel, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone.

2.2.1 Buildings

The inner light shall be ASTM C1172, clear annealed flat glass Type I, Class I, Quality q3 1/4 inch thick or ASTM C1048, Grade B (fully tempered), Style I (uncoated), Type I, Class 1 (transparent), Quality q4, 1/4 inch thick where temper is indicated on the drawings. The outer light shall be 2 (tinted heat absorbing), 1/4 inch thick.

2.2.2 Low Emissivity Insulating Glass

Interior and exterior glass panes for Low-E insulating units shall be Type I annealed flat glass, Class 1-clear with anti-reflective low-emissivity coating on Quality q3 - glazing select, conforming to ASTM C1036.

2.3 SETTING AND SEALING MATERIALS

Provide as specified in the GANA Glazing Manual, IGMA TM-3000, IGMA TB-3001, and manufacturer's recommendations, unless specified otherwise herein. Do not use metal sash putty, nonskinning compounds, nonresilient preformed sealers, or impregnated preformed gaskets. Materials exposed to view and unpainted shall be gray or neutral color.

2.3.1 Putty and Glazing Compound

Glazing compound shall be as recommended by manufacturer for face-glazing metal sash. Putty shall be linseed oil type. Putty and glazing compounds shall not be used with insulating glass or laminated glass.

2.3.2 Glazing Compound

Use for face glazing metal sash. Do not use with insulating glass units or laminated glass.

2.3.3 Sealants

Provide elastomeric and structural sealants.

2.3.3.1 Elastomeric Sealant

ASTM C920, Type S, Grade NS, Class 12.5, Use G. Use for channel or stop glazing metal sash. Sealant shall be chemically compatible with setting

blocks, edge blocks, and sealing tapes, with sealants used in manufacture of insulating glass units.

2.3.3.2 Structural Sealant

ASTM C1184, Type S.

2.3.4 Joint Backer

Joint backer shall have a diameter size at least 25 percent larger than joint width; type and material as recommended in writing by glass and sealant manufacturer.

2.3.5 Preformed Channels

Neoprene, vinyl, or rubber, as recommended by the glass manufacturer for the particular condition.

2.3.6 Sealing Tapes

Preformed, semisolid, PVC-based material of proper size and compressibility for the particular condition, complying with ASTM D 2287. Use only where glazing rabbet is designed for tape and tape is recommended by the glass or sealant manufacturer. Provide spacer shims for use with compressible tapes. Tapes shall be chemically compatible with the product being set.

2.3.7 Setting Blocks and Edge Blocks

Closed-cell neoprene setting blocks shall be dense extruded type conforming to ASTM C509 and ASTM D 395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (plus or minus 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer. Block color shall be black.

2.3.8 Glazing Gaskets

Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Glazing gasket profiles shall be as indicated on drawings.

2.3.8.1 Fixed Glazing Gaskets

Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C509, Type 2, Option 1.

2.3.8.2 Wedge Glazing Gaskets

Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C864, Option 1, Shore A durometer between 65 and 75.

2.3.8.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing shall be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

2.3.9 Accessories

Provide as required for a complete installation, including glazing points, clips, shims, angles, beads, and spacer strips. Provide noncorroding metal accessories. Provide primer-sealers and cleaners as recommended by the glass and sealant manufacturers.

PART 3 EXECUTION

3.1 PREPARATION

Preparation, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Determine the sizes to provide the required edge clearances by measuring the actual opening to receive the glass. Grind smooth in the shop glass edges that will be exposed in finish work. Leave labels in place until the installation is approved, except remove applied labels on heat-absorbing glass and on insulating glass units as soon as glass is installed. Securely fix movable items or keep in a closed and locked position until glazing compound has thoroughly set.

3.2 GLASS SETTING

Shop glaze or field glaze items to be glazed using glass of the quality and thickness specified or indicated. Glazing, unless otherwise specified or approved, shall conform to applicable recommendations in the GANA Glazing Manual, GANA Sealant Manual, IGMA TB-3001, IGMA TM-3000, and manufacturer's recommendations. Aluminum windows, wood doors, and wood windows may be glazed in conformance with one of the glazing methods described in the standards under which they are produced, except that face puttying with no bedding will not be permitted. Handle and install glazing materials in accordance with manufacturer's instructions. Use beads or stops which are furnished with items to be glazed to secure the glass in place. Verify products are properly installed, connected, and adjusted.

3.2.1 Sheet Glass

Cut and set with the visible lines or waves horizontal.

3.2.2 Patterned Glass

Set glass with one patterned surface with smooth surface on the weather side. When used for interior partitions, place the patterned surface in same direction in all openings.

3.2.3 Insulating Glass Units

Do not grind, nip, or cut edges or corners of units after the units have left the factory. Springing, forcing, or twisting of units during setting will not be permitted. Handle units so as not to strike frames or other objects. Installation shall conform to applicable recommendations of IGMA TB-3001 and IGMA TM-3000.

3.3 CLEANING

Clean glass surfaces and remove labels, paint spots, putty, and other defacement as required to prevent staining. Glass shall be clean at the time the work is accepted.

3.4 PROTECTION

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Reflective glass shall be protected with a protective material to eliminate any contamination of the reflective coating. Protective material shall be placed far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Upon removal, separate protective materials for reuse or recycling. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

3.5 WASTE MANAGEMENT

Disposal and recycling of waste materials, including corrugated cardboard recycling, shall be in accordance with the Waste Management Plan. Separate float glass and reuse or recycle. Upon removal, separate protective materials and reuse or recycle. Separate tempered glass for use as aggregate or nonstructural fill. Close and seal tightly all partly used sealant containers and store protected in well-ventilated, fire-safe area at moderate temperature.

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SECTION 09 23 00

GYPSUM PLASTERING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for interior and exterior plaster work.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM C 11	Standard Terminology Relating to Gypsum and Related Building Materials and Systems
ASTM C 206	Standard Specification for Finishing Hydrated Lime
ASTM C 28/C 28M	Gypsum Plasters
ASTM C 35	Inorganic Aggregates for Use in Gypsum Plaster
ASTM C 472	Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete
ASTM C 59/C 59M	Gypsum Casting Plaster and Gypsum Molding Plaster
ASTM C 61/C 61M	Gypsum Keene's Cement
ASTM C 631	Bonding Compounds for Interior Gypsum Plastering
ASTM C 842	Application of Interior Gypsum Plaster
ASTM E 1042	Acoustically Absorptive Materials Applied by Trowel or Spray

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Certification

SD-04 Samples

Gypsum Plaster

Submit four 36 inch square panels of varying texture for the COR's approval.

Full Size Sample

SD-08 Manufacturer's Instructions

ready-mix gypsum plaster

Submit manufacturer's printed mixing instructions for ready-mix plaster.

1.4 QUALITY ASSURANCE

1.4.1 Sample Panels

Erect sample panel at the building site, or as otherwise directed. Finished gypsum plaster work must match the approved sample panel.

1.4.2 Sustainable Design Certification

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver manufactured materials in the manufacturers' original unbroken packages or containers which are labeled plainly with the manufacturers' names and brands. Keep cementitious materials dry and stored off the ground, under cover, and away from sweating walls and other damp surfaces until ready for use.

1.6 ENVIRONMENTAL CONDITIONS

1.6.1 Gypsum Plaster

Maintain an ambient temperature of not less than 55 degrees F continuously during plastering, and drying, and until occupancy heating conditions are established in the area. Maintain this temperature for not less than one week prior to the application of plaster. Provide regulated ventilation to

prevent "sweatouts" or "dry-outs." When the building is exposed to hot dry winds or day-to-night temperature differentials of 20 degrees F or more, cover openings that are not glazed. Gypsum and related materials must conform to ASTM C 11. Provide permanent ventilation for spaces enclosed by suspended ceilings as indicated.

1.7 Gypsum Plaster Full Size Sample

After selection of an acceptable texture, construct a sample panel separate from the building, minimum size of 8 ftin height, by 8 ft in length, using 6 inch metal studs, and gypsum board, metal lath and gypsum plaster. The sample wall must show all aspects of gypsum plaster work, including but not limited to, expansion joints, control joints, corner extrusions, electrical, mechanical, and fire sprinkler penetrations and casing beads. A sample of a control joint and extrusion butt joint must also be incorporated into the sample wall. Finish work must match the approved sample panel. The Contractor shall protect the sample wall from damage during the length of the contract.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the specifications, standards, and requirements specified herein. Provide asbestos-free materials.

2.2 GYPSUM BASE COAT PLASTER

2.2.1 Gypsum Neat Plaster Base Coat

ASTM C 28/C 28M.

2.2.2 Gypsum Ready-Mixed Plaster Base Coat

ASTM C 28/C 28M.

2.2.3 Gypsum Wood-Fibered Plaster Base Coat

ASTM C 28/C 28M.

2.2.4 High Strength Gypsum Plaster Base Coat

ASTM C 28/C 28M, gypsum neat plaster, except plaster must have a compressive strength of not less than 2,500 psi, when tested dry in accordance with ASTM C 472.

2.3 GYPSUM FINISH COAT PLASTER

2.3.1 Gypsum Gaging Plaster Finish Coat

ASTM C 28/C 28M.

2.3.2 High Strength Gypsum Gaging Plaster Finish Coat

ASTM C 28/C 28M, gypsum gaging plaster, except plaster must have a compressive strength of not less than 4,500 psi when tested dry in accordance with ASTM C 472.

2.3.3 Gypsum Molding Plaster for Ornamental Plaster

ASTM C 59/C 59M.

2.3.4 Keene's Cement Finish Coat

ASTM C 61/C 61M.

2.3.5 Acoustical Plaster Finish Coat

ASTM E 1042 Type I, Class A, noncombustible.

2.4 HYDRATED LIME

ASTM C 206, Type S.

2.5 AGGREGATES

2.5.1 Sand for Gypsum Base Coats

ASTM C 35.

Sand Gradation: Percentage retained by weight (plus or minus 2 percent) on each sieve.

Sieve Size	Max.	Min.
No. 4	0	0
No. 8	5	0
No. 16	30	5
No. 30	65	30
No. 50	95	65
No. 100	100	90

2.5.2 Sand for Gypsum Sand Float Finish

ASTM C 842.

Sand Gradation: Percentage retained by weight (plus or minus 2 percent) on each sieve.

Sieve Size	Max.	Min.
No. 20	0	
No. 30	0.5	
No. 100	100	40
No. 200	100	70

2.5.3 Lightweight Aggregates, Perlite or Vermiculite for Gypsum Base Coat

ASTM C 35.

2.5.4 Silica Sand or Perlite Fines

For use in lime-putty gypsum-gaged finish, aggregated white coat, must have the following gradation: 10 percent maximum retained on a No. 30 sieve , 4 percent minimum and 70 percent maximum retained on a No. 100 sieve , and 70 percent minimum and 100 percent maximum retained on No. 200 sieve .

2.6 WATER

Use only potable water , free of mineral and organic substances that affect the hardening and durability of the plaster or stucco.

2.7 PROPORTIONING

Unless specified otherwise, materials are specified on a volume basis and must be measured in approved containers, to ensure that the specified proportions will be controlled and accurately maintained during the progress of the work. Measuring materials with shovels (shovel count) is not be permitted. Prepare ready-mix gypsum plaster for use by the addition of water only.

2.7.1 Gypsum Base Coat Plaster

Use of sand or lightweight aggregate is optional in gypsum plaster basecoats, except provide (1) sand for Keene's cement and high strength gypsum-gaged finish coats; (2) lightweight aggregate when necessary for a required fire resistance rating.

2.7.1.1 Sand and Gypsum Plaster Base Coat

Mix scratch coat in the proportion of 100 lb of gypsum neat plaster to not more than 2 cu ft of damp loose sand; mix brown coat in the proportion of 100 lb of gypsum neat plaster to not more than 3 cu ft of damp loose sand; or scratch and brown coats may both be mixed in the proportion of 100 lb of gypsum neat plaster to not more than 2-1/2 cubic feet of damp loose sand.

2.7.2 Gypsum Plaster Finish Coat

2.7.2.1 Lime-Putty

Prepare lime-putty in accordance with the printed directions of the manufacturer. Use putty following preparation or following a soaking period as recommended by the manufacturer.

2.8 MIXING

2.8.1 Job-Mixed Materials

Mix materials in mechanical mixers except finish coats containing lime may be hand mixed. Mechanical mixers must be an approved type that accurately and uniformly controls the quantity of water. When mixing by hand, mix dry plaster aggregate to a uniform color in the mixing box, add water, and hoe the plaster immediately into the water and mix thoroughly to a proper consistency.

Water used for rinsing and cleaning containers and tools must not be used in mixing the materials.

Sand proportions must be damp and in loose condition. A volume of damp loose sand must contain a minimum of 80 lb of dry sand in one cu ft.

Mix the material while the mixer is in continuous operation in the following sequence:

a. Add maximum close to 90 percent of estimated quantity of water.

b. Add approximately one-half of the sand. If vermiculite or perlite is used, add all the aggregate.

c. Add cement and approved admixtures. Add lime prior to cement.

d. Add remainder of sand.

e. Mix with remainder of water as required. Mix until the mixture is uniform in color and consistency.

Avoid excessive mixing and agitation. Discard gypsum plaster which has begun to set before it is used; do not permit retempering. Do not use frozen, caked, or lumped materials. Empty mixers and mixing boxes after each batch is mixed, and keep free of old plaster.

2.8.2 Ready-Mixed Packaged Materials

Mix ready-mixed packaged gypsum plaster in accordance with manufacturer's printed instructions.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Clean surfaces before application of gypsum plaster of projections, dust, loose particles, grease, bond breakers, and foreign matter . Do not apply plaster directly to surfaces (1) of masonry or concrete that have been coated with bituminous compound or other waterproofing agents, or (2) that have been painted or previously plastered. Before plaster work is started, wet masonry and concrete surfaces thoroughly with a fine fog spray of clean water to produce a uniformly moist condition. Check metal grounds, corner beads, screeds, and other accessories carefully for alignment before starting work. Do not apply gypsum plaster to surfaces containing frost.

3.2 WORKMANSHIP

3.2.1 Slump Tests

Apply Plaster by hand or machine. When a plastering machine is used, control the fluidity of gypsum plaster to have a slump of not more than 3 inch when tested using a 2 by 4 by 6 inch high slump cone. Subsequent to determining water content to meet the specified slump, do not add additional water to the mix. Conduct the slump test according to the following procedure:

a. Place cone on level, dry, non-absorptive base plate.

b. While holding cone firmly against base plate, fill cone with plaster taken directly from the hose or nozzle of the plastering machine, tamping with metal rod during filling to release air bubbles.

c. Screed off plaster level with top of cone. Remove cone by lifting it straight up with a slow and smooth motion.

d. Place cone in a vertical position adjacent to freed plaster sample, using care not to shake or move base plate.

e. Lay a straightedge across top of cone, being careful not to shake or move cone. Measure slump in inches from the bottom edge of the

straightedge to the top of the slumped plaster sample.

3.2.2 Application

Apply gypsum plaster in three coats.

Apply base coats with sufficient pressure and ensure plaster is sufficiently plastic to provide a strong bond to bases. Work base coats into screeds at intervals from 5 to 8 ft. Plaster must not be continuous across expansion and control joints occurring in walls, partitions, and ceilings. Finish work level, plumb, square, and true, within a tolerance of 1/8 inch in 8 ft, without waves, cracks, blisters, pits, crazing, discoloration, projections, or other imperfections. Form plaster work carefully around angles and contours, and well-up to screeds. Take special care to prevent sagging and consequent dropping of applications. There must be no visible junction marks in finish coat where one day's work adjoins another. Plastered surfaces to receive rubber or vinyl base coves must extend to wood ground indicated as backing for base. Plaster not required behind built-in cabinets and equipment.

3.2.3 Control And Expansion Joints

Install control joints at locations indicated before applying gypsum plaster. Vertical joints must be continuous and butt horizontal joints against the vertical joints. Check expansion, control joints and accessories to ensure unrestrained movement, metal lath not continuous behind the joints, and area between joints do not exceed 150 sq ft.

3.2.4 Curing

3.2.4.1 Gypsum Plaster

Before the plaster has set, provide environmental controls to prevent the plaster from drying too fast. After the plaster has set, provide for rapid drying to develop high strength.

3.3 GYPSUM PLASTER WORK

ASTM C 842.

3.3.1 Gypsum Plaster Thickness Requirements

Plaster thicknesses are from face of metal lath plaster base (scratch coat) or solid base surfaces.

a. Vertical Surfaces

Base Types	Base Coat	Finish Coat	Total Thickness
Metal Lath	1/2 inch	1/8 inch	5/8 inch
Masonry	1/2 inch	1/8 inch	5/8 inch
Concrete	1/2 inch	1/8 inch	5/8 inch
Other Bases	3/8 inch	1/8 inch	1/2 inch

b. Horizontal Surfaces. Total plaster thickness for metal lath plaster, masonry and concrete bases is 5/8 inch. Total thickness of plaster for horizontal concrete surfaces is1/8 to 3/8 inch.

3.3.2 Gypsum Plaster Basecoat Work

3.3.2.1 Gypsum Three-Coat System

Apply scratch coat 3/16 to 1/4 inch thick to cover the base with sufficient material and pressure to form a good bond on the wall or ceiling base. Rake or scratch the surface and allow to set firm and hard. Apply the brown coat to bring the base coat out to the screeds, compact and straighten to a true surface without the application of water, and cross rake or scratch to receive the finish coat.

3.3.3 Gypsum Plaster Finish Coats

Moderately moisten or fog spray base coat of plaster that has become dry before finish coat is applied. Accelerate plaster, if necessary, to provide a setting time of not more than 4 hours from the time the plaster is mixed.

3.3.3.1 Lime-Putty and Gypsum-Gaged Finish Coats

Apply lime-putty gypsum-gaged finish white coat or aggregated white coat and high strength gypsum gaged finish over the base coat, scratch in thoroughly, lay on well, double back, and fill out to a true, even surface. Allow the finish to dry a few minutes, then trowel well with water. Apply maximum pressure in order to compact the finish coat and provide a smooth finish free from blemishes and irregularities. Apply trowel finish coats of gypsum-gaged lime-putty over properly prepared base coats as thin as possible and 1/16 to 1/8 inch thick for conventional plaster system, except as necessary in spots to level out hollows in base coat.

3.4 PATCHING AND POINTING

Cut out and patch loose, cracked, damaged, or defective gypsum plaster. Patch must match existing work in texture, color and finish flush with previously applied gypsum plaster surfaces. Point work abutting or adjoining finish work in a neat manner. Remove droppings or spatterings from surfaces. Leave clean and in a condition to receive paint or other finish. Remove protective covering from floors and other surfaces, and rubbish and debris from the interior and exterior of the building.

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SECTION 09 29 00

GYPSUM BOARD

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for gypsum board, cementitious backer units, and accessories intended for use in drywall construction.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM E 283	Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM F 883	Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

ANSI/BHMA A156.1	Butts and Hinges
ANSI/BHMA A156.12	Interconnected Locks & Latches
ANSI/BHMA A156.13	Mortise Locks & Latches Series 1000
ANSI/BHMA A156.15	Release Devices Closer Holder, Electromagnetic and Electromechanical
ANSI/BHMA A156.16	Auxiliary Hardware
ANSI/BHMA A156.17	Self Closing Hinges & Pivots
ANSI/BHMA A156.18	Materials and Finishes
ANSI/BHMA A156.2	Bored and Preassembled Locks and Latches
ANSI/BHMA A156.21	Thresholds
ANSI/BHMA A156.22	Door Gasketing and Edge Seal Systems
ANSI/BHMA A156.3	Exit Devices

ANSI/BHMA A156.4	Door Controls - Closers
ANSI/BHMA A156.5	Auxiliary Locks and Associated Products
ANSI/BHMA A156.6	Architectural Door Trim
ANSI/BHMA A156.7	Template Hinge Dimensions
ANSI/BHMA A156.8	Door Controls - Overhead Stops and Holders

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	Life Safety Code
NFPA 80	Standard for Fire Doors and Other Opening Protectives

STEEL DOOR INSTITUTE (SDI/DOOR)

SDI/DOOR A250.8	Recommended Specifications for Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir	Building Materials Directory

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Hardware schedule

Keying system

SD-03 Product Data

Hardware items

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1

Submit data package in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

SD-11 Closeout Submittals

Key Bitting

1.4 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hardware Item	Quantity	Size	Reference Publication Type No.	Finish	Mfr. Name and Catalog No.	Key Control Symbols	UL Mark (If fire rated and listed)	BHMA Finish Designation

1.5 KEY BITTING CHART REQUIREMENTS

Submit key bitting charts to the COR prior to completion of the work. Include:

a. Complete listing of all keys (AA1, AA2, etc.).

b. Complete listing of all key cuts (AA1-123456, AA2-123458).

c. Tabulation showing which key fits which door.

d. Copy of floor plan showing doors and door numbers.

e. Listing of 20 percent more key cuts than are presently required in each master system.

1.6 QUALITY ASSURANCE

1.6.1 Key Shop Drawings Coordination Meeting

Prior to the submission of the key shop drawing, the COR, Contractor, Door Hardware subcontractor, using Activity and Base Locksmith shall meet to discuss key requirements for the facility.

1.7 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Deliver permanent keys and removable cores to the COR, either directly or by certified mail. Deliver construction master keys with the locks.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Provide hardware to be applied to metal or to prefinished doors manufactured to template. Promptly furnish template information or templates to door and frame manufacturers. Conform to ANSI/BHMA A156.7 for template hinges. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors, as well as to other requirements indicated, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." Provide the label of Underwriters

Laboratories, Inc. for such hardware listed in UL Bld Mat Dir or labeled and listed by another testing laboratory acceptable to the COR.

2.3 ACCEPTABLE MANUFACTURERS

Acceptable manufacturers or pre-approved equal meeting or exceeding salient product features listed below, except Locksets, Latchsets, and Cylinders (Item B) shall be Best 9K only. Numbers in Hardware Schedule refer to those of the first names manufacturer below.

a. Hinges - Hager, Stanley, Lawrence, or McKinney.

b. Locksets, Latchsets, and Cylinders - Best 9K (Ames Research Center Standard).

c. Exit Devices - Von Duprin.

d. Overhead Closers -- LCN or Sargent.

e. Manual Bolts - Glynn Johnson, Builders Brass, or Ives.

f. Gasketing, Astragals, and Thresholds - Pemko, Zero, NGP.

g. Stops, Holders - Glynn Johnson, Ives, Quality.

2.4 FASTENERS

Fasteners of the proper type, size, quantity, and finish for each hardware item shall be provided. Visible fasteners shall be Phillips-head, bronze or stainless steel finished to match specified hardware.

2.5 HINGES

Hinges shall be full mortise, heavy weight, ball bearing, button tip, template type conforming to ANSI A156.1, Grade 1. Size shall be 4.5 inches x 4.5 inches.

2.6 LOCKSETS

a. Cylinder bored locksets and latchsets shall conform to ANSI A156.2, plain design and wrought trim.

b. Cylinder bored locksets and latchsets for fire-rated doors shall be UL listed and labeled, heavy duty, Series 4000, Grade 1.

c. Heavy duty usage cylinder bored locksets and latchsets shall be Series 4000, Grade 1.

d. Locksets and latchsets shall have standardized fronts, cases, and strikes so that varying functions will be interchangeable and will require only one mortise for their installation. Locks and latches shall have beveled bronze fronts, bronze bolts and strikes, brass hubs, and cases with specified finish. Locks shall have Best cylinders conforming to ANSI A156.5, with seven-pin tumblers, steel cylindrical cases, and interior non-corrosive parts.

e. All locksets shall be furnished with "Best" 7-pin green construction cores. Temporary construction cores shall be furnished, installed, and maintained in locks during the construction and shall be left in place

and shall become the property of the Government. All excess lock parts (throw members, strikes, screws, etc.) from new locksets shall be turned over to the Government.

f. Where existing door hardware is removed, locksets and lockset cores shall be turned over to the Government.

2.7 THRESHOLDS

a. Thresholds shall be extruded bronze anodized aluminum 6063-alloy.

b. Thresholds shall be provided for the full width of the opening at exterior doors.

2.8 FLUSH BOLTS

a. Flush bolts shall be aluminum, specified finish, conforming to ANSI A156.16, with 12.008 in. lever extensions.

b. Flush bolts shall be a type listed in UL for fire-rated doors.

2.9 CLOSERS

a. Closers shall conform to ANSI A156.4, and shall be provided on emergency fire exits UL labeled, exterior doors, restrooms and general office doors, and where specified in the hardware schedule.

b. Closers shall be the surface mounted heavy duty, parallel arm type, Grade 1. Style shall be traditional or modern.

c. Brackets, reinforcing plates, and accessory fittings shall be provided as required.

2.10 ASTRAGALS

Astragals shall be prime steel, 13 ga minimum by 1.6 in. side minimum.

2.11 EXIT DEVICES

Provide exit devices as required to fulfill all requirements of NFPA 80, NFPA 100, UL and California Building Code. Provide levers and other trim compatible with other hardware, drop forged trim with solid lever handle, and cylinders of proper size and finishes for smooth operation of exit devices. All lock cylinders in exit devices shall be "Best" 7-pin mortise or rim cylinders with green construction core.

2.12 MISCELLANEOUS AND SHELF HARDWARE

a. Door Holders - Floor holder, type L11241, conforming to ANSI/BHMA A156.16.

b. Door Stops

1. Door stops or bumpers conforming to ANSI/BHMA A156.16 shall be provided for all doors to protect the hardware and prevent doors from striking walls and fixtures.

2. Floor mounted stops, Type L02141 (dome type) or Type L02161 (dome type for door with thresholds) shall be provided.

c. Door Silencers

1. Door silencers conforming to ANSI/BHMA A156.16 shall be provided except on fire-rated door frames.

2. Door silencers shall be Type L03011 for metal frames.

3. Three silencers shall be provided for single doors. Two silencers shall be provided for each leaf of pairs of doors for installation in the head rail of the door frame.

2.13 KEYING SYSTEM

Provide an extension of the existing keying system. Existing locks were manufactured by Best 9K; do not have interchangeable cores.

2.14 LEVER HANDLES

Provide lever handles. Conform to the minimum requirements of ANSI/BHMA A156.13 for mortise locks of lever handles for exit devices. Provide lever handle locks with a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when force in excess of that specified in ANSI/BHMA A156.13 is applied to the lever handle. Provide lever handles return to within 1/2 inch of the door face.

2.15 KEYS

Furnish one file key, one duplicate key, and one working key for each key change and for each master and grand master keying system. Furnish one additional working key for each lock of each keyed-alike group. Coordinate quantity of great grand master keys, quantity of construction master keys, and quantity of control keys for removable cores with COR. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - Do no duplicate." Do not place room number on keys.

2.16 DOOR PROTECTION PLATES

ANSI/BHMA A156.6.

2.16.1 Sizes of Armor, Mop, and Kick Plates

Two inches less than door width for single doors; one inch less than door width for pairs of doors. Provide 10 inch kick plates for flush doors and 1 inch less than height of bottom rail for panel doors. Provide minimum 48 inch armor plates for flush doors and completely cover lower panels of panel doors, except 16 inch high armor plates on fire doors. Provide 6 inch mop plates.

2.17 SPECIAL TOOLS

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.18 FINISHES

Provide hardware with the following finishes conforming to ANSI/BHMA A156.18:

a. Hinges, Locksets and Latchsets - Satin stainless steel, BHMA Code 630, unless otherwise indicated.

b. Hinges at Labeled Openings - Satin chromium plated on steel, BHMA Code 652.

c. Panic Hardware - Satin chrome, clear anodized, BHMA Code 626 at interior; dull bronze, BHMA Code 612 at exterior.

d. Astragals - Primed for painting, steel, BHMA Code 600.

e. Closures - Sprayed, matching locksets and latchsets.

f. Door Stops, Finish Bolts - Match locksets and latchsets.

g. Door Holders - Match new exterior hardware finish.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed installation instructions. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Provide through bolts where necessary for satisfactory installation.

3.1.1 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

3.2 FIRE DOORS AND EXIT DOORS

Install hardware in accordance with NFPA 80 for fire doors, NFPA 101 for exit doors.

3.3 HARDWARE LOCATIONS

SDI/DOOR A250.8, unless indicated or specified otherwise.

a. Kick and Armor Plates: Push side of single-acting doors. Both sides of double-acting doors.

b. Mop Plates: Bottom flush with bottom of door.

3.4 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the COR. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the COR. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.5 HARDWARE SCHEDULE

a. Group 1 - Standard Doors (non-rated)
1.5 pr Butts 4.4 in. x 4.4 in., Hager BB1279
1 Lockset, Best 93K7AB15D626
1 Doorstop, Glynn Johnson FB19X
Silencers

b. Group 2 - Standard Double Doors (non-rated)
3 pr Butts 4.4 in. x 4.4 in., Hager BB1279
1 pr Flush bolts Glynn Johnson FB6W, DP2
1 Lockset, Best 93K7AB15D626
1 Doorstop, Glynn Johnson FH19X
Silencers

c. Group 3 - Standard Office Door (fire-rated)
1.5 pr Butts 4.4 in. x 4.4 in., Hager BB1279
1 Door closer, LCN 4011
1 Lockset, Best 93K7AB15D626
1 Doorstop, Glynn Johnson GB19X
Door seals, Pemko S88D17

d. Group 4 - Standard Double Doors (fire-rated)
3 pr Butts 4.4 in. x 4.4 in., Hager BB1279
1 pr Flush bolts Glynn Johnson FB6W, DP2
1 Lockset, Best 93K7AB15D626
1 Door closer, LCN 4011
1 Doorstop, Glynn Johnson FH19X
Door seals, Pemko S88D20
1 Astragal, Pemko 357SP

e. Group 5 - Single Doors with Panic Hardware
1.5 pr Butts 4.4 in. x 4.4 in., Hager BB1168
1 Door closer, LCN 4011
1 Exit device, Von Duprin 98L-F
1 Door stop, Glynn Johnson FH19X
Door seals, Pemko S88D17
1 Best 1E, 7-pin, cylinder housing(s)

f. Group 6 - Double Doors with Panic Hardware
3 pr Butts 4.4 in. x 4.4 in., Hager BB1168
1 pr Door closers, LCN 4011
1 Exit device, Von Duprin 9927L
2 Door stops, Glynn Johnson FH19X
1 Astragal, Pemko 357SP
Door seals, Pemko S88D20
1 Best 1E, 7-pin, cylinder housing(s)

-- End of Section --

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DIVISION 09 - FINISHES

SECTION 09 30 00

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SECTION 09 30 00

CERAMIC TILE AND PORCELAIN TILE

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for ceramic tile for walls and floors, porcelain tile, quarry tile, paver tile, and marble thresholds.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM A185/A185M	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM C 1026	Standard Test Method for Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C 1027	Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C 1028	Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
ASTM C 1178/C 1178M	Standard Specification for Glass Mat Water-Resistant Gypsum Backing Panel
ASTM C 144	Standard Specification for Aggregate for Masonry Mortar
ASTM C 150/C 150M	Standard Specification for Portland Cement
ASTM C 206	Standard Specification for Finishing Hydrated Lime
ASTM C 207	Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C 33/C 33M	Standard Specification for Concrete

	Aggregates
ASTM C 373	Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
ASTM C 482	Bond Strength of Ceramic Tile to Portland Cement
ASTM C 501	Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser
ASTM C 648	Breaking Strength of Ceramic Tile
ASTM C 847	Standard Specification for Metal Lath
ASTM D 2103	Standard Specification for Polyethylene Film and Sheeting
ASTM D 226/D 226M	Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 4068	Chlorinated Polyethylene Sheeting for Concealed Water-Containment Membrane

BAY AREA AIR QUALITY MANAGEMENT DISTRICT (BAAQMD)

Bay Area AQMD Rule 8-51	Adhesive and Sealant Products

GREEN SEAL (GS)

GS-36	Commercial Adhesives

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

MARBLE INSTITUTE OF AMERICA (MIA)

MIA Design Manual	Dimension Stone Design Manual

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	Adhesive and Sealant Applications

TILE COUNCIL OF NORTH AMERICA (TCNA)

TCA Hdbk	Handbook for Ceramic Tile Installation

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Architectural Barriers Act (ABA)

Accessibility Guidelines

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

For materials like Tile, Accessories, and marble Thresholds submit Samples of sufficient size to show color range, pattern, type and joints.

1.3.2 Sustainable Design Certification

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Tile
Setting-Bed
Mortar, Grout, and Adhesive
Waterproofing and Crack Suppression Membrane

SD-04 Samples

Tile
Accessories
Marble Thresholds
Grout

Test Reports

Testing

SD-07 Certificates

Tile
Mortar, Grout, and Adhesive

1.5 QUALITY ASSURANCE

Dimension and draw detail drawings at a minimum scale of 1/4 inch = 1 foot. Include drawings of pattern at inside corners, outside corners, termination points and location of all equipment items such as thermostats, switch plates, mirrors and toilet accessories mounted on surface. Submit drawings showing ceramic tile pattern elevations floor plans.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Protect

materials from weather, and store them under cover in accordance with manufacturer's printed instructions.

1.7 ENVIRONMENTAL REQUIREMENTS

Do not perform ceramic tile work unless the substrate and ambient temperature is at least 50 degrees F and rising. Maintain temperature above 50 degrees F while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used, ventilate the area to the outside to avoid carbon dioxide damage to new tilework.

1.8 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period.

1.9 EXTRA MATERIALS

Supply an extra two percent of each type tile used in clean and marked cartons.

PART 2 PRODUCTS

2.1 TILE

Conform to TCA Hdbk for standard grade tile. Provide grade sealed containers. Mark seals with the marks on the signed master grade certificate. Provide an impact resistant tile with a minimum floor breaking strength for wall tile of 90 pound and for floor tile of 250 pound in accordance with ASTM C 648. The manufacturer will provide a frost resistant rating for tile used in cold climate projects as determined by ASTM C 1026. Provide a 0.50 maximum percent water absorption in accordance with ASTM C 373. Provide a minimum coefficient of friction of 0.50 wet and dry in accordance with ASTM C 1028. Identify floor tile as Class IV Plus-Extra Heavy Traffic, durability classification as rated by the manufacturer when tested in accordance with ASTM C 1027 for abrasion resistance as related to foot traffic. Submit manufacturer's catalog data and preprinted installation and cleaning instructions plus a master grade certificate for tile.

2.1.1 Quarry Tile

Furnish an unglazed quarry tile and trim with abrasive surface. Use 6 in. x 6 in. Coordinate color with drawings or COR.

2.1.2 Porcelain Tile

Furnish an unglazed porcelain tile and integral cove trim with the color extending uniformly through the body of the tile. Provide a nominal size of 12 by 12 by 5/16 inch thick. Criteria for tile to meet or exceed is as follows: Abrasive wear in accordance with ASTM C 501 and bonding strength in accordance with ASTM C 482. Comply with 36 CFR 1191 for coefficient of friction for interior tiled floors.

2.1.3 Glazed Wall Tile

Provide glazed wall tile with cushioned edges and trim edged with lead-free matte finish. Provide tile 6 by 6 inch.

2.2 SETTING-BED

Compose the setting-bed of the following materials:

2.2.1 Aggregate for Concrete Fill

Conform to ASTM C 33/C 33M for aggregate fill. Do not exceed one-half the thickness of concrete fill for maximum size of coarse aggregate.

2.2.2 Portland Cement

Conform to ASTM C 150/C 150M for cement, Type I, white for wall mortar and gray for other uses.

2.2.3 Sand

Conform to ASTM C 144 for sand.

2.2.4 Hydrated Lime

Conform to ASTM C 206 for hydrated lime, Type S or ASTM C 207, Type S.

2.2.5 Metal Lath

Conform to ASTM C 847 for flat expanded type metal lath, and weighing a minimum 2.5 pound/square yard.

2.2.6 Reinforcing Wire Fabric

Conform to ASTM A185/A185M for wire fabric. Provide 2 by 2 inch mesh, 16/16 wire or 1-1/2 by 2 inch mesh, 16/13 wire.

2.3 WATER

Provide potable water.

2.4 MORTAR, GROUT, AND ADHESIVE

Submit certificates indicating conformance with specified requirements. Conform to Bay Area AQMD Rule 8-51, and to the following for mortar, grout, adhesive, and sealant:

2.4.1 Dry-Set Portland Cement Mortar

ANSI A108.1.

2.4.2 Latex-Portland Cement Mortar

TCA Hdbk. Zero-VOC content.

2.4.3 Ceramic Tile Grout

TCA Hdbk; petroleum-free and plastic-free commercial portland cement grout. Maximum VOC content of 150 grams/liter.

2.4.4 Organic Adhesive

ANSI A136.1, Type I. Water-resistant. Comply with applicable regulations regarding toxic and hazardous materials.

2.4.5 Epoxy Resin Grout

TCA Hdbk Prohibited unless specifically indicated otherwise.

2.4.6 Sealants

Comply with applicable regulations regarding toxic and hazardous materials and as specified. Single-component polyurethane sealant shall have a zero-VOC content. Two-component polyurethane sealant shall have a maximum VOC content of 45 grams/liter.

2.4.7 Cementitious Backer Board

Provide cementitious backer units, for use as tile substrate over wood sub-floors, in accordance with TCA Hdbk. Furnish 1/2 inch thick cementitious backer units.

2.5 MEMBRANE MATERIALS

Conform to ASTM D 226/D 226M, Type 1, No. 15 asphalt-saturated building felt.

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Inspect surface to receive tile in conformance to the requirements of TCA Hdbk for surface conditions for the type setting bed specified and for workmanship. Provide variations of tiled surfaces that fall within maximum values shown below:

TYPE	WALLS	FLOORS
Dry-Set Mortar	1/8 inch in 8 ft.	1/8 inch in 10 ft.
Organic Adhesives	1/8 inch in 8 ft.	1/16 inch in 3 ft.
Epoxy	1/8 inch in 8 ft.	1/8 inch in 10 ft.

3.2 GENERAL INSTALLATION REQUIREMENTS

Do not start tile work until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Do not start floor tile installation in spaces requiring wall tile until after wall tile has been installed. Apply tile in colors and patterns indicated in the area shown on the drawings. Install tile with the respective surfaces in true even planes to the elevations and grades shown. Provide special shapes as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Solidly back tile bases and coves with mortar.

3.3 INSTALLATION OF WALL TILE

Install wall tile in accordance with the TCA Hdbk, method W211, W221, W222,

W231, W241, or W202 or W223, W242, W243, or W244.

3.3.1 Workable or Cured Mortar Bed

Install tile over workable mortar bed or a cured mortar bed at the option of the Contractor. Install a 4 mil polyethylene membrane, metal lath, and scratch coat. Conform to TCA Hdbk for workable mortar bed, materials, and installation of tile. Conform to TCA Hdbk for cured mortar bed and materials.

3.3.2 Dry-Set Mortar and Latex-Portland Cement Mortar

Use Dry-set or Latex-Portland Cement to install tile in accordance with TCA Hdbk. Use Latex Portland Cement when installing porcelain ceramic tile.

3.3.3 Organic Adhesive

Conform to TCA Hdbk for the organic adhesive installation of ceramic tile.

3.4 INSTALLATION OF FLOOR TILE

Install floor tile in accordance with TCA Hdbk method F111, F112, F114, F121 or F113, F115. Install shower receptors in accordance with TCA Hdbk method B414 B415.

3.4.1 Workable or Cured Mortar Bed

Install floor tile over a workable mortar bed or a cured mortar bed at the option of the Contractor. Conform to TCA Hdbk for workable mortar bed materials and installation. Conform to TCA Hdbk for cured mortar bed materials and installation. Provide minimum 1/4 inch to maximum 3/8 inch joints in uniformed width.

3.4.2 Dry-Set and Latex-Portland Cement

Use dry-set or Latex-Portland cement mortar to install tile directly over properly cured, plane, clean concrete slabs in accordance with TCA Hdbk. Use Latex Portland cement when installing porcelain ceramic tile.

3.4.3 Resinous Grout

When resinous grout is indicated, grout quarry tile with epoxy resin grout. Rake and clean joints to the full depth of the tile and neutralize when recommended by the resin manufacturer. Install epoxy resin grout in conformance with TCA Hdbk. Install resin grout in accordance with manufacturer's printed installation instructions. Provide a coating of wax applied from the manufacturer on all tile installed and furan resin. Follow manufacturer's printed installation instruction soft installed resin grout for proportioning, mixing, installing, and curing. Maintain the recommended temperature in the area and on the surface to be grouted. Protect finished grout of grout stain.

3.4.4 Ceramic Tile Grout

Prepare and install ceramic tile grout in accordance with TCA Hdbk.

3.4.5 Waterproofing

Shower pans are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.5 EXPANSION JOINTSForm and seal joints as specified in Section 07 92 00 JOINT SEALANTS.

3.5.1 Walls

Provide expansion joints at control joints in backing material. Wherever backing material changes, install an expansion joint to separate the different materials.

3.5.2 Floors

Provide expansion joints over construction joints, control joints, and expansion joints in concrete slabs. Provide expansion joints where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 24 to 36 feet each way in large interior floor areas and 12 to 16 feet each way in large exterior areas or areas exposed to direct sunlight or moisture. Extend expansion joints through setting-beds and fill.

3.6 CLEANING AND PROTECTING

Upon completion, thoroughly clean tile surfaces in accordance with manufacturer's approved cleaning instructions. Do not use acid for cleaning glazed tile. Clean floor tile with resinous grout or with factory mixed grout in accordance with printed instructions of the grout manufacturer. After the grout has set, provide a protective coat of a noncorrosive soap or other approved method of protection for tile wall surfaces. Cover tiled floor areas with building paper before foot traffic is permitted over the finished tile floors. Provide board walkways on tiled floors that are to be continuously used as passageways by workmen. Replace damaged or defective tiles.

3.7 WASTE MANAGEMENT

Separate waste, including metal and cardboard, in accordance with the Waste Management Plan and recycle or reuse. Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in designated containers and areas. Close and seal tightly partly used sealant and adhesive containers and store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in designated containers and areas and dispose of properly. Set aside and protect half-tile and larger offcuts and remainders for reuse by the Government. Crush broken tile, offcuts smaller than a half tile, and excess mortar and grout for use as mosaic, sub-base, or fill. Identify manufacturer's policy for collection or return of construction scrap, unused material, demolition scrap, and packaging material. Institute recycling to take advantage of manufacturer's programs. When such a service is not available, seek local recyclers to reclaim the materials.

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DIVISION 09 - FINISHES

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SECTION 09 51 00

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for conventional and impact/abrasion resistant acoustical ceiling tile and panels, unit acoustical absorbers, hangers, and suspension system grid for installation in commercial-type work.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A489	Standard Specification for Carbon Steel Lifting Eyes
ASTM A580/A580M	Standard Specification for Stainless Steel Wire
ASTM A641/A641M	Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 633	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C 423	Sound Absorption and Sound Absorption

	Coefficients by the Reverberation Room Method
ASTM C 635/C 635M	Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636/C 636M	Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM C 834	Latex Sealants
ASTM E 119	Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 1264	Acoustical Ceiling Products
ASTM E 1414	Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
ASTM E 1477	Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers
ASTM E 580/E 580M	Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint
ASTM E 795	Mounting Test Specimens During Sound Absorption Tests
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04	Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL Fire Resistance	Fire Resistance Directory

1.3 SYSTEM DESCRIPTION

Provide sound controlling units mechanically mounted on a ceiling suspension system for acoustical treatment. The unit size, texture, finish, and color must be as specified. The location and extent of acoustical treatment shall be as shown on the approved detail drawings.

Submit drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan. Coordinate with paragraph RECLAMATION PROCEDURES for reclamation of mineral fiber acoustical ceiling panels to be removed from the job site.

1.3.1 Ceiling Attenuation Class and Test

Provide a ceiling system with an attenuation class (CAC) of 40 minimum when determined in accordance with ASTM E 1414. Provide fixture attenuators over light fixtures and other ceiling penetrations, and provide acoustical blanket insulation adjacent to partitions, as required to achieve the specified CAC. Provide test ceiling continuous at the partition and assembled in the suspension system in the same manner that the ceiling will be installed on the project.

1.3.2 Ceiling Sound Absorption

Determine the Noise Reduction Coefficient (NRC) in accordance with ASTM C 423 Test Method.

1.3.3 Light Reflectance

Determine light reflectance factor in accordance with ASTM E 1477 Test Method.

1.3.4 Other Submittals Requirements

The following shall be submitted:

a. Manufacturer's data indicating percentage of recycle material in acoustic ceiling tiles to verify affirmative procurement compliance.

   Reports by an independent testing laboratory attesting that acoustical ceiling systems meet specified sound transmission requirements.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings

SD-03 Product Data

Acoustical Ceiling Systems
Certification

SD-04 Samples

Acoustical Units
Acoustic Ceiling Tiles

SD-06 Test Reports

Ceiling Attenuation Class and Test

SD-07 Certificates

Acoustical Units
Acoustic Ceiling Tiles

1.5 SUSTAINABLE DESIGN CERTIFICATION

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.6 DELIVERY, STORAGE. AND HANDLING

Deliver materials to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Carefully handle and store materials in dry, watertight enclosures. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.7 ENVIRONMENTAL REQUIREMENTS

Maintain a uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent for 24 hours before, during, and 24 hours after installation of acoustical units.

1.8 SCHEDULING

Complete and dry interior finish work such as plastering, concrete and terrazzo work before ceiling installation. Complete mechanical, electrical, and other work above the ceiling line; install and start operating heating, ventilating, and air conditioning systems in order to maintain temperature and humidity requirements.

1.9 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period. Include an agreement to repair or replace acoustical panels that fail within the warranty period in the standard performance guarantee or warranty. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturers defects of grid system.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS. Submit two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color. Conform acoustical units to ASTM E 1264, Class A, and the following requirements:

2.1.1 Affirmative Procurement

Mineral Wool, Cellulose, and Laminated Paperboard used in acoustic ceiling tiles are materials listed in the EPA's Comprehensive Procurement Guidelines (CPG) (http://www.epa.gov/cpg/). EPA's recommended Recovered Materials Content Levels for Mineral Wool, Cellulose, Structural Fiberboard and Laminated Paperboard are:

Product	Material	Percent of Post Consumer Materials	Percent of Total Recovered Materials
Laminate Paperboard	Post Consumer Paper	100	100
Rock Wool	Slag	75	
Cellulose	Post Consumer Paper	75	75

a. The recommended recovered materials content levels are based on the weight (not volume) of materials in the insulating core only.

b. Submit recycled material content data for acoustic ceiling tiles indicating compliance with affirmative procurement.

c. Submit total weight and volume quantities of acoustic ceiling tiles with recycle material.

2.1.2 Units for Exposed-Grid System

a. Type: III (non-asbestos mineral fiber with painted finish).

b. Flame Spread: Class A, 25 or less

c. Pattern: as indicated on the drawings.

d. Minimum NRC: 0.75 in open office areas; 0.60 in conference rooms, executive offices, teleconferencing rooms, and other rooms as designated; 0.50 in all other rooms and areas when tested on mounting Type E-400 of ASTM E 795.

e. Minimum Light Reflectance Coefficient: LR-1, 0.75 or greater.

f. Nominal size: 24 by 48 inches.

g. Edge detail: Square.

h. Finish: Factory-applied standard finish.

i. Minimum CAC: 40.

2.2 SUSPENSION SYSTEM

Provide standard suspension system conforming to ASTM C 635/C 635M for heavy-duty systems. Provide surfaces exposed to view of aluminum or steel with a factory-applied white. Provide wall molding having a flange of not less than 15/16 inch. Provide mitered corners. Suspended ceiling framing system must have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. Provide a suspension system with a maximum deflection of 1/360 of the span length. Conform seismic details to the contract drawings.

2.3 HANGERS

Provide hangers and attachment capable of supporting a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

2.3.1 Wires

Conform wires to ASTM A641/A641M, Class 1, 0.11 inch in diameter.

2.3.2 Rods

Provide 3/16 inch diameter threaded steel rods, zinc or cadmium coated.

2.3.3 Eyebolts

Provide eyebolts of weldless, forged-carbon-steel, with a straight-shank in accordance with ASTM A489. Eyebolt size must be a minimum 1/4 inch, zinc coated.

2.3.4 Masonry Anchorage Devices

Comply with ASTM C 636/C 636M for anchorage devices for eyebolts, machine screws, and wood screws.

2.4 ACCESS PANELS

Provide access panels that match adjacent acoustical units, designed and equipped with suitable framing and fastenings for removal and replacement without damage. Size panel to be not less than 12 by 12 inch or more than 12 by 24 inch.

a. Attach an identification plate of 0.032 inch thick aluminum, 3/4 inch in diameter, stamped with the letters "AP" and finished the same as the unit, near one corner on the face of each access panel.

b. Identify ceiling access panel by a number utilizing white identification plates or plastic buttons with contrasting numerals. Provide plates or buttons of minimum 1 inch diameter and securely attached to one corner of each access unit. Provide a typewritten card framed under glass listing the code identification numbers and corresponding system descriptions listed above. Mount the framed card where directed and furnish a duplicate card to the COR. Code identification system is as follows:

1. Fire detection/alarm system

2. Air conditioning controls

3. Plumbing system

4. Heating and steam systems

5. Air conditioning duct system

6. Sprinkler system

7. Intercommunication system

8. Nurse's call system

9. Pneumatic tube system

10. Medical piping system

11. Program entertainment

12. Telephone junction boxes

13. Detector X-ray

2.5 FINISHES

Use manufacturer's standard textures, patterns and finishes as specified for acoustical units and suspension system members. Treat ceiling suspension system components to inhibit corrosion.

2.6 COLORS AND PATTERNS

Use colors and patterns for acoustical units and suspension system components as indicated on the drawings.

2.7 ACOUSTICAL SEALANT

Conform acoustical sealant to ASTM C 834, nonstaining.

PART 3 EXECUTION

3.1 INSTALLATION

Examine surfaces to receive directly attached acoustical units for unevenness, irregularities, and dampness that would affect quality and execution of the work. Rid areas, where acoustical units will be cemented, of oils, form residue, or other materials that reduce bonding capabilities of the adhesive. Complete and dry interior finish work such as plastering, concrete, and terrazzo work before installation. Complete and approve mechanical, electrical, and other work above the ceiling line prior to the start of acoustical ceiling installation. Provide acoustical work complete with necessary fastenings, clips, and other accessories required for a complete installation. Do not expose mechanical fastenings in the finished work. Lay out hangers for each individual room or space. Provide hangers to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Keep main runners and carrying channels clear of abutting walls and partitions. Provide at least two main runners for each ceiling span. Wherever required to bypass an object with the hanger wires, install a subsuspension system so that all hanger wires will be plumb.

3.1.1 Suspension System

Install suspension system in accordance with ASTM C 636/C 636M and as specified herein. Do not suspend hanger wires or other loads from underside of steel decking.

3.1.1.1 Plumb Hangers

Install hangers plumb and not pressing against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, provide hangers at a minimum of four hangers per fixture and located not more than 6 inch from each corner of each fixture.

3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions,

offset the resulting horizontal force by bracing, countersplaying, or other acceptable means.

3.1.2 Wall Molding

Provide wall molding where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Secure wall molding not more than 3 inch from ends of each length and not more than 16 inches on centers between end fastenings. Provide wall molding springs at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Install acoustical units in accordance with the approved installation instructions of the manufacturer. Ensure that edges of acoustical units are in close contact with metal supports, with each other, and in true alignment. Arrange acoustical units so that units less than one-half width are minimized. Hold units in exposed-grid system in place with manufacturer's standard hold-down clips, if units weigh less than 1 psf or if required for fire resistance rating.

3.1.4 Caulking

Seal all joints around pipes, ducts or electrical outlets penetrating the ceiling. Apply a continuous ribbon of acoustical sealant on vertical web of wall or edge moldings.

3.2 CEILING ACCESS PANELS

Locate ceiling access panels directly under the items which require access.

3.3 CLEANING

Following installation, clean dirty or discolored surfaces of acoustical units and leave them free from defects. Remove units that are damaged or improperly installed and provide new units as directed.

3.4 RECLAMATION PROCEDURES

Neatly stack ceiling tile, designated for recycling by the COR, on 4 by 4 foot pallets not higher than 4 foot. Panels must be completely dry. Shrink wrap and symmetrically stack pallets on top of each other without falling over.

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SECTION 09 65 00

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SECTION 09 65 00

RESILIENT FLOORING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for resilient floor coverings, base materials, and accessory items.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM D 4078	Water Emulsion Floor Polish
ASTM D 5603	Rubber Compounding Materials - Recycled Vulcanizate Particulate Rubber
ASTM E 2129	Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 648	Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM F 1066	Standard Specification for Vinyl Composition Floor Tile
ASTM F 1303	Sheet Vinyl Floor Covering with Backing
ASTM F 1344	Rubber Floor Tile
ASTM F 1482	Installation and Preparation of Panel Type Underlayments to Receive Resilient Flooring
ASTM F 1700	Solid Vinyl Floor Tile
ASTM F 1859	Rubber Sheet Floor Covering Without Backing
ASTM F 1860	Rubber Sheet Floor Covering With Backing
ASTM F 1861	Resilient Wall Base

ASTM F 1869	Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
ASTM F 1913	Vinyl Sheet Floor Covering Without Backing
ASTM F 2169	Resilient Stair Treads
ASTM F 2170	Determining Relative Humidity in Concrete Floor Slabs in situ Probes
ASTM F 710	Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring

GREEN SEAL (GS)

GS-36	Commercial Adhesives

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 3813	Resilient Floor Coverings - Cork Floor Tiles

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	Adhesive and Sealant Applications

1.3 SYSTEM DESCRIPTION

1.3.1 Fire Resistance Requirements

Provide a minimum average critical radiant flux of 0.22 watts per square centimeter for flooring in corridors and exits when tested in accordance with ASTM E 648.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Resilient Flooring and Accessories

SD-03 Product Data

Resilient Flooring and Accessories
Adhesives
Vinyl Composition Tile

Sheet Vinyl Flooring
Wall Base
Environmental Data
Certification

SD-04 Samples

Resilient Flooring and Accessories

SD-06 Test Reports

Moisture, Alkalinity and Bond Tests

SD-08 Manufacturer's Instructions

Surface Preparation
Installation

SD-10 Operation and Maintenance Data

Resilient Flooring and Accessories

SD-11 Closeout Submittals

Resilient Flooring and Accessories
Adhesives

1.5 SUSTAINABLE DESIGN CERTIFICATION

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the building site in original unopened containers bearing the manufacturer's name, style name, pattern color name and number, production run, project identification, and handling instructions. Store materials in a clean, dry, secure, and well-ventilated area free from strong contaminant sources and residues with ambient air temperature maintained above 68 degrees F and below 85 degrees F, stacked according to manufacturer's recommendations. Remove resilient flooring products from packaging to allow ventilation prior to installation. Protect materials from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances. Observe ventilation and safety procedures specified in the MSDS. Do not store rubber surface products with materials that have a high capacity to adsorb volatile organic compound (VOC) emissions.

1.7 ENVIRONMENTAL REQUIREMENTS

Maintain areas to receive resilient flooring at a temperature above 68 degrees F and below 85 degrees F for 3 days before application, during application and 2 days after application, unless otherwise directed by the flooring manufacturer for the flooring being installed. Maintain a minimum temperature of 55 degrees F thereafter. Provide adequate ventilation to remove moisture from area and to comply with regulations limiting concentrations of hazardous vapors.

1.8 SCHEDULING

Schedule resilient flooring application after the completion of other work which would damage the finished surface of the flooring.

1.9 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a one year period.

PART 2 PRODUCTS

2.1 VINYL COMPOSITION TILE

Conform to ASTM F 1066 Class 2, (through pattern tile), Composition 1, asbestos-free, 1/8 inch thick. Provide color and pattern uniformly distributed throughout the thickness of the tile. Tile shall contain a minimum of 90 percent recycled material.

2.2 SHEET VINYL FLOORING

Conform to ASTM F 1303, Type II, Grade 1, without backing (minimum wear layer thickness 0.080 inch and minimum overall thickness 0.080 inch), and a minimum 6 feet wide. Extend color and pattern through the total thickness of the material. Flooring shall contain 100 percent post-industrial recycled PVC plastic. As required, provide welding rods as recommended by the manufacturer for heat welding of joints.

2.3 WALL BASE

Conform to ASTM F 1861, Type TV (thermoplastic vinyl), Style A (straight - installed with carpet and Style B (coved - installed with resilient flooring). Provide 4 inch high and a minimum 1/8 inch thick wall base. Provide preformed corners in matching height, shape, and color.

2.4 INTEGRAL COVE BASE

Extend integral coved base for sheet vinyl flooring up the wall 4 inch. Provide a clear anodized aluminum, square cap strip and vinyl, rubber, or wood fillet strip with a minimum radius of 3/4 inch for integral coved bases. Provide integral cove of the same material as flooring.

2.5 MOULDING

Provide tapered mouldings of vinyl and types as recommended by flooring manufacturer for both edges and transitions of flooring materials specified. Provide vertical lip on moulding of maximum 1/4 inch. Provide bevel change in level between 1/4 and 1/2 inch with a slope no greater than 1:2.

2.6 ADHESIVES

Provide adhesives for flooring, base and accessories as recommended by the manufacturer and comply with local indoor air quality standards. Submit manufacturer's descriptive data, documentation stating physical characteristics, and mildew and germicidal characteristics. Provide Material Safety Data Sheets (MSDS) for all primers and adhesives to the COR COR. Highlight VOC emissions.

2.7 SURFACE PREPARATION MATERIALS

Provide surface preparation materials, such as panel type underlayment, lining felt, and floor crack fillers as recommended by the flooring manufacturer for the subfloor conditions.

2.8 POLISH/FINISH

Provide polish finish as recommended by the manufacturer and conform to ASTM D 4078 for polish.

2.9 CAULKING AND SEALANTS

Provide caulking and sealants in accordance with Section 07 92 00 JOINT SEALANTS.

2.10 MANUFACTURER'S COLOR, PATTERN AND TEXTURE

Provide color, pattern and texture for resilient flooring and accessories as indicated on the drawings, selected from manufacturer's standard colors. Color listed is not intended to limit the selection of equal colors from other manufacturers. Provide flooring in any one continuous area or replacement of damaged flooring in continuous area from same production run with same shade and pattern. Submit scaled drawings indicating patterns (including location of patterns and colors) and dimensions. Submit manufacturer's descriptive data and three samples of each indicated color and type of flooring, base, and accessories sized a minimum 2-1/2 by 4 inch. Submit Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

PART 3 EXECUTION

3.1 EXAMINATION

Examine and verify that site conditions are in agreement with the design package. Report all conditions that will prevent a proper installation. Do not take any corrective action without written permission from the Government. Work will proceed only when conditions have been corrected and accepted by the installer. Submit manufacturer's printed installation instructions for all flooring materials and accessories, including preparation of substrate, seaming techniques, and recommended adhesives.

3.2 SURFACE PREPARATION

Provide a smooth, true, level plane for surface preparation of the flooring, except where indicated as sloped. Floor to be flat to within 3/16 inch in 10 feet. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Prepare the surfaces of lightweight concrete slabs (as defined by the flooring manufacturer) as recommended by the flooring manufacturer. Comply with ASTM F 710 for concrete subfloor preparation. Floor fills or toppings may be required as recommended by the flooring manufacturer. Install underlayments, when required by the flooring manufacturer, in accordance with manufacturer's recommended printed installation instructions. Comply with ASTM F 1482 for panel type underlayments. Before any work under this section is begun, correct all defects such as rough or scaling concrete, chalk and dust, cracks, low spots, high spots, and uneven surfaces. Repair all damaged portions of concrete slabs as recommended by the flooring manufacturer. Remove concrete curing and sealer compounds from the slabs, other than the

type that does not adversely affect adhesion. Remove paint, varnish, oils, release agents, sealers, waxes, and adhesives, as required by the flooring product in accordance with manufacturer's printed installation instructions.

3.3 MOISTURE, ALKALINITY AND BOND TESTS

Determine the suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content and pH level by moisture and alkalinity tests. Conduct moisture testing in accordance with ASTM F 1869 or ASTM F 2170, unless otherwise recommended by the flooring manufacturer. Conduct alkalinity testing as recommended by the flooring manufacturer. Determine the compatibility of the resilient flooring adhesives to the concrete floors by a bond test in accordance with the flooring manufacturer's recommendations. Submit copy of test reports for moisture and alkalinity content of concrete slab, and bond test stating date of test, person conducting the test, and the area tested.

3.4 PLACING VINYL COMPOSITION AND SOLID VINYL TILES

Install tile flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's directions. Keep tile lines and joints square, symmetrical, tight, and even. Keep each floor in true, level plane, except where slope is indicated. Vary edge width as necessary to maintain full-size tiles in the field, no edge tile to be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Cut, fit, and scribe edge tile to walls and partitions after field flooring has been applied.

3.5 PLACING SHEET VINYL FLOORING

Install sheet vinyl flooring and accessories in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Provide square, symmetrical, tight, and even flooring lines and joints. Keep each floor in true, level plane, except where slope is indicated. Cut flooring to fit around all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Lay out sheets to minimize waste. Cut, fit, and scribe flooring to walls and partitions after field flooring has been applied. Provide chemically bonded or heat welded seams and edges in accordance with the manufacturer's written installation instructions. Finish joints flush, free from voids, recesses, and raised areas. Install flooring with an integral coved base.

3.6 PLACING FEATURE STRIPS

Install feature strips in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions.

3.7 PLACING MOULDING

Provide moulding where flooring termination is higher than the adjacent finished flooring and at transitions between different flooring materials. When required, locate moulding under door centerline. Moulding is not required at doorways where thresholds are provided. Secure moulding with adhesive as recommended by the manufacturer. Prepare and apply adhesives in accordance with manufacturer's printed directions.

3.8 PLACING WALL BASE

Install wall base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Tighten base joints and make even with adjacent resilient flooring. Fill voids along the top edge of base at masonry walls with caulk. Roll entire vertical surface of base with hand roller, and press toe of base with a straight piece of wood to ensure proper alignment. Avoid excess adhesive in corners.

3.9 PLACING INTEGRAL COVED BASE

Install integral cove base in accordance with manufacturer's printed installation instructions. Prepare and apply adhesives in accordance with manufacturer's printed directions. Shape integral coved base by extending the flooring material 4 inches onto the wall surface. Support cove by a filler. Provide a cap strip at the top of the base. Fill voids along the top edge of base at masonry walls with caulk.

3.10 CLEANING

Immediately upon completion of installation of flooring in a room or an area, dry/clean the flooring and adjacent surfaces to remove all surplus adhesive. Clean flooring as recommended in accordance with manufacturer's printed maintenance instructions. No sooner than 5 days after installation, wash flooring with a nonalkaline cleaning solution, rinse thoroughly with clear cold water, and, except for rubber flooring and stair treads, risers and stringers, vinyl and other flooring not requiring polish finish by manufacturer, apply the number of coats of polish in accordance with manufacturer's written instructions. Clean and maintain all other flooring as recommended by the manufacturer.

3.11 WASTE MANAGEMENT

Separate offcuts and waste materials and reuse or recycle in accordance with the Waste Management Plan, keeping sheet materials larger than 2 square feet and tiles larger than 1/2 tiles separate for reuse. Identify manufacturer's policy for collection or return of construction scrap, unused material, demolition scrap, and/or packaging material. Place materials defined as hazardous or toxic waste in designated containers and dispose of properly. Close and seal tightly partly used sealant and adhesive containers and store protected in a well ventilated fire-safe area at moderate temperature.

3.12 PROTECTION

From the time of installation until acceptance, protect flooring from damage as recommended by the flooring manufacturer. Remove and replace flooring which becomes damaged, loose, broken, or curled and wall base which is not tight to wall or securely adhered.

-- End of Section --

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SECTION 09 68 00

CARPET

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for broadloom carpet, modular tile carpet, and entrance carpet.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC TM 107	Colorfastness to Water
AATCC TM 134	Electrostatic Propensity of Carpets
AATCC TM 16	Colorfastness to Light
AATCC TM 165	Colorfastness to Crocking: Textile Floor Coverings - Crockmeter Method
AATCC TM 174	Antimicrobial Activity Assessment of Carpets

ASTM INTERNATIONAL (ASTM)

ASTM D 1667	Flexible Cellular Materials - Poly (Vinyl Chloride) Foam (Closed-Cell)
ASTM D 297	Rubber Products - Chemical Analysis
ASTM D 3278	Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM D 3574	Standard Test Methods for Flexible Cellular Materials—Slab, Bonded, and Molded Urethane Foams
ASTM D 3676	Rubber Cellular Cushion Used for Carpet or Rug Underlay
ASTM D 5793	Binding Sites Per Unit Length or Width of Pile Yarn Floor Coverings

ASTM D 5848	Mass Per Unit Area of Pile Yarn Floor Coverings
ASTM D 6859	Standard Test Method for Pile Thickness of Finished Level Pile Yarn Floor Coverings
ASTM E 2129	Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM E 648	Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

CARPET AND RUG INSTITUTE (CRI)

CRI 104	Standard for Installation Specification of Commercial Carpet

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 2551	Machine-made Textile Floor Coverings - Determination of Dimensional Changes Due to the Effects of Varied Water and Heat Conditions

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

16 CFR 1630	Standard for the Surface Flammability of Carpets and Rugs (FF 1-70)
40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

WOOLMARK BUSINESS INTELLIGENCE (WBI)

Woolmark	Certification for Use of 100 Percent Wool

1.3 SYSTEM DESCRIPTION

1.3.1 Scheduling

Install carpet systems after the installation and ventilation period of materials or finishes which have high short-term emissions of VOCs, formaldehyde, particulates, or other air-borne compounds which may be adsorbed by or settle on the carpet tiles.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation
Moldings

SD-03 Product Data

Carpet
Carpet Cushion
Moldings
Surface Preparation
Installation
Regulatory Requirements

SD-04 Samples

Carpet
Moldings

SD-06 Test Reports

Moisture and Alkalinity Tests

SD-07 Certificates

Carpet
Regulatory Requirements

SD-10 Operation and Maintenance Data

Carpet
Cleaning and Protection
Maintenance Service

1.5 QUALITY ASSURANCE

Provide the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) label for carpet, carpet cushion, and adhesives or demonstrate compliance with testing criteria and frequencies through independent laboratory test results. Carpet, carpet cushion, and adhesives bearing the label will indicate that the carpet has been tested and meets the Regulatory Requirements and criteria of the CRI IAQ Carpet Testing Program, and minimizes the impact on indoor air quality. Procure carpet in accordance with 40 CFR 247, and where possible, purchased locally to reduce emissions of fossil fuels from transporting. Conform to EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS for carpet.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Remove materials from packaging and store them in a clean, dry, well ventilated area (100 percent outside air supply, minimum of 1.5 air changes per hour, and no recirculation), protected from damage, soiling, and moisture, and strong contaminant sources and residues, and maintain at a temperature above 60 degrees F for 2 days prior to installation. Carpet or carpet tiles shall not be stored with materials which have high emissions of volatile organic compounds (VOCs) or other contaminants. Do not store carpet near materials that may offgas or emit harmful fumes, such as kerosene heaters, fresh paint, or adhesives.

1.7 AMBIENT CONDITIONS

Maintain areas in which carpeting is to be installed at a temperature above 60 degrees F and below 90 degrees F for 2 days before installation, during

installation, and for 2 days after installation. Provide temporary ventilation during work of this section. Maintain a minimum temperature of 55 degrees F thereafter for the duration of the contract. Do not permit traffic or movement of furniture or equipment in carpeted area for 24 hours after installation. Complete other work which would damage the carpet prior to installation of carpet.

1.8 WARRANTY

Provide manufacturer's standard performance guarantees or warranties including minimum ten (10) year wear warranty, two (2) year material and workmanship and ten (10) year tuft bind and delamination.

PART 2 PRODUCTS

2.1 CARPETING

Submit samples of the following:

a. Carpet: Two "Production Quality" samples 18 by 18 inches of each carpet proposed for use, showing quality, pattern, and color specified.

b. Vinyl or Aluminum Moldings: Two pieces of each type at least 12 inches long.

c. Special Treatment Material/Other Accessories: Two samples showing system and installation method.a. These specifications are based on products of Mohawk Commercial Carpet. Products similarly designed and closely comparable in appearance, finish, physical properties and detail may be provided by alternative manufacturers on condition that complete manufacturer's data verifying products equal to or exceeding those of the recommended products are submitted and approved.

b. The following specifies construction for broadloom carpet Type I, 100 percent Amoco XXX Continuous Multifilament Polypropylene:

Type:	Tufted textured level loop
Finished pile height:	0.16 in.
Stitches per meter:	446
Pile content:	DuPont Antron legacy nylon
Pile weight:	0.18 lbs/ft2 minimum
Primary backing:	100% polypropylene
Secondary backing:	Action Bac
Dye method:	Solution dyed
Weight density factor:	Denier - 3000 ply - 3
Flammability:	
Radiant panel test:	Class I, 0.45 W/cm2
Smoke density:	450 maximum, NFPA 258
Color and pattern:	As indicated on drawings

2.2 CARPET PAD

Where indicated on drawings, sponge rubber, flame spread per NFPA 253.

2.3 BASE

See Specification Section 09 65 00 RESILIENT FLOORING.

2.4 ADHESIVES AND CONCRETE PRIMER

Adhesives and concrete primers shall comply with applicable regulations regarding toxic and hazardous materials. Provide water resistant, mildew resistant, nonflammable, and nonstaining adhesives and concrete primers for carpet installation to meet local air-quality standards, and as required by the carpet manufacturer. Provide release adhesive for modular tile carpet as recommended by the carpet manufacturer. Provide adhesives flashpoint of minimum 140 degrees F in accordance with ASTM D 3278.

2.5 MOLDINGS

Install carpet moldings, either vinyl or aluminum, where floor covering material changes or carpet edge does not abut a vertical surface. Provide a hammered surface aluminum molding, pinless clamp-down type, designed for the type of carpet being installed. Provide prefinished color finish. Provide a floor flange of a minimum 1-1/2 inch wide and face a minimum 5/8 inch wide or heavy-duty vinyl molding designed for the type of carpet being installed. Provide floor flange of a minimum 1 1/2 inches wide. Provide color to match \resilient base.

2.6 TAPE

Provide tape for seams as recommended by the carpet manufacturer for the type of seam used in installation. Any seam sealant shall have a maximum VOC content of 50 grams/liter. Do not use sealants that contain 1,1,1-trichloroethane or toluene.

2.7 COLOR, TEXTURE, AND PATTERN

Provide color, texture, and pattern in accordance with the drawings.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Do not install carpet on surfaces that are unsuitable and will prevent a proper installation. Prepare subfloor in accordance with flooring manufacturer's recommended instructions. Repair holes, cracks, depressions, or rough areas using material recommended by the carpet or adhesive manufacturer. Free floor of any foreign materials and sweep clean. Before beginning work, test subfloor with glue and carpet to determine "open time" and bond. Submit three copies of the manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.

3.2 MOISTURE AND ALKALINITY TESTS

Test concrete slab for moisture content and excessive alkalinity in accordance with CRI 104. Submit three copies of test reports of moisture and alkalinity content of concrete slab stating date of test, person conducting the test, and the area tested.

3.3 PREPARATION OF CONCRETE SUBFLOOR

Do not commence installation of the carpeting until concrete substrate is at least 90 days old. Prepare the concrete surfaces in accordance with instructions of the carpet manufacturer. Match carpet, when required, and adhesives to prevent off-gassing to a type of curing compounds, leveling

agents, and concrete sealer.

3.4 INSTALLATION

Isolate area of installation from rest of building. Perform all work by installers who are CFI certified (International Certified Floorcovering Installer Association), or manufacturer's approved installers. Conduct installation in accordance with the manufacturer's printed instructions and CRI 104. Protect edges of carpet meeting hard surface flooring with molding and install in accordance with the molding manufacturer's printed instructions. Use autofoam mothproofing system for wool carpets. Follow ventilation, personal protection, and other safety precautions recommended by the adhesive manufacturer. Continue ventilation during installation and for at least 72 hours following installation. Submit three copies of drawings indicating areas receiving carpet, carpet types, textures and patterns, direction of pile, location of seams, and locations of edge molding. Submit installation drawings for: 1) Carpet Cushion and 2) Carpet Moldings diagramming the location of seams, edge moldings, and carpet direction for approval prior to installation.

3.5 CLEANING AND PROTECTION

Submit three copies of carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles.

3.5.1 Cleaning

As specified in Section 01 78 00 CLOSEOUT SUBMITTALS. After installation of the carpet, remove debris, scraps, and other foreign matter. Remove soiled spots and adhesive from the face of the carpet with appropriate spot remover. Cut off and remove protruding face yarn. Vacuum carpet clean with a high-efficiency particulate air (HEPA) filtration vacuum.

3.5.2 Protection

Protect the installed carpet from soiling and damage with heavy, reinforced, nonstaining kraft paper, plywood, or hardboard sheets. Lap and secure edges of kraft paper protection to provide a continuous cover. Restrict traffic for at least 48 hours. Remove protective covering when directed by the COR.

3.5.3 Acceptance Provisions

Thoroughly clean surfaces of new carpeting and adjacent surfaces soiled as a result of this work. Remove work equipment, surplus materials, and rubbish from Worksite. Remove damaged and unacceptable portions of work, and replace with new carpeting.

3.6 REMNANTS

Collect information from manufacturer about maintenance agreement take-back program options, and provide to COR. Manage waste as specified in the Waste Management Plan. Provide remnants remaining from the installation, consisting of scrap pieces more than 2 feet in dimension with more than 6 square feet total to the Government. Non-retained scraps shall be set aside and returned to manufacturer for recycling into new product.

3.7 MAINTENANCE

3.7.1 Maintenance Service

Collect information from the manufacturer about maintenance agreement or green lease options, and submit to COR. Service shall reclaim materials for recycling and/or reuse. Service shall not landfill or burn reclaimed materials. When such a service is not available, seek local recyclers to reclaim the materials. Submit documentation of manufacturer's maintenance agreement ,take-back program, or green lease for carpet. Include contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

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SECTION 09 90 00.00

PAINTS AND COATINGS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for painting of new and existing, interior and exterior substrates, including masonry, concrete, metal, wood and other miscellaneous materials.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH 0100Doc	Documentation of the Threshold Limit Values and Biological Exposure Indices

ASME INTERNATIONAL (ASME)

ASME A13.1	Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM D 235	Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D 2824	Aluminum-Pigmented Asphalt Roof Coatings, Non-Fibered, Asbestos Fibered, and Fibered without Asbestos
ASTM D 4214	Standard Test Method for Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4263	Indicating Moisture in Concrete by the Plastic Sheet Method
ASTM D 4444	Use and Calibration of Hand-Held Moisture Meters
ASTM D 523	Standard Test Method for Specular Gloss

ASTM D 6386	Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM E 2129	Standard Practice for Data Collection for Sustainability Assessment of Building Products
ASTM F 1869	Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

MASTER PAINTERS INSTITUTE (MPI)

MPI 1	Aluminum Paint
MPI 10	Exterior Latex, Flat, MPI Gloss Level 1
MPI 101	Epoxy Anti-Corrosive Metal Primer
MPI 107	Rust Inhibitive Primer (Water-Based)
MPI 108	High Build Epoxy Coating, Low Gloss
MPI 11	Exterior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 113	Exterior Pigmented Elastomeric Coating (Water Based)
MPI 116	Epoxy Block Filler
MPI 119	Exterior Latex, Gloss
MPI 13	Exterior Solvent-Based Semi-Transparent Stain
MPI 134	Galvanized Primer (Waterbased)
MPI 138	Interior High Performance Latex, MPI Gloss Level 2
MPI 139	Interior High Performance Latex, MPI Gloss Level 3
MPI 140	Interior High Performance Latex, MPI Gloss Level 4
MPI 141	Interior High Performance Latex MPI Gloss Level 5
MPI 144	Institutional Low Odor / VOC Interior Latex, MPI Gloss Level 2

MPI 145	Institutional Low Odor / VOC Interior Latex, MPI Gloss Level 3
MPI 146	Institutional Low Odor/VOC Interior Latex, MPI Gloss Level 4
MPI 147	Institutional Low Odor / VOC Interior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 151	Interior W.B. Light Industrial Coating, MPI Gloss Level 3
MPI 153	Interior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 154	Interior W.B. Light Industrial Coating, Gloss, MPI Gloss Level 6
MPI 16	Exterior Latex-Based Solid Hide Stain
MPI 161	Exterior W.B. Light Industrial Coating, MPI Gloss Level 3
MPI 163	Exterior W.B. Light Industrial Coating, Semi-Gloss, MPI Gloss Level 5
MPI 164	Exterior W.B. Light Industrial Coating, Gloss, MPI Gloss Level 6
MPI 19	Inorganic Zinc Rich Primer
MPI 2	Aluminum Heat Resistant Enamel (up to 427 C and 800 F
MPI 21	Heat Resistant Enamel, Gloss (up to 205 degrees C and 400 degrees F), MPI Gloss Level 6
MPI 22	Aluminum Paint, High Heat (up to 590 degrees C and 1100 degrees F.
MPI 23	Surface Tolerant Metal Primer
MPI 26	Cementitious Galvanized Metal Primer
MPI 27	Exterior / Interior Alkyd Floor Enamel, Gloss
MPI 31	Polyurethane, Moisture Cured, Clear Gloss
MPI 39	Interior Latex-Based Wood Primer
MPI 4	Interior/Exterior Latex Block Filler
MPI 42	Latex Stucco and Masonry Textured Coating
MPI 44	Interior Latex, MPI Gloss Level 2

MPI 45	Interior Alkyd Primer Sealer
MPI 46	Interior Enamel Undercoat
MPI 47	Interior Alkyd, Semi-Gloss, MPI Gloss Level 5
MPI 48	Interior Alkyd, Gloss, MPI Gloss Level 6
MPI 49	Interior Alkyd, Flat, MPI Gloss Level 1
MPI 5	Exterior Alkyd Wood Primer
MPI 50	Interior Latex Primer Sealer
MPI 51	Interior Alkyd, Eggshell, MPI Gloss Level 2
MPI 52	Interior Latex, MPI Gloss Level 3
MPI 54	Interior Latex, Semi-Gloss, MPI Gloss Level 5
MPI 56	Interior Oil Modified Urethane Clear Gloss
MPI 57	Interior Oil Modified Urethane Clear Satin
MPI 59	Interior/Exterior Floor Enamel, Low Gloss
MPI 6	Exterior Latex Wood Primer
MPI 60	Interior/Exterior Latex Floor Paint, Low Gloss
MPI 68	Interior/Exterior Latex Floor Enamel, Gloss
MPI 7	Exterior Oil Wood Primer
MPI 71	Polyurethane, Moisture Cured, Clear, Flat
MPI 72	Polyurethane, Two Component, Pigmented, Gloss
MPI 77	Epoxy Gloss
MPI 79	Alkyd Anti-Corrosive Metal Primer
MPI 8	Exterior Alkyd, Flat, MPI Gloss Level I
MPI 9	Exterior Alkyd, Gloss, MPI Gloss Level 6
MPI 90	Interior Wood Stain, Semi-Transparent
MPI 94	Exterior Alkyd, Semi-Gloss, MPI Gloss Level 5
MPI 95	Quick Drying Primer for Aluminum

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage
SCS SP-01	Environmentally Preferable Product Specification for Architectural and Anti-Corrosive Paints

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Guide 6	Guide for Containing Surface Preparation Debris Generated During Paint Removal Operations
SSPC Guide 7	Guide to the Disposal of Lead-Contaminated Surface Preparation Debris
SSPC PA 1	Shop, Field, and Maintenance Painting of Steel
SSPC PA Guide 3	A Guide to Safety in Paint Application
SSPC Paint 18	Chlorinated Rubber Intermediate Coat Paint
SSPC QP 1	Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures)
SSPC SP 1	Solvent Cleaning
SSPC SP 10/NACE No. 2	Near-White Blast Cleaning
SSPC SP 12/NACE No.5	Surface Preparation and Cleaning of Metals by Waterjetting Prior to Recoating
SSPC SP 2	Hand Tool Cleaning
SSPC SP 3	Power Tool Cleaning
SSPC SP 6/NACE No.3	Commercial Blast Cleaning
SSPC SP 7/NACE No.4	Brush-Off Blast Cleaning
SSPC VIS 1	Guide and Reference Photographs for Steel Surfaces Prepared by Dry Abrasive Blast Cleaning
SSPC VIS 3	Guide and Reference Photographs for Steel Surfaces Prepared by Hand and Power Tool Cleaning
SSPC VIS 4/NACE VIS 7	Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	Safety and Health Requirements Manual

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-PRF-680	Degreasing Solvent
MIL-STD-101	Color Code for Pipelines & for Compressed Gas Cylinders

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA Method 24	Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings

U.S. FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	Obstruction Marking and Lighting

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-313	Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities
FED-STD-595	Colors Used in Government Procurement

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.1000	Air Contaminants
29 CFR 1910.1001	Asbestos
29 CFR 1910.1025	Lead
29 CFR 1926.62	Lead

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

SD-03 Product Data

Coating

Manufacturer's Technical Data Sheets

SD-04 Samples

Color

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

SD-07 Certificates

Applicator's qualifications

SD-08 Manufacturer's Instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, potlife, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings:; G

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

SD-11 Closeout Submittals

Material Safety Data Sheet

Paint MSDS submitted to Code JQ for compliance documentation.

1.4 APPLICATOR'S QUALIFICATIONS

1.4.1 SSPC QP 1 Certification

All contractors and subcontractors that perform surface preparation or coating application shall be certified by the Society for Protective Coatings (formerly Steel Structures Painting Council) (SSPC) to the requirements of SSPC QP 1 prior to contract award, and shall remain certified while accomplishing any surface preparation or coating application. The painting contractors and painting subcontractors must remain so certified for the duration of the project. If a contractor's or subcontractor's certification expires, the firm will not be allowed to perform any work until the certification is reissued. Requests for extension of time for any delay to the completion of the project due to an inactive certification will not be considered and liquidated damages will apply. Notify the COR of any change in contractor certification status.

1.5 QUALITY ASSURANCE

1.6 REGULATORY REQUIREMENTS

1.6.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Bay Area Air Quality Management District (BAAQMD) and regional jurisdiction. Notify COR of any paint specified herein which fails to conform.

1.6.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.6.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.6.4 Asbestos Content

Materials shall not contain asbestos.

1.6.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.6.6 Silica

Abrasive blast media shall not contain free crystalline silica.

1.6.7 Human Carcinogens

Materials shall not contain ACGIH 0100Doc and ACGIH 0100Doc confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.6.8 Volatile Organic Compounds (VOC)

All coatings used in the Project shall meet BAAQMD, Architectural Coatings, Regulation 8, Rule 3, for VOC limits. Submit Manufacturer's Material Safety Data Sheets to Code JQ for pre-approval and upon project completion, MSDS of coatings shall be sent to Code JQ for compliance documentation.

1.7 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 5 gallons. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 40 to 95 degrees F.

1.8 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS and in Appendix A of EM 385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.8.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA Guide 3.

1.8.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.

b. 29 CFR 1910.1000.

c. ACGIH 0100Doc, threshold limit values.

d. The appropriate OSHA standard in 29 CFR 1910.1025 and 29 CFR 1926.62 for surface preparation on painted surfaces containing lead. Removal and disposal of coatings which contain lead is specified in Section 02 83 13.00 20 LEAD IN CONSTRUCTION. Additional guidance is given in SSPC Guide 6 and SSPC Guide 7. Refer to drawings for list of hazardous materials located on this project. Contractor to coordinate paint preparation activities with this specification section.

e. The appropriate OSHA standards in 29 CFR 1910.1001 for surface preparation of painted surfaces containing asbestos. Removal and disposal of coatings which contain asbestos materials is specified in Section 02 82 14.00 10 ASBESTOS HAZARD CONTROL ACTIVITIES. Refer to drawings for list of hazardous materials located on this project. Contractor to coordinate paint preparation activities with this specification section.

1.9 ENVIRONMENTAL CONDITIONS

Comply, at minimum, with manufacturer recommendations for space ventilation during and after installation. Isolate area of application from rest of building when applying high-emission paints or coatings.

1.9.1 Coatings

Do not apply coating when air or substrate conditions are:

a. Less than 5 degrees F above dew point;

b. Below 50 degrees F or over 95 degrees F, unless specifically pre-approved by the COR and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer

recommendations.

1.10 COLOR SELECTION

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the COR. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

1.11 LOCATION AND SURFACE TYPE TO BE PAINTED

1.11.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.

b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.

c. Existing coated surfaces that are damaged during performance of the work.

1.11.1.1 Exterior Painting

Includes new surfaces, existing coated surfaces, and existing uncoated surfaces, of the buildings and appurtenances. Also included are existing coated surfaces made bare by cleaning operations.

1.11.1.2 Interior Painting

Includes new surfaces, existing uncoated surfaces, and existing coated surfaces of the buildings and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

a. Exposed columns, girders, beams, joists, and metal deck; and

b. Other contiguous surfaces.

1.11.2 Painting Excluded

Do not paint the following unless indicated otherwise.

a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.

b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, attic spaces, crawl

spaces, elevator shafts and chases.

c. Steel to be embedded in concrete.

d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.

e. Hardware, fittings, and other factory finished items.

1.11.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new and existing surfaces.

a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.

1. Exposed piping, conduit, and ductwork;

2. Supports, hangers, air grilles, and registers;

3. Miscellaneous metalwork and insulation coverings.

b. Do not paint the following, unless indicated otherwise:

1. New zinc-coated, aluminum, and copper surfaces under insulation

2. New aluminum jacket on piping

3. New interior ferrous piping under insulation

1.11.4 Definitions and Abbreviations

1.11.4.1 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendaring, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.11.4.2 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.11.4.3 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.11.4.4 EPP

Environmentally Preferred Products, a standard for determining

environmental preferability in support of Executive Order 13101.

1.11.4.5 EXT

MPI short term designation for an exterior coating system.

1.11.4.6 INT

MPI short term designation for an interior coating system.

1.11.4.7 micron / microns

The metric measurement for one/one-thousandth of a millimeter.

1.11.4.8 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns.

1.11.4.9 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.11.4.10 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units at 60 degrees	Units at 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.11.4.11 MPI System Number

The MPI coating system number in each Division found in either the MPI

Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.11.4.12 Paint

See Coating definition.

1.11.4.13 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.11.4.14 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 REPUTTYING AND REGLAZING

Remove cracked, loose, and defective putty or glazing compound on glazed sash and provide new putty or glazing compound. Where defective putty or glazing compound constitutes 30 percent or more of the putty at any one light, remove the glass and putty or glazing compound and reset the glass. Remove putty or glazing compound without damaging sash or glass. Clean rabbets to bare wood or metal and prime prior to reglazing. Putty for wood sash shall be a linseed oil putty. Patch surfaces to provide smooth transition between existing and new surfaces. Finish putty or glazing compound to a neat and true bead. Allow glazing compound time to cure, in accordance with manufacturer's recommendation, prior to coating application. Allow putty to set one week prior to coating application.

3.3 RESEALING OF EXISTING EXTERIOR JOINTS

3.3.1 Surface Condition

Surfaces shall be clean, dry to the touch, and free from frost and moisture; remove grease, oil, wax, lacquer, paint, defective backstop, or other foreign matter that would prevent or impair adhesion. Where adequate

grooves have not been provided, clean out to a depth of 1/2 inch and grind to a minimum width of 1/4 inch without damage to adjoining work. Grinding shall not be required on metal surfaces.

3.4 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, disintegrated coatings, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.5 PREPARATION OF METAL SURFACES

3.5.1 Existing and New Ferrous Surfaces

a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, SSPC SP 6/NACE No.3, or SSPC SP 10/NACE No. 2. Brush-off blast remaining surface in accordance with SSPC SP 7/NACE No.4; Water jetting to SSPC SP 12/NACE No.5 WJ-4 may be used to remove loose coating and other loose materials. Use inhibitor as recommended by coating manufacturer to prevent premature rusting. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.

3.5.2 Galvanized Surfaces

a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 6386, Appendix X2, and remove by one of the methods described therein.

b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC SP 12/NACE No.5 WJ3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.

c. Galvanized With Severe Deteriorated Coating or Severe Rusting: Water jet to SSPC SP 12/NACE No.5 WJ3 degree of cleanliness. Spot abrasive blast rusted areas as described for steel in SSPC SP 6/NACE No.3, and waterjet to SSPC SP 12/NACE No.5, WJ3 to remove existing coating.

3.5.3 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.5.4 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D 235. Wipe dry with clean, dry cloths.

3.5.5 Existing Surfaces with a Bituminous or Mastic-Type Coating

Remove chalk, mildew, and other loose material by washing with a solution of 1/2 cup trisodium phosphate, 1/4 cup household detergent, one quart 5 percent sodium hypochlorite solution and 3 quarts of warm water.

3.6 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.6.1 Concrete and Masonry

a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.

b. Surface Cleaning: Remove the following deleterious substances.

1. Dirt, Chalking, Grease, and Oil: Wash new and existing uncoated surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cuphousehold detergent, and 4 quarts of warm water. Then rinse thoroughly with fresh water. Wash existing coated surfaces with a suitable detergent and rinse thoroughly. For large areas, water blasting may be used.

2. Fungus and Mold: Wash new, existing coated, and existing uncoated surfaces with a solution composed of 1/2 cup trisodium phosphate, 1/4 cup household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

3. Paint and Loose Particles: Remove by wire brushing.

4. Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 4 square feet of surface, per workman, at one time.

c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.

d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D 4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F 1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.6.2 Gypsum Board, Plaster, and Stucco

a. Surface Cleaning: Plaster and stucco shall be clean and free from loose matter; gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.

c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263. New plaster to be coated shall have a maximum moisture content of 8 percent, when measured in accordance with ASTM D 4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.6.3 Existing Asbestos Cement Surfaces

Remove oily stains by solvent cleaning with mineral spirits, ASTM D 235. Remove loose dirt, dust, and other deleterious substances by brushing with a soft brush or rubbing with a dry cloth prior to application of the first coat material. Do not wire brush or clean using other abrasive methods. Surfaces shall be dry and clean prior to application of the coating.

3.7 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.7.1 New, Existing Uncoated, and Existing Coated Plywood and Wood Surfaces, Except Floors:

a. Wood surfaces shall be cleaned of foreign matter.

   Surface Cleaning: Surfaces shall be free from dust and other deleterious substances and in a condition approved by the COR prior to receiving paint or other finish. Do not use water to clean uncoated wood. Scrape to remove loose coatings. Lightly sand to roughen the entire area of previously enamel-coated wood surfaces.

b. Removal of Fungus and Mold: Wash existing coated surfaces with a solution composed of 3 ounces (2/3 cup) trisodium phosphate, 1 ounce (1/3 cup) household detergent, 1 quart 5 percent sodium hypochlorite solution and 3 quarts of warm water. Rinse thoroughly with fresh water.

c. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter in accordance with ASTM D 4444, Method A, unless otherwise authorized.

d. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints.

e. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.

f. Cosmetic Repair of Minor Defects:

   1. Knots and Resinous Wood and Fire, Smoke, Water, and Color Marker

Stained Existing Coated Surface: Prior to application of coating, cover knots and stains with two or more coats of 3-pound-cut shellac varnish, plasticized with 5 ounces of castor oil per gallon. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.

2. Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.

3. Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.

3.8 PIPING IDENTIFICATION

Color code (paint) exposed piping and outside surface of non-metallic insulation jackets in accordance with ASME A13.1 - 2007 Scheme for the Identification of Piping Systems.

3.9 APPLICATION

3.9.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Use trigger operated spray nozzles for water hoses. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated. Wear protective clothing and respirators when applying oil-based paints or using spray equipment with any paints.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat adhesion problems. Provide each coat in specified condition to receive next coat.

b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.

c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.

d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.

3.9.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the COR to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 1 pint of suitable thinner per gallon. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.9.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.9.4 Coating Systems

a. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 1.5 mil each coat unless specified otherwise by the manufacturer. Coating thickness where specified, refers to the minimum dry film thickness.

b. Coatings for Surfaces Not Specified Otherwise: Coat surfaces which have not been specified, the same as surfaces having similar conditions of exposure.

c. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:

1. One coat of primer.

2. One coat of undercoat or intermediate coat.

3. One topcoat to match adjacent surfaces.

d. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.10 COATING SYSTEMS FOR METAL

a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.

b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.

c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.

d. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.

e. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.11 COATING SYSTEMS FOR WOOD AND PLYWOOD

a. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces which will be inaccessible after erection.

b. Apply stains in accordance with manufacturer's printed instructions.

3.12 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the COR. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.13 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows. Do not use kerosene or any such organic solvents to clean up water based paints. Properly dispose of paints or solvents in designated containers. Close and seal partially used containers of paint to maintain quality as necessary for reuse. Store in protected, well-ventilated, fire-safe area at moderate temperature. Place materials defined as hazardous or toxic waste in designated containers. Coordinate with manufacturer for take-back program. Set aside scrap to be returned to manufacturer for recycling into new product. When such a service is not available, local recyclers shall be sought after to reclaim the materials. Set aside extra paint for future color matches or reuse by the Government. Where local options exist for leftover paint recycling, collect all waste paint by type and provide for delivery to recycling or collection facility for reuse by local

organizations.

3.14 PAINT TABLES

All DFT's are minimum values. Use only materials that do not exceed the VOC limits of BAAQMD.

3.15 EXTERIOR PAINT TABLES

3.15.1 Division 3: Exterior Concrete

New and existing, either coated or uncoated vertical surfaces, including undersides of balconies and soffits, but excluding tops of slabs.

Elastomeric Coating - New: MPI EXT 3.1F / Existing: MPI REX 3.1F

Primer:	As recommended by manufacturer
Intermediate:	MPI 113
Topcoat:	MPI 113
DFT:	Minimum of 16 mils.

3.15.2 Division 4: Exterior Concrete Masonry Units

Elastomeric Coating - New MPI 4.2D / Existing: MPI REX 4.2D

Primer:	As recommended by manufacturer
Intermediate:	MPI 113
Topcoat:	MPI 113
DFT:	Minimum of 16 mils.

3.15.3 Division 5: Exterior Galvanized Surfaces

Waterborne Primer / Latex - MPI EXT 5.3H-G5 (Semigloss)

Primer	MPI 134
Intermediate:	MPI 11
Topcoat:	MPI 11
DFT:	4.5 mils

Waterborne Primer / Latex - MPI EXT 5.3H-G6 (Gloss)

Primer	MPI 134
Intermediate:	MPI 119
Topcoat:	MPI 119
DFT:	4.5 mils

3.16 INTERIOR PAINT TABLES

3.16.1 Division 3: Interior Concrete

New and existing, either coated or uncoated vertical surfaces.

Institutional low odor / low VOC - New MPI INT 3.1M-G3 (Eggshell), Existing MPI RIN 3.1L-G3 (Eggshell)

Primer	MPI 50
Intermediate:	MPI 145
Topcoat:	MPI 145
DFT:	4.0 mils

3.16.2 Division 4: Interior Concrete Masonry

A. Previously painted.

Institutional low odor / low VOC - Existing MPI RIN 4.2L-G3 (Eggshell)
Spot Primer: MPI 50
Intermediate: MPI 145
Topcoat: MPI 145
DFT: 4.0 mils

B. New and existing, uncoated.

Institutional low odor / low VOC - New MPI INT 4.2E-G3 (Eggshell)
Filler: MPI 4
Intermediate: MPI 145
Topcoat: MPI 145
DFT: 4.0 mils

C. New and uncoated existing concrete masonry units in toilets, food-preparation, food-serving, restrooms, shower areas, areas requiring a high degree of sanitation, and other high humidity areas unless otherwise specified.

Waterborne Light Industrial Coating - MPI INT 4.2G-G3 (Eggshell)
Spot Primer: MPI 151
Intermediate: MPI 151
Topcoat: MPI 151
DFT: 4.5 mils

3.16.3 Division 5: Interior Ferrous Metals

Hollow metal doors and frames, and other items not otherwise specified.

Latex over galvanized primer - MPI INT 5.3J-G5 (Semigloss)
Primer MPI 134
Intermediate: MPI 153
Topcoat: MPI 153
DFT: 4 mils

3.16.4 Division 6: Interior Wood

Dressed lumber including doors, door and window frames, casings and moldings.

New and Existing, uncoated.

Institutional low odor / low VOC - Existing MPI INT 6.3V-G5 (Semigloss)
Spot Primer: MPI 39
Intermediate: MPI 147
Topcoat: MPI 147
DFT: 4.0 mils

3.16.5 Division 9: Interior Plaster or Gypsum Board, High-humidity areas

New and existing, previously painted wallboard in toilets, shower areas, and other high humidity areas not otherwise specified.

New: MPI INT 9.2L-G5 (Semigloss), Existing: MPI RIN 9.2L-G5 (Semigloss), Waterborne Light Industrial Coating
Primer MPI 50
Intermediate: MPI 153
Topcoat: MPI 153
DFT: 4 mils

3.16.6 Division 9: Interior Plaster or Gypsum Board

New and existing, previously painted wallboard and other areas not otherwise specified.

New: MPI INT 9.2M-G3 (Eggshell), Existing: MPI RIN 9.2M-G3 (Eggshell), Institutional Low Odor / Low VOC Latex

Primer	MPI 50
Intermediate:	MPI 145
Topcoat:	MPI 145
DFT:	4 mils

-- End of Section --

SECTION TABLE OF CONTENTS

DIVISION 09 - FINISHES

SECTION 09 96 00

HIGH-PERFORMANCE COATINGS

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SECTION 09 96 00

HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for special coatings as required for harsh indoor locations or operations (any area subjected to chemical and/or abrasive action), and all outdoor installations.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 380	Standard Practice for Use of the International System of Units (SI) (The Modernized Metric System)

MILITARY SPECIFICATIONS (MS)

MS MIL-C-83286	Coating Urethane, Aliphatic Isocyanate, For Aerospace Applications
MS MIL-P-24441/1	Paint, Epoxy-Polyamide, Green Primer, Formula 150, Type I
MS MIL-P-24441/GEN	Paint Epoxy-Polyamide

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 27	Basic Zinc Chromate-Vinyl Butyral Wash Primer
SSPC SP 1	Solvent Cleaning
SSPC SP 2	Hand Tool Cleaning
SSPC SP 3	Power Tool Cleaning
SSPC SP 5/NACE No. 1	White Metal Blast Cleaning

ASTM INTERNATIONAL (ASTM)

IEEE/ASTM SI 10	American National Standard for Use of the

International System of Units (SI): The Modern Metric System

MASTER PAINTERS INSTITUTE (MPI)

MPI ASM Architectural Painting Specification Manual

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 7/NACE No.4 Brush-Off Blast Cleaning

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

QPL-TNT-AP-28 Paint, Aluminum, Heat Resisting (1200 Degrees F)

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment and Fixture List in accordance with paragraph entitled, "Delivery, Handling and Storage," of this section.

SD-03 Product Data

Submit manufacturer's catalog data for the following items including manufacturer's name and identification. Data shall include detailed analysis of each special coating material required for the project, with all the coating constituents measured as percentages of the total weight of the coating. Manufacturer's data concerning application, thinning, and average coverage per gallon shall be included.

Heat-Resistant Coatings
Epoxy Coatings
Polyurethane Coatings
Chlorinated-Rubber Coatings

SD-04 Samples

Submit sample Color Chips in accordance with paragraph entitled, "Delivery, Handling and Storage," of this section.

SD-07 Certificates

Submit certificates for following items showing conformance with the referenced standards contained in this section.

Heat-Resistant Coatings
Epoxy Coatings
Polyurethane Coatings
Chlorinated-Rubber Coatings

1.4 DELIVERY, HANDLING AND STORAGE

Special coating materials must be delivered to the project in their original containers bearing manufacturer's name, descriptive label, and coating formulations. Provide new and unopened containers.

Special coating materials must be stored in tightly closed containers in a covered, well-ventilated area where they will not be exposed to excessive heat, fumes, sparks, flame, or direct sunlight. Protect water-based coatings against freezing.

Solvents, thinners, and equipment cleaners must be stored with the same care as the coating materials with ambient temperatures continuously maintained at a minimum 45 degrees F.

Submit Material, Equipment and Fixture List consisting of a list of proposed equipment to be used in performance of construction work.

Submit three color chips 3 inch by 4 inch or manufacture pull-down of each finish color and gloss as scheduled.

1.5 FIELD TESTS

Government may take dry-film tests from time to time on finished surfaces. Apply additional coatings to surfaces where there is less than the minimum specified dry-film thickness.

1.6 PROTECTIONS AND SAFETY PRECAUTIONS

Protect adjacent materials and equipment against damage from spillage, dripping, and spatter of coating materials. Building materials and equipment must be left clean and with all damaged surfaces corrected. Provide "WET PAINT" signs to indicate newly painted surfaces.

Provide forced ventilation for interior spaces during application and drying of coatings to prevent the buildup of toxic or explosive concentrations of solvent vapors.

Provide fire extinguishers of the required quantity and correct type to combat flammable liquid fires.

Dispose of rags that are used to wipe up coating materials, solvents, and thinners by drenching them with water and placing in a covered metal container.

1.7 QUALITY ASSURANCE

Comply with Master Painters Institute (MPI) Standards indicated and listed in "MPI Approved Products List." Comply with the requirements in "MPI Architectural Painting Specification Manual" before any project is started.

1.8 CLEANUP

a. Application equipment shall be cleaned promptly and thoroughly with a suitable solvent after each use and stored in clean, covered, well-ventilate container.

b. At the end of each working day, discarded paint materials, rubbish, dirty rags, and other similar trash shall be removed from the project.

c. At the completion of the work, paint spots shall be removed from finish surfaces and the project left in a clean condition.

PART 2 PRODUCTS

2.1 EPOXY COATINGS

2.1.1 General

Epoxy coatings shall conform to MS MIL-P-24441/GEN, as modified.

2.1.2 Vehicle Resins

Vehicle resins for finish coats shall be based on a polyamide-cured, epoxy-resin material. Finish coats shall be applied with a dry-film thickness of not less than 0.004 in. per coat. Finish color and gloss shall be as indicated.

2.1.3 Ferrous and Galvanized Metal Surface Coatings

Coatings on ferrous and galvanized metal surfaces shall be a prime coat and not less than two finish coats. Prime coat shall be based on an epoxy-resin material with a metallic-zinc pigment as recommended by the coating manufacturer for the substrate to be coated and the end use of the coated surface. Resin solids and zinc pigment shall not be less that 80 percent of the total weight of the coating material. Prime coat shall be applied with a total dry-film thickness of not less than 0.004 in. Finish coats shall be epoxy-based coatings as specified.

2.1.4 Aluminum Surface Coatings

Coatings on aluminum surfaces shall be a prime coat and not less than two finish coats. Prime coat shall be epoxy polyamide conforming to MS MIL-P-24441/1. Prime coat shall be applied with a total dry-film thickness of not less than 0.004 in. Finish coats shall be aliphatic polyurethane using ASTM E 380 and conforming to MS MIL-C-83286.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

a. Ferrous Metals

1. Ferrous metals shall be cleaned in accordance with SSPC SP 5 using wet-sand blasting or vacuum-blast cleaning equipment. Surfaces shall be primed promptly after cleaning.

2. After cleaning, ferrous surfaces shall be coated with an epoxy coating using ASTM E 380 and conforming to MS MIL-P-24441/GEN.

b. Galvanized Surfaces

1. Galvanized surfaces scheduled to be painted shall be solvent cleaned in accordance with SSPC SP 1. Rusted and highly soiled surfaces shall be cleaned in accordance with SSPC SP 2 or SSPC SP 3. Care shall be taken not to damage or remove galvanizing.

2. After cleaning, galvanized surfaces shall be treated with a metal

pretreatment coating applied in accordance with SSPC PAINT 27 and coated with an epoxy coating using ASTM E 380 and conforming to MS MIL-P-24441/GEN.

c. Aluminum Surfaces

1. Aluminum and aluminum-alloy surfaces scheduled to be painted shall be solvent cleaned to remove oil, grease, soil, and other foreign matter. Soiled surfaces shall be cleaned with a stiff bristle brush or aluminum wool.

2. After cleaning, aluminum surfaces shall be coated with an epoxy coating using ASTM E 380 and conforming to MS MIL-P-24441/GEN.

3.2 COATING MATERIAL PREPARATION

a. General

1. Coating materials shall be mixed and prepared in accordance with the coating manufacturer's directions for the particular material and coat to be applied. Materials that are not in actual use shall be kept in closed containers.

2. Coating materials that have been mixed with an automatic shaker shall be allowed to stand to let air bubbles escape, then given a final hand mixing before application. Materials shall be stirred so as to produce a mixture of uniform density, and shall be stirred at frequent intervals during application to prevent skinning. Film that may form on the surfaces of the material shall not be stirred into the material. Film shall be removed and strained, if necessary.

b. Thinning - Thinning shall be done in accordance with coating manufacturer's directions for the particular material and coat.

c. Tinting - Prime and intermediate coats of paint shall be a slightly different tint from the finish coat to facilitate identification of each coat. Tinting shall be done by the coating manufacturer and clearly identified as to color and coat.

3.3 APPLICATION OF COATING MATERIALS

a. General

1. Exterior painting shall not be performed in damp or rainy weather. Interior painting shall not be allowed until the building in enclosed and has thoroughly dried out. No painting will be allowed below 50°F and above 95°F. Painting application shall be in accordance with the coating manufacturer's recommendations, and as specified.

2. Application of coating shall be done by skilled applicators. Coatings shall be applied to clean and properly prepared surfaces. Coatings shall be applied carefully with clean, high-quality application equipment. Sufficient time shall be allowed between coats to ensure complete drying and curing. Surfaces shall be sanded and dusted between coatings, as required, to produce a surface free of visible defects. High gloss coatings and clear finished shall be lightly sanded between coats to ensure

bond of following coats.

3. Coats shall be applied to the surfaces in an even film. Cloudiness, spotting, holidays, laps, application marks, runs, sags, and other similar surface imperfections shall be removed and recoated as directed.

4. Coating lines such as wainscots shall be sharp, true, and well-defined. Tape may be used to establish coating lines, providing tape is removed before ragging or sawtooth edges form.

5. Surfaces, including edges, corners, crevices, welds, and other similar changes in surface plane, shall receive a dry-film thickness not less than specified.

b. Brush Application - Brushes shall be clean and the proper size and type for high-quality application of the specified coating materials. Slow-dry coatings shall be brushed out. Quick-dry coatings shall be brushed only enough to spread out evenly.

c. Roller Application

1. Roller covers shall be clean and of the proper nap length, nap texture, and material for high-quality application of the specified coating materials.

2. Roller application shall be done carefully and shall be equivalent in all respects to the same coats applied by high-quality brush application.

d. Spray Application

1. Spray application equipment shall be limited to airless-spray equipment and electrostatic-spray equipment. Equipment shall be clean and operated by workmen skilled in high quality application of coating materials.

2. Spray application of coatings shall be limited to finish coats on metal frameworks, siding, decking, wire mesh, and other surfaces where hand work would be inferior. Sprayed coatings shall be carefully applied and equivalent in all respects to the same coats applied by high quality brush application. Each spray coat shall be permitted to cure before the succeeding coat is applied. Doubling back with application equipment, for the purpose of building up film thickness of two coats in one operation, will not be permitted.

3. Surfaces adjacent to areas to be spray coated shall be covered to prevent damage from overspray, coating rebound, and spray drift.

3.4 ACCEPTANCE PROVISIONS

a. Repairing - Damaged and unacceptable portions of completed work shall be removed and replaced with new work to match adjacent surfaces at no additional cost to the Government.

b. Cleaning - Surfaces of the work, and adjacent surfaces soiled as a result of the work, shall be cleaned. Equipment, surplus materials, and rubbish from the work shall be removed from the site.

-- End of Section --

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DIVISION 09 - FINISHES

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2.2 SEALANT COMPOUND
2.3 PROTECTIVE COATINGS
2.3.1 Coating Systems

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SECTION 09 97 13.00 40

STEEL COATINGS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for coating systems, materials, surface preparation, and application of protective coatings on carbon steel.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM C 920	Standard Specification for Elastomeric Joint Sealants

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC AB 1	Mineral and Slag Abrasives
SSPC Painting Manual	Good Painting Practice, Steel Structures Painting Manual, Volume 1
SSPC SP 1	Solvent Cleaning
SSPC SP 10/NACE No. 2	Near-White Blast Cleaning
SSPC SP 3	Power Tool Cleaning

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists shall be submitted in accordance with paragraph entitled, "General," of this section.

A Safety Plan shall be submitted in accordance with paragraph entitled, "General," of this section.

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items:

Abrasive Blasting Material
Sealant Compound
Inorganic Zinc
Inhibitive Polyamide Epoxy
Aliphatic Polyurethane

SD-04 Samples

Manufacturer's Standard Color Charts shall be submitted in accordance with paragraph entitled, "General," of this section.

Inspection Forms shall be submitted in accordance with paragraph entitled, "Inspection," of this section.

SD-05 Design Data

Mix Designs shall be submitted in accordance with paragraph entitled, "General," of this section.

Inorganic Zinc
Inhibitive Polyamide Epoxy
Aliphatic Polyurethane

SD-06 Test Reports

Inspection reports shall be submitted for protective coating systems in accordance with paragraph entitled, "Inspection," of this section.

SD-07 Certificates

Certificates shall be submitted for following items showing conformance with the referenced standards contained in this section.

Abrasive Blasting Material
Sealant Compound
Inorganic Zinc Coating
Inhibitive Polyamide Epoxy
Aliphatic Polyurethane

SD-08 Manufacturer's Instructions

Manufacturer's instructions shall be submitted for Protective Coatings including details of thinning, mixing, handling, and application.

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered in their original, unopened containers bearing the manufacturer's name, shelf-life, product identification, and batch number.

Coatings, thinners, and cleaners shall be stored in tightly closed containers in a covered, well-ventilated area where they will be protected from exposure to extreme cold or heat, sparks, flame, direct sunlight, or

rainfall. Manufacturer's instructions for storage limitations shall be followed.

1.5 GENERAL

A Safety Plan shall be submitted for protective coating systems in accordance with OSHA regulations.

Material, Equipment, and Fixture Lists shall be submitted for manufacturer's style or catalog numbers, specification and drawing reference numbers and warranty information for the Protective Coatings Systems fabrication site.

Manufacturer's Standard Color Charts shall be submitted showing manufacturer's standard finish colors.

Mix Designs shall be submitted for each type of protective coating including a complete list of ingredients and admixtures. Applicable test report shall verify that the mix has been successfully tested and meets design requirements.

PART 2 PRODUCTS

2.1 ABRASIVE BLASTING MATERIAL

Abrasive blasting materials shall be per SSPC Painting Manual, Chapter 2.4, and SSPC AB 1.

2.2 SEALANT COMPOUND

Sealant shall be a self-curing, single component, polysulfide-rubber type conforming to ASTM C 920. Sealant shall be gray in color and capable of being applied into the joint with a calking gun.

2.3 PROTECTIVE COATINGS

2.3.1 Coating Systems

The following two coating systems definitions are to be specified for use on the surfaces listed in the Coating Schedule, of this section, and as directed.

Coating System No. 1 shall consist of inorganic zinc only, no top coat unless specified. Inorganic zinc shall be selected from the following listing. Coatings, thinners, and cleaners shall be the product of one manufacturer.

Coating System No. 2 shall consist of inorganic zinc first coat, inhibitive polyamide epoxy intermediate coat, and aliphatic polyurethane finish coat. Coatings shall be selected from the following listing and all coatings, thinners, and cleaners shall be the product of the same manufacturer. Each successive coating shall be of a contrasting color to provide a visual assurance of complete coverage.

COATING SYSTEMS

INORGANIC ZINC	INHIBITIVE POLYAMIDE EPOXY	ALIPHATIC POLYURETHANE	MANUFACTURER
Dimetcote 9	Amercoat 370	Amercoat 450HS	Ameron International 201 N. Berry Street Brea, CA 92621 714/529-1951
Carbo Zinc 11	Carboguard 893	Carbothane 134HG	Carboline Company 350 Hanley Industrial Court St. Louis, MO 63144 800/848-4645 Ext. 2557
Catha-Coat 304V	Devran 201	Devthane 369	ICI-DEVOE 925 Euclid Ave. Cleveland, OH 44115 216/344-8798
347-Y-912	525-333 or 71125P	Imron 333	DuPont Company DuPont Building 1007 Market Street Wilmington, DE 19898 800/441-7515
Porter Zinc 3200	Porter Glaze 4400 High Build	Porterthane 9000 Glass Urethane	Porter Paint Company 400 South 13th Street Louisville, KY 40203 800/332-6270

PART 3 EXECUTION

3.1 SURFACE PREPARATION

3.1.1 General

Faying surfaces that will become inaccessible after installation shall be abrasive blasted and coated with inorganic zinc only, prior to installation.

Surfaces that are part of slip-critical joints shall be faying abrasive blasted or mechanically cleaned coated with inorganic zinc prior to installation.

Surfaces to be welded shall be left uncoated. Welded areas shall then be masked and touched up.

Prepared surfaces shall be coated within 6 hours after completion of surface preparation and before rusting or recontamination occurs. Surfaces not coated within 6 hours or which show rusting or contamination, regardless of the length of time after preparation, shall be reprepared.

Surface preparation and coating operations shall be sequenced so that freshly applied coatings will not be contaminated by dust or foreign matter.

Surfaces shall be inspected and degreased as required prior to subsequent surface preparation and the application of protective coatings. Degreasing

shall be by solvent cleaning, detergent washing, or steam cleaning. SSPC SP 1 shall apply for solvent cleaning.

3.1.2 Abrasive Blasting (AB)

a. Abrasive blasting shall conform to SSPC SP 10/NACE No. 2 and SSPC Painting Manual.

b. Compressed air used for abrasive blasting shall be free of moisture and oil.

c. Surfaces not to be blasted are:

   Galvanized steel and prefinished surfaces except when specified to be blast-cleaned in the coating schedule

   Piston rods and bearing surfaces

d. A minimum nozzle pressure of 90 pounds per square inch shall be maintained.

e. Weld slag, weld spatter, and foreign matter shall be removed from surfaces to be coated prior to abrasive blasting using mechanical methods as specified.

f. Blast cleaning shall achieve a 1-to 2-mil anchor profile as indicated by a surface profile comparator, replica tape, or similar device.

g. Rust and corrosion shall be removed from pits and depressions.

h. Abrasive blast aggregate shall not be reused.

i. All traces of abrasive residue and dust shall be removed from the surface, leaving it clean and dry.

3.1.3 Mechanical Cleaning (MC)

Where mechanical cleaning is specified in the coating schedule for existing surfaces and AB is prohibited, needle scalers or abrasive disks or wheels shall be used in accordance with SSPC SP 3, leaving the surface cleanliness equivalent to near-white metal (SSPC SP 10/NACE No. 2).

3.2 COATING APPLICATION

3.2.1 General Requirements

Manufacturer's instructions for thinning, mixing, handling, and applying products shall be considered a part of this specification. In the event of conflict between the requirements of this specification and the manufacturer's recommendations, this specification shall take precedence.

Compressed air used for spraying coatings shall be free of moisture and oil.

Each coat of material applied shall be free from runs; sags; blisters; bubbles; mud cracking; variations in color, gloss, and texture; holidays (missed areas); excessive film build; foreign contaminants; and dry overspray.

No coating shall be applied when rain is imminent or when the temperature

or humidity is outside the limits recommended by the coating manufacturer.

Surface temperature shall be at least 5 degrees F above the dew point.

Coatings shall be thoroughly worked into all joints, crevices, and open spaces. Special attention shall be paid to welds, cutouts, sharp edges, rivets, crevices, and bolts to ensure proper coverage and thickness.

Newly coated surfaces shall be adequately protected from damage.

Coatings shall be applied by airless or conventional spray. Airless spraying shall be used for uniform large surface areas. Conventional spraying shall be used for small areas of intricate configuration and for touchup. During application of inorganic zinc coating, maintain uniform suspension.

3.2.2 Mixing and Application Procedures

Material shall be stirred thoroughly using an instrument that will not induce air into coating.

Mixed material shall be strained through a 30- to 60-mesh screen.

Continuous slow agitation of the material shall be provided during application of inorganic zinc coating, maintain uniform suspension. Continuous rapid agitation shall be avoided.

Material shall be thinned for workability and improved spray characteristics only.

Material shall be applied in even, parallel passes, overlapping 50 percent. Special attention shall be paid to welds, cutouts, sharp edges, rivets, crevices, and bolts to ensure proper coverage and thickness.

3.2.3 Dry-Film Thickness (DFT)

Coatings shall be applied to the following dry-film thicknesses:

Coating System No. 1:

a. 3 to 6 mils, inorganic zinc, as specified in Coating Schedule.

b. Top coat 2 to 4 mils

c. Second coat, inorganic zinc, 2 to 4 mils

d. Inorganic primer zinc: 2.5 to 4 mils

e. Aliphatic polyurethane, third coat: 2 to 4 mils, but sufficient to hide previous coat

3.3 TOUCH-UP

Abrasions that occurred during shipment or erection shall be touched up as follows:

a. Surface preparation and coating application shall conform to the manufacturer's instructions.

b. Inorganic zinc shall be used for touch-up and repair of inorganic zinc and hot-dip galvanizing.

c. Inhibitive polyamide epoxy and aliphatic polyurethane shall be used for touch-up and repair of coating system No. 2.

3.4 SEALANT COMPOUND APPLICATION

For Coating System No. 1, calking shall be accomplished after application and cure of inorganic zinc coating.

For Coating System No. 2, calking shall be accomplished after application and cure of inhibitive epoxy coat and prior to aliphatic polyurethane coat.

Exterior joints shall be calked, including, but not limited to, the following:

a. Perimeter of faying and bearing surfaces of structural members

b. Joints in members between intermittent welds

c. Perimeter of bearing surfaces between floor plates and supporting members (inside, outside, top, and bottom)

d. Stair treads, where joined to channel stringers

e. Openings of 1/2 inch or smaller (Foam filler backup shall be used as required.)

f. Hot-dipped galvanized vent holes

3.5 INSPECTION

On-site work as described herein shall be inspected for compliance with this specification by a NACE (National Association of Corrosion Engineers) Certified Coating Inspector provided by the COR.

For all protective coatings applied off-site locations, the Contractor shall provide full inspection by NACE Certified Coating Inspector. Inspector shall be present at the pre-work conference to address necessary clarification of inspection and specification requirements. Apparent deviation from the specified requirements or any out of tolerance condition shall be immediately reported to the COR for determination of corrective action. Submit inspection reports performed by the Coating Inspector.

Inspection Forms shall be submitted at the pre-work conference which shall be used by the Coating Inspector and forwarded to the COR prior to delivery of the coated work to the job site.

3.6 COATING SCHEDULE

SURFACE DESCRIPTION	SURFACE PREPARATION	COATING SYSTEM	FINISH COLOR FOR COATING SYSTEM NO. 2	DRY FILM THICK-NESS, PRIMER COAT, MILS

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DIVISION 10 - SPECIALTIES

SECTION 10 14 02

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SECTION 10 14 02

INTERIOR SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for common types of signs, dimensional letters, and metal plaques used inside buildings.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	Designation System for Aluminum Finishes
AA PK-1	Pink Sheets: Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings & Ingot

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2604	Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2/D1.2M	Structural Welding Code - Aluminum

ASTM INTERNATIONAL (ASTM)

ASTM B 209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

ASTM B 221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM C 1036	Standard Specification for Flat Glass
ASTM D 635	Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities
CBC	California Building Code, Ch. 10 & 11, California Code of Regulations, Title 24, Part 2, Volume 1 of 2

1.3 SYSTEM DESCRIPTION

Submit samples of each of the following sign types showing typical quality, workmanship and color: Directional sign, Standard Room sign, Changeable message strip sign; submit interior signage samples of the design, detail, sizes, types, and message content shown on the detail drawings, attachments, signage placement schedule (as applicable), conforming to the requirements specified, and placed at the locations indicated. The samples may be installed in the work, provided each sample is identified and location recorded. Submit drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, mounting height, shape and thickness of materials, and details of construction. A schedule showing the location, each sign type, and message shall be included. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation. Signage shall be obtained from a single manufacturer with edges and corners of finished letterforms and graphics true and clean. Recyclable materials shall conform to EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS. Interior signage shall comply with 2010 CBC, Chapters 10 and 11.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Installation

SD-04 Samples

Interior Signage
Software

SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions
Protection and Cleaning

1.5 DELIVERY, STORAGE, AND HANDLING

Materials shall be packaged to prevent damage and deterioration during shipment, handling, storage and installation. Product shall be delivered to the jobsite in manufacturer's original packaging and stored in a clean, dry area in accordance with manufacturer's instructions.

1.6 EXTRA MATERIALS

Provide 5 extra frames and extra stock of the following: 5 blank plates of each color and size. Provide 5 paper inserts and one copy of the software for user produced signs and for creating text and symbols for IBM compatible computers for Owner production of paper inserts after project completion equipment necessary for removal of signage parts and pieces.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of such products that essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening.

2.2 ROOM IDENTIFICATION/DIRECTIONAL SIGNAGE SYSTEM

2.2.1 Standard Room Signs

Signs shall consist of acrylic plastic 0.080 inch thickness minimum conforming to ANSI Z97.1 and shall conform to the following:

a. Frames shall be molded acrylic 1/8 inch wide.

b. End caps shall be molded acrylic with round style corners.

c. Units shall be frameless. Corners of signs shall be rounded to 3/8 inch radius.

2.2.2 Changeable Message Strip Signs

Changeable message strip signs shall be of same construction as standard room signs to include a clear sleeve that will accept a paper or plastic insert identifying changeable text. Provide paper and software for creating text and symbols for IBM compatible computers for Owner production of paper inserts after project completion. Sliding inserts or slide knobs that slide horizontally exposing different graphic information shall be

provided as identified in the signage placement schedule and drawings and/or attachments.

2.2.3 Type of Mounting For Signs

Provide extruded aluminum brackets for hanging, projecting, and double-sided signs. Mounting for framed, hanging, and projecting signs shall be by mechanical fasteners. Surface mounted signs shall be mounted with countersunk mounting holes in plaques and mounting screws fabricated from materials that are not corrosive to sign material and mounting surface.

2.2.4 Graphics

Signage graphics for modular signs shall conform to the following:

a. Subsurface copy: Copy is transferred to the back face of clear acrylic sheeting forming the panel face to produce precisely formed opaque image. This method bonds all sign elements (color, graphics, lettering, braille and substrate) into a single unit.

b. Silkscreened First Surface Copy (non-tactile): Message shall be applied to panel using the silkscreen process. Silkscreened images shall be executed with photo screens prepared from original art. Handcut screens will not be accepted. Original art is defined as artwork that is a first generation reproduction of the specified art. Edges and corners shall be clean.

c. Surface Applied Photopolymer: Integral graphics and braille achieved by photomechanical stratification processes. Photopolymer used for ADA compliant graphics shall be of the type that has a minimum durometer reading of 90. Tactile graphics shall be raised 1/32 inch from the first surface of plaque by photomechanical stratification process.

2.2.5 Character Proportions and Heights

Letters and numbers on signs conform to CBC (2010 California Building Code).

2.2.6 Raised and Braille Characters and Pictorial Symbol Signs (Pictograms)

Raised letters and numbers on signs shall conform to 2010 CBC.

2.3 FABRICATION AND MANUFACTURE

2.3.1 Factory Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

2.3.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

2.4 COLOR, FINISH, AND CONTRAST

Color shall be as indicated on the drawings. Finish of all signs shall be eggshell, matte, or other non-glare finish as required in

handicapped-accessible buildings.

PART 3 EXECUTION

3.1 INSTALLATION

Signs shall be installed plumb and true and in accordance with approved manufacturer's instructions at locations shown on the detail drawings, schedule and/or attachments. Submit six copies of operating instructions outlining the step-by-step procedures required for system operation. The instructions shall include simplified diagrams for the system as installed, the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Each set shall be permanently bound and shall have a hard cover. The following identification shall be inscribed on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS", name and location of the facility, name of the Contractor, and contract number. Mounting height and mounting location shall conform to 2010 CBC. Required blocking shall be installed. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed. Signs installed on glass surfaces shall be installed with matching blank back-up plates in accordance with manufacturer's instructions and requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA, package 1.

SIGNAGE PLACEMENT SCHEDULE:

DOOR ROOM NUMBER	SIGN TYPE	TEXT	INSERT(S)	SYMBOL/REMARKS

3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Exposed anchor and fastener materials shall be compatible with metal to which applied and shall have matching color and finish. Where recommended by signage manufacturer, foam tape pads may be used for anchorage. Foam tape pads shall be minimum 1/16 inch thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech formulation on two sides of the vinyl foam. Adhesive surfaces shall be protected with a 5 mil green flatstock treated with silicone. Foam pads shall be sized for the signage in accordance with signage manufacturer's recommendations. Signs mounted to painted gypsum board surfaces shall be removable for painting maintenance. Signs mounted to lay-in ceiling grids shall be mounted with clip connections to ceiling tees.

3.1.2 Protection and Cleaning

Protect the work against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned at completion of sign installation in accordance with the manufacturer's approved instructions and the requirements of Section 01 78 23 OPERATION AND MAINTENANCE DATA, Package 1. Submit six copies of maintenance instructions listing routine procedures, repairs, and guides.

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SECTION 10 21 13

TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for ceiling-hung, floor anchored, and overhead-braced toilet partitions.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ALUMINUM ASSOCIATION (AA)

AA DAF45	Designation System for Aluminum Finishes

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A336/A336M	Standard Specification for Alloy Steel Forgings for Pressure and High-Temperature Parts
ASTM A385/A385M	Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B221	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B221M	Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

ASTM B36/B36M	Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar
ASTM B456	Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
ASTM B86	Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings
ASTM D 1972	Standard Practice for Generic Marking of Plastic Products
ASTM D 6386	Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
ASTM E 2129	Standard Practice for Data Collection for Sustainability Assessment of Building Products

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1	Accessible and Usable Buildings and Facilities

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS2460	Plating, Chromium

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-60003	Partitions, Toilet, Complete

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

36 CFR 1191	Architectural Barriers Act (ABA) Accessibility Guidelines

1.3 SYSTEM DESCRIPTION

Provide a complete and usable toilet partition system, including toilet enclosures, room entrance screens, urinal screens, system of panels, hardware, and support components. Comply with EPA requirements in accordance with Section 01 62 35 RECYCLED / RECOVERED MATERIALS and Affirmative Procurement guidelines. Furnish the partition system from a single manufacturer, with a standard product as shown in the most recent catalog data. Submit Fabrication Drawings for metal toilet partitions and urinal screens consisting of fabrication and assembly details to be performed in the factory. Submit manufacturer's Cleaning and Maintenance Instructions with Fabrication Drawings for review.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings
Installation Drawings

SD-03 Product Data

Cleaning and Maintenance Instructions
Colors And Finishes
Galvanized Steel Sheet
Sound-Deadening Cores
Anchoring Devices and Fasteners
Hardware and Fittings
Brackets
Door Hardware

SD-04 Samples

Colors and Finishes
Hardware and Fittings
Anchoring Devices and Fasteners

SD-07 Certificates

Warranty

1.5 REGULATORY REQUIREMENTS

Conform to ICC/ANSI A117.1 code for access for the handicapped operation of toilet compartment door and hardware.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the manufacturer's original unopened packages with the brand, item identification, and project reference clearly marked. Store components in a dry location that is adequately ventilated; free from dust, water, other contaminants, and damage during delivery, storage, and construction.

1.7 WARRANTY

Provide certification or warranties that metal toilet partitions will be free of defects in materials, fabrication, finish, and installation and will remain so for a period of not less than 1 year after completion.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Galvanized Steel Sheet

Provide galvanized steel sheet cold-rolled, stretcher-level, commercial quality material, conforming to ASTM A653/A653M. Conform surface preparation of material for painting to ASTM D 6386, Method A.

2.1.2 Sound-Deadening Cores

Provide sound deadening consisting of treated kraft paper honeycomb cores

with a cell size of not more than 1 inch. Resin-material content shall weigh not less than 11 percent of the finished core weight. Expanded cores shall be faced on both sides with kraft paper.

2.1.3 Anchoring Devices and Fasteners

Provide steel anchoring devices and fasteners hot-dipped galvanized after fabrication, in conformance with ASTM A385/A385M and ASTM A123/A123M. Conceal all galvanized anchoring devices.

2.1.4 Brackets

Wall brackets shall be two-ear panel brackets, T-style, 1-inch stock. Provide stirrup style panel-to-pilaster brackets.

2.1.5 Hardware and Fittings

2.1.5.1 General Requirements

Conform hardware for the toilet partition system to CID A-A-60003 for the specified type and style of partitions. Provide hardware finish highly resistant to alkalis, urine, and other common toilet room acids. Comply latching devices and hinges for handicap compartments with 36 CFR 1191; provide chrome-plated steel devices and hinges with door latches that operate without either tight grasping or twisting of the wrist of the operator. Submit three samples of each item, including anchoring devices and fasteners. Approved hardware samples may be installed in the work if properly identified.

a. Conform cold-rolled sheet steel to ASTM A336/A336M, commercial quality.

b. Zinc-base alloy shall conform to ASTM B86, Alloy AC41-A.

c. Brass shall conform to ASTM B36/B36M, Alloy C26800.

d. Aluminum shall conform to ASTM B221

e. Corrosion-resistant steel shall conform to ASTM A167, Type 302 or 304.

2.1.5.2 Finishes

a. Chrome plating shall conform to ASTM B456.

b. Finish shall conform to SAE AMS2460, Class I, Type I.

c. Aluminum shall have a clear anodic coating conforming to AA DAF45.

d. Corrosion-resistant steel shall have a No. 4 finish.

e. Exposed fasteners shall match the hardware and fittings

2.1.6 Door Hardware

2.1.6.1 Hinges

Hinges shall be adjustable to hold in-swinging doors open at any angle up to 90 degrees and outswinging doors to 10 degrees. Provide self-lubricating hinges with the indicated swing. Hinges shall be the cutout-insert type and have the following type of return movement:

a. Gravity return movement

2.1.6.2 Latch and Pull

Latch and pull shall be a combination rubber-faced door strike and keeper equipped with emergency access.

2.1.6.3 Coat Hooks

Coat hooks shall be combination units with hooks and rubber tipped pins.

2.2 PARTITION PANELS AND DOORS

Fabricate partition panels and doors not less than 1 inch thick with face sheets not less than 0.0396 inch thick.

2.2.1 Toilet Enclosures

Conform toilet enclosures to CID A-A-60003, Type I, Style A, floor supported C, overhead braced. Furnish width, length, and height of toilet enclosures as shown. Provide a width of 1 inch. Finish surface of panels shall be painted metal, Finish 1; water resistant; graffiti resistant; non-absorbent; 25 percent recycled steel, with a minimum of 16 percent post-consumer recycled steel. Reinforce panels indicated to receive toilet paper holders or grab bars for mounting of the items required. Provide grab bars to withstand a bending stress, shear stress, shear force, and a tensile force induced by 250 lbf. Grab bars shall not rotate within their fittings.

2.2.2 Room Entrance Screens

Conform room entrance screens to CID A-A-60003, Type II, Style A, floor anchored C, overhead braced D, wall hung. Finish surface of screens shall be painted metal, Finish 1; water resistant; graffiti resistant; non-absorbent 25 percent recycled steel, with a minimum of 16 percent post-consumer recycled steel. Furnish length and height of screens as shown. Provide thickness of 1 inch. Fabricate screens from the same types of panels, pilasters, and fittings as the toilet partitions.

2.2.3 Urinal Screens

Conform urinal screens to CID A-A-60003, Type III, Style A, floor supported C, overhead bracedE, floor to ceiling post supported. Provide finish for surface of screens as painted metal, Finish 1; water resistant; graffiti resistant; non-absorbent; 25 percent recycled steel, with a minimum of 16 percent post-consumer recycled steel. Furnish width and height of urinal screens as shown. Provide thickness of 1 inch. Secure wall hung urinal screens with a minimum of three wall stirrup brackets. Fabricate screens from the same types of panels and pilasters as the toilet partitions. Use corrosion-resistant steel fittings and fasteners.

2.3 FLOOR-ANCHORED PARTITIONS

Pilasters shall be not less than 1-1/4 inch thick with face sheets not less than 0.0635 inch thick. Provide anchoring device at the bottom of the pilaster consisting of a steel bar not less than 1/2 by 7/8 inch welded to the reinforced face sheets and having not less than two 3/8 inch round anchorage devices for securing to the floor slab. Provide anchorage

devices complete with threaded rods, expansion shields, lock washers, and leveling-adjustment nuts. Trim piece at the floor shall be 3 inch high and fabricated from not less than 0.030 inch thick corrosion-resistant steel.

2.4 OVERHEAD-BRACED PARTITIONS

Pilasters shall be not less than 1-1/4 inch thick with face sheets not less than 0.0393 inch thick. Provide anchoring device at the bottom of the pilaster consisting of a channel-shaped floor stirrup fabricated from not less than 0.0635 inch thick material and a leveling bolt. Secure the stirrup to the pilaster with not less than a 3/16 inch bolt and nut after the pilaster is leveled. Secure the stirrup to the floor with not less than two lead expansion shields and sheetmetal screws. Fabricate overhead brace from a continuous extruded aluminum tube not less than 1 inch wide by 1-1/2 inch high, 0.125-inch wall thickness. Finish shall be AA-C22A31 in accordance with AA DAF45. Set and secure brace into the top of each pilaster. Fabricate 3 inch high trim piece at the floor from not less than 0.030 inch thick corrosion-resistant steel.

2.5 PILASTER SHOES

Provide shoes at pilasters to conceal floor-mounted anchorage. Pilaster shoes shall be stainless steel. Shoes shall contain a minimum of 10 percent post-consumer recycled content, or a minimum of 20 percent post-industrial recycled content. Height shall be 3 inches.

2.6 HARDWARE

Hardware for the toilet partition system shall conform to CID A-A-60003 for the specified type and style of partitions. Hardware shall be pre-drilled by manufacturer. Hardware finish shall be highly resistant to alkalis, urine, and other common toilet room acids. Latching devices and hinges for handicap compartments shall comply with 36 CFR 1191 and shall be chrome-plated steel door latches that operate without either tight grasping or twisting of the wrist of the operator. Screws and bolts shall be stainless steel, tamper proof type. Wall mounting brackets shall be continuous, full height, stainless steel, in accordance with toilet compartment manufacturer's instructions. Floor-mounted anchorage shall consist of corrosion-resistant anchoring assemblies with threaded rods, lock washers, and leveling adjustment nuts at pilasters for structural connection to floor.

2.7 COLORS AND FINISHES

2.7.1 Colors

Provide manufacturer's standard color charts for color of finishes for toilet partition system components. Submit three samples showing a finished edge on two adjacent sides and core construction, each not less than 12-inch square

PART 3 EXECUTION

3.1 PREPARATION

Take field measurements prior to the preparation of drawing and fabrication to ensure proper fits. Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive work. Verify correct spacing of plumbing fixtures. Verify correct location of

built in framing, anchorage, and bracing. Report in writing to COR prevailing conditions that will adversely affect satisfactory execution of the work of this section. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 METAL PARTITION FABRICATION

a. Fabricate metal Partition Panels, doors, screens, and pilasters required for the project from galvanized-steel face sheets with formed edges. Face sheets shall be pressure-laminated to the sound-deadening core with edges sealed with a continuous locking strip and corners mitered and welded. Ground all welds smooth. Provide concealed reinforcement for installation of hardware, fittings, and accessories. Surface of face sheets shall be smooth and free from wave, warp, or buckle.

b. Before application of an enamel coating system, solvent-clean galvanized-steel surfaces to remove processing compounds, oils, and other contaminants harmful to coating-system adhesion. After cleaning,coat the surfaces with a metal-pretreatment phosphate coating. After pretreatment, finish exposed galvanized-steel surfaces with a baked-enamel coating system as specified.

c. Provide an enamel coating system consisting of a factory-applied baked acrylic enamel coating system. Coating system shall be a durable, washable, stain-resistant, mar-resistant finish.

3.3 INSTALLATION

Install partitions rigid, straight, plumb, and level, with the panels centered between the fixtures. Provide a panel clearance of not more than 1/2 inch and secure the panels to walls and pilasters with not less than two wall brackets attached near the top and bottom of the panel. Locate wall brackets so that holes for wall bolts occur in masonry or tile joints. Secure Panels to pilasters with brackets matching the wall brackets. Provide for adjustment due to minor floor variations. Locate head rail joints at pilaster center lines. Install adjacent components for consistency of line and plane. Equip each door with hinges, one door latch, and one coat hook and bumper. Align hardware to uniform clearance at vertical edges of doors.

a. Secure panels to hollow plastered walls with toggle bolts using not less than 1/4-20 screws of the length required for the wall thickness. Toggle bolts shall have a load-carrying strength of not less than 600 pounds per anchor.

b. Secure panels to ceramic tile on hollow plastered walls or hollow concrete-masonry walls with toggle bolts using not less than 1/4-20 screws of the length required for the wall thickness. Toggle bolts shall have a load-carrying strength of not less than 600 pounds per anchor.

c. Secure panels to solid masonry or concrete with lead or brass expansion shields designed for use with not less than 1/4-20 screws, with a shield length of not less than 1-1/2 inch. Expansion shields shall have a load-carrying strength of not less than 600 pounds per anchor.

d. Submit Installation Drawings for metal toilet partitions and urinal screens showing plans, elevations, details of construction, hardware,

reinforcing and blocking, fittings, mountings and escutcheons. Indicate on drawings the type of partition, location, mounting height, cutouts, and reinforcement required for toilet-room accessories.

3.4 FLOOR-ANCHORED PARTITIONS

Secure pilasters to the floor with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Level tops of doors with tops of pilasters when doors are in a closed position. Expansion shields shall have a minimum 2-inch penetration into the concrete slab.

3.5 OVERHEAD-BRACED PARTITIONS

Secure pilasters to the floor with the anchorage device specified. Make all leveling devices readily accessible for leveling, plumbing, and tightening the installation. Secure overhead brace to the pilaster face with not less than two fasteners per face. Expansion shields shall have a minimum 2-inch penetration into the concrete slab. Make tops of doors parallel with the overhead brace when doors are in a closed position.

3.6 FINAL ADJUSTMENT

After completion of the installation, make final adjustments to the pilaster-leveling devices, door hardware, and other working parts of the partition assembly. Doors shall have a uniform vertical edge clearance of approximately 3/16 inch and shall rest open at approximately 30 degrees when unlatched.

3.7 CLEANING

Baked enamel finish shall be touched up with the same color of paint that was used for the finish. Clean all surfaces of the work, and adjacent surfaces soiled as a result of the work, in an approved manner compliant with the manufacturer's recommended cleaning and protection from damage procedures until accepted. Remove all equipment, tools, surplus materials, and work debris from the site.

3.8 WASTE MANAGEMENT PLAN

Identify manufacturer's policy for collection or return of construction scrap, demolition scrap, unused material and packaging material. Institute demolition and construction waste separation and recycling to take advantage of manufacturer's programs. When such a service is not available, seek local recyclers to reclaim the materials.

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SECTION 10 28 13

TOILET ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for toilet accessories suitable for a wide variety of applications.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM A366/A366M	Standard Specification for Commercial Steel (CS) Sheet, Carbon,(0.15 Maximum Percent) Cold-Rolled
ASTM A526M	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process Commercial Quality
ASTM C 1036	Standard Specification for Flat Glass

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Finishes
Accessory Items

SD-04 Samples

Finishes

SD-07 Certificates

Accessory Items

SD-10 Operation and Maintenance Data

Electric Hand Dryer

1.4 DELIVERY, STORAGE, AND HANDLING

Wrap toilet accessories for shipment and storage, then deliver to the jobsite in manufacturer's original packaging, and store in a clean, dry area protected from construction damage and vandalism.

1.5 WARRANTY

Provide manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

Provide toilet accessories where indicated in accordance with paragraph SCHEDULE. Porcelain type, tile-wall accessories are specified in Section 09 30 00 CERAMIC TILE QUARRY TILE, AND PAVER TILE. Provide each accessory item complete with the necessary mounting plates of sturdy construction with corrosion resistant surface.

2.1.1 Materials

a. Stainless Steel - AISI, Type 304. Provide exposed surfaces with a #4 finish, unless otherwise specified.

b. Steel Sheet - Cold-rolled commercial quality, ASTM A366M and ASTM A568M, Surface Preparation and Pretreatment - provided as required for subsequent finish.

2.1.2 Anchors and Fasteners

a. Provide anchors and fasteners capable of developing a restraining force commensurate with the strength of the accessory to be mounted and suited for use with the supporting construction. Provide tamperproof design exposed fasteners with finish to match the accessory.

b. Concealed mounting devices and fasteners for accessories - fabricated from same materials as accessories or from galvanized steel. Exposed mounting devices and fasteners - finished to match accessories. Provide fasteners of theft-resistant type.

2.1.3 Finishes

Except where noted otherwise, provide the following finishes on metal:

Metal	Finish
Stainless steel	No. 4 satin finish
Carbon steel, copper alloy, and brass	Chromium plated, bright

Enamel Coating - factory applied, gloss white, baked acrylic. Provide coating that is washable and suitable for intended use.

2.2 ACCESSORY ITEMS

Conform to the requirements for accessory items specified below. Submit fasteners proposed for use for each type of wall construction, mounting, operation, and cleaning instructions and one sample of each other accessory proposed for use. Incorporate approved samples into the finished work, provided they are identified and their locations noted. Submit certificate for each type of accessory specified, attesting that the items meet the specified requirements.

2.2.1 Grab Bar (GB)

Provide an 18 gauge, 1-1/4 inch grab bar OD Type 304 stainless steel. Provide form and length for grab bar as indicated. Provide concealed mounting flange, minimum 3 inches in diameter. Provide grab bar with satin finish. Furnish installed bars capable of withstanding a 500 pound vertical load without coming loose from the fastenings and without obvious permanent deformation. Allow 1-1/2 inch space between wall and grab bar.

2.2.2 Mirrors, Glass (MG)

Provide Type I transparent flat type, Class 1-clear glass for mirrors. Glazing Quality q1 1/4 inch thick conforming to ASTM C 1036. Coat glass on one surface with silver coating, copper protective coating, and mirror backing paint. Provide highly adhesive pure silver coating of a thickness which provides reflectivity of 83 percent or more of incident light when viewed through 1/4 inch thick glass, free of pinholes or other defects. Provide copper protective coating with pure bright reflective copper, homogeneous without sludge, pinholes or other defects, of proper thickness to prevent "adhesion pull" by mirror backing paint. Provide mirror backing paint with two coats of special scratch and abrasion-resistant paint and baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.2.3 Paper Towel Dispenser (PTD)

Provide 400 paper towel dispenser constructed of a minimum 0.03 inch Type 304 stainless steel, surface mounted. Furnish tumbler key lock locking mechanism.

2.2.4 Sanitary Napkin Disposer (SND)

Construct a Type 304 stainless steel sanitary napkin disposal with removable leak-proof receptacle for disposable liners. Provide fifty disposable liners of the type standard with the manufacturer. Retain receptacle in cabinet by tumbler lock. Provide disposer with a door for inserting disposed napkins, partition mounted, double access and surface mounted (see drawings for type and locations).

2.2.5 Sanitary Napkin and Tampon Dispenser (SNTD)

Provide sanitary napkin and tampon dispenser surface mounted. Dispenser, including door of Type 304 stainless steel that dispense both napkins and tampons with a minimum capacity of 20 each. Furnish dispensing mechanism for coin operation. Provide coin mechanisms with minimum denominations of 10 cents, 25 cents, 50 cents. Hang doors with a full-length corrosion-resistant steel piano hinge and secure with a tumbler lock. Provide keys for coin box different from the door keys.

2.2.6 Soap Dispenser (SD)

Provide soap dispenser surface mounted, liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 40 fluid ounces with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps.

2.2.7 Shelf, Metal, Heavy Duty (SMHD)

Furnish a minimum 18 gauge stainless steel heavy duty metal shelf with hemmed edges and brackets. Provide shelves over 30 inch with intermediate supports. Provide minimum of 16 gauge supports, welded to the shelf, and spaced no more than 30 inch apart.

2.2.8 Shelf, Metal, Light Duty (SMLD)

Support light duty metal shelf between brackets or on brackets. Purpose of brackets is to prevent lateral movement of the shelf. Furnish 18 inch long shelf. Provide stainless steel shelf and brackets.

2.2.9 Towel Bar (TB)

Provide stainless steel towel bar with a minimum thickness of 0.015 inch. Provide minimum 3/4 inch diameter bar, or 5/8 inch square. Provide satin finish.

2.2.10 Towel Pin (TP)

Provide towel pin with concealed wall fastenings, and a pin integral with or permanently fastened to wall flange with maximum projection of 4 inch. Provide satin finish.

2.2.11 Toilet Tissue Dispenser (TTD)

Furnish Type II - surface mounted toilet tissue holder with two rolls of standard tissue mounted horizontally. Provide carbon steel, stainless steel, satin finish cabinet.

2.2.12 Toilet Tissue Dispenser, Jumbo (TTDJ)

Provide surface mounted toilet tissue dispenser with 2 rolls of jumbo tissue. Fabricate cabinet of high-impact plastic body and transparent plastic front cover. Provide cover with key lock.

2.2.13 Waste Receptacle (WR)

Provide Type 304 stainless steel waste receptacle, designed for surface mounting. Provide reusable liner, of the type standard with the receptacle manufacturer. Provide receptacles with push doors and doors for access to the waste compartment with continuous hinges.

a. Surface-mounted receptacle - seamless construction, continuously welded bottom pan, heavy-duty vinyl removable liners with capacity of 2.8 ft^3. Liner secured to receptacle at four points with grommeted holes hung from stainless steel hooks.

2.2.14 Toilet Seat Cover Dispenser (TSCD)

Provide Type 304 stainless steel with surface mounted toilet seat cover

dispensers. Provide dispenser with a minimum capacity of seat covers.

PART 3 EXECUTION

3.1 INSTALLATION

Provide the same finish for the surfaces of fastening devices exposed after installation as the attached accessory. Provide oval exposed screw heads. Install accessories at the location and height indicated. Protect exposed surfaces of accessories with strippable plastic or by other means until the installation is accepted. After acceptance of accessories, remove and dispose of strippable plastic protection. Coordinate accessory manufacturer's mounting details with other trades as their work progresses. Use sealants for brackets, plates, anchoring devices and similar items in showers (a silicone or polysulfide sealant) as they are set to provide a watertight installation.After installation, thoroughly clean exposed surfaces and restore damaged work to its original condition or replace with new work.

3.1.1 Anchorage

Secure accessories to supporting substrates with anchors of types indicated by following substrate construction.

a. Plaster, Gypsum Board and Thin-Set tile - secure accessories with toggle bolts or wood screws passing through plaster to a wood backing. Toggle bolts - minimum #10-24 screws of required lengths for finish thickness. Wood screws - minimum #8 of length required for finish thickness and providing minimum 0.75 inch penetration into wood.

b. Solid Masonry, Concrete, or Tile set in Mortar - secure accessories with lead expansion shields or cast-in integral anchors. Lead expansion shields - minimum #8 wood screws with a shield length of 1 inch minimum. Integral anchors - deformed bars minimum 1.5 inches long cast into a predrilled hole with quickset mortar or plaster of paris.

c. Metal Partitions - secure accessories with T-nuts and through-bolts minimum #10-24, of lengths required for partition thickness.

3.1.2 Grab-Bar Anchors

a. Through-bolt Anchors - designed and installed for a minimum withdrawal strength of 300 lbs. per anchor. Front and back plates - fabricated from minimum 0.2 inch thick steel, with surface area required for design strength. Through bolts - minimum 0.236 inch diameter threaded rod with hexnut and lockwasher; length of rod determined by wall thickness.

b. Adhesive-applied Anchor Plate - fabricated from minimum 0.039 inch thick perforated plate adhesive-applied to supporting substrate. Adhesive - thermoset epoxy-based resin developing minimum 300 lbs. shear strength per bar anchor. Secure grab-bar back plate to anchor plate with minimum two #10-24 screws of length required for thickness.

c. Embedded Plate Anchors - fabricated from minimum 0.1 inch thick plates, with width and length of bar as indicated. Plate U-clamped to partition studs or channels. Secure embedded plates to studs for channels on each side of grab-bar support. Secure bar back plate to anchor plate with minimum two #10-24 screws of length required for

thickness.

3.1.3 Recessed Accessories

Fasten accessories with wood screws to studs, blocking or rough frame in wood construction. Set anchors in mortar in masonry construction. Fasten to metal studs or framing with sheet metal screws in metal construction.

3.1.4 Surface Mounted Accessories

Mount on concealed backplates, unless specified otherwise. Conceal fasteners on accessories without backplates. Install accessories with sheet metal screws or wood screws in lead-lined braided jute, teflon or neoprene sleeves, or lead expansion shields, or with toggle bolts or other approved fasteners as required by the construction. Install backplates in the same manner, or provide with lugs or anchors set in mortar, as required by the construction. Fasten accessories mounted on gypsum board and plaster walls without solid backing into the metal or wood studs or to solid wood blocking secured between wood studs, or to metal backplates secured to metal studs.

3.2 CLEANING

Clean material in accordance with manufacturer's recommendations. Do mot use alkaline or abrasive agents. Take precautions to avoid scratching or marring exposed surfaces.

3.3 SCHEDULE

Accessories Required

Room or Space	MG	PTD	SMLD	SD	SH	TTD
_____	_____	_____	_____	_____	_____	_____

3.4 ACCEPTANCE PROVISIONS

a. Remove damaged and unacceptable portions or completed work, and replace with new work at no additional cost to the Government.

b. Clean surfaces of work and adjacent surfaces soiled as a result of work, in an approved manner. Remove equipment, surplus materials, and rubbish from worksite.

-- End of Section --

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SECTION 13 48 00.00 10

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SECTION 13 48 00.00 10

SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for seismic protection of mechanical equipment, building piping, and exterior utilities.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	Steel Construction Manual

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 2008	Seismic Restraint Manual Guidelines for Mechanical Systems, 3rd Edition

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	Minimum Design Loads for Buildings and Other Structures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	National Fuel Gas Code

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

Apply the requirements for seismic protection measures described in this section to the mechanical equipment and systems listed below.

1.3.2 Mechanical Equipment

Mechanical equipment to be seismically protected shall include the following items to the extent required on the drawings or in other sections of these specifications:

Boilers and furnaces	Storage Tanks for Oil and Water

Water Heaters	Steam, Water, Oil and Gas Piping
Expansion Air Separator Tanks	Valves and Fittings for Piping
Heat Exchangers	Steam-fed Kitchen Appliances
Water Chiller Units	Thermal Storage Units
Cooling Towers	Air and Refrigerant Compressors
Refrigerant Piping	Air Handling Units
Pumps with Motors	Lab Scrubbers
Large Commercial Dryers	Pollution Control Equipment
Gas Dryers	Ducts
Flash Tanks	Unit Heaters
Accumulator Tank	Exhaust and Return Fans

1.3.3 Mechanical Systems

Install the following mechanical systems as required on the drawings and other sections of these specifications and seismically protect them in accordance with this specification:

a. All Piping Inside the Building Except as Specifically Stated Below Under "Items Not Covered By This Section".

b. Chilled Water Distribution Systems Outside of Buildings.

c. Fuel Piping Outside of Buildings.

d. All Water Supply Systems.

e. Storm and Sanitary Sewer Systems.

f. All Process Piping.

g. Heat Distribution Systems (Supply, Return, and Condensate Return) Outside of Buildings.

h. Condenser Water Piping Outside the Building.

i. Pneumatic Tube Distribution System.

j. Cold Storage Refrigeration Systems

k. Fuel Storage Tanks.

l. Water Storage Tanks.

1.3.4 Contractor Designed Bracing

Submit copies of the design calculations with the drawings to the COR for Government review and approval. Calculations shall be approved, certified, stamped and signed by a registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace. Seismic support for mechanical equipment shall be in accordance with ASCE 7 and all process piping to the requirements of ASME B31.3, unless specified otherwise on the design drawings.

1.3.5 Items Not Covered By This Section

1.3.5.1 Fire Protection Systems

Seismic protection of piping for fire protection systems shall be installed as specified in Sections 21 13 00.00 40 FIRE-SUPPRESSION SPRINKLER SYSTEMS..

1.3.5.2 Natural Gas Piping

Facility natural gas piping shall be designed and installed per NFPA 54.

1.3.5.3 Items Requiring No Seismic Restraints

Seismic restraints are not required for the following items:

a. Rectangular air handling ducts less than 6 square feet in cross sectional area unless specified otherwise on the design drawings.

b. Round air handling ducts less than 28 inches in diameter unless specified otherwise on the design drawings.

c. Ducts suspended by hangers 12 inches or less in length from the top of the duct to the bottom of the supporting structural member, unless specified otherwise on the design drawings.

Interior piping and ducts not listed above shall be seismically protected in accordance with the provisions of this specification.

1.4 EQUIPMENT REQUIREMENTS

Submit copies of the design calculations with the detail drawings to COR for Government review and approval. Calculations shall be stamped by a California registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Coupling and Bracing
Flexible Couplings or Joints
Equipment Requirements
Contractor Designed Bracing

SD-03 Product Data

Coupling and Bracing
Equipment Requirements
Contractor Designed Bracing

SD-07 Certificates

Flexible Ball Joints.

PART 2 PRODUCTS

2.1 FLEXIBLE COUPLINGS

Flexible couplings shall have same pressure and temperature ratings as adjoining pipe.

2.2 FLEXIBLE BALL JOINTS

Flexible ball joints shall have cast or wrought steel casing and ball parts capable of 360-degree rotation with not less than 15-degree angular movement. Flexible ball joints shall be certified to be suitable for the service intended by the manufacturer. Information verifying experience at not less than 3 locations of 2 years' satisfactory operation in a similar application shall be submitted.

2.3 FLEXIBLE MECHANICAL JOINTS

a. Mechanical couplings for steel or cast iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.

b. Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets.

2.4 MANUFACTURED BALL JOINTS

Manufactured ball joints shall be as recommended by the manufacturer for the intended use, and shall be approved by the COR before installation.

2.5 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13 48 00.00 10 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

PART 3 EXECUTION

3.1 COUPLING AND BRACING

a. Submit detail drawings, as specified here and throughout this specification, along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

b. Coupling installation shall conform to the details shown on the drawings. Provisions of this paragraph apply to all piping within a 5 foot line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the most frequent interval as determined by applying the requirements

of this specification to each piping run on the common support.

c. Bracing components shall be sized as required for the total load carried by the common supports. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

3.2 BUILDING DRIFT

Joints capable of accommodating seismic displacements shall be provided for vertical piping between floors of the building, where pipes pass through a building seismic or expansion joint, or where rigidly supported pipes connect to equipment with vibration isolators. Horizontal piping across expansion joints shall accommodate the resultant of the drifts of each building unit in each orthogonal direction. For threaded piping, swing joints made of the same piping material shall be provided. For piping with manufactured ball joints the seismic drift shall be 0.015 feet per foot of height above the base where the seismic separation occurs; this drift value shall be used in place of the expansion given in the manufacturer's selection table.

3.3 FLEXIBLE COUPLINGS OR JOINTS

3.3.1 Building Piping

Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers for pipe larger than 3-1/2 inches in diameter. Flexible couplings or joints shall be braced laterally without interfering with the action of the flexible coupling or joint. Cast iron waste and vent piping need only comply with these provisions when caulked joints are used. Flexible bell and spigot pipe joints using rubber gaskets may be used at each branch adjacent to tees and elbows for underground waste piping inside of building to satisfy these requirements.

3.3.2 Underground Piping

Underground piping and 4 inch or larger conduit, except heat distribution system, shall have flexible couplings installed where the piping enters the building. Additional flexible couplings shall be provided where shown on the drawings.

3.4 PIPE SLEEVES

Pipe sleeves in interior non-fire rated walls shall be sized as indicated on the drawings to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve.

3.5 SWAY BRACES FOR PIPING

Sway braces shall be provided to prevent movement of the pipes under seismic loading. Braces shall be provided in both the longitudinal and transverse directions, relative to the axis of the pipe. The bracing shall not interfere with thermal expansion requirements for the pipes as described in other sections of these specifications.

3.5.1 Transverse Sway Bracing

Transverse sway bracing for steel and copper pipe shall be provided as specified in Section 13 48 00.00 10 SEISMIC PROTECTION FOR MISCELLANEOUS

EQUIPMENT. All runs (length of pipe between end joints) shall have a minimum of two transverse braces. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.5.2 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided per SMACNA 2008 unless specified otherwise on the design drawings. Sway braces shall be constructed in accordance with the drawings. Branch lines, walls, or floors shall not be used as sway braces.

3.5.3 Vertical Runs

Run is defined as length of pipe between end joints. Vertical runs of piping shall be braced per SMACNA 2008 unless specified otherwise on the design drawings. Braces for vertical runs shall be above the center of gravity of the segment being braced. All sway braces shall be constructed in accordance with the drawings. Sway braces shall attach to the structural system and shall not be connected to branch lines, walls, or floors.

3.5.4 Clamps and Hangers

Clamps or hangers on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps or hangers applied over insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.6 SWAY BRACES FOR DUCTS

3.6.1 Braced Ducts

Bracing details and spacing for rectangular and round ducts shall be in accordance with SMACNA 2008, including Appendix E.

3.6.2 Unbraced Ducts

Hangers for unbraced ducts shall be attached to the duct within 2 inches of the top of the duct in accordance with SMACNA 2008. Unbraced ducts shall be installed with a 6 inch minimum clearance to vertical ceiling hanger wires.

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SECTION 21 13 00.00 40

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SECTION 21 13 00.00 40

FIRE-SUPPRESSION SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for wet and dry fire protection sprinkler systems, hydrants, standpipe equipment, and firehose stations.

The work shall include the provision and installation and testing of a complete and operational automatic fire sprinkler system in accordance with this specification covering the complete building (i.e., 100% area coverage) including canopies, blind spaces, and other areas as required by code and as indicated on the drawings,.

The automatic fire sprinkler system shall include all standard accessories as are necessary for a complete and operable system. Pipe sizing and head layout shall be by hydraulic calculation performed by a C-16 licensed Contractor and approved by NASA prior to installation.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISC/AISI 121	Standard Definitions for Use in the Design of Steel Structures

AMERICAN WELDING SOCIETY (AWS)

AWS B2.1	Specification for Welding Procedures and Performance Qualification

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast, for

	Water
AWWA C503	Wet-Barrel Fire Hydrants
AWWA C510	Standard for Double Check Valve Backflow Prevention Assembly

ASME INTERNATIONAL (ASME)

ASME A112.18.1/CSA B125.1	Plumbing Supply Fittings
ASME A13.1	Scheme for the Identification of Piping Systems
ASME B16.1	Gray Iron Threaded Fittings; Classes 25, 125 and 250
ASME B16.3	Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.34	Valves - Flanged, Threaded and Welding End
ASME B16.39	Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.4	Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.9	Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	Power Piping

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A135/A135M	Standard Specification for Electric-Resistance-Welded Steel Pipe
ASTM A183	Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A197/A197M	Standard Specification for Cupola Malleable Iron
ASTM A234/A234M	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A307	Standard Specification for Carbon Steel

	Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A568/A568M	Standard Specifications for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM B370	Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B749	Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products
ASTM C592	Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM D 2000	Standard Classification System for Rubber Products in Automotive Applications
ASTM F 568M	(Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

FEDERAL SPECIFICATIONS (FS)

FS TT-E-489	Enamel, Alkyd, Gloss (for Exterior and Interior Surfaces)
FS TT-P-645	Primer, paint, Zinc Chromate, Alkyd Type

FM GLOBAL (FM)

FM APP GUIDE	Approval Guide http://www.approvalguide.com/

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	Pipe Hangers and Supports - Materials,

	Design and Manufacture, Selection, Application, and Installation

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	Standard for the Installation of Sprinkler Systems
NFPA 13E	Recommended Practice for Fire Department Operations in Properties Protected by Sprinkler and Standpipe Systems
NFPA 14	Standard for the Installation of Standpipes and Hose Systems
NFPA 1961	Standard on Fire Hose
NFPA 1963	Standard for Fire Hose Connections
NFPA 24	Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 291	Recommended Practice for Fire Flow Testing and Marking of Hydrants
NFPA 70	National Electrical Code
NFPA 72	National Fire Alarm and Signaling Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-C-18480	Coating Compound, Bituminous, Solvent, Coal-Tar Base
MIL-STD-101	Color Code for Pipelines & for Compressed Gas Cylinders

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FED-STD-595	Colors Used in Government Procurement
FS FF-S-325	Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
FS WW-P-421	Pipe, Cast, Gray and Ductile Iron, Pressure (For Water and Other Liquids)

UNDERWRITERS LABORATORIES (UL)

UL 19	Lined Fire Hose and Hose Assemblies
UL 6	Electrical Rigid Metal Conduit-Steel

1.3 GENERAL REQUIREMENTS

Design Analysis and Calculations and installation shall be in accordance with NFPA 13.

Records of Existing Conditions shall be submitted showing the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work shall constitute acceptance of existing conditions.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Records of Existing Conditions shall be submitted in accordance with the paragraph entitled, "General Requirements," of this section.

SD-02 Shop Drawings

Detailed working drawings shall be prepared by a contractor qualified in the layout and design of fire sprinkler systems, including all new wet pipes sprinkler system. Working drawings shall show all pipe lengths, fittings, change in direction, pipe sizes, drain locations and seismic bracing. Detailed working drawings shall be 1/8 inch scale (minimum) and shall conform to NFPA 13. Drawings shall include a site plan and include sufficient building cross sections to show elevations of all building and piping changes. Complete sets of working drawings shall be submitted to the COR.

As-built drawings shall be shop or working drawings corrected to the actual installed conditions. As-built drawings shall show the installed piping, exact locations of all installed equipment, specific interconnections between pressure switch and fire alarm equipment. Drawings shall be submitted to the COR prior to final testing of the system.

All submittal and as-built drawings shall be drafted in a Computer Aided Engineering (CAE) application. The final delivery as-built disks shall be in AutoCAD Release 2010 or later. Font shall be "Simplex". Minimum text size shall be 1/8 inch when plotted at "D" size, and Filename in lower right-hand corner of drawing. The Contractor shall verify the successful conversion to AutoCAD Release 2010 or later prior to delivery to the Government. The data shall be submitted electronically per Section 01 33 00 SUBMITTAL PROCEDURES, labeled as "sprinkler as-builts" and contain the following:

a. Building number and floor or area.

b. Date and name of person or company who made the drawings. Date and name of sprinkler system design engineer or plan checker and approved by.

c. Operating system used to develop the drawing.

d. Software used to create the drawing and version.
File name

e. Filename.

Piping Materials

Supporting Elements

Fire-Department Connections

Fire Alarm System

Compressor

Sprinkler Heads

Valves

Underground Piping Materials

SD-03 Product Data

Manufacturer's catalog data shall be submitted for the following items in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Underground Piping Materials

Aboveground Piping Materials

Valves

Fire-Department Connections

Riser Alarm Equipment

Air Compressor

Pre-action System Riser Assembly

Wet Pipe Riser Assembly

Backflow Preventer Assembly

Sprinkler Heads and Sprinkler Cabinet

Miscellaneous Materials

Supporting Elements

Equipment and Performance Data shall be submitted in accordance with paragraph entitled, "General," of this section.

SD-05 Design Data

Design Analysis and Calculations shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

Hydraulic calculation sheets shall be submitted in tabular form conforming to the requirements and recommendations of NFPA 13. Friction losses shall be based on a value of "C" = 120 and "C" = 90 in the Hazen Williams formula and shall apply to above ground piping and underground piping, respectively.

SD-06 Test Reports

Test reports shall be submitted for the following tests in accordance with the paragraph entitled, "System Testing," of this section.

Hydrant Flow Tests

Water flow test data shall be submitted on a form similar to that contained in NFPA 291 and shall include all required information, including the time of the test.

Hydrostatic Pressure Tests

System Leak Tests

System Operating Tests

Air Tests

Valve-Operating Tests

Drainage Tests

SD-07, Certificates

All equipment and devices shall be of a make and type listed in the U.L. Fire Protection Equipment List and/or Factory Mutual Approval Guide for specific purpose for which it used. Satisfactory proof as to the quality of the equipment and materials shall be furnished by the Contractor at the time the drawings are submitted.

All piping and fitting welding shall be performed by qualified welders and shall meet or exceed AWS B2.1, level AR-3.

Welders qualification shall be submitted for approval.

The Contractor shall possess a valid C-16, California Fire Sprinkler Contractor's License

SD-08, Manufacturer's Instructions

Complete, simple, understandable, step-by-step testing instructions giving recommended and required testing frequency of all equipment, methods for testing all equipment, and a complete trouble-shooting manual.

SD-10, Operation and Maintenance Manuals

Maintenance instructions shall be complete, easy-to-read, understandable, and shall provide the following information:

instruction on replacing any components of the system including internal parts; instruction on periodic cleaning and adjustment of equipment with a schedule of these functions; and a complete list of all equipment and components with information as to the address and phone number of both the manufacturer and local supplier of each item.

1.5 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS.

PART 2 PRODUCTS

2.1 GENERAL

Fire-protection system materials and equipment provided under this section shall conform to the requirements of Underwriters Laboratories (UL) or the Factory Mutual (FM APP GUIDE) and requirements of NFPA 13.

Products with UL label or seal or listing in UL 6, and products with FM label or listed in the FM APP GUIDE are acceptable fire-protection system materials and equipment. Materials and equipment furnished shall be compatible with existing system.

Equipment and Performance Data shall be submitted for fire protection sprinkler systems consisting of information on use life, system functional flows, safety features, and mechanical automated details.

2.2 SYSTEM DESIGN

2.2.1 Spacing of Sprinkler Heads

The spacing of the sprinkler heads shall be for ordinary hazard occupancy, 130 ft^2 per head maximum, and light hazard occupancy of 225 ft^2 per head maximum.

2.2.2 Piping Sizing

System pipe sizing shall be as follows: The sprinkler piping shall be sized by hydraulic calculations based upon a density of 0.14 and 0.19 gpm/ft^2 over a design area of 2000 ft^2 for ordinary hazard group I, and ordinary hazard group II, respectively. A hose stream of 250 gpm per minute shall be added at the base of the riser. Calculation shall be based on a flow of 1000 gpm per minute with a residual pressure of 45 psi, and a static pressure of 60 psi. Water supply is at point of connection with the underground main. The use of restricted orifices will not be permitted.

2.2.3 Area of Protection

Protection shall be complete and include any and all combustible concealed spaces. All unheated areas subject to freezing shall be protected with antifreeze loops not exceeding 20 heads each designed in conformance with NFPA 13. Design shall be based on a 100% coverage basis.

2.2.4 Hydraulic Flow Data

Prior to design, the Contractor shall perform a flow test from the existing street fire hydrants located as close as practical to the new work to verify that the above stated flow rates are, at least, exceeded. Flow test shall be witnessed by NASA Fire Protection Engineer, and conducted in accordance with the procedures and forms contained in NFPA 291. Test shall not be used for basis of design of the system, but only for verification of the available water supply. Scheduling of the test shall be coordinated with the COR, and five (5) days written notice of the agreed date shall be provided to the COR prior to the test. Test results shall be immediately given to the COR, to be forwarded to the Safety Office Fire Protection Engineer.

2.2.5 Interference

The sprinkler system shall be designed and installed in such a manner to prevent interference with doors, windows, lights, heating, plumbing or electrical equipment. In the event of a conflict between sprinkler piping and other equipment, the sprinkler piping shall be relocated to the extent that the required sprinkler coverage shall be maintained.

2.3 UNDERGROUND PIPING MATERIALS

Elbows, tees, reducing tees, wyes, couplings, increasers, crosses, transitions, and end caps shall be the same type and class of material as the pipe or shall be material having equal or superior physical and chemical properties.

Underground piping shall be listed for fire service and comply with AWWA Standards and shall be cast iron bell and spigot or ductile iron. Underground piping shall be wrapped in a pipe wrap approved for underground applications. Tie-rods, nuts, and other fastening hardware shall be 304 stainless steel.

2.3.1 Type CIWP

Cast-iron waterpipe shall be mechanical joint or push-on type, centrifugally cast, UL listed and labeled, conforming to FS WW-P-421and, as applicable, to AWWA C151/A21.51, AWWA C110/A21.10, AWWA C111/A21.11. Piping shall be Class 150. Bell-and-spigot fittings shall conform to AWWA C110/A21.10.

For FS WW-P-421 wall-thickness criteria only, depth of cover shall be 5 feet unless drawings indicate less, in which case, drawing requirements shall apply; field-laying conditions shall be B (flat-bottom trench, without blocks, tamped backfill).

Flanged cast-iron pipe fittings shall be Class 125 conforming to ASME B16.1.

Piping and fittings shall be coated on the outside with a bituminous sealer in accordance with AWWA C104/A21.4.

Restraining joint against endwise separation due to internal pressure may be accomplished by NFPA-recommended metal harness consisting of clamping devices and bolting or by hardened-metal retainers molded into a push-on gasket and engaged by a groove in the spigot end.

Where electrical continuity is indicated, pipe shall be supplied with factory-brazed heavy cross section copper connectors to be joined with copper fasteners upon joint assembly. Connectors, as a minimum, shall be equal to No. 1/0.

2.3.2 Type DIWP

Ductile-iron water pipe shall be mechanical-joint or push-on type, centrifugally cast, UL listed and labeled, conforming to applicable provisions of AWWA C111/A21.11, and AWWA C151/A21.51. Wall-thickness criteria shall be 200-pounds per square inch (psi) working pressure plus 100-psi surge allowance, AASHTO H-20 loading with specified trench conditions. Gasket elastomer shall be chloroprene.

Piping shall be coated on the outside with a bituminous sealer in accordance with AWWA C104/A21.4.

Restraining joint against endwise separation due to internal pressure may be accomplished by using a metal harness consisting of clamping devices and bolting or by hardened-metal retainers molded into a pushon gasket and engaged by a groove in the spigot end.

Where electrical continuity is indicated, pipe shall be supplied with factory-brazed heavy cross section copper connectors to be joined with copper fasteners upon joint assembly. Connectors, at a minimum, shall be equal to No. 1/0.

2.4 ABOVEGROUND PIPING MATERIALS

2.4.1 Type BCS - Black Carbon Steel

Pipe (1/8 through 2 inches): Schedule 40 furnace butt weld black-carbon steel conforming to ASTM A53/A53M, or ASTM A135/A135M, Type F furnace butt welded; Schedule 10 conforming to ASTM A135/A135M, Grade B

Pipe (2-1/2 through 8 inches): Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to ASTM A53/A53M or ASTM A135/A135M, Type E (electric-resistance welded), Grade B, or Type S (seamless), Grade B. Rolled grooved piping shall be Schedule 10 black carbon steel conforming to ASTM A135/A135M.

Pipe (10 inches and over): Schedule 30 black carbon steel conforming to ASTM A53/A53M, Type E (electric-resistance welded) or Type S (seamless)

Unions (2 inches and under): 300-pound per square inch gage (psig) working steam pressure (wsp) female, screwed, black malleable iron, with ground joint and brass-to-iron seat conforming to ASME B16.39

Standard pipe couplings: Extra-heavy screwed black steel

Grooved pipe couplings (all sizes): Rigid couplings shall be pressure rated at 500 psig with grade E gasket.

Fittings (2 inches and under): Malleable iron screwed fittings class 150 and 300.

Fittings (2-1/2 inches and larger): Screwed, conforming to ASME B16.4, or flanged, conforming to ASME B16.1. Screwed fittings shall be extra heavy pattern.

Fittings (8 inches and under): Couplings shall be rolled-groove type or mechanical locking (push-on) type. Grooves for rolled-groove type shall be rolled only; cut grooving will not be allowed. Rolled grooves shall be dimensionally compatible with the couplings.

Grooved fittings (all sizes): Grooved fittings shall be ductile iron, pressure rated at minimum 500 psig.

Tapping T's or hole cut T's shall not be used except when connecting to existing piping. In such cases tapping T's shall be Victaulic style 920 or equal, 500 psi rated couplings. Bushings shall not be used.

Welded pipe and fittings shall be in accordance with NFPA 13. All welding shall be shop done, by properly qualified welders. The welding of earthquake braces or hangers is not permitted.

2.5 SUPPORTING ELEMENTS

Piping system components and miscellaneous supporting elements shall be provided, including, but not limited to, building-structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical-pipe attachments; horizontal-pipe attachments; restraining anchors; and guides. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures, natural, and other external forces.

Supporting elements shall be FM approved or UL listed and shall conform to ASME B31.1, MSS SP-58, and ASME B16.34.

Supports, hangers, etc., shall be of an approved pattern and placed to conform to the requirements of NFPA 13. Sway bracing types and locations shall conform to NFPA 13.

2.5.1 Building-Structure Attachments

2.5.1.1 Anchor Devices, Concrete and Masonry

Anchor devices shall conform to FS FF-S-325:

Group I: Shield, expansion (lead, bolt, and stud anchors)

Group II: Shield, expansion (bolt anchors), Type 2, Class 2, Style 1 or 2

Group III: Shield, expansion (self drilling tubular expansion shell bolt anchors

Cast-in floor-mounted equipment-anchor devices shall provide adjustable positions.

Powder-actuated anchoring devices shall not be used to support mechanical-systems components.

2.5.1.2 Beam Clamps

Beam clamps shall be center-loading Types 21, 28, 29, and 30, UL listed, cataloged, and load-rated commercially manufactured products.

Type 20 beam clamps shall be used for pipe 2 inches and under.

Two Type 25 beam clamps shall be used per point of pipe support.

2.5.1.3 C-Clamps

C-clamps shall be used to support piping sizes 1-1/2 inches and smaller. C-clamps shall be FM approved and UL listed, with hardened cup-tip setscrew, locknut, and retaining strap. Retaining-strap section shall be not less than 1/8 by 1 inch. Beam-flange thickness to which clamps are attached shall not exceed 0.60 inch.

2.5.1.4 Inserts, Concrete

Concrete inserts shall be constructed in accordance with the requirements of MSS SP-58 for Type 18 and ASME B16.34. When applied to piping in sizes 2-inch iron pipe size (ips) and larger, and where otherwise required by imposed loads, a 1-foot length of 1/2-inch reinforcing rod shall be inserted and wired through wing slots.

2.5.2 Horizontal-Pipe Attachments

2.5.2.1 Single Pipes

Piping in sizes up to and including 2-inch ips shall be supported by Type 1, 5, 6, 7, 9, 10, 11, or 12 solid, split-ring, or band type attachments.

Piping in sizes 2-1/2 inches and larger shall be supported by Type 1, 2, 3, or 4 attachments or with Type 41 or Type 49 pipe rolls.

2.5.2.2 Parallel Fire-Protection Pipes

Trapeze hangers fabricated from approved structural steel shapes, with U-bolts, shall be used when so specified. Structural-steel shapes shall conform to supplementary steel requirements or the support shall be of commercially available, approved proprietary-design rolled steel.

2.5.3 Vertical-Pipe Attachments

Single vertical-pipe attachments shall be Type 8.

2.5.4 Hanger Rods and Fixtures

Only circular solid cross section rod hangers shall be used to connect building structure attachments to pipe-support devices. Pipe, straps, or bars of equivalent strength shall be used for hangers.

Turnbuckles, swing eyes, and clevises shall be provided as required by support system to accommodate temperature changes, pipe accessibility, and adjustment for load and pitch.

2.5.5 Supplementary Steel

Where it is necessary to frame structural members between existing members

or where structural members are used in lieu of commercially rated supports, such supplementary steel shall be designed and fabricated in accordance with AISC/AISI 121.

2.6 FIRE-DEPARTMENT CONNECTIONS

Hose connections shall have National Firehose standard-thread form and rocker lugs in accordance with NFPA 1963. Hose-connection sizes and threads shall be compatible with the equipment used by the fire department serving the facility.

2.6.1 Sidewalk Siamese

Unit shall be cast brass or bronze, with two 2-1/2-inch, fire-department, swivel, female inlets; double-clapper valves; rocker-lug caps and chains; and cast-in function-identifying lettering. Finish shall be chrome-plated or polished surface. Chrome plate shall be in accordance with ASME A112.18.1/CSA B125.1.

Unit shall be mounted on a Schedule 40 ASTM A53/A53M galvanized carbon-steel pipe with red-enameled finish on prime-coated surface. All surfaces embedded in concrete or below grade shall be protected with a 20-mil thick bituminous coating.

2.6.2 Fire Hydrants

Hydrants shall be wet-barrel type, with low-profile and modern appearance. Hydrants shall be designed to remain closed with breakaway assembly, if hydrant barrel is sheared or damaged. Unit shall have two 2-1/2-inch, hose outlets and one 4-1/2-inch hose outlet complete with nonbinding caps and cap chains. Hydrant direction of opening shall be counterclockwise. Surface shall be filled, primed, and finished with a multiple-coat high-gloss weather-resistant enamel. All surfaces below grade shall receive a coating of bitumen not less than 20 mils thick. Care shall be exercised not to plug barrel drainage provisions. Color shall be standard for the project site.

2.7 RISER ALARM EQUIPMENT

Riser alarm equipment shall be UL listed or FM approved for fire-protection use.

2.7.1 Wet-Pipe Alarm Check Valve

Wet-pipe alarm check valve shall be complete with standard accessories and trim necessary to give an alarm and shall include pressure gages, retard chamber, testing provisions, and all necessary intercomponent piping, fittings, and valves. Pilot valve and clapper shall have individual elastomer seats.

2.7.2 Standard Check Valve

Check valve shall be FM-approved or UL-listed standard swing-check type with elastomer-disc seat. Pressure gages shall be provided on both sides of the clapper. Water-flow alarm shall be vane type.

Riser swing check valve assembly shall be UL listed and Factory Mutual approved. The riser swing check valve shall be equipped with a removable cover assembly, gauge connections on the system side and supply side of the

valve clapper, and a main drain outlet in the body of the valve above the rubber-faced clapper assembly. The riser swing check valve shall be listed for installation in the vertical or horizontal position. The riser swing check valve trim piping is to be externally galvanized and the maximum water working pressure is to be 250 psi.

2.7.3 Dry-Pipe Alarm Check Valve

Dry-pipe alarm check valve shall be complete with standard accessories and trim necessary to give an alarm, and shall include pressure gages, accelerator, priming provisions, testing provisions, and all necessary intercomponent compressed-air and water piping, fittings, and valves.

System shall include a trouble alarm indicating a loss of air pressure.

2.7.4 Water-Flow Alarm Device

Water-flow alarm devices shall be UL listed for the particular type of system.

2.7.4.1 Water Motor Gong Local Alarm

Assembly shall include a gong with an aluminum or chrome-plated brass hood with nonstaining weather-resistant mounting. Water motor shaft shall have tetrafluoroethylene bearings and an inlet strainer. Waste water shall drain as indicated.

2.7.4.2 Pressure Switch Remote Alarm

Pressure switch shall be wired to make or break a circuit depending on rise or fall of water pressure.

2.7.4.3 Vane-Type Flow Alarm

Vane-type flow alarm shall make or break an alarm circuit upon deflection by a volume of flowing water that equals or exceeds the capacity of a single sprinkler. Alarm shall have an instant-recycle pneumatic-retard time delay.

2.7.4.4 Electric Motor Gong

Electric motor gong shall be a 6-inch diameter bell, synchronous-motor type.

Weather-exposed units shall be weatherproof and shall be provided with a weather hood. Assembly shall be constructed of nonstaining materials.

2.7.5 SYSTEM CONTROL VALVE

The wet system control valve shall be a listed indicating type valve. The control valve shall be UL listed and Factory Mutual approved for fire protection installations. The system control valve shall be rated for normal system pressure, but in no case less than 175 psi.

2.8 DRY-PIPE MAINTENANCE AIR

2.8.1 Independent Source

Dry-pipe system air pressure shall be maintained by an independent Air Compressor mounted on the riser. Compressor shall be spring and elastomer

vibration-isolated from the riser, of oil-free construction, complete with adjustable set point low-differential pressure switch, check valve, and necessary unloader and intercomponent piping and wiring. Spare inlet-air filter media shall be provided.

2.8.2 Continuous Source

Dry-pipe system air pressure shall be maintained by an adjustable set point low-differential-diaphragm pressure-reducing valve connected to 100 psig facility compressed-air system to maintain air side of dry-pipe valve. Unit shall be entirely of nonferrous-metal construction with a replaceable cartridge inlet-air filter. Air-maintenance device shall be complete with intercomponent piping, fittings, and valves. Spare inlet-air filter media shall be provided.

2.8.3 Retard Orifice

Air-supply line near each dry-pipe valve shall be provided with an orifice union with a 1/8-inch orifice corrosion-resistant steel plate, externally identified, and a 1/2-inch three-valve bypass around the orifice union.

2.9 SPRINKLER HEADS

2.9.1 Head Types

Standard 1/2-inch orifice sprinkler heads shall be used. Heads shall be automatic on-off type. On-off type heads shall be installed only in wet-pipe systems.

Heads in finished areas below suspended ceiling shall be flush or pendant type. Heads and escutcheon plates shall be chrome-plated brass.

Sprinkler heads shall be of ordinary temperature rating,155°F , except where excessive temperatures are anticipated, as indicated in NFPA 13. Sprinkler heads shall be of intermediate temperature rating, 175 degrees F, for mechanical room. Corrosion resistant, lead coated sprinkler heads shall be installed where they are exposed to weather, moisture, or corrosive vapors. Heads installed where they might receive mechanical injury shall be protected with approved guards. Sprinklers in finished areas below suspended ceilings shall be pendant, semi-recessed type, chrome finish.

Sidewall sprinklers shall be U.L. listed for the intended area of coverage and be semi-recessed, chrome finish.

2.9.2 Spares

Spares shall be furnished for each type of sprinkler head, complete with appropriate storage cabinet and wrench.

2.9.3 Head Protection

Heads shall be protected with paper or plastic bags during painting operations. Protection shall be removed immediately upon finishing painting operations.

Head guards shall be provided wherever mechanical damage could occur. Guard finish shall be red enamel.

2.9.4 Sprinkler Cabinet

A sprinkler cabinet with the required number of sprinkler heads of all ratings and types installed and a sprinkler wrench shall be provided for each system and located adjacent to the riser or shown otherwise on the drawings.

2.10 VALVES

2.10.1 Underground

2.10.1.1 Post Indicator Valve Assembly (PIV)

Assembly shall consist of a standard FM-approved or UL-listed inside-screw gate valve with an above-grade post indicator or a completely factory-assembled FM-approved quarter-turn valve and above-grade post indicator-operator. Direction to open shall be counterclockwise.

Quarter-turn valve shall be a wafer-type butterfly valve, rated at 175 psi, elastomer-lined and sealed. Liner shall act as a gasket between ASME B16.1, Class 125 or Class 250 flanges. Post shall have a fail-safe feature to keep valve intact in case of breaking off above grade. Operator shall be worm-gear type with permanently oil-lubricated watertight gear case complete with handle.

Surfaces below grade shall receive a coating of bitumen not less than 20 mils thick. Above-grade surfaces shall be filled, primed, and finished with a multiple coat of high-gloss, weather-resistant, red enamel.

Post indicator valves shall be fitted to accommodate electrical supervisory switches.

Electrical supervisory switches shall be provided for interconnection to the building Fire Alarm System.

2.10.1.2 Fire-Hydrant Service Valves

Fire-hydrant service valves shall be standard FM-approved or UL-listed inside-screw gate valve, with valve box connection flange.

2.10.1.3 Valve Boxes

Valve boxes shall be not less than 3/16-inch thick cast-iron construction with locking cover that has a cast-in identification legend. Boxes shall be adjustable extension type with screw- or slide-type adjustment. Base flange shall be fitted to the valve flange. Full extended length of box shall be greater than required by depth of cover by not less than 4 inches. One valve-operating wrench shall be supplied for each size valve nut. Guide rings shall be provided where operating rods are longer than 6 feet.

2.10.1.4 CAST-IRON ROADWAY VALVE BOX

Integral belled base section, (standard 36", where greater length is required, a 5" "no-hub" coupling with required length of 5" cast-iron pipe shall be used). Top section shall be a slip type-cast-iron with "WATER" lid installed flush with grade.

2.10.2 Aboveground

Gate, globe, and check valves (all sizes) shall be FM approved or UL listed.

Above grade shall be the OS&Y type, iron body with brass trim and shall be designed for a 175 psi working pressure. Screwed end gate valves shall be bronze. Check valves shall be of a type having an iron body, brass seat and rubber faced clapper, clear way swinging, drip connections, and designed for 175 psi working pressure. Screwed end angle, check and globe valves shall be bronze.

Ball valves, 2 inches and under, shall be FM approved, rated 300 psi, with provisions to wire or lock handle in place where critical alarm function may be isolated.

Butterfly valves, 6-, 8-, and 10-inch shall be FM approved, rated 175 psi, cast-iron bodied wafer type, with elastomer liners and seals. Liners shall act as gasket between standard piping-system flanges. Operator shall be worm-gear type, with permanently lubricated gears, and oiltight and watertight case, complete with handle and automatic position indication.

2.11 MISCELLANEOUS MATERIALS

2.11.1 Bituminous Coating

Bituminous coating shall be a solvent cutback, heavy-bodied material to produce not less than a 12-mil dry-film thickness in one coat and shall be as recommended by the conduit manufacturer for compatibility with factory coating and rubber joints.

For previously coal-tar-coated and for uncoated ferrous surfaces underground, bituminous coating shall be solvent cutback coal-tar type, conforming to MIL-C-18480.

2.11.2 Bolting

Flange and general-purpose bolting shall be hex-head and shall conform to ASTM A307, Grade B. Heavy hex-nuts shall conform to ASTM A563. Square-head bolts and nuts are not acceptable.

2.11.3 Elastomer Caulk

Polysulfide- or polyurethane-base elastomer-calking material shall be two-component type, conforming to ASTM C920.

2.11.4 Escutcheons

Escutcheons shall be manufactured from nonferrous metals and shall be chrome-plated, except when AISI 300 series corrosion-resistant steel is provided. Metals and finish shall conform to ASME A112.18.1/CSA B125.1.

Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing and one-piece or split-pattern type elsewhere. Escutcheons shall have provisions consisting of internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.11.5 Flashing

2.11.5.1 Lead

Sheet lead shall conform to ASTM B749, and shall weigh not less than 4 pounds per square foot.

2.11.5.2 Copper

Sheet copper shall conform to ASTM B370 and shall weigh not less than 16 ounces per square foot.

2.11.6 Flange Gaskets

Gaskets shall be suitable for the intended use and shall contain no asbestos.

2.11.7 Pipe-Thread Compounds

Tetrafluoroethylene tape or other suitable compounds shall be used.

2.11.8 Tapered Reducer

When a reduction in the size of pipe is required in the transition from the underground to the main riser, a concentric tapered reducer shall be installed to meet this pipe size reduction.

2.11.9 Sleeves

Galvanized steel pipe sleeves shall be provided for all pipes passing through masonry or concrete walls, floors, or ceilings with clearance around the sleeve as stated in NFPA 13. Space between the pipe and sleeve shall be packed with fire retardant sealant in fire rated walls and mineral wool and caulked in non-rated walls. When permitted by the COR, flexible couplings on each side of the wall may be used in lieu of the required pipe clearances.

2.11.10 Flexible Couplings

Flexible couplings shall be provided in locations where flexibility is required and in conformance with NFPA 13.

2.11.11 Gauges

Gauges shall be provided in conformance with NFPA 13.

2.11.12 Wall, Floor, and Ceiling Plates

Piping passing through walls, floors, and ceilings shall be provided with chrome plated steel escutcheon plates, except where penetrations are located in concealed spaces. All penetrations shall be filled with fire stopping material.

2.11.13 Sight Glass

Sight glass shall be UL listed and FM approved for fire sprinkler system and shall be bronze/glass with pipe thread ends and rated for the system pressure.

2.11.14 Zone Control Assembly

The zone control assembly shall consist of a OS&Y gate valve, drain, test orifice, and time retard water flow switch with a built in adjustable time retard feature. The flow switch shall be installed as shown on the drawing assembly. The pressure switch time delay shall be set for thirty (30) seconds and be installed and connected in such a manner that a flow of water equal to or greater than that from a single head will automatically light the appropriate annunciator light. The connection to the building alarm system shall conform to NFPA 72. The switch shall be equipped with two contacts of the normally open type.

2.11.15 Valve Tamper Switch

The sprinkler system main shut off valve, and other valves as shown on the drawings, shall be equipped with a valve shut off/tamper switch. Upon two complete turns or less, the switch shall initiate a supervisory alarm at the control panel and transmit an alarm to the alarm receivers.

2.11.16 Inspector's Test Valves

Inspector's test valves shall be installed and supplied from the highest most hydraulically remote portion of the systems in relation to the riser assembly. Test valves shall be located per NFPA 13 and accessible within 7 feet of the finished floor. Piping termination shall contain a sprinkler test orifice discharging to the outside of the building, either to a roof drain or terminate at the ground level.

2.12 FIRE-PROTECTION SYSTEM IDENTIFICATION

A coordinated system of piping and equipment identification shall be provided which includes the following:

Framed and plastic-protected diagrammatic layout of all piping systems, identifying and locating piping, equipment, and valves. Where existing systems are being modified, existing layouts shall be brought up to date.

Metal-tag-identified major valves, piping-system components, and equipment

Metal identification plate at controlling alarm valve identifying system and area protected

Service-labeled piping

Color coding shall be used for flow-capacity identification of fire hydrants only. Color coding shall be in accordance with NFPA 291. Numbering of post-indicator valves, hydrants, and other components shall be an extension of existing systems.

2.12.1 Diagrams

Chart listing of equipment shall be by designation number and shall show pertinent data. Diagrams shall be neat, mechanical drawings mounted in extruded aluminum frames, with 1/8-inch thick acrylic plastic protection. Location shall be as directed by the COR. A minimum of one mounted chart and diagram, plus one extra copy of each, shall be provided for each fire-protection system.

2.12.2 Metal Tags

Identification tags made of brass or aluminum and indicating function of valve or similar component, shall be installed on such system devices. Tags shall be not less than 2 inches in diameter and marking shall be stamped.

Equipment shall be provided with metal identification tags bearing an equipment designation number matching the drawing or diagram designations.

Tags shall be secured to valve or equipment items with 12-gage galvanized wire.

2.12.3 Service Labeling

Piping, including that concealed in accessible spaces, shall be labeled to designate service. Each label shall include an arrow or arrows to indicate flow direction. Labels or tag designations shall be as follows:

SERVICE	LABEL OR TAG DESIGNATION
Main sprinkler supply	MAIN SPRINKLER SUPPLY
Sprinkler riser number	SPRINKLER RISER NO.
Sprinkler branch	SPRINKLER BRANCH
Standpipe piping	STANDPIPE

Piping shall be labeled and arrowed in accordance with the following:

Each point of entry and exit through walls

Each change in direction

In congested or hidden areas, at each point required to clarify service or indicate hazard

In long straight runs, labels shall be located at a distance visible to each other, but in no case shall the distance between labels exceed 40 feet.

Label lettering shall be 2 inches high. Where the size of pipes is 2-1/2-inch outside diameter and smaller, labels shall be attached to 16-gage aluminum sheet which shall be attached to the pipe with 12-gage galvanized wire. Labels shall be legible from the primary service and operating area.

Labels shall be made of self-sticking plastic film designed for permanent installation. Labels shall have red letters on white background.

Label and valve tag schedule above shall not be construed as defining or limiting the work. All piping systems shall be labeled.

2.12.4 Signs

Standard signs shall be attached as appropriate in accordance with NFPA 13.

All system valves, drains, test lines, and system piping shall be labeled and identified with signs in accordance with ASME A13.1. All piping shall be labeled as fire sprinkler piping with band type labels at 20 foot intervals with flow direction indicated by arrows.

2.13 DOUBLE CHECK BACKFLOW PREVENTER ASSEMBLY (DCBFP)

All DCBFP's shall conform to AWWA C510, UL listed, FM approved and approved by the Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California. All DCBFP's shall have test cocks. The bottom of the DCBFP shall be located between 12" and 36" above the ground. The side with the test cocks shall be a minimum of 24" from the nearest fixed wall or obstruction, and all other sides shall be a minimum of 12" from the nearest fixed wall or obstruction. All DCBFP's shall be tested and certified before a system is accepted. Test results and certifications shall be forwarded to the COR and included in the O&M Manuals.

2.14 PAINTING

Equipment of the manufacturer's standard product shall be furnished with the manufacturer's standard finish coat.

Other mechanical equipment shall be furnished with a shop-applied prime paint.

PART 3 EXECUTION

3.1 GENERAL

Installation of system materials and equipment shall be in accordance with the recommendations and provisions of NFPA 13, NFPA 13E, NFPA 14, and NFPA 24. Work shall be performed in the presence of the COR who shall be notified by the Contractor 48 hours in advance of the start of work.

All installation work shall be performed by licensed fire protection sprinkler contractors, licensed for such work in the state where the work is to be performed.

The installation shall be accomplished by personnel experienced in the installation of the specific type of system. The services of a qualified technician, experienced in the installation and operation of the type of system being installed, shall be provided to supervise the installation and testing of the system. Piping shall be installed above suspended ceilings and concealed wherever possible. In unfinished areas where piping is exposed, piping shall be installed in a neat and orderly manner and un-objectionable in appearance.

3.1.1 Installation of Screw Jointed Pipe

All piping shall be accurately cut to measurements established by the Contractor and shall be worked into place without springing or forcing. In any situation where bending of pipe is required, such bending shall be accomplished by the use of a standard pipe-bending template. Pipe compounds shall be applied to male threads only.

3.1.2 Welding

All welding is required to conform to the requirements and recommendations

in NFPA 13.

3.1.3 Repairs

Damage to building and/or equipment resulting from the installation of the sprinkler system shall be repaired by the Contractor.

3.1.4 Pitch of Piping

All sprinkler piping shall be designed and installed to be pitched to drain back to the main riser drain and as required by NFPA 13, except in wet pipe systems where the piping may be installed level. Where conditions are such that piping cannot be pitched to drain, such as a change in direction to avoid an obstruction, auxiliary drains shall be installed so there are no trapped sections of piping.

All drains shall be valved and shall have a 5/8 inch hose connection.

3.1.5 Drains

All main drains shall be valved and piped to discharge at safe points outside each building or to sight cones attached to drains of adequate size to readily carry the full flow from each sprinkler drain under maximum pressure. All drains (both auxiliary and main) shall be installed where necessary and shall discharge outside the building, or to open slight drains or standard interior floor drains. In no case shall a direct connection be made to any of the sewer systems. In case of any trapped section of piping, a 1/2 inch valved connection shall be provided with associated flexible hose to drain any water.

3.1.6 Interruption of Service

There shall be no interruption of existing sprinkler protection, water, electric, or fire alarm services without prior written permission of the COR. Permission shall be requested at least 72 hours before planned interruption. If system is interrupted past normal working hours, a fire watch shall be provided by the Contractor.

3.2 UNDERGROUND PIPING INSTALLATION

Installation of piping materials shall conform to the written or published instructions of the manufacturer.

Pipes passing through walls below grade and ground-floor slab shall pass through pipe sleeves one size larger than pipe and shall be calked watertight with lead and oakum or mechanically expandable chloroprene inserts with bitumen sealed metal components.

In fill areas, pipe passing under or through building grade beams shall have a minimum clearance of 4 inches in all directions.

Rubber- or elastomer-jointed piping embedded in concrete walls shall have a joint within 6 inches of the face of the wall, capable of absorbing movement without leakage.

Piping penetrating earth or concrete grade shall be extended-joint or flange-bolt height plus 6 inches above the grade.

Underground piping below supported or suspended slabs shall be supported

from the slab with a minimum of two supports per length of pipe. Supports shall be protected with a coating of bitumen.

On excavations near and below building footings, the backfilling material shall consist of 2,000-psi cured-strength concrete poured or pressure-grouted up to the level of the footing.

After piping has been inspected, and not less than 48 hours prior to being lowered into a trench, external surfaces of the piping, valves, valve operators, and valve boxes shall be coated with a compatible bituminous coating suitable for protection against brackish ground water. Application shall be in accordance with the manufacturer's instructions to a dry-film thickness of not less than 12 mils.

3.2.1 Construction Tolerances for Types CIWP and DIWP

Maximum deviation from design elevation at any point along piping shall not exceed 2-1/2 inches for all sizes of piping.

Maximum deviation from line at the end of an 18-foot length of piping shall be 2-1/2 inches and cumulatively shall not exceed 6 inches. Corrections from line within preceding tolerances shall be made at a rate not to exceed 2-1/2 inches for any one length of piping.

Maximum deflection for curves for 18-foot lengths of cast ferrous pipe shall be in accordance with NFPA 24.

When the alignment requires deflections in excess of the above limitations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within established limits, as approved.

3.2.2 Fire Hydrants

Hydrant outlets shall be 24 inches, minimum, to 36 inches, maximum, above grade. The 4-1/2-inch outlet shall face the road or area of access.

3.2.3 Valve Boxes

Valves and valve boxes and shall be set plumb. Valve boxes shall be centered on the valves. Where feasible, valves shall be located outside traffic areas. Soil shall be carefully tamped around each valve box to a distance of 4 feet on all sides of the box or to the undisturbed trench face when less than 4 feet.

3.2.4 Thrust Blocks

Thrust blocks shall be provided to absorb hydraulic thrust at caps, plugs, and at system change-of-direction fittings.

Thrust block shall be 3,000-psi cured-strength concrete placed against undisturbed soil, with an area sufficient to provide load transmittal.

3.3 ABOVEGROUND PIPING-SYSTEMS INSTALLATION

Piping shall run parallel with the lines of the building. Piping and components shall be spaced and installed so that a threaded pipe fitting may be removed between adjacent pipes and so that there will be not less than 1/2 inch of clear space between the finished surface and other work

and between the finished surface of parallel adjacent piping. Hangers on different adjacent service lines running parallel shall be arranged to be in line with each other and parallel to the lines of the building.

Load rating for pipe-hanger supports shall be based on all lines filled with water. Deflection per span shall not exceed slope gradient of pipe. Schedule 40 and heavier ferrous pipe supports shall be in accordance with the following minimum rod size and maximum allowable hanger spacing. For concentrated loads such as valves, allowable span shall be reduced proportionately.

PIPE SIZE (INCHES)	ROD SIZE (INCHES)	HANGER SPACING FOR STEEL PIPE (FEET)
Up to 1	3/8	8
1-1/4	3/8	12
1-1/2	3/8	15
2-1/2 to 3-1/2	3/8	15
5	1/2	15
6	1/2	15
8	1/2	15

Vertical risers shall be supported at the base where possible and at intervals specified. Piping shall be guided for lateral stability as necessary. Clamps shall be placed under fittings wherever possible. Carbon-steel pipe shall be supported at each floor at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20-foot intervals for pipe 2-1/2 inches and larger.

Piping shall be securely supported with allowance for thrust forces and thermal expansion and contraction and shall not be subject to mechanical, chemical, vibrational, or other damage, in conformance with ASME B31.1.

3.4 SOUND STOPPING

Effective sound stopping and adequate operating clearance shall be provided to prevent structure contact where piping penetrates walls, floors, or ceilings; into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces include space above ceiling where no special acoustic treatment of ceiling is provided. Penetrations shall be finished to be compatible with surface being penetrated.

Sound stopping and vapor-barrier sealing of pipe shafts, and large floor and wall openings may be accomplished by packing with properly supported mineral fiber insulation or by foaming-in-place with self-extinguishing, 2-pound density polyurethane foam to a depth not less than 6 inches. Foam shall be finished with a rasp. Vapor barrier shall be not less than 1/8-inch thickness of vinyl mastic applied to visible and accessible surfaces. Where fire stopping is a consideration, only mineral fiber shall be used, and, in addition, openings shall be covered with 16-gage sheet

metal.

3.5 SLEEVES

Sleeves shall be provided where piping passes through roofs, masonry or concrete walls, or floors.

Sleeves passing through steel decks shall be continuously welded or brazed to the deck.

Sleeves extending through floors, roofs, or load-bearing walls, and sleeves through fire barriers shall be continuous and fabricated from Schedule 40 steel pipe with welded anchor lugs. Other sleeves shall be formed by molded linear polyethylene liners or similar materials that are removable. Diameter of sleeves shall be large enough to accommodate pipe, insulation, and jacketing without touching the sleeve, and additionally shall provide a minimum 3/8-inch clearance. Sleeve shall accommodate mechanical and thermal motion of pipe to preclude transmission of vibration to walls and generation of noise.

Space between a pipe and the inside of a pipe sleeve or a construction surface penetration shall be packed solid with mineral fiber conforming to ASTM C592 wherever the piping passes through firewalls, equipment-room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction-surface penetrations occur between conditioned and unconditioned spaces, the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction-surface penetration shall be filled with an elastomer caulk to a depth of 1/2 inch. Surfaces to be calked shall be oil- and grease-free.

Exterior wall sleeves shall be calked watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed components.

3.6 ESCUTCHEONS

Escutcheons shall be provided at penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, escutcheons shall be provided on both sides of the partition. Where suspended ceilings are installed, plates shall be provided at the underside only of such ceilings. Escutcheons shall be chrome plated in occupied spaces and shall conceal openings in building construction. Escutcheons shall be firmly attached.

3.7 FLASHINGS

Flashings at systems penetrations of building boundaries shall be provided as indicated.

3.8 BRANCH-LINE TESTERS

Branch-line testers shall permit testing and flushing lines without shutdown of system or loss of fire-protection capability. Line testers shall be fitted with chain-attached caps.

Line testers shall be installed where indicated and on most remote branch lines being served by cross mains, so that testing may be accomplished at the dead corners of each sprinkler system.

3.9 PAINTING

Manufacturer's standard-finish equipment surfaces damaged during construction shall be brought to as-new condition by touchup or repainting to the satisfaction of the COR, or replaced with new undamaged equipment at no additional cost to the Government.

Pipe hangers, supports, and other iron work in concealed spaces shall be thoroughly cleaned and painted with one coat of primer paint.

All firex piping, valves, and appurtenances, including hose racks and reels, but excluding hoses, hose nozzles and siamese connections, shall receive two coats of enamel, color No. 11105 (red) in accordance with MIL-STD-101 and FED-STD-595.

After installation has passed a satisfactory hydrostatic test, all iron and steel parts shall be thoroughly cleaned. All piping and other metal except sprinkler heads, bronze or brass fittings, and moving parts, shall be given a priming coat of zinc chromate in accordance with FS TT-P-645, and a finish coat of red enamel in accordance with FS TT-E-489. Exposed sprinkler piping in finished areas shall be given a finish coat with the background color. Piping shall be field painted by an experienced craftsman in that trade unless otherwise approved by the COR. All sprinkler piping shall be labeled as "Fire Sprinkler Water" at intervals not exceeding 25 feet. Exposed piping where allowed shall be painted to match the background color and labeled.

3.10 ELECTRICAL WORK

Electrical work is specified in DIVISION 26 ELECTRICAL except for control and fire alarm wiring which shall be provided under this section in accordance with CEC and NFPA 70. Rigid metal conduit or intermediate metal conduit shall be used, except that electrical metallic tubing may be used in dry locations not enclosed in concrete or where not subject to mechanical damage.

Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 26 05 00.00 40 COMMON WORK RESULTS FOR ELECTRICAL. Controllers and contactors shall have maximum 120-volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment are furnished larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.

3.11 SYSTEM TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS.

Prior to acceptance of the work, completed systems shall be tested in the presence of the COR. Upon approval, certificates of testing shall be provided.

Tests shall be hydrostatic, unless otherwise specified. Only potable water shall be used for testing.

Air Tests, Valve-Operating Tests, and Drainage Tests shall be performed for dry-pipe systems.

Full-flow System Operating Tests shall be performed for standpipe systems.

Government will supply testing water at a location determined by the COR, but the Contractor shall be responsible for approved disposal of contaminated water.

Contractor shall prepare and maintain test records of piping-system tests. Records shall show personnel responsibilities, dates, test-gage identification numbers, ambient and test-water temperatures, pressure ranges, rates of pressure drops, and leakage rates. Each test acceptance shall require the signature of the COR.

3.11.1 Test Gages

Test gages, to be acceptable, shall have 4-1/2-inch dials or larger with accuracy of plus or minus 1/2 of 1 percent of full-scale range and dial graduations and pointer width compatible with readability to within one-half of the accuracy extremes. Maximum permissible scale range for a given test shall be such that the pointer during a test shall have a starting position at midpoint of the dial or within the middle third of the scale range. Certification of accuracy and correction table shall bear a date within 90 calendar days prior to the test, test gage number, and the project number.

3.11.2 Test and Acceptable Criteria

Aboveground systems shall have Pressure Tests at 200 psi and the applied pressure shall be maintained without further addition of test media for not less than 2 hours. Maximum allowable pressure drop shall be 2 psi.

Underground rubber-jointed ferrous-pipe water systems shall be tested at 200 psi, and the applied test pressure shall be maintained for not less than 2 hours. Maximum allowable pressure drop shall be 2 psi. After satisfactory hydrostatic testing, piping shall be tested for leakage as follows:

Duration of each leakage test shall be not less than 2 hours; during the test, the main shall be subjected to 200 psi pressure based on the elevation of the lowest section under test and corrected to the elevation of the test gage.

Leakage shall be defined as the quantity of water supplied into the laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

No piping installation will be accepted if the leakage in gallons per hour exceeds 0.00054 times the number of joints in the length of the pipe line tested times the nominal diameter of the pipe in inches times the square root of the average test pressure expressed as psig. Amount of leakage at the joints shall not exceed 2 quarts per 100 joints regardless of pipe diameter.

Hydrostatic tests shall be applied to piping with concrete thrust blocking only after the concrete has cured for more than 5 working days.

Backflow prevention into connected potable-water systems and system devices shall be tested for proper functioning under conditions normal to their application.

Dripping or weeping joints shall be repaired.

3.12 STERILIZATION OF WATER MAINS

All piping including valves, fittings, and other devices shall be sterilized in accordance with AWWA Standards with a solution of chlorine and water. The solution shall contain not less than 50 parts per million (ppm) of available chlorine. The solution shall be held for a period of not less than 8 hours, at which time the solution shall contain a minimum residue of 2 ppm of available chlorine or the system shall be re-sterilized. After successful sterilization the piping shall be thoroughly flushed before placing in service. Disposal of contaminated water shall be the responsibility of the Contractor. Systems with backflow preventer installed will not require sterilization of the piping system downstream of the new backflow preventer assembly.

3.13 CLEANING AND ADJUSTING

At the completion of the work, all parts of the installation shall be thoroughly cleaned. Equipment, pipes, valves, and fittings shall be cleaned of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system. Automatic control devices shall be adjusted for proper operation.

3.14 FINAL INSPECTION AND TESTS

Upon completion of the installation and as-built drawings, the following inspection and tests shall be made:

3.14.1 Hydrostatic Tests

The system shall be hydrostatically tested, including the fire department connection, as specified in NFPA 13, in the presence of the COR or his authorized representative. Materials and test certificate, as specified in NFPA 13, shall be filled out for hydrostatic tests and submitted. Alarm tests shall be completed and all necessary corrections shall be made prior to final inspection by the Fire Protection Engineer.

3.14.2 Pressure Tested

The system shall be pressure tested. Provide a 200 psi pressure test for 2 hours with no loss in pressure or visible leaks.

3.14.3 Inspection and Tests

The system shall be subjected to operational tests, and when all necessary corrections have been accomplished, the COR shall be advised and will schedule a final inspection and test with the Center's Fire Protection Engineer, QH. The connection of the fire alarm system shall have been in service for at least ten days prior to the final inspection, with adjustments made to prevent false alarms. The Contractor shall furnish all

instruments, labor, and materials required for the tests and shall provide the services of the installation foreman or other competent representative of the Contractor to perform the tests. Any deficiencies found shall be corrected by the Contractor and system re-tested as necessary. Tests shall include the operation of all features of the systems under normal operations.

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SECTION 22 00 00

PLUMBING, GENERAL PURPOSE

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for general purpose plumbing systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 1010	Self-Contained, Mechanically Refrigerated Drinking-Water Coolers

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.10.1	Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less
ANSI Z21.10.3	Gas Water Heaters Vol.III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous
ANSI Z21.22/CSA 4.4	Relief Valves for Hot Water Supply Systems
ANSI Z358.1	Emergency Eye Wash and Shower Equipment

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	Performance Requirements for Atmospheric Type Vacuum Breakers (ANSI approved 2009)
ASSE 1003	Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)

ASSE 1010	Performance Requirements for Water Hammer Arresters (ANSI approved 2004)
ASSE 1011	Performance Requirements for Hose Connection Vacuum Breakers (ANSI approved 2004)
ASSE 1012	Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent - (ANSI approved 2009)
ASSE 1013	Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers - (ANSI approved 2010)
ASSE 1018	Performance Requirements for Trap Seal Primer Valves - Potable Water Supplied (ANSI Approved 2002
ASSE 1019	Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type (ANSI Approved 2004)
ASSE 1020	Performance Requirements for Pressure Vacuum Breaker Assembly (ANSI Approved 2004)
ASSE 1037	Performance Requirements for Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084	Standard Methods for the Examination of Water and Wastewater
AWWA C203	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	Grooved and Shouldered Joints
AWWA C651	Standard for Disinfecting Water Mains
AWWA C652	Disinfection of Water-Storage Facilities
AWWA C700	Standard for Cold Water Meters - Displacement Type, Bronze Main Case
AWWA C701	Standard for Cold-Water Meters - Turbine Type for Customer Service
AWWA D100	Welded Steel Tanks for Water Storage

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	Specification for Filler Metals for Brazing and Braze Welding
AWS B2.2/B2.2M	Specification for Brazing Procedure and Performance Qualification

ASME INTERNATIONAL (ASME)

ASME A112.1.2	Standard for Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)
ASME A112.19.2	Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals
ASME A112.19.3	Stainless Steel Plumbing Fixtures
ASME A112.36.2M	Cleanouts
ASME A112.6.1M	Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.6.3	Standard for Floor and Trench Drains
ASME A112.6.4	Roof, Deck and Balcony Drains
ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ASME B16.12	Cast Iron Threaded Drainage Fittings
ASME B16.15	Cast Bronze Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500
ASME B16.29	Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.3	Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.34	Valves - Flanged, Threaded and Welding End

ASME B16.39	Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.50	Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
ASME B31.1	Power Piping
ASME B31.5	Refrigeration Piping and Heat Transfer Components
ASME B40.100	Pressure Gauges and Gauge Attachments
ASME BPVC SEC IV	BPVC Section IV-Rules for Construction of Heating Boilers
ASME BPVC SEC IX	BPVC Section IX-Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1
ASME CSD-1	Control and Safety Devices for Automatically Fired Boilers

ASTM INTERNATIONAL (ASTM)

ASTM A105/A105M	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A183	Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A193/A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A47/A47M	Standard Specification for Ferritic Malleable Iron Castings
ASTM A515/A515M	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516/A516M	Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A518/A518M	Standard Specification for Corrosion-Resistant High-Silicon Iron Castings
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A733	Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A74	Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A888	Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B111/B111M	Standard Specification for Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock
ASTM B306	Standard Specification for Copper Drainage Tube (DWV)
ASTM B32	Standard Specification for Solder Metal
ASTM B42	Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B43	Standard Specification for Seamless Red Brass Pipe, Standard Sizes
ASTM B584	Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B75	Standard Specification for Seamless Copper Tube
ASTM B813	Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B828	Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM B88	Standard Specification for Seamless Copper Water Tube
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM D2235	Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D2239	Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

ASTM D2241	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2657	Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D2661	Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40, Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D2683	Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D2737	Polyethylene (PE) Plastic Tubing
ASTM D3138	Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
ASTM D3261	Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM E1	Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM F 628	Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core

CALIFORNIA CODE OF REGULATIONS (CCR)

CPC	California Plumbing Code, CCR Title 24, Part 5

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015	Copper Tube Handbook

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO PS 117	Press Type Or Plain End Rub Gasketed W/ Nail CU & CU Alloy Fittings 4 Install On CU Tubing
IAPMO UPC	Uniform Plumbing Code

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC	International Plumbing Code
ICC/ANSI A117.1	Accessible and Usable Buildings and Facilities

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ANSI/ISEA Z358.1	American National Standard for Emergency Eyewash and Shower Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-44	Steel Pipeline Flanges
MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-67	Butterfly Valves
MSS SP-69	Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
MSS SP-70	Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-78	Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	Class 3000 Steel Pipe Unions Socket Welding and Threaded

MSS SP-85	Gray Iron Globe & Angle Valves Flanged and Threaded Ends

NACE INTERNATIONAL (NACE)

NACE SP0169	Control of External Corrosion on Underground or Submerged Metallic Piping Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA MG 1	Motors and Generators
NEMA MG 11	Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	National Fuel Gas Code
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA Fire Man	Firestopping: Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI G 101	Testing and Rating Procedure for Hydro Mechanical Grease Interceptors with Appendix of Installation and Maintenance
PDI WH 201	Water Hammer Arresters Standard

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508	Hose Clamp Specifications

UNDERWRITERS LABORATORIES (UL)

UL 1951	Electric Plumbing Accessories

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the

Plumbing Code. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

SD-03 Product Data

Fixtures

Flush valve water closets

Flush valve urinals

Wall hung lavatories

Countertop lavatories

Service sinks

Drinking-water coolers

Water heaters

Pumps

Backflow preventers

Welding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Plumbing System

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

1.4 PERFORMANCE REQUIREMENTS

1.4.1 Welding

Piping shall be welded in accordance with qualified procedures using certified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPVC SEC IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The COR shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record.

All welding of ASME piping shall be performed by a contractor having a current ASME U or PP authorization, in full compliance with their ASME QA program, except the U or PP stamp need not be affixed to piping unless

mandated by applicable piping code.

PART 2 PRODUCTS

2.1 Materials

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Solder containing lead shall not be used with copper pipe. Cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Institute. Joints and gasket materials shall conform to the following:

a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A74, AWWA C606. For hubless type: CISPI 310

b. Coupling for Steel Pipe: AWWA C606.

c. Couplings for Grooved Pipe: Ductile Iron ASTM A536 (Grade 65-45-12) Malleable Iron ASTM A47/A47M, Grade 32510. Copper ASTM A536.

d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.

e. Brazing Material: Brazing material shall conform to AWS A5.8/A5.8M, BCuP-5, and ASME Section IX.

f. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.

g. Solder Material: Solder metal shall conform to ASTM B32.

h. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B813, Standard Test 1.

Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.

Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A183.

k. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A105/A105M. Blind flange material shall conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A193/A193M. Underground flanges shall use stainless steel bolts and nuts.

l. Press fittings for Copper Pipe and Tube: Copper press fittings shall conform to the material and sizing requirements of ASME B16.18 or

ASME B16.22 and performance criteria of IAPMO PS 117. Sealing elements for copper press fittings shall be EPDM, FKM or HNBR. Sealing elements shall be factory installed or an alternative supplied fitting manufacturer. Sealing element shall be selected based on manufacturer's approved application guidelines.

m. Copper tubing shall conform to ASTM B88, Type K, L or M.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arrester: PDI WH 201. Water hammer arrester shall be piston type.

b. Hose Clamps: SAE J1508.

c. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.

d. Metallic Cleanouts: ASME A112.36.2M.

e. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

f. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: AWWA C203.

g. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.

h. Thermometers: ASTM E1. Mercury shall not be used in thermometers.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 2-1/2 inches and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67

Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Vacuum Relief Valves	ANSI Z21.22/CSA 4.4
Water Pressure Reducing Valves	ASSE 1003
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22/CSA 4.4

2.3.1 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 3/4 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

2.3.2 Relief Valves

Potable water heaters and hot water storage tanks that are listed exceptions to ASME BPVC Section IV, Part HLW, paragraph HLW-101 shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22/CSA 4.4. Relief valves for systems where the maximum rate of heat input is less than 200,000 Btuh shall have 3/4 inch minimum inlets, and 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 200,000 Btuh shall comply with ASME BPVC Section IV, HLW-700 and HLW-800. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.3.3 Thermostatic Mixing Valves

Provide thermostatic mixing valve for lavatory faucets. Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desited temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 5 degrees F of any setting.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with CPC. Fixtures for use by the physically handicapped shall be in accordance with ICC/ANSI A117.1. ASME A112.19.3 302 stainless steel or Vitreous China, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years or shall be copper alloy with all visible surfaces chrome plated. Plastic in contact with hot water shall be suitable for 180 degrees F water temperature.

2.4.1 Lavatories

Vitreous china lavatories shall be provided with two integral molded lugs on the back-underside of the fixture and drilled for bolting to the wall in a manner similar to the hanger plate.

2.4.2 Automatic Controls

Provide automatic, sensor operated faucets and flush valves to comply with ASSE 1037 and UL 1951 for lavatory faucets, urinals, and water closets. Flushing and faucet systems shall consist of solenoid-activated valves with light beam sensors. Flush valve for water closet shall include an override pushbutton. Flushing devices shall be provided as described in paragraph FIXTURES AND FIXTURE TRIMMINGS.

2.4.3 Flush Valve Water Closets

ASME A112.19.2, white vitreous china, siphon jet, elongated bowl, floor-mounted, floor outlet or wall mounted, wall outlet. Top of toilet seat height above floor shall be 14 to 15 inches, except 17 to 19 inches for wheelchair water closets. Provide wax bowl ring including plastic sleeve for floor mounted closets. Provide white solid plastic elongated open-front seat.

Water flushing volume of the water closet and flush valve combination shall not exceed 1.6 gallons per flush.

Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Mounted height of flush valve shall not interfere with the hand rail in ADA stalls. Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

2.4.4 Flush Valve Urinals

ASME A112.19.2, white vitreous china, wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields. Provide urinal with the rim 17 inches above the floor. Provide urinal with the rim 24 inches above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 1.0 gallon per flush. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 11 inches above the fixture. Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.

2.4.5 Wall Hung Lavatories

ASME A112.19.2, white vitreous china, straight back type, minimum dimensions of 19 inches, wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets, and openings for concealed arm carrier installation. Provide aerator with faucet. Water flow rate shall not exceed 1.5 gpm when measured at a flowing water pressure of 60 psi. Provide ASME A112.6.1M concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount

lavatory with the front rim 34 inches above floor and with 29 inches minimum clearance from bottom of the front rim to floor. Provide top mounted washerless centerset lavatory faucets or provide top-mounted solenoid-activated lavatory faucets including electrical-operated light-beam-sensor to energize the solenoid.

2.4.6 Countertop Lavatories

ASME A112.19.2, white vitreous china, self-rimming, minimum dimensions of 19 inches wide by 17 inches front to rear, with supply openings for use with top mounted centerset faucets. Furnish template and mounting kit by lavatory manufacturer. Provide aerator with faucet. Water flow rate shall not exceed 1.5 gpm when measured at a flowing water pressure of 60 psi. Mount counter with the top surface 34 inches above floor and with 29 inches minimum clearance from bottom of the counter face to floor. Provide top mounted washerless centerset lavatory faucets or provide top-mounted solenoid-activated lavatory faucets including electrical-operated light-beam-sensor to energize the solenoid.

2.4.7 Service Sinks

ASME A112.19.2, ASME A112.19.3 302 stainless steel with integral back and wall hanger supports, minimum dimensions of 22 inches wide by 20 inches front to rear, with two supply openings in 10 inch high back. Provide floor supported wall outlet cast iron P-trap and stainless steel rim guards as recommended by service sink manufacturer. Provide back mounted washerless service sink faucets with vacuum breaker and 0.75 inch external hose threads.

2.4.8 Drinking-Water Coolers

AHRI 1010 with more than a single thickness of metal between the potable water and the refrigerant in the heat exchanger, wall-hung, bubbler style, air-cooled condensing unit, 4.75 gph minimum capacity, stainless steel splash receptor and basin, and stainless steel cabinet. Bubblers shall be controlled by push levers or push bars, front mounted or side mounted near the front edge of the cabinet. Bubbler spouts shall be mounted at maximum of 36 inches above floor and at front of unit basin. Spouts shall direct water flow at least 4 inches above unit basin and trajectory parallel or nearly parallel to the front of unit. Provide ASME A112.6.1M concealed steel pipe chair carriers.

2.4.9 Wheelchair Drinking Water Cooler

AHRI 1010, wall-mounted bubbler style with ASME A112.6.1M concealed chair carrier, air-cooled condensing unit, 4.75 gph minimum capacity, stainless steel splash receptor, and all stainless steel cabinet, with 27 inch minimum knee clearance from front bottom of unit to floor and 36 inch maximum spout height above floor. Bubblers shall also be controlled by push levers, by push bars, or touch pads one on each side or one on front and both sides of the cabinet.

2.4.10 Emergency Eyewash and Shower

ANSI, floor supported free standing unit. Provide deluge shower head, stay-open ball valve operated by pull rod and ring or triangular handle. Provide eyewash and stay-open ball valve operated by foot treadle or push handle. Tempered water supply (minimum 60°F) is required to emergency showers to prevent hypothermia during prolonged exposure to shower water.

2.4.11 Emergency Eye and Face Wash

ANSI/ISEA Z358.1, wall-mounted self-cleaning, nonclogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor. Unit shall deliver 3 gpm of aerated water at 30 psig flow pressure, with eye and face wash nozzles 33 to 45 inches above finished floor. Provide copper alloy control valves. Provide an air-gap with the lowest potable eye and face wash water outlet located above the overflow rim by not less than the International Plumbing Code minimum. Provide a pressure-compensated tempering valve, with leaving water temperature setpoint adjustable throughout the range 60 to 95 degrees F. Provide packaged, UL listed, alarm system; including an amber strobe lamp, horn with externally adjustable loudness and horn silencing switch, mounting hardware, and waterflow service within NEMA Type 3 or 4 enclosures.

2.5 BACKFLOW PREVENTERS

Backflow prevention devices must be approved by the State or local regulatory agencies. If there is no State or local regulatory agency requirements, the backflow prevention devices must be listed by the Foundation for Cross-Connection Control & Hydraulic Research, or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention devices and assemblies.

Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be meet the above requirements.

Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor and Shower Drains

Floor and shower drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.6.3.

2.6.1.1 Drains and Backwater Valves

Drains installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.

2.6.2 Area Drains

Area drains shall be plain pattern with polished stainless steel perforated or slotted grate and bottom outlet. The drain shall be circular or square with a 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Outlet shall be suitable for inside caulked connection to drain pipe. Drains shall conform to ASME A112.6.3.

2.6.3 Floor Sinks

Floor sinks shall be circular or square, with 12 inch nominal overall width or diameter and 10 inch nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, aluminum sediment bucket, and perforated grate of cast iron in industrial areas and stainless steel in finished areas. The outlet pipe size shall be as indicated or of the same size as the connecting pipe.

2.6.4 Boiler Room Drains

Boiler room drains shall have combined drain and trap, hinged grate, removable bucket, and threaded brass cleanout with brass backwater valve. The removable galvanized cast-iron sediment bucket shall have rounded corners to eliminate fouling and shall be equipped with hand grips. Drain shall have a minimum water seal of 4 inches. The grate area shall be not less than 100 square inches.

2.6.5 Roof Drains and Expansion Joints

Roof drains shall conform to ASME A112.6.4, with dome and integral flange, and shall have a device for making a watertight connection between roofing and flashing. The whole assembly shall be galvanized heavy pattern cast iron. For aggregate surface roofing, the drain shall be provided with a gravel stop. On roofs other than concrete construction, roof drains shall be complete with underdeck clamp, sump receiver, and an extension for the insulation thickness where applicable. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided when required to suit the building construction. Strainer openings shall have a combined area equal to twice that of the drain outlet. The outlet shall be equipped to make a proper connection to threaded pipe of the same size as the downspout. An expansion joint of proper size to receive the conductor pipe shall be provided. The expansion joint shall consist of a heavy cast-iron housing, brass or bronze sleeve, brass or bronze fastening bolts and nuts, and gaskets or packing. The sleeve shall have a nominal thickness of not less than 0.134 inch. Gaskets and packing shall be close-cell neoprene, O-ring packing shall be close-cell neoprene of 70 durometer. Packing shall be held in place by a packing gland secured with bolts.

2.7 TRAPS

Unless otherwise specified, traps shall be copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout.

Provide traps with removable access panels for easy clean-out at sinks and lavatories. Tubes shall be copper alloy with walls not less than 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 2 inches. The interior diameter shall be not more than 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.8 POTABLE WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater shall have replaceable anodes. All water heaters shall comply with ASME Section IV, Part HLW, unless specifically exempted therein. Each primary water heater shall have controls with an adjustable range that includes 90 to 160 degrees F. Each gas-fired water heater and booster water heater shall have controls with an adjustable range that includes 120 to 180 degrees F. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to TABLE III for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 500 gallons storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 200 degrees F water temperature and 150 psi working pressure.

2.8.1 Automatic Storage Type

Heaters shall be complete with control system, temperature gauge, and pressure gauge, and shall have ASME rated combination pressure and temperature relief valve.

2.8.1.1 Gas-Fired Type

Gas-fired water heaters shall conform to ANSI Z21.10.1 when input is 75,000 BTU per hour or less or ANSI Z21.10.3 for heaters with input greater than 75,000 BTU per hour.

2.9 HOT-WATER STORAGE TANKS

Hot-water storage tanks shall be constructed by one manufacturer, ASME "U" stamped for the working pressure, and shall have the National Board (ASME) registration. The tank shall be cement-lined or glass-lined steel type in accordance with AWWA D100. The heat loss shall conform to TABLE III as determined by the requirements of ASHRAE 90.1 - IP. Each tank shall be equipped with a thermometer, conforming to ASTM E1, Type I, Class 3, Range

C, style and form as required for the installation, and with 7 inch scale. Thermometer shall have a separable socket suitable for a 3/4 inch tapped opening. Tanks shall be equipped with a pressure gauge 6 inch minimum diameter face. Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Storage tank capacity shall be as shown.

2.10 PUMPS

2.10.1 Sump Pumps

Sump pumps shall be of capacities indicated. The pumps shall be of the automatic, electric motor-driven, submerged type, complete with necessary control equipment and with a split or solid cast-iron or steel cover plate. The pumps shall be direct-connected by an approved flexible coupling to a vertical electric motor having a continuous oiling device or packed bearings sealed against dirt and moisture. Motors shall be totally enclosed, fan-cooled of sizes as indicated and shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 or 4 enclosure. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 1. Each pump shall be fitted with a high-grade thrust bearing mounted above the floor. Each shaft shall have an alignment bearing at each end, and the suction inlet shall be between 3 and 6 inches above the sump bottom. The suction side of each pump shall have a strainer of ample capacity. A float switch assembly, with the switch completely enclosed in a NEMA 250, Type 1 or 4 enclosure, shall start and stop each motor at predetermined water levels. Duplex pumps shall be equipped with an automatic alternator to change the lead operation from one pump to the other, and for starting the second pump if the flow exceeds the capacity of the first pump. The discharge line from each pump shall be provided with a union or flange, a nonclog swing check valve, and a stop valve in an accessible location near the pump.

2.10.2 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump and motor shall be integrally mounted on a cast-iron or steel subbase, close-coupled with an overhung impeller, or supported by the piping on which it is installed. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze.

Motor shall be totally enclosed, fan-cooled and shall have sufficient horsepower for the service required. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover.

Integral size motors shall be premium efficiency type in accordance with NEMA MG 1. Pump motors smaller than 1 hp Fractional horsepower pump motors shall have integral thermal overload protection in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Guards shall shield exposed moving parts.

2.10.3 Booster Pumps

2.10.3.1 Centrifugal Pumps

Horizontal split-case centrifugal-type booster pumps shall be furnished.

The capacities shall be as shown, and the speed shall not exceed 1800 rpm. Pumps shall have a casing of close-grained iron or steel with smooth water passages. A gasket shall be provided between the upper and lower halves of the casing. Suction and discharge connections shall be flanged. Impellers shall be nonoverloading, bronze, balanced to eliminate vibration, and shall be keyed to corrosion-resisting steel shafts. The casings shall be fitted with bronze wearing or sealing rings. Bearings shall be cartridge type, enabling the entire rotating element to be removed without disturbing alignment or exposing the bearings to dirt, water, and other foreign matter. Pumps shall be provided with mechanical seals. Seal boxes shall be machined in the pump casing and at both sides of the pump, and shall be of sufficient depth to include a conventional bronze seal ring and rows of shaft packing. Bedplates shall be close-grain cast iron or steel with ribs and lugs, complete with foundation bolts, and shall have a drip lip with drain hole. Each pump shall be tested at the manufacturer's plant for operating characteristics at the rated capacity and under specified operating conditions. Test curves shall be furnished showing capacity in gpm, head in feet, efficiency, brake horsepower, and operation in parallel with similar pumps. Multiple pump installations shall have pump characteristics compatible for operation in parallel with similar pumps. The electric motor shall be sized for non-overload when operating at any point along the characteristic curve of the pump. Guards shall shield exposed belts and moving parts.

2.10.3.2 Controls

Each pump motor shall be provided with enclosed across-the-line-type magnetic controller complete in a NEMA 250 Type 1 enclosure with three position, "HAND-OFF-AUTOMATIC," selector switch in cover. Pumps shall be automatically started and stopped by float or pressure switches, as indicated. The pumps shall start and stop at the levels and pressures indicated. A multiposition sequence selector switch shall be provided so that any two pumps may be operated simultaneously beeping a third pump as a standby.

2.10.4 Flexible Connectors

Flexible connectors shall be provided at the suction and discharge of each pump that is 1 hp or larger. Connectors shall be constructed of neoprene, rubber, or braided bronze, with Class 150 standard flanges. Flexible connectors shall be line size and suitable for the pressure and temperature of the intended service.

2.10.5 Sewage Pumps

Provide single type duplex type with automatic controls to alternate the operation from one pump to the other pump and to start the second pump in the event the first pump cannot handle the incoming flow. Provide high water alarm and check valve.

2.11 DOMESTIC WATER SERVICE METER

Cold water meters 2 inches and smaller shall be positive displacement type conforming to AWWA C700. Cold water meters 2-1/2 inches and larger shall be turbine type conforming to AWWA C701. Meter register may be round or straight reading type. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA Fire Man. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 5 feet outside the building, unless otherwise indicated. A gate valve and drain shall be installed on the water service line inside the building approximately 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 12 inches below the finish grade or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body. Install all equipment according to manufacturer's written instructions and recommendations.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with

the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains indicated shall consist of 3/4 inch hose bibb with renewable seat and gate, full port ball, or ball valve ahead of hose bibb. At other low points, 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.2 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.2.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.2.2 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.

3.1.2.3 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.2.4 Copper Tube and Pipe

a. Brazed. Brazed joints shall be made in conformance with ASME Section IX with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of

dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.

b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015. Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.

c. Copper Tube Extracted Joint. Mechanically extracted joints shall be made in accordance with ICC IPC.

d. Press connection. Copper press connections shall be made in strict accordance with the manufacturer's installation instructions for manufactured rated size. The joints shall be pressed using the tool(s) approved by the manufacturer of that joint. Minimum distance between fittings shall be in accordance with the manufacturer's requirements.

3.1.3 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.4 Flashing Requirements

Pipes passing through roof shall be installed through a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.5 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend

or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 18 inches of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron or plastic.

3.2 POTABLE WATER HEATERS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 6 inches above the top of the tank or water heater.

3.2.2 Installation of Gas- and Oil-Fired Water Heater

Installation shall conform to NFPA 54 for gas fired. Storage water heaters that are not equipped with integral heat traps and having vertical pipe risers shall be installed with heat traps directly on both the inlet and outlet. Circulating systems need not have heat traps installed. An acceptable heat trap may be a piping arrangement such as elbows connected so that the inlet and outlet piping make vertically upward runs of not less than 24 inches just before turning downward or directly horizontal into the water heater's inlet and outlet fittings. Commercially available heat traps, specifically designed by the manufacturer for the purpose of effectively restricting the natural tendency of hot water to rise through vertical inlet and outlet piping during standby periods may also be approved.

3.2.3 Heat Traps

Piping to and from each water heater shall be routed horizontally and downward a minimum of 2 feet before turning in an upward direction.

3.2.4 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.2.5 Expansion Tank

A pre-charged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor shall adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

3.2.6 Direct Fired and Domestic Water Heaters

Notify the COR when any direct fired domestic water heater over 400,000 BTU/hour is operational and ready to be inspected and certified.

3.3 FIXTURES AND FIXTURE TRIMMINGS

3.3.1 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with IAPMO UPC at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

-- End of Section --

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SECTION 22 15 14.00 40

GENERAL SERVICE COMPRESSED-AIR SYSTEMS, LOW PRESSURE

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for aboveground and underground piping systems and certain components with pressure ratings of 125 pounds per square inch, gage and less, using existing air supply.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

ANSI/AISC 360	Specification for Structural Steel Buildings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C504	Standard for Rubber-Seated Butterfly Valves

AMERICAN WELDING SOCIETY (AWS)

AWS WHB-2.9	Welding Handbook; Volume 2, Welding Processes, Part 1
AWS-03	Welding Handbook, Volumes 1 thru 4

ASME INTERNATIONAL (ASME)

ASME A112.18.1/CSA B125.1	Plumbing Supply Fittings
ASME B16.1	Gray Iron Threaded Fittings; Classes 25, 125 and 250
ASME B16.22	Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.3	Malleable Iron Threaded Fittings, Classes 150 and 300

ASME B16.39	Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.42	Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B18.2.2	Standard for Square and Hex Nuts
ASME B19.3	Safety Standard for Compressors for Process Industries
ASME B31.3	Process Piping
ASME B40.100	Pressure Gauges and Gauge Attachments
ASME BPVC	Boiler and Pressure Vessels Code
ASME BPVC SEC VIII D1	BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A105/A105M	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A181/A181M	Standard Specification for Carbon Steel Forgings, for General-Purpose Piping
ASTM A183	Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A197/A197M	Standard Specification for Cupola Malleable Iron
ASTM A216/A216M	Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A234/A234M	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A278/A278M	Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 degrees F (350 degrees C)

ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A395/A395M	Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures
ASTM A436	Standard Specification for Austenitic Gray Iron Castings
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A563M	Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A666	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM B148	Standard Specification for Aluminum-Bronze Sand Castings
ASTM B164	Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire
ASTM B280	Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B370	Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B584	Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B61	Standard Specification for Steam or Valve Bronze Castings
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B749	Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products
ASTM C592	Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM C920	Standard Specification for Elastomeric Joint Sealants

ASTM D 1693	Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
ASTM D 2000	Standard Classification System for Rubber Products in Automotive Applications
ASTM D 2239	Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM E 1	Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM F 104	Standard Classification System for Nonmetallic Gasket Materials
ASTM F 568M	Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

ISA - INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ISA 7.0.01	Quality Standard for Instrument Air

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-67	Butterfly Valves
MSS SP-69	Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
MSS SP-70	Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-72	Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-80	Bronze Gate, Globe, Angle and Check Valves

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS FF-S-325	Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
FS L-C-530	Coating, Pipe, Thermoplastic Resin

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Submit Installation Drawings for low-pressure compressed air systems in accordance with paragraphs entitled, "Drawings," "Aboveground Piping Materials," and "Underground Piping Materials," of this section.

SD-03 Product Data

Submit Equipment and Performance Data for piping systems.

Submit manufacturer's catalog data for the following items:

Underground Piping Materials

Aboveground Piping Materials

Piping Specialties

Supporting Elements

Air Compressors

Valves

Accessories

Miscellaneous Materials

Vibration Isolation

SD-05 Design Data

Submit Design Analysis and Calculations for low-pressure compressed air systems for the following in accordance with paragraph entitled, "General Requirements," of this section.

Flow Rates

Air Distribution

Pressure Requirements

Insulation Requirements

Equipment and Performance Data submitted for piping systems shall show conformance with ASME Code.

SD-06 Test Reports

Submit test reports for the following items in accordance with paragraph entitled, "Compressed Air Systems Testing," of this section.

ASME Code Manufacturer's Data Reports

Hydrostatic Testing

Compressed Air Systems Testing

Valve-Operating Tests

Drainage Tests

Pneumatic Testing

Safety and Relief Valve Test Report

Each acceptance test shall require the signature of the COR and record copies shall be delivered to the COR after acceptance.

SD-07 Certificates

Submit certificates for the following items showing conformance with the referenced standards contained in this section.

Underground Piping Materials

Aboveground Piping Materials

Supporting Elements

Valves

Miscellaneous Materials

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals in accordance with paragraph entitled, "Operation and Maintenance," of this section.

1.4 GENERAL REQUIREMENTS

Equipment and performance data submitted for piping systems shall show conformance with ASME Code.

1.5 OPERATION AND MAINTENANCE

Contractor shall submit copies of the operation and maintenance manuals 30 calendar days prior to testing the low-pressure compressed air System. Update and resubmit data for final approval no later than 30 calendar days prior to contract completion.

1.6 DRAWINGS

Submit installation drawings for low-pressure compressed air systems in accordance with paragraphs entitled, "Aboveground Piping Materials" and "Underground Piping Materials," of this section.

Submit complete shop drawing data for pipe attachments for approval.

PART 2 PRODUCTS

2.1 UNDERGROUND PIPING MATERIALS

2.1.1 Piping Types

Type BCS-PS black carbon steel piping with polyethylene sheath shall conform to ASTM A53/A53M, Type S, or ASTM A106/A106M, Grade B, in sizes through 10 inch iron pipe size (ips). Pipe in size 12 inches and larger shall have Schedule 40 wall.

Thermoplastic sheath shall conform to FS L-C-530. Make sheath joints with thermally fitted shrinking sleeves applied with factory-approved shrinking devices. Make taped fitting protection and repairs in accordance with manufacturer's instructions. Electrical flaw detection testing at the factory shall require 10,000 volts to be impressed across the sheath. Sheath breakdown voltage shall be not less than 13,000 volts.

2.1.2 Fittings

Fittings shall be threaded carbon steel conforming to ASTM A105/A105M and ASME B16.11 to match pipe wall thickness. Pipe bending is not permitted. Aboveground terminal fittings shall be 150-pound working steam pressure (wsp) forged steel flanges to match wall thickness, conforming to ASME B16.5 and ASTM A1105/A1105M, Grade B, Class 150.

2.2 ABOVEGROUND PIPING MATERIALS

2.2.1 Compressed Air Systems 150 Psig and Less

2.2.1.1 Type BCS Black Carbon Steel

Pipe NPS 1/8 through 1-1/2 inches shall be Schedule 40, furnace butt welded, black carbon steel, conforming to ASTM A53/A53M, Type F, Grade B or ASTM A106, Grade B.

Pipe NPS 2 through 10 inches shall be Schedule 40, seamless, black carbon steel, conforming to ASTM A53/A53M, Grade B, Type S or ASTM A106, Grade B.

Pipe NPS 12 inches and over shall be 0.375 inch wall, seamless, black carbon steel, conforming to ASTM A53/A53M, Grade B, Type S or ASTM A106, Grade B.

Fittings 2 inches and under shall be 150-pounds per square inch, gage (psig) wsp, banded, black malleable iron, screwed, conforming to ASTM A197/A197M and ASME B16.3.

Unions 2 inches and under shall be Class 150, female, screwed, black malleable iron, conforming to ASTM A197/A197M and ASME B16.39, ductile iron conforming to ASTM A536 for grooved pipe couplings.

Couplings 2 inches and under shall be Class 150, screwed, black malleable iron, conforming to ASTM A197/A197M and ASME B16.3.

Fittings 2-1/2 inches and over shall be ductile iron conforming to ASTM A536 and ASME B16.42.

Flanges 2-1/2 inches and over shall be 150-psig wsp, forged steel, welding neck to match pipe wall thickness, conforming to ASME B16.5.

2.2.1.2 Type GCS Galvanized Carbon Steel

Pipe 1/2 through 10 inches shall be Schedule 40, seamless, galvanized steel, conforming to ASTM A53/A53M, Grade B, Type S and ASME B31.3. Type F is acceptable for sizes less than 2 inches.

Fittings 2 inches and under shall be 150-psig wsp, banded, galvanized, malleable iron, screwed, conforming to ASTM A197/A197M, ASME B16.3.

Fittings 2-1/2 inches and over shall be 125-psig wsp, cast-iron flanges and flanged fittings, conforming to ASTM A126, Class A, and ASME B16.1.

Unions 2 inches and under shall be 300-psig wsp, female, screwed, galvanized, malleable iron with brass-to-iron seat and ground joint.

2.2.2 Control and Instrumentation Tubing, to 30 Psig

2.2.2.1 Copper

Tubing all sizes with 1/4 inch minimum outside diameter shall be hard-drawn seamless copper, conforming to ASTM B280.

Fittings shall be solder joint wrought copper conforming to ASME B16.22.

Ball sleeve shall be of the compression type, forged brass, conforming to SAE 88, UL approved, with minimum pressure rating 200 pounds per square inch (psi) at 100 degrees F.

Solder shall be 95-5 tin-antimony, alloy Sb 5, conforming to AWS WHB-2.9.

Copper tubing systems may be installed using mechanical pipe couplings of a bolted type with a central cavity design pressure responsive gasket. Groove copper pipe and fittings in accordance with the coupling manufacturer's recommendations.

2.3 PIPING SPECIALTIES

2.3.1 Air Pressure Reducing Stations

Install pressure reducing station complete with relieving type pressure reducing valve, valved bypass, particle filter, pressure indicator upstream of station, pressure indicator downstream of station, and regulated air pressure relief valve.

Construct pressure regulator body of zinc or aluminum die castings, rated for the service. Diaphragm shall be reinforced air-, oil-, and water-resistant elastomer. All components, exposed to fluid stream being controlled, shall be of suitable nonmetallic materials. Valves shall be of a balanced construction relieving type to automatically prevent excess pressure buildup.

Construct filters of aluminum die castings, rated for the service, and furnished with ips connections. Bowl materials shall be aluminum. Filter shall be serviceable by bowl quick-disconnect devices. Equip bowl with manual drain cock. Separate liquid particles by centrifugal and quiet zone action. Remove solid particles to 15-micrometer size by filter elements of corrosion-resistant steel mesh.

Combination manual drain filter-regulator units conforming to the above requirements will be acceptable in lieu of separate units.

Pressure relief valves shall be rated for the pressure of the high-pressure side and sized for the full open flow capacity (i.e., pressure regulator maximum C_v)of the pressure regulating station at the pressure of the low-pressure side. Set valve at not more than 20 percent more than the correct low side pressure or no higher than the lowest rated pressure of the inline components. Rate and label valve. Seat material shall be suitable for the service.

2.3.2 Air Line Lubricators

Air line lubricators shall be of the pulse-type with pickup tube, polycarbonate resin bowl, large fill opening, metering rod flow adjuster, sight ball, and drain cock.

Lubricators shall be suitable for 200 psig at 165 degrees F.

2.3.3 Compressed Air Receivers

Compressed air receivers shall conform to the sizes and capacities specified. Design such vessels for the applicable working pressures and service in accordance with the ASME BPVC SEC VIII D1, and label.

Vessels shall be complete with connections for drain, supports, and other required accessories.

2.3.4 Pressure Gages

Pressure gages shall conform to ASME B40.100 with minimum accuracy grade 1A. Pressure gages shall be Type I, Class 1, (pressure) for pressures indicated. Pressure gage size shall be3-1/2 inches nominal diameter. Case shall be corrosion-resistant steel conforming to the AISI 300 series with an ASM No. 4 standard commercial polish or better. Equip gages with damper screw adjustment in inlet connection.

2.3.5 Line Strainers

Strainers shall be T-type grooved end with removable basket. Strainers in sizes 2 inch ips and smaller shall have screwed ends and in sizes 2-1/2 inch ips and larger shall have flanged ends. Body working pressure rating shall exceed maximum service pressure of system in which installed by at least 50 percent. Body shall have cast-in arrows to indicate direction of flow. Fit strainers larger than 2-1/2-inches with manufacturer's standard blowdown valve. Body material shall be cast bronze conforming to ASTM B62. Where system material is nonferrous, strainer body material shall be nonferrous.

Strainer screens shall have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material shall be AISI Type 304 corrosion-resistant steel.

2.4 AIR COMPRESSORS

Provide an air compressor of the standard piston type complete with air tank, and other appurtenances. Compressor and installation shall conform to ASME B19.3.

2.5 VALVES

2.5.1 Ball Valves (BAV)

Ball valves shall conform to MSS SP-72.

Grooved end ball valves may be used provided that the manufacturer certifies valve performance in accordance with MSS SP-72.

Rate valves for service at not less than 175 psi at 200 degrees F.

Design valves for flow from either direction and seal equally tight in either direction.

Valves shall have full pipe size flow areas.

Valves with ball seals kept in place by spring washers are not acceptable. All valves shall have adjustable packing glands. Seats and seals shall be tetrafluoroethylene.

Valve body construction shall be such that torque from a pipe with valve in installed condition shall not tend to disassemble the valve by stripping setscrews or by loosening body end inserts or coupling nuts. Torque from a pipe shall be resisted by a one-piece body between end connections or by bolts in shear where body is of mating flange or surface-bolted construction.

2.5.2 Butterfly Valves (BUV)

Butterfly valves shall conform to MSS SP-67.

Grooved end butterfly valves may be used in services to 230 degrees F provided the manufacturer certifies valve performance in accordance with MSS SP-67.

Butterfly valves shall be wafer type for mounting between specified flanges and rated for 150-psig shutoff and nonshock working pressure. Body shall be cast ferrous metal conforming to ASTM A126, Class B, and to ASME B16.1 for body wall thickness.

Provide valves installed in insulated piping systems with extended bonnets, placing the operator beyond the specified insulation.

Butterfly valves used in buried piping systems shall conform to requirements of AWWA C504, Class 150B, with integrally cast flanges and manual worm gear operator. Design and construct valves for buried or 20-foot head submerged service in brackish water. Flanged ends shall conform to requirements of ASME B16.1.

Valve boxes shall be of not less than 3/16 inch thick cast-iron construction with locking cover with an appropriate identification legend. Fit valves 3 inches and under with 4-1/4 inch diameter shaft and valves 4 inches and fit larger with 5-1/4 inch shaft. Fit bases to the valve. Box full-extended length shall be greater than required by depth of cover by not less than 4 inches. Supply one valve operating wrench for each size of valve wrench nut. Provide guide rings where operating rods are longer than 6 feet. Coat internal and external surfaces with bituminous sealer conforming to AWWA C104/A21.4.

2.5.3 Diaphragm Control and Instrument Valves (DCIV)

Diaphragm valves in sizes 1/4- and 3/8 inch shall have a forged brass body with reinforced tetrafluoroethylene diaphragm, AISI 300 series corrosion-resistant steel spring, and round phenolic handle.

2.5.4 Gage Cocks (GC)

Gage cocks shall be T-head or lever handle ground key type with washer and screw, constructed of polished ASTM B62 bronze, and rated for 125 psi saturated steam service. End connections shall suit the service, with or without union and nipple.

2.5.5 Gate Valves (GAV)

Gate valves 2 inches and smaller shall conform to MSS SP-80.

Gate valves 2-1/2 inches and larger shall be Type I, Class 1, conforming to MSS SP-70. Valves shall be flanged, with bronze trim and outside screw and yoke (OS&Y) construction.

2.5.6 Globe and Angle Valves (GLV and ANV)

Globe and angle valves 2 inches and smaller shall conform to MSS SP-80.

Globe and angle valves 2-1/2 inches and larger shall conform to MSS SP-80. Valve bodies shall be cast iron conforming to ASTM A126, Class A, as specified for Class 1 valves under MSS SP-70. Flange valve ends in conformance with ASME B16.1, and valve construction shall be OS&Y type.

2.6 MISCELLANEOUS MATERIALS

2.6.1 Bolting

Flange and general-purpose bolting shall be hex-head and shall conform to ASTM A307, Grade B. Heavy hex-nuts shall conform to ASME B18.2.2. Square-head bolts shall not be acceptable.

Grooved couplings shall utilize bolts and nuts of heat treated carbon steel conforming to ASTM A183.

2.6.2 Flange Gaskets

Compressed non-asbestos sheet shall conform to ASTM F 104, Type 1, and be coated on both sides with graphite.

Grooved flange adapters gasketing shall be a pressure responsive elastomer conforming to ASTM D 2000.

2.6.3 Pipe Thread Compounds

Use tetrafluorethylene tape not less than 2 mils thick in compressed air systems for pipe sizes to and including 1 inch ips. Tetrafluoroethylene dispersions and other suitable compounds may be used for other applications upon approval by the COR.

2.7 SUPPORTING ELEMENTS

Contractor shall provide all necessary piping system components and

miscellaneous required supporting elements. Supporting elements shall be suitable for stresses imposed by system pressures and temperatures, and natural and other external forces including seismic.

Supporting elements shall be FM-approved UL-listed and conform to requirements of ASME B31.3, MSS SP-58, and MSS SP-69, except as otherwise noted. Type devices specified herein are defined in MSS standards unless otherwise noted.

2.7.1 Building Structure Attachments

Cast-in floor-mounted equipment anchor devices shall provide adjustable positions.

Masonry anchor devices shall be built-in, unless otherwise approved by the COR.

Do not use power actuated anchoring devices to support mechanical systems components.

Construct concrete inserts in accordance with the requirements of MSS SP-58, for Type 18 and MSS SP-69.

2.7.2 Vertical Pipe Attachments

Vertical pipe attachments shall be Type 8.

2.7.3 Hanger Rods and Fixtures

Use only circular cross-section rod hangers to connect building structure attachments to pipe support devices. Pipe, straps, or bars of equivalent strength may be used for hangers only where approved by the COR.

Provide turnbuckles, swing eyes, and clevises as required by support system to accommodate pipe accessibility and adjustment for load and pitch.

2.7.4 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, such supplementary steel shall be designed and fabricated in accordance with ANSI/AISC 360.

PART 3 EXECUTION

3.1 ABOVE GROUND PIPING SYSTEM INSTALLATION

3.1.1 Piping Systems

Fabricate and install piping systems in accordance with ASME B31.3, MSS SP-69, and applicable ASME BPVC requirements.

3.1.2 Joints

Ream pipe ends before joint connections are made.

Make up screwed joints with joint compound.

Field welded joints shall conform to the requirements of the

ASME Section IX and ASME B31.3. All welding shall be performed by a U or PP contractor per their ASME QA program except for stamping is not required.

3.1.3 Control and Instrument Air Tubing

Use hard-drawn copper tubing in exposed areas. Do not use anneal copper in concealed locations.

3.1.4 General Service Valve Locations

Provide valves to permit isolation of branch piping and each equipment item from the balance of the system, to allow safe and convenient access without moving equipment, and to require a minimum of piping and equipment disassembly.

Provide valves in piping mains and branches at equipment and equipment items.

3.1.5 Supporting Elements Installation

Provide support elements in accordance with the requirements of ASME B31.1, MSS SP-58, MSS SP-69. Hang piping from building construction. No piping shall be hung from roof deck or from other pipe.

3.1.6 Sleeves

Sleeves are required where piping passes through roofs, through masonry or concrete walls, or through floor.

3.1.7 Escutcheons

Provide escutcheons at penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, provide escutcheons on both sides of the partition. Provide plates at the underside only of such ceilings, where suspended ceilings are installed. Plates shall be large enough to fit around the insulation, for insulated pipes. Escutcheons shall be chrome-plated in occupied spaces and shall be of sufficient size to conceal openings in building construction. Firmly attach escutcheons with setscrews.

3.1.8 Flashings

Provide required flashings at mechanical systems penetrations of building boundaries.

3.2 COMPRESSED AIR SYSTEMS TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS.

Prior to acceptance of the work, pressure-test completed systems in the presence of the COR.

3.2.1 Test Gages

Contractor's test gages shall conform to ASME B40.100 and have a dial size of 4 inches or larger. Maximum permissible scale range for a given test shall be such that the pointer during a test shall have a starting position at midpoint of the dial or within the middle third of the scale range.

Certification of accuracy and correction table shall bear a date within 90 calendar days prior to test use, test gage number, and the project number, unless otherwise approved by the COR.

3.2.2 Acceptance Pressure Testing

Testing shall take place during steady-state ambient temperature conditions.

Test ferrous piping systems at 1-1/2 times maximum operating pressure. Maintain test pressure for a period of not less than 10 minutes with an allowable pressure drop of 2 psi during that time unless otherwise approved by the COR.

Test control and instrumentation tubing systems at 30 psi. Maintain test pressure for a period of not less than 24 hours with essentially no pressure drop during that time.

3.3 COMPRESSED AIR SYSTEM CLEANING

Remove rust and dirt from the bore and exterior surface of all piping and equipment. Clean pipeline strainers, temporary and permanent, during purging operations, after startup, and immediately prior to final acceptance by the Government.

Flush and clean new steel piping with a suitable degreasing agent until visible, grease, dirt, and other contaminants have been removed. Degreased waste material including the degreaser itself shall be disposed of in accordance with written instructions received from the Environmental authority having jurisdiction through the COR and in accordance with all Local, State and Federal Regulations.

3.4 COMPRESSED AIR SYSTEMS IDENTIFICATION

Identification plates shall be protected and kept clean. Replace damaged and illegible identification plates at no additional expense.

Label and arrow piping at each point of entry and exit of piping passing through walls; at each change in direction, such as at elbows and tees; and in congested or hidden areas, at each point required to clarify service or indicate a hazard. Also label each riser.

In long straight runs, locate labels at distances visible to each other, but in no case shall the distance between labels exceed 75 feet. Labels shall be legible from the primary service and operating area.

-- End of Section --

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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

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SECTION 23 00 00

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for air supply, distribution, ventilation, and exhaust portions of an HVAC system.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 201	Fans and Systems
AMCA 210	Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 220	Test Methods for Air Curtain Units
AMCA 300	Reverberant Room Method for Sound Testing of Fans
AMCA 301	Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 500-D	Laboratory Methods of Testing Dampers for Rating

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 260	Sound Rating of Ducted Air Moving and Conditioning Equipment
AHRI 350	Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment
AHRI 410	Forced-Circulation Air-Cooling and Air-Heating Coils
AHRI 430	Central-Station Air-Handling Units
AHRI 440	Room Fan-Coils and Unit Ventilators

AHRI 880	Performance Rating of Air Terminals
AHRI 885	Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets
AHRI DCAACP	Directory of Certified Applied Air-Conditioning Products
AHRI Guideline D	Application and Installation of Central Station Air-Handling Units

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 11	Load Ratings and Fatigue Life for Roller Bearings
ABMA 9	Load Ratings and Fatigue Life for Ball Bearings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

Ref Id	Energy Consumption in Accordance with T-24
ANSI/ASHRAE 15 & 34	ANSI/ASHRAE Standard 15-Safety Standard for Refrigeration Systems and ANSI/ASHRAE Standard 34-Designation and Safety Classification of Refrigerants
ASHRAE 52.2	Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 62.1	Ventilation for Acceptable Indoor Air Quality
ASHRAE 68	Laboratory Method of Testing to Determine the Sound Power In a Duct
ASHRAE 70	Method of Testing for Rating the Performance of Air Outlets and Inlets
ASHRAE 84	Method of Testing Air-to-Air Heat Exchangers
ASHRAE 90.1 - IP	Energy Standard for Buildings Except Low-Rise Residential Buildings

ASME INTERNATIONAL (ASME)

ASME A13.1	Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B766	Standard Specification for Electrodeposited Coatings of Cadmium
ASTM C1071	Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM C553	Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C916	Standard Specification for Adhesives for Duct Thermal Insulation
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials

INSTITUTE OF ENVIRONMENTAL SCIENCES AND TECHNOLOGY (IEST)

IEST RP-CC-001	HEPA and ULPA Filters

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	Enclosures
NEMA MG 1	Motors and Generators
NEMA MG 10	Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code
NFPA 701	Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 96	Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1143	HVAC Air Duct Leakage Test Manual
SMACNA 1403	Accepted Industry Practice for Industrial Duct Construction
SMACNA 1819	Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
SMACNA 1966	HVAC Duct Construction Standards Metal and Flexible

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	Color Code for Pipelines & for Compressed Gas Cylinders

UNDERWRITERS LABORATORIES (UL)

UL 181	Factory-Made Air Ducts and Air Connectors
UL 1995	Heating and Cooling Equipment
UL 555	Standard for Fire Dampers
UL 555S	Smoke Dampers
UL 586	Standard for High-Efficiency Particulate, Air Filter Units
UL 6	Electrical Rigid Metal Conduit-Steel
UL 705	Standard for Power Ventilators
UL 723	Test for Surface Burning Characteristics of Building Materials
UL 900	Standard for Air Filter Units
UL 94	Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL Bld Mat Dir	Building Materials Directory
UL Electrical Construction	Electrical Construction Equipment Directory
UL Fire Resistance	Fire Resistance Directory

1.3 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.3.1 Mechanical Equipment Identification

The number of charts and diagrams shall be equal to or greater than the number of mechanical equipment rooms. Where more than one chart or diagram per space is required, mount these in edge pivoted, swinging leaf, extruded aluminum frame holders which open to 170 degrees.

1.3.2 Color Coding

Unless otherwise noted, color coding of all piping systems shall be in accordance with MIL-STD-101.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Metallic Flexible Duct
Duct Connectors
Duct Access Doors
Fire Dampers
Manual Balancing Dampers
Motors
Automatic Smoke Dampers
Sound Attenuation Equipment
Diffusers
Registers and Grilles
Centrifugal Fans
In-Line Centrifugal Fans
Ceiling Exhaust Fans
Air Handling Units
Constant Volume, Single Duct Terminal Units
Variable Volume, Single Duct Terminal Units
Variable Volume, Single Duct, Fan-Powered Terminal Units

SD-05 Design Data

Design Analysis and Calculations
Equipment and Performance Data

SD-06 Test Reports

Performance Tests

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals (Data Package 3)

Fire Dampers
Manual Balancing Dampers
Automatic Smoke Dampers
Centrifugal Fans
In-Line Centrifugal Fans
Ceiling Exhaust Fans
Air Handling Units
Constant Volume, Single Duct Terminal Units
Variable Volume, Single Duct Terminal Units
Variable Volume, Single Duct, Fan-Powered Terminal Units
Ceiling Induction Terminal Units

1.5 QUALITY ASSURANCE

Except as otherwise specified, approval of materials and equipment is based on manufacturer's published data.

a. Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 is acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Outline methods of testing used by the specified agencies.

b. Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the ASTM International (ASTM), the ASME International (ASME), or other standards, a manufacturer's certificate of compliance of each item is acceptable as proof of compliance.

c. Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

1.6 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide components and equipment that are "standard products" of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening, including applications of components and equipment under similar circumstances and of similar size, satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Provide equipment items that are supported by a service organization. Where applicable, provide

equipment that is an ENERGY STAR Qualified product or a Federal Energy Management Program (FEMP) designated product.

2.2 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function of the equipment. Submit designation with the shop drawings. Identification plates shall be three layers, black-white-black, engraved to show white letters on black background. Letters shall be upper case. Identification plates 1-1/2-inches high and smaller shall be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high shall be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger shall have beveled edges. Install identification plates using a compatible adhesive.

2.3 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard. The requirements for catwalks, operating platforms, ladders, and guardrails are specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

2.4 ELECTRICAL WORK

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown. For packaged equipment, include manufacturer provided controllers with the required monitors and timed restart.

b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Integral size motors shall be the premium efficiency type in accordance with NEMA MG 1.

c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system , and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Select premium efficiency polyphase motors in accordance with NEMA MG 10.

d. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Provide motors rated for continuous duty with the enclosure specified. Provide motor duty that allows for maximum frequency start-stop operation and minimum encountered interval between start and stop. Provide motor torque capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period.

Provide motor starters complete with thermal overload protection and other necessary appurtenances. Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure, or use sealed bearings.

e. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers are allowed to accomplish the same function. Use solid-state variable-speed controllers for motors rated 10 hp or less and adjustable frequency drives for larger motors.

2.5 ANCHOR BOLTS

Provide anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts to be of the size and number recommended by the equipment manufacturer and located by means of suitable templates. Installation of anchor bolts shall not degrade the surrounding concrete.

2.6 SEISMIC ANCHORAGE

Anchor equipment in accordance with applicable seismic criteria in accordance with Section 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

2.7 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

2.8 DUCT SYSTEMS

2.8.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with SMACNA 1966, as supplemented and modified by this specification.

a. Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes are allowed.

b. Provide ductwork that meets the requirements of Seal Class C. Provide ductwork in VAV systems upstream of the VAV boxes that meets the requirements of Seal Class A.

c. Provide sealants that conform to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS and are suitable for the range of air distribution and ambient temperatures to which it is exposed. Do not use pressure sensitive tape as a sealant.

2.8.1.1 Metallic Flexible Duct

a. Provide duct that conforms to UL 181 and NFPA 90A with factory-applied insulation, vapor barrier, and end connections. Provide duct assembly that does not exceed 25 for flame spread and 50 for smoke developed. Provide ducts designed for working pressures of two inches water gauge positive and 1.5 inches water gauge negative. Provide flexible round duct length that does not exceed five feet. Secure connections by applying adhesive for two inches over rigid duct, apply flexible duct

two inches over rigid duct, apply metal clamp, and provide minimum of three No. 8 sheet metal screws through clamp and rigid duct.

b. Inner duct core: Provide interlocking spiral or helically corrugated flexible core constructed of zinc-coated steel, aluminum, or stainless steel; or constructed of inner liner of continuous galvanized spring steel wire helix fused to continuous, fire-retardant, flexible vapor barrier film, inner duct core.

c. Insulation: Provide inner duct core that is insulated with mineral fiber blanket type flexible insulation, minimum of one inch thick. Provide insulation covered on exterior with manufacturer's standard fire retardant vapor barrier jacket for flexible round duct.

2.8.1.2 General Service Duct Connectors

Provide a flexible duct connector approximately 6 inches in width where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods. Provide a composite connector system that complies with NFPA 701 and is classified as "flame-retarded fabrics" in UL Bld Mat Dir.

2.8.1.3 Aluminum Ducts

ASTM B209, alloy 3003-H14 for aluminum sheet and alloy 6061-T6 or equivalent strength for aluminum connectors and bar stock.

2.8.2 Duct Access Doors

Provide hinged access doors conforming to SMACNA 1966 in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system. Provide access doors upstream and downstream of air flow measuring primaries and heating and cooling coils. Provide doors that are a minimum 15 by 18 inches, unless otherwise shown. Where duct size does not accommodate this size door, make the doors as large as practicable. Equip doors 24 by 24 inches or larger with fasteners operable from inside and outside the duct. Use insulated type doors in insulated ducts.

2.8.3 Fire Dampers

Use 1.5 hour rated fire dampers unless otherwise indicated. Provide fire dampers that conform to the requirements of NFPA 90A and UL 555. Perform the fire damper test as outlined in NFPA 90A. Provide a pressure relief door upstream of the fire damper. If the ductwork connected to the fire damper is to be insulated then provide a factory installed pressure relief damper. Provide automatic operating fire dampers with a dynamic rating suitable for the maximum air velocity and pressure differential to which it is subjected. Provide fire dampers approved for the specific application, and install according to their listing. Equip fire dampers with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, does not impair the operation of the damper. Equip sleeves or frames with perimeter mounting angles attached on both sides of the wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce

the ceiling of the assemblies in conformance with UL Fire Resistance. Provide in the air stream fire dampers. Install dampers that do not reduce the duct or the air transfer opening cross-sectional area. Install dampers so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, comply with the installation details given in SMACNA 1819 and in manufacturer's instructions for fire dampers. Perform acceptance testing of fire dampers according to paragraph Fire Damper Acceptance Test and NFPA 90A.

2.8.4 Manual Balancing Dampers

Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators. Install dampers that are 2 gauges heavier than the duct in which installed. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 12 inches. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer.

2.8.5 Automatic Balancing Dampers

Provide dampers as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS.

2.8.6 Automatic Smoke-Fire Dampers

Multiple blade type, 180 degrees F fusible fire damper link; smoke damper assembly to include pneumatically powered operator. UL 555 as a 1.5 hour rated fire damper; further qualified under UL 555S as a leakage rated damper. Provide a leakage rating under UL 555S that is no higher than Class II at an elevated temperature Category B (250 degrees F for 30 minutes). Ensure that pressure drop in the damper open position does not exceed 0.1 inch water gauge with average duct velocities of 2500 fpm.

2.8.7 Air Supply And Exhaust Air Dampers

Where outdoor air supply and exhaust air dampers are required they shall have a maximum leakage rate when tested in accordance with AMCA 500-D as required by ASHRAE 90.1, including:

Maximum Damper Leakage for:

a. Climate Zones 1,2,6,7,8 the maximum damper leakage at 1.0 inch w.g. for motorized dampers is 4 cfm per square foot of damper area and non-motorized dampers are not allowed.

b. All other Climate Zones the maximum damper leakage at 1.0 inch w.g. is 10 cfm per square foot and for non-motorized dampers is 20 cfm per square foot of damper area.

Dampers smaller than 24 inches in either direction may have leakage of 40 cfm per square foot.

2.8.7.1 Cartridge Type Filters

Provide 12 inch depth, sectional, replaceable dry media type filters of the size indicated with a MERV of 13 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.56 inches, water gauge. Provide UL class 1 filters, and pleated microglass paper media with corrugated aluminum separators, sealed inside the filter cell to form a totally rigid filter assembly.

2.8.8 Sound Attenuation Equipment

a. For systems with total pressure above 4 Inches Water Gauge: Provide sound attenuators on the discharge duct of each fan operating at a total pressure above 4 inch water gauge, and, when indicated, at the intake of each fan system. Provide sound attenuators elsewhere as indicated. Provide factory fabricated sound attenuators, tested by an independent laboratory for sound and performance characteristics. Provide a net sound reduction as indicated. Maximum permissible pressure drop is not to exceed 0.63 inch water gauge. Construct traps to be airtight when operating under an internal static pressure of 10 inch water gauge. Provide air-side surface capable of withstanding air velocity of 10,000 fpm. Certify that the equipment can obtain the sound reduction values specified after the equipment is installed in the system and coordinated with the sound information of the system fan to be provided. Provide sound absorbing material conforming to ASTM C1071, Type I or II. Provide sound absorbing material that meets the fire hazard rating requirements for insulation specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. For connection to ductwork, provide a duct transition section. Factory fabricated double-walled internally insulated spiral lock seam and round duct and fittings designed for high pressure air system can be provided if complying with requirements specified for factory fabricated sound attenuators, in lieu of factory fabricated sound attenuators. Construct the double-walled duct and fittings from an outer metal pressure shell of zinc-coated steel sheet, 1 inch thick acoustical blanket insulation, and an internal perforated zinc-coated metal liner. Provide a sufficient length of run to obtain the noise reduction coefficient specified. Certify that the sound reduction value specified can be obtained within the length of duct run provided. Provide welded or spiral lock seams on the outer sheet metal of the double-walled duct to prevent water vapor penetration. Provide duct and fittings with an outer sheet that conforms to the metal thickness of high-pressure spiral and round ducts and fittings shown in SMACNA 1966. Provide acoustical insulation with a thermal conductivity "k" of not more than 0.27 Btu/inch/square foot/hour/degree F at 75 degrees F mean temperature. Provide an internal perforated zinc-coated metal liner that is not less than 24 gauge with perforations not larger than 1/4 inch in diameter providing a net open area not less than 10 percent of the surface.

b. For system with total pressure of 4 Inch Water Gauge and Lower: Use sound attenuators only where indicated. Provide factory fabricated sound attenuators that are constructed of galvanized steel sheets. Provide attenuator with outer casing that is not less than 22 gauge. Provide fibrous glass acoustical fill. Provide net sound reduction indicated. Obtain values on a test unit not less than 24 by 24 inches outside dimensions made by a certified nationally recognized independent acoustical laboratory. Provide air flow capacity as

indicated or required. Provide pressure drop through the attenuator that does not exceed the value indicated, or that is not in excess of 15 percent of the total external static pressure of the air handling system, whichever is less. Acoustically test attenuators with metal duct inlet and outlet sections while under the rated air flow conditions. Include with the noise reduction data the effects of flanking paths and vibration transmission. Construct sound attenuators to be airtight when operating at the internal static pressure indicated or specified for the duct system, but in no case less than 2 inch water gauge.

2.8.9 Diffusers, Registers, and Grilles

Provide factory-fabricated units of steel or aluminum that distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Provide outlets for diffusion, spread, throw, and noise level as required for specified performance. Certify performance according to ASHRAE 70. Provide sound rated and certified inlets and outlets according to ASHRAE 70. Provide sound power level as indicated. Provide diffusers and registers with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device is acceptable. Provide opposed blade type volume dampers for all diffusers and registers, except linear slot diffusers. Provide linear slot diffusers with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 7 feet above the floor, protect them by a grille or screen according to NFPA 90A.

2.8.9.1 Diffusers

Provide diffuser types indicated. Furnish ceiling mounted units with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Provide diffusers with air deflectors of the type indicated. Provide air handling troffers or combination light and ceiling diffusers conforming to the requirements of UL Electrical Construction for the interchangeable use as cooled or heated air supply diffusers or return air units. Install ceiling mounted units with rims tight against ceiling. Provide sponge rubber gaskets between ceiling and surface mounted diffusers for air leakage control. Provide suitable trim for flush mounted diffusers. For connecting the duct to diffuser, provide duct collar that is airtight and does not interfere with volume controller. Provide return or exhaust units that are similar to supply diffusers.

2.8.9.2 Perforated Plate Diffusers

Provide adjustable air pattern controls as indicated. Provide diffuser faceplates that do not sag or deflect when operating under design conditions.

2.8.9.3 Registers and Grilles

Provide units that are four-way directional-control type, except provide return and exhaust registers that are fixed horizontal or vertical louver type similar in appearance to the supply register face. Furnish registers with sponge-rubber gasket between flanges and wall or ceiling. Install wall supply registers at least 6 inches below the ceiling unless otherwise indicated. Locate return and exhaust registers 6 inches above the floor unless otherwise indicated. Achieve four-way directional control by a

grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Provide grilles as specified for registers, without volume control damper.

2.9 AIR SYSTEMS EQUIPMENT

2.9.1 Fans

Test and rate fans according to AMCA 210. Calculate system effect on air moving devices in accordance with AMCA 201 where installed ductwork differs from that indicated on drawings. Install air moving devices to minimize fan system effect. Where system effect is unavoidable, determine the most effective way to accommodate the inefficiencies caused by system effect on the installed air moving device. The sound power level of the fans shall not exceed 85 dBA when tested according to AMCA 300 and rated in accordance with AMCA 301. Provide all fans with an AMCA seal. Connect fans to the motors either directly or indirectly with V-belt drive. Use V-belt drives designed for not less than 150 percent of the connected driving capacity. Provide variable pitch motor sheaves for 15 hp and below, and fixed pitch as defined by AHRI Guideline D. Select variable pitch sheaves to drive the fan at a speed which can produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, provide a replaceable sheave when needed to achieve system air balance. Provide motors for V-belt drives with adjustable rails or bases. Provide removable metal guards for all exposed V-belt drives, and provide speed-test openings at the center of all rotating shafts. Provide fans with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Provide fan and motor assemblies with vibration-isolation supports or mountings as indicated. Use vibration-isolation units that are standard products with published loading ratings. Select each fan to produce the capacity required at the fan static pressure indicated. Provide sound power level as indicated. Obtain the sound power level values according to AMCA 300. Provide standard AMCA arrangement, rotation, and discharge as indicated. Provide power ventilators that conform to UL 705 and have a UL label.

2.9.1.1 Centrifugal Fans

Provide fully enclosed, single-width single-inlet, or double-width double-inlet centrifugal fans, with AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Provide forward curved or backward-inclined airfoil design fan blades in wheel sizes up to 30 inches. Provide backward-inclined airfoil design fan blades for wheels over 30 inches in diameter. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide steel, accurately finished fan shafts, with key seats and keys for impeller hubs and fan pulleys. Provide fan outlets of ample proportions, designed for the attachment of angles and bolts for attaching flexible connections. Provide automatically operated inlet vanes on suction inlets. Provide automatically operated outlet dampers. Unless otherwise indicated, provide motors that do not exceed 1800 rpm. Provide magnetic type motor starters with weather-resistant and watertight enclosure. Provide remote manual switch with pilot indicating light where indicated.

2.9.1.2 In-Line Centrifugal Fans

Provide in-line fans with centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and

adjustable motor mounts. Mount fans in a welded tubular casing. Provide a fan that axially flows the air in and out. Streamline inlets with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Enclose and isolate fan bearings and drive shafts from the air stream. Provide precision, self aligning ball or roller type fan bearings that are sealed against dust and dirt and are permanently lubricated. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11.

2.9.1.3 Centrifugal Type Power Roof Ventilators

Provide direct or V-belt driven centrifugal type fans with backward inclined, non-overloading wheel. Provide hinged or removable and weatherproof motor compartment housing, constructed of heavy gauge aluminum. Provide fans with birdscreen, disconnect switch, motorized dampers, roof curb, and extended base. Provide dripproof type motor enclosure. Provide centrifugal type kitchen exhaust fans according to UL 705, fitted with V-belt drive, round hood, and windband upblast discharge configuration, integral residue trough and collection device, with motor and power transmission components located in outside positively air ventilated compartment. Use only lubricated bearings.

2.9.1.4 Ceiling Exhaust Fans

Provide centrifugal type, direct driven suspended cabinet-type ceiling exhaust fans. Provide fans with acoustically insulated housing. Provide chatter-proof backdraft damper. Provide egg-crate design or louver design integral face grille. Mount fan motors on vibration isolators. Furnish unit with mounting flange for hanging unit from above. Provide U.L. listed fans.

2.9.2 Coils

Provide fin-and-tube type coils constructed of seamless copper tubes and copper fins mechanically bonded or soldered to the tubes. Provide copper tube wall thickness that is a minimum of 0.016 inches Provide copper fins that are 0.0045 inch minimum thickness. Provide casing and tube support sheets that are not lighter than 16 gauge galvanized steel, formed to provide structural strength. Test each coil at the factory under water at not less than 400 psi air pressure and make suitable for 200 psi working pressure and 300 degrees F operating temperature unless otherwise stated. Mount coils for counterflow service. Rate and certify coils to meet the requirements of AHRI 410.

2.9.2.1 Water Coils

Install water coils with a pitch of not less than 1/8 inch/foot of the tube length toward the drain end. Use headers constructed of cast iron, welded steel or copper. Furnish each coil with a plugged vent and drain connection extending through the unit casing. Provide removable water coils with drain pans.

2.9.3 Air Filters

List air filters according to requirements of UL 900, except list high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method under the Label Service to meet the requirements of UL 586.

2.9.3.1 Extended Surface Pleated Panel Filters

Provide 2 inch depth, sectional, disposable type filters of the size indicated with a MERV of 8 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.36 inches water gauge. Provide UL Class 2 filters, and nonwoven cotton and synthetic fiber mat media. Attach a wire support grid bonded to the media to a moisture resistant fiberboard frame. Bond all four edges of the filter media to the inside of the frame to prevent air bypass and increase rigidity.

2.9.3.2 High-Efficiency Particulate Air (HEPA) Filters

Provide HEPA filters that meet the requirements of IEST RP-CC-001 and are individually tested and certified to have an efficiency of not less than 99.97 percent, and an initial resistance at 500 fpm that does not exceed 0.5 inches water gauge. Provide filters that are constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by corrugated aluminum or mineral-fiber inserts, strips of filter medium, or by honeycomb construction of the pleated filter medium. Provide interlocking, dovetailed, molded neoprene rubber gaskets of 5-10 durometer that are cemented to the perimeter of the downstream face of the filter cell sides. Provide self-extinguishing rubber-base type adhesive or other materials conforming to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Provide filter cell sides that are galvanized steel assembled in a rigid manner. Provide overall cell side dimensions that are correct to 1/16 inch, and squareness that is maintained to within 1/8 inch. Provide holding frames that use spring loaded fasteners or other devices to seal the filter tightly within it and that prevent any bypass leakage around the filter during its installed life. Provide air capacity and the nominal depth of the filter as indicated. Install each filter in a factory preassembled side access housing or a factory-made sectional supporting frame as indicated. Provide prefilters of the type, construction and efficiency indicated.

2.9.3.3 Holding Frames

Fabricate frames from not lighter than 16 gauge sheet steel with rust-inhibitor coating. Equip each holding frame with suitable filter holding devices. Provide gasketed holding frame seats. Make all joints airtight.

2.9.3.4 Filter Gauges

Provide dial type filter gauges, diaphragm actuated draft for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Gauges shall be at least 3-7/8 inches in diameter, with white dials with black figures, and graduated in 0.01 inch of water, with a minimum range of 1 inch of water beyond the specified final resistance for the filter bank on which each gauge is applied. Provide each gauge with a screw operated zero adjustment and two static pressure tips with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter aluminum tubing, and all hardware and accessories for gauge mounting.

2.10 AIR HANDLING UNITS

2.10.1 Factory-Fabricated Air Handling Units

Units shall include fans, coils, airtight insulated casing, prefilters,

secondary filter sections, and vibration-isolators and appurtenances required for specified operation.Provide air handling unit that is rated in accordance with AHRI 430 and AHRI certified for cooling.

2.10.1.1 Casings

Provide the following:

a. Casing sections 2 inch double wall type, constructed of a minimum 18 gauge galvanized steel, or inner casing of double-wall units that are a minimum 20 gauge solid galvanized steel or corrosion-resisting sheet steel conforming to ASTM A167, Type 304. Design and construct casing with an integral insulated structural galvanized steel frame such that exterior panels are non-load bearing.

b. Individually removable exterior panels with standard tools. Removal shall not affect the structural integrity of the unit. Furnish casings with access sections, according to paragraph AIR HANDLING UNITS, inspection doors, and access doors, all capable of opening a minimum of 90 degrees, as indicated.

c. Insulated, fully gasketed, double-wall type inspection and access doors, of a minimum 18 gauge outer and 20 gauge inner panels made of either galvanized steel or corrosion-resisting sheet steel conforming to ASTM A167, Type 304. Doors shall be rigid and provided with heavy duty hinges and latches. Inspection doors shall be a minimum 12 inches wide by 12 inches high. Access doors shall be a minimum 24 inches wide, the full height of the unit casing or a minimum of 6 foot, whichever is less. Install a minimum 8 by 8 inches sealed glass window suitable for the intended application, in all access doors.

d. Double-wall insulated type drain pan (thickness equal to exterior casing) constructed of corrosion resisting sheet steel conforming to ASTM A167, Type 304, conforming to ASHRAE 62.1. Construct drain pans water tight, treated to prevent corrosion, and designed for positive condensate drainage. When 2 or more cooling coils are used, with one stacked above the other, condensate from the upper coils shall not flow across the face of lower coils. Provide intermediate drain pans or condensate collection channels and downspouts, as required to carry condensate to the unit drain pan out of the air stream and without moisture carryover. Construct drain pan to allow for easy visual inspection, including underneath the coil without removal of the coil and to allow complete and easy physical cleaning of the pan underneath the coil without removal of the coil. Coils shall be individually removable from the casing.

e. Casing insulation that conforms to NFPA 90A. Single-wall casing sections handling conditioned air shall be insulated with not less than 1 inch thick, 1-1/2 pound density coated fibrous glass material having a thermal conductivity not greater than 0.23 Btu/hr-sf-F. Double-wall casing sections handling conditioned air shall be insulated with not less than 2 inches of the same insulation specified for single-wall casings. Foil-faced insulation is not an acceptable substitute for use with double wall casing. Double wall insulation shall be completely sealed by inner and outer panels.

f. Factory applied fibrous glass insulation that conforms to ASTM C1071, except that the minimum thickness and density requirements do not apply, and that meets the requirements of NFPA 90A. Make air handling

unit casing insulation uniform over the entire casing. Foil-faced insulation is not an acceptable substitute for use on double-wall access doors and inspections doors and casing sections.

g. Duct liner material, coating, and adhesive that conforms to fire-hazard requirements specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Protect exposed insulation edges and joints where insulation panels are butted with a metal nosing strip or coat to meet erosion resistance requirements of ASTM C1071.

h. A latched and hinged inspection door, in the fan and coil sections. Plus additional inspection doors, access doors and access sections where indicated.

2.10.1.2 Heating and Cooling Coils

Provide coils as specified in paragraph AIR SYSTEMS EQUIPMENT.

2.10.1.3 Air Filters

Provide air filters as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.10.1.4 Fans

Provide the following:

a. Fans that are double-inlet, centrifugal type with each fan in a separate scroll. Dynamically balance fans and shafts prior to installation into air handling unit, then after it has been installed in the air handling unit, statically and dynamically balance the entire fan assembly. Mount fans on steel shafts, accurately ground and finished.

b. Fan bearings that are sealed against dust and dirt and are precision self-aligning ball or roller type, with L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Bearings shall be permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Support bearings by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Do not fasten bearings directly to the unit sheet metal casing. Furnish fans and scrolls with coating indicated.

c. Fans that are driven by a unit-mounted, or a floor-mounted motor connected to fans by V-belt drive complete with belt guard for externally mounted motors. Furnish belt guards that are the three-sided enclosed type with solid or expanded metal face. Belt drives shall be designed for not less than a 1.3 service factor based on motor nameplate rating.

d. Motor sheaves that are variable pitch for 25 hp and below and fixed pitch above 25 hp. Where fixed sheaves are required, the use of variable pitch sheaves is allowed during air balance, but replace them with an appropriate fixed sheave after air balance is completed. Select variable pitch sheaves to drive the fan at a speed that produces the specified capacity when set at the approximate midpoint of the sheave adjustment. Furnish motors for V-belt drives with adjustable bases, and with totally enclosed enclosures.

e. Motor starters of magnetic type with weather-resistant enclosure. Select unit fan or fans to produce the required capacity at the fan static pressure with sound power level as indicated. Obtain the sound power level values according to AMCA 300, ASHRAE 68, or AHRI 260.

2.10.1.5 Access Sections and Filter/Mixing Boxes

Provide access sections where indicated and furnish with access doors as shown. Construct access sections and filter/mixing boxes in a manner identical to the remainder of the unit casing and equip with access doors. Design mixing boxes to minimize air stratification and to promote thorough mixing of the air streams.

2.11 TERMINAL UNITS

2.11.1 Variable Air Volume (VAV)

a. Provide VAV and dual duct terminal units that are the type, size, and capacity shown, mounted in the ceiling or wall cavity, plus units that are suitable for single or dual duct system applications. Provide actuators and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. For each VAV terminal unit, provide a temperature sensor in the unit discharge ductwork.

b. Provide unit enclosures that are constructed of galvanized steel not lighter than 22 gauge or aluminum sheet not lighter than 18 gauge. Provide single or multiple discharge outlets as required. Units with flow limiters are not acceptable. Provide unit air volume that is factory preset and readily field adjustable without special tools. Provide reheat coils as indicated.

2.11.1.1 Constant Volume, Single Duct Terminal Units

Provide constant volume, single duct, terminal units that contain within the casing, a constant volume regulator. Provide volume regulators that control air delivery to within plus or minus 5 percent of specified air flow subjected to inlet pressure from 3/4 to 6 inch water gauge.

2.11.1.2 Variable Volume, Single Duct Terminal Units

Provide variable volume, single duct, terminal units with a calibrated air volume sensing device, air valve or damper, actuator, and accessory relays. Provide units that control air volume to within plus or minus 5 percent of each air set point volume as determined by the thermostat with variations in inlet pressures from 3/4 to 6 inch water gauge. Provide units with an internal resistance not exceeding 0.4 inch water gauge at maximum flow range. Provide external differential pressure taps separate from the control pressure taps for air flow measurement with a 0 to 1 inch water gauge range.

2.11.1.3 Variable Volume, Single Duct, Fan-Powered Terminal Units

Provide variable volume, single duct, fan-powered terminal units with a calibrated air volume sensing device, air valve or damper, actuator, fan and motor, and accessory relays. Provide units that control primary air volume to within plus or minus 5 percent of each air set point as determined by the thermostat with variations in inlet pressure from 3/4 to 6 inch water gauge. Provide unit fan that is centrifugal, direct-driven,

double-inlet type with forward curved blades. Provide either single speed with speed controller or three-speed, permanently lubricated, permanent split-capacitor type fan motor. Isolate fan/motor assembly from the casing to minimize vibration transmission. Provide factory furnished fan control that is wired into the unit control system. Provide a factory-mounted pressure switch to operate the unit fan whenever pressure exists at the unit primary air inlet or when the control system fan operates.

2.11.1.4 Series Fan Powered Variable Air Volume (VAV) Terminals

Provide units factory assembled, designed, tested, rated in accordance with AHRI 880, that are AHRI certified, listed in the AHRI DCAACP and that produce a supply air discharge mix by modulation of conditioned primary air and recirculating of return air. Provide units that include casing, centrifugal fan and motor, primary VAV damper or valve, electronic volume regulator, discharge air damper, primary air inlet cone with high and low pressure flow sensors, recirculating air filter frames, filter, and electrical disconnect. Provide hot water heating coils integral to the terminal, or provide insulated hot water coil section attached to the discharge of the terminal.

2.12 SUPPLEMENTAL COMPONENTS/SERVICES

2.12.1 Backflow Preventers

The requirements for backflow preventers are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.12.2 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.12.3 Controls

The requirements for controls are specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the COR of any discrepancy before performing the work.

3.2 INSTALLATION

a. Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.

3.2.1 Condensate Drain Lines

Provide water seals in the condensate drain from all units. Provide a depth of each seal of 2 inches plus .004 inch per each .004 in water for each PA the number of inches, measured in water gauge, of the total static

pressure rating of the unit to which the drain is connected. Provide pipe cap or plug cleanouts where indicated. Connect drains indicated to connect to the sanitary waste system using an indirect waste fitting. Insulate air conditioner drain lines as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2.2 Equipment and Installation

Provide frames and supports for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Floor mount or ceiling hang air handling units as indicated. Anchor and fasten as detailed. Set floor-mounted equipment on not less than 6 inch concrete pads or curbs doweled in place unless otherwise indicated. In lieu of a concrete pad foundation, build a concrete pedestal block with isolators placed between the pedestal block and the floor. Make the concrete foundation or concrete pedestal block a mass not less than three times the weight of the components to be supported. Provide the lines connected to the pump mounted on pedestal blocks with flexible connectors.

3.2.3 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced.

3.2.4 Flexible Duct

Install pre-insulated flexible duct in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Provide hangers, when required to suspend the duct, of the type recommended by the duct manufacturer and set at the intervals recommended.

3.2.5 Metal Ductwork

Install according to SMACNA 1966 unless otherwise indicated. Install duct supports for sheet metal ductwork according to SMACNA 1966, unless otherwise specified. Do not use friction beam clamps indicated in SMACNA 1966. Anchor risers on high velocity ducts in the center of the vertical run to allow ends of riser to move due to thermal expansion. Erect supports on the risers that allow free vertical movement of the duct. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, provide retainer clips.

3.2.6 Acoustical Duct Lining

Apply lining in cut-to-size pieces attached to the interior of the duct with nonflammable fire resistant adhesive conforming to ASTM C916, Type I, NFPA 90A, UL 723, and ASTM E 84. Provide top and bottom pieces that lap the side pieces and are secured with welded pins, adhered clips of metal, nylon, or high impact plastic, and speed washers or welding cup-head pins installed according to SMACNA 1966. Provide welded pins, cup-head pins, or adhered clips that do not distort the duct, burn through, nor mar the finish or the surface of the duct. Make pins and washers flush with the surfaces of the duct liner and seal all breaks and punctures of the duct

liner coating with the nonflammable, fire resistant adhesive. Coat exposed edges of the liner at the duct ends and at other joints where the lining is subject to erosion with a heavy brush coat of the nonflammable, fire resistant adhesive, to prevent delamination of glass fibers. Apply duct liner to flat sheet metal prior to forming duct through the sheet metal brake. Additionally secure lining at the top and bottom surfaces of the duct by welded pins or adhered clips as specified for cut-to-size pieces. Other methods indicated in SMACNA 1966 to obtain proper installation of duct liners in sheet metal ducts, including adhesives and fasteners, are acceptable.

3.2.7 Insulation

Provide thickness and application of insulation materials for ductwork, piping, and equipment according to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Externally insulate outdoor air intake ducts and plenums.

3.2.8 Duct Test Holes

Provide holes with closures or threaded holes with plugs in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Plug insulated duct at the duct surface, patched over with insulation and then marked to indicate location of test hole if needed for future use.

3.3 CLEANING

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. When the work area is in an occupied space such as office, laboratory or warehouse protect all furniture and equipment from dirt and debris. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean.

3.4 DUCTWORK LEAK TEST

Perform ductwork leak test for the entire air distribution and exhaust system, including fans, coils. Provide test procedure, apparatus, and report that conform to SMACNA 1143. The maximum allowable leakage rate is 1 percent of total system. Complete ductwork leak test with satisfactory results prior to applying insulation to ductwork exterior.

3.5 TESTING, ADJUSTING, AND BALANCING

The requirements for testing, adjusting, and balancing are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC. Begin testing, adjusting, and balancing only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.6 PERFORMANCE TESTS

After testing, adjusting, and balancing is complete as specified, test each

system as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Record the testing during the applicable season. Make corrections and adjustments as necessary to produce the conditions indicated or specified.

Submit test reports for the ductwork leak test, and performance tests in booklet form, upon completion of testing.

3.7 CLEANING AND ADJUSTING

Provide a temporary bypass for water coils to prevent flushing water from passing through coils. Inside of air terminal units, thoroughly clean ducts, plenums, and casing of debris and blow free of small particles of rubbish and dust and then vacuum clean before installing outlet faces. Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots. Provide temporary filters prior to startup of all fans that are operated during construction, and install new filters after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. Maintain system in this clean condition until final acceptance. Properly lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension. Adjust control valves and other miscellaneous equipment requiring adjustment to setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions. Maintain all equipment installed under the contract until close out documentation is received, the project is completed and the building has been documented as beneficially occupied.

3.8 OPERATION AND MAINTENANCE

3.8.1 Operation and Maintenance Manuals

Submit six manuals at least 2 weeks prior to field training. Submit data complying with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data.

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SECTION 23 01 30.41

HVAC SYSTEM CLEANING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for cleaning of HVAC systems, including applicable industry standards, qualifications of cleaning contractor, cleaning methodology, and performance verification.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 62.1	Ventilation for Acceptable Indoor Air Quality

NATIONAL AIR DUCT CLEANERS ASSOCIATION (NADCA)

ACR	Standard for Assessment, Cleaning, and Restoration of HVAC Systems
NADCA HVAC Inspection Manual	Procedures for Assessing the Cleanliness of Commercial HVAC Systems

NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION (NAIMA)

NAIMA AH112	Cleaning Fibrous Glass or Lined Sheet Metal Ducts
NAIMA AH122	Cleaning Fibrous Insulated Duct Systems - Recommended Practices
NAIMA AH127	Impact of Duct Cleaning on Internal Duct Insulation

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1966	HVAC Duct Construction Standards Metal and Flexible, 3rd Edition

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 402-C-01-001	IAQ Building Education and Assessment Tool (I-BEAM)
EPA 402-F-91-102	Building Air Quality: A Guide for Building Owners and Facility Managers

UNDERWRITERS LABORATORIES (UL)

UL 181	Factory-Made Air Ducts and Air Connectors
UL 181A	Standard for Closure Systems for Use with Rigid Air Ducts and Air Connectors
UL 181B	Standard for Closure Systems for Use with Flexible Air Ducts and Air Connectors

1.3 DEFINITIONS

1.3.1 NADCA Standards

Perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (ACR and NADCA HVAC Inspection Manual).

a. All terms in this specification are defined as stated in the NADCA Standards.

b. Follow NADCA Standards without modification or deviation.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Record of Existing Conditions

Coordination Plan

NADCA Firm

Designation of NADCA Team Assistants

Designation of NADCA Air System Cleaning Specialist (ASCS)

Designation of NADCA Supervisor Qualifications

Records of Experience in the Field of HVAC System Cleaning

NADCA Work Execution Schedule

SD-06 Test Reports

Testing Procedures Summary

Gravimetric Analysis

Post-Project Report

1.5 QUALITY ASSURANCE

1.5.1 NADCA Firm

To secure approval for the proposed agency, submit information certifying that the NADCA firm is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including furnishing equipment. Further, submit the following, for the firm, to COR for approval:

a. Independent NADCA firm:

NADCA Firm: NADCA registration number and expiration date of current certification;

NADCA Supervisor Qualifications: Name and copy of NADCA supervisor certificate and expiration date of current certification.

NADCA Air System Cleaning Specialist (ASCS): Name and documented evidence that the team field leader has satisfactorily performed full-time supervision of HVAC cleaning work in the field for not less than 3 years immediately preceding this contract's bid opening date.

NADCA Team Assistants: Names and documented evidence that each field technician has satisfactorily assisted a NADCA team field leader in performance of HVAC cleaning work in the field for not less than one year immediately preceding this contract's bid opening date.

Current Certificates: Registrations and certifications are current, and valid for the duration of this contract. Renew Certifications which expire prior to completion of the HVAC cleaning work, in a timely manner so that there is no lapse in registration or certification. NADCA agency or NADCA team personnel without a current registration or current certification are not to perform HVAC cleaning work on this contract.

b. TAB Team Members: NADCA team approved to accomplish work on this contract are full-time employees of the NADCA firm. No other personnel is allowed to do HVAC cleaning work on this contract.

c. Replacement of NADCA Team Members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the COR.

1.5.2 Experience

Submit records of experience in the field of HVAC system cleaning. Bids will only be considered from firms which are regularly engaged in HVAC system maintenance with an emphasis on HVAC system cleaning and decontamination.

1.5.3 Equipment, Materials and Labor

Possess and furnish all necessary equipment, materials and labor to adequately perform the specified services and comply with the applicable provisions of NADCA General Specifications for the Cleaning of Commercial

HVAC Systems and ASHRAE 62.1.

a. Assure that all employees have received safety equipment training, medical surveillance programs, individual health protection measures, and manufacturer's product and Material Safety Data Sheets (MSDS) as required for the work by the U.S. Occupational Safety and Health Administration, and as described by this specification.

b. Maintain a copy of all current MSDS documentation and safety certifications at the site at all times, as well as comply with all other site documentation requirements of applicable OSHA programs and this specification.

c. Submit all Material Safety Data Sheets (MSDS) for all chemical products proposed to be used in the cleaning process, including all VOC ratings.

1.5.4 Licensing

Provide proof of maintaining the proper license(s), if any, as required to do work in the state ofCalifornia. Comply with all Federal, state and local rules, regulations, and licensing requirements.

1.6 STANDARDS

1.6.1 NADCA Standards

Perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (ACR and NADCA HVAC Inspection Manual).

a. All terms in this specification have their meaning defined as stated in the NADCA Standards.

b. Follow NADCA Standards with no modifications or deviations being allowed.

1.7 DOCUMENTS

1.7.1 Mechanical Drawings

Obtain one copy of the following documents:

a. Project drawings and specifications

b. Approved construction revisions pertaining to the HVAC system

c. Any existing indoor air quality (IAQ) assessments or environmental reports prepared for the facility.

Submit a NADCA Work Execution Schedule to the COR within 10 working days of the contract award.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 SCOPE OF WORK

3.1.1 Scope

This section defines the minimum requirements necessary to render HVAC components clean, and to verify the cleanliness through inspection and/or testing in accordance with items specified herein and applicable NADCA Standards. Conform all inspection work to NADCA HVAC Inspection Manual.

Remove visible surface contaminants and deposits from within the HVAC system in strict accordance with these specifications.

The HVAC system includes any interior surface of the facility's air distribution system for conditioned spaces and/or occupied zones. This includes the entire heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system. The return air grilles, return air ducts (except ceiling plenums and mechanical room) to the air handling unit (AHU), the interior surfaces of the AHU, mixing box, coil compartment, condensate drain pans, humidifiers and dehumidifiers, supply air ducts, fans, fan housing, fan blades, air wash systems, spray eliminators, turning vanes, filters, filter housings, reheat coils, and supply diffusers are all considered part of the HVAC system. The HVAC system may also include other components such as dedicated exhaust and ventilation components and make-up air systems.

3.2 HVAC SYSTEM INSPECTIONS AND SITE PREPARATIONS

3.2.1 HVAC System Evaluation

Prior to the commencement of any cleaning work, perform a visual inspection of the HVAC system in the presence of the COR to determine appropriate methods, tools, and equipment required to satisfactorily complete this project. Notify the COR 10 days prior to the planned inspection.

Document damaged system components found during the inspection and submit to the COR, clearly labeled "Record of Existing Conditions."

3.2.2 Site Evaluation and Preparations

Conduct a site evaluation, and establish a specific, coordination plan which details how each area of the building will be protected during the various phases of the project.

3.3 GENERAL HVAC SYSTEM CLEANING REQUIREMENTS

3.3.1 Containment

Collect debris removed during cleaning and take precautions to ensure that debris is not otherwise dispersed outside the HVAC system during the cleaning process.

3.3.2 Particulate Collection

Where the Particulate Collection Equipment (PCE) is exhausting inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron size (or greater). When the PCE is exhausting outside the

building, undertake Mechanical Cleaning operations only with PCE, including adequate filtration to contain Debris removed from the HVAC system. When the PCE is exhausting outside the building, take precautions to locate the equipment down wind and away from all air intakes and other points of entry into the building.

3.3.3 Controlling Odors

Take all reasonable measures to control offensive odors and/or mist vapors during the cleaning process.

3.3.4 Component Cleaning

Employ cleaning methods such that all HVAC system components are Visibly Clean as defined in applicable standards. Upon completion, return all components to those settings recorded just prior to cleaning operations.

3.3.5 Air-Volume Control Devices

Mark the position of dampers and any air-directional mechanical devices inside the HVAC system prior to cleaning and, upon completion, restore to their marked position.

3.3.6 Service Openings

Utilize service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry, and inspection. Utilize the existing service openings already installed in the HVAC system where possible.

Create other openings where needed, created and resealed in conformance with NADCA Standard 05. Place closures so they do not significantly hinder, restrict, alter the air-flow within the system, or compromise the structural integrity of the system. Properly insulate closures to prevent heat loss/gain or condensation on surfaces within the system. Conform construction techniques used in the creation of openings to requirements of applicable building and fire codes, and applicable NFPA, SMACNA and NADCA Standards. Cutting service openings into flexible duct is not permitted. Disconnect flexible duct at the ends as needed for proper cleaning and inspection.

Reseal rigid fiber glass ductboard duct systems in accordance with NAIMA recommended practices; NAIMA AH112, NAIMA AH122, and NAIMA AH127. Only closure techniques which comply with UL 181, UL 181A, or UL 181B are suitable for fiber glass duct system closures.

Clearly mark all service openings, capable of being re-opened for future inspection or remediation, and report their location in project report documents.

3.3.7 Ceiling Sections (Tile)

Carefully remove and reinstall ceiling sections to gain access to HVAC systems during the cleaning process. Replace any damaged ceiling sections caused by the removal at no cost to the Government.

3.3.8 Air Distribution Devices (Registers, Grilles and Diffusers)

Clean all air distribution devices.

3.3.9 Air Handling Units, Terminal Units, Blowers and Exhaust Fans

Insure that supply, return, and exhaust fans and blowers are thoroughly cleaned. Areas to be cleaned include blowers, fan housings, plenums (except ceiling supply and return plenums), scrolls, blades, or vanes, shafts, baffles, dampers and drive assemblies. Remove all visible surface contamination deposits in accordance with NADCA Standards.

a. Clean all air handling unit (AHU) internal surfaces, components and condensate collectors and drains.

b. Assure that a suitable operative drainage system is in place prior to beginning wash down procedures.

c. Clean all coils and related components, including evaporator fins.

3.3.10 Duct Systems

a. Create service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas.

b. Mechanically clean all duct systems to remove all visible contaminants, such that the systems are capable of passing Cleaning Verification Testings NADCA Standards.

3.4 HEALTH AND SAFETY

3.4.1 Safety Standards

Comply with all applicable federal, state, and local requirements for protecting the safety of the contractors' employees, building occupants, and the environment. In particular, follow all applicable standards of the Occupational Safety and Health Administration (OSHA) when working in accordance with this specification.

3.4.2 Occupant Safety

Employ no processes or materials in such a manner that they will introduce additional hazards into occupied spaces.

3.4.3 Disposal of Debris

Dispose of all debris removed from the HVAC System in accordance with applicable federal, state and local requirements.

3.5 MECHANICAL CLEANING METHODOLOGY

3.5.1 Source Removal Cleaning Methods

Clean the HVAC system using Source Removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and safely remove contaminants from the facility. Select Source Removal methods which will render the HVAC System Visibly Clean and capable of passing cleaning verification methods NADCA Standards and other specified standards and tests, in accordance with all general requirements. Use no cleaning method, or combination of methods, which could potentially damage components of the HVAC system or negatively alter the integrity of the system.

Incorporate the use of vacuum collection devices that are operated continuously during cleaning for all methods used. Connect a vacuum device to the downstream end of the section being cleaned through a predetermined opening. Use a vacuum collection device of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment is assured.

Equip all vacuum devices exhausting air inside the building, including hand-held vacuums and wet-vacuums, with HEPA filters (minimum efficiency).

Equip all vacuum devices exhausting air outside the facility with Particulate Collection including adequate filtration to contain Debris removed from the HVAC system, in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors which violates any outdoor environmental standards, codes or regulations is not allowed.

All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces, such that debris may be safely conveyed to vacuum collection devices. Acceptable methods will include those which will not potentially damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.

3.5.2 Methods of Cleaning Fibrous Glass Insulated Components

Thoroughly clean glass thermal or acoustical insulation elements present in any equipment or ductwork with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet in accordance with applicable NADCA and NAIMA standards and recommendations.

Do not use cleaning methods which cause damage to fibrous glass components or which will render the system capable of passing Cleaning Verification Tests NADCA Standards).

3.5.3 Damaged Fibrous Glass Material

If there is any evidence of damage, deterioration, delamination, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be restored by cleaning or resurfacing with an acceptable insulation repair coating, identify them for replacement.

When requested or specified, be capable of remediating exposed damaged insulation in air handlers and/or ductwork requiring replacement.

3.5.4 Replacement Material

If replacement of fiber glass materials is required, conform all materials to applicable industry codes and standards, including those of UL and SMACNA 1966.

Replacement of damaged insulation is **not** covered by this specification.

3.5.5 Cleaning of Coils

Use any cleaning method which will render the Coil Visibly Clean and capable of passing Coil Cleaning Verification applicable NADCA Standards. Coil drain pans are subject to Non-Porous Surfaces Cleaning Verification. Maintain operability of the drain for the condensate at all times. Do not

damage, displace, inhibit heat transfer, or cause erosion of the coil surface or fins, and conform to coil manufacturer recommendations when available. Thoroughly rinse coils with clean water to remove any latent residues. Coil cleaning with anything other than water is forbidden unless all contaminated water is collected and disposed of by HazMat.

3.5.6 Antimicrobial Agents and Coatings

Only apply antimicrobial agents if active fungal growth is reasonably suspected, or where unacceptable levels of fungal contamination have been verified through testing.

Perform application of any antimicrobial agents used to control the growth of fungal or bacteriological contaminants after the removal of surface deposits and debris.

Use only antimicrobial agents registered by the U.S. Environmental Protection Agency (EPA 402-F-91-102)(EPA 402-C-01-001) specifically for use within HVAC system.

Apply antimicrobial agents in strict accordance with manufacturer's instructions.

Use only antimicrobial coating products, for both porous and non-porous surfaces,which are EPA registered, water soluble solutions with supporting efficacy data and MSDS records.

Apply antimicrobial coatings according to manufacturer's instructions. Spray coatings directly onto interior ductwork surfaces, rather than "fog" downstream onto surfaces. Achieve a continuous film on the surface to be treated by the coating application, and apply in strict accordance with manufacturer's minimum millage surface application rate standards for effectiveness.

3.6 CLEANLINESS VERIFICATION

3.6.1 General

Verification of HVAC System cleanliness will be determined after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system, including antimicrobial agents and coatings.

3.6.2 Visual Inspection

Visually inspect the HVAC system to ensure that no visible contaminants are present.

If no contaminants are evident through visual inspection, consider the HVAC system clean; however, further verification of the system cleanliness through gravimetric or wipe testing analysis testing may be requested at the discretion of the COR, as specified herein.

If visible contaminants are evident through visual inspection, re-clean those portions of the system where contaminants are visible, and subject to re-inspection for cleanliness.

3.6.3 Gravimetric Analysis

At the expense of the Contractor, test sections of the HVAC system for cleanliness using the NADCA Vacuum Test (gravimetric analysis) as specified in applicable NADCA Standards. Levels of debris collected are to be equal to or less than acceptable levels defined in applicable NADCA Standards.

If gravimetric analysis determines that levels of debris are equal to or lower than those levels specified, the system is considered clean and to have passed cleanliness verification.

If gravimetric analysis determines that levels of debris exceed those specified in applicable NADCA standards, the system will not be considered clean, and re-cleaning of those sections of the system which failed cleanliness verification will be required at the expense of the HVAC system cleaning contractor.

Perform cleanliness verification immediately after mechanical cleaning and before the HVAC system is restored to normal operation.

3.6.4 Verification of Coil Cleaning

Cleaning is to restore the coil pressure drop to within 10 percent of the pressure drop measured when the coil was first installed. If the original pressure drop is not known, the coil will be considered clean only if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection (see NADCA HVAC Inspection Manual Standards).

3.7 POST-PROJECT REPORT

At the conclusion of the project, provide a Testing Procedures Summary and Post-Project Report indicating the following:

a. Success of the cleaning project, as verified through visual inspection and/or gravimetric analysis.

b. Areas of the system found to be damaged and/or in need of repair.

-- End of Section --

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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

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BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

This section specifies standard basic mechanical work.

1.2 REFERENCES

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S328	Specification for Structural Steel Buildings - Load and Resistance Factor Design

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B40.1	Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.19.2M	Vitreous China Plumbing Fixtures
ASME B16.1	Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	Malleable-Iron Threaded Fittings
ASME B16.5	Pipe Flanges and Flanged Fittings
ASME B16.9	Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.22	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.25	Buttwelding Ends
ASME B16.26	Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.39	Malleable Iron Threaded Pipe Unions, Classes 150, 250, and 300
ASME B31.1	Power Piping
ASME B31.3	Chemical Plant and Petroleum Refinery Piping
ASME B36.10M	Welded and Seamless Wrought Steel Pipe
ASME-16	Boiler and Pressure Vessel Code; Section

	VIII, Pressure Vessels Division 1 - Basic Coverage
ASME-17	Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A6M	General Requirements for Rolled Structural Bars, Plates, Shapes, and Sheet Piling
ASTM A105M	Forgings, Carbon Steel, for Piping Components
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A183	Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A197M	Cupola Malleable Iron
ASTM A216M	Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A234M	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A278M	Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 662°F
ASTM A312M	Seamless and Welded Austenitic Stainless Steel Pipes
ASTM A480M	General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A563M	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A74	Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM B32	Standard Specification for Solder Metal
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B88M	Seamless Copper Water Tube
ASTM B370	Copper Sheet and Strip for Building

	Construction
ASTM B749	Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products
ASTM C109	Compressive Strength of Hydraulic Cement Mortars (Using 2-in. Cube Specimens)
ASTM C190	Tensile Strength of Hydraulic Cement Mortars
ASTM C404	Standard Specification for Aggregates for Masonry Grout
ASTM C476	Standard Specification for Grout for Masonry
ASTM C564	Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C67	Standard Specification for Sampling and Testing Brick and Structural Clay Tile
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM D2000	Standard Classification System for Rubber Products in Automotive Applications
ASTM E1	ASTM Thermometers
ASTM F104	Standard Classification System for Nonmetallic Gasket Materials
ASTM F568	Carbon and Alloy Steel Externally Threaded Metric Fasteners

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	Filler Metals for Brazing and Braze Welding
AWS WHB-2	Welding Handbook, Volume 2

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	Approval Guide

FEDERAL SPECIFICATIONS (FS)

FS FF-S-325	Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
FS HH-I-558	Insulation, Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Thermal Fiber, Industrial Type)

MILITARY SPECIFICATIONS (MS)

MS MIL-C-18480	Coating Compound, Bituminous, Solvent, Coal-Tar Base

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-67	Butterfly Valves
MSS SP-69	Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
MSS SP-70	Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-72	Ball Valves with Flanged or Butt-Welding Ends for General Service

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA-91	Seismic Restraint Manual, Guidelines for Mechanical Systems

1.3 GENERAL REQUIREMENTS

Section 23 00 00, AIR SUPPLY, DISTRIBUTION, VENTILATION AND EXHAUST SYSTEMS, applies to work specified in this section.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00, SUBMITTAL PROCEDURES:

SD-01, Data

Equipment Foundation Data for Piping Systems shall include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

SD-01, Data

Manufacturer's Catalog Data shall be submitted for the following items:

1. Pipe and fittings
2. Piping specialties
3. Valves
4. Miscellaneous materials
5. Supporting elements
6. Spare parts
7. Pumps
8. Compressors

9. Fans
10. Motors

SD-04, Drawings

Coordination Drawings shall be submitted for pipes, valves, and specialties showing the physical layout of all components and coordination of work between different trades and with the structural and architectural elements of work. Drawings shall be in sufficient detail to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Drawings shall indicate where conflicts or clearance problems exist between various trades.

SD-04, Drawings

As-Built Drawings shall be submitted for pipes, valves, and accessories providing current factual information including deviations and amendments to the drawings, and concealed and visible changes in the work.

SD-07, Schedules

Material, Equipment, and Fixture Lists shall be submitted for pipes, valves, and specialties including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information. A complete list of construction equipment to be used shall be provided.

SD-09, Reports

Test Reports on the following tests shall be submitted for pipes, valves, and specialties.

1. Hydrostatic tests
2. Air tests
3. Valve-operating tests
4. Drainage tests
5. Pneumatic tests
6. Non-destructive electric tests
7. System operation tests

SD-19, Operation and Maintenance Manuals

Operation and Maintenance Manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions. Test data shall be legible and of good quality.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

a. Type BCS, Black Carbon Steel (for Chilled, Hot, and Cooling-Tower Water Pipes)

1. Pipe ¾ in. through 10 in. shall be Schedule 40 seamless black carbon steel, conforming to ASTM A53, Type S. Grade A should be used for permissible field bending.

2. Pipe 12 in. through 2 ft shall be 3/8 in. wall seamless black carbon steel, conforming to ASTM A53, Type S.

3. Fittings 2 in. and under shall be Class 150 working steam pressure (wsp) banded black malleable iron, screwed, conforming to ASTM A197M and ASME B16.3.

4. Unions 2 in. and under shall be Class 250 female, screwed, black malleable iron with brass-to-iron seat, and ground joint, conforming to ASME B16.39.

5. Fittings DN65 and over shall be steel butt weld, conforming to ASTM A234M and ASME B16.9 to match pipe wall thickness.

6. Flanges 2½ in. and over shall be Class 150 forged-steel conforming to ASME B16.5, welding neck to match pipe wall thickness.

b. Type BCS-125, (12 psi Service for Steam and Condensate Piping)

1. Pipe 1/8 in. through 1½ in. shall be Schedule 40 steam, Schedule 80 condensate, furnace butt welded, black carbon steel, conforming to ASTM A53, Type F and ASME B36.10M.

2. Pipe 2 in. through 10 in. shall be Schedule 40 steam, Schedule 80 condensate, seamless or electric-resistance welded black carbon steel, conforming to ASTM A53 Type S and ASME B36.10M.

3. Pipe 12 in. through 2 feet shall be 3/8 in. wall seamless welded black carbon steel, conforming to ASTM A53 Type S and ASME B36.10M.

4. Fittings 2 in. and under shall be Class 150 wsp banded black malleable iron, screwed, conforming to ASTM A197M and ASME B16.3.

5. Fittings 2½ in. and over shall be wall thickness to match pipe, long radius butt weld, black carbon steel, conforming to ASTM A234M, Grade WPB and ASME B16.9.

6. Flanges 2½ in. and over shall be Class 150, forged carbon-steel welding neck, with raised face or flat face and concentric serrated finish, conforming to ASTM A105M and ASME B16.5.

7. Grooved pipe couplings and fittings shall not be used.

c. Type GCS, Galvanized Carbon Steel (for Potable Water and Rain Water Leader System)

1. Pipe ½ in. through 10 in. and where indicated shall be Schedule 40 seamless steel conforming to ASTM A53, Type S.

2. Pipe 12 in. and over shall be 3/8 in. wall, seamless, galvanized steel, conforming to ASTM A53, Grade B.

3. Fittings 2 in. and under shall be Class 150 wsp banded galvanized malleable iron, screwed, conforming to ASTM A197M and ASME B16.3.

4. Unions 2 in. and under shall be Class 150 wsp female, screwed, galvanized malleable iron with brass-to-iron seat and ground joint.

5. Fittings 2½ in. and over shall be 125 psi wsp cast-iron flanges

and flanged fittings, conforming to ASTM A126, Class A and ASME B16.1.

6. Grooved pipe couplings and fittings shall conform to Paragraph 2.2.G, Grooved Pipe Couplings and Fittings.

7. Contractor has the option of using Class 150 wsp banded galvanized malleable iron screwed fittings, conforming to ASTM A 197M and ASME B16.3.

d. Type GCS-DWV, Galvanized Steel Drain, Waste and Vent

1. Pipe (all sizes) shall be Schedule 40 seamless galvanized carbon steel, conforming to ASTM A53, Grade A.

2. Furnace butt weld pipe is acceptable for sizes less than 2 in.

3. Risers 3 in. and larger shall be Type CISP-DWV.

4. Fittings shall be galvanized, screwed, cast iron, recessed pattern drainage fittings, conforming to ASTM A126.

5. Long radius fittings shall be used wherever space permits. Short-turn tees, branches, and ells may be used for vent piping and connections of branch lines to battery fixtures, except wall-hung water closets.

e. Type CISP-DWV, Cast-Iron Drain, Waste and Vent - Soil pipe drain, waste, and vent bell-and-spigot type pipe shall be cast iron, conforming to ASTM A74. Joints shall be calked and leaded in lines where necessary to provide proper leaktight support and alignment. Joints may be elastomeric compression type, conforming to ASTM C564. Hubless joints may be used where indicated. Pipe class shall be extra-heavy (CISP-DWV-XH).

f. Type CPR, Copper

1. Type CPR-A, Copper Above Ground

a) Tubing 2 in. and under shall be seamless copper tubing, conforming to ASTM B88M, Type L (hard-drawn for all horizontal and all exposed vertical lines, annealed for concealed vertical lines).

b) Fittings 2 in. and under shall be Class 150 wsp wrought-copper solder joint fittings conforming to ASME B16.22.

c) Unions 2 in. and under shall be Class 150 wsp wrought-copper solder joint conforming to ASME B16.22.

d) Solder shall be 60-40 tin-antimony, alloy Sb-5, conforming to ASTM B32.

2. Type CPR-U, Copper Under Ground

a) Piping shall be Type K seamless copper tube, conforming to ASTM B88M. Socket-joint fittings shall be wrought copper, conforming to ASME B16.22.

b) Fittings for connection to corporation cocks shall be cast

bronze, flared-type, conforming to ASME B16.26. Joints shall be brazed, except joints in drain lines may be soldered. Brazing rod shall be Classification BCP-5, conforming to AWS A5.8.

3. Type CPR-INS, Copper Under Ground Insulated

a) Piping shall be insulated type K seamless copper tube conforming to ASTM B88M. Socket-joint fittings shall be wrought copper, conforming to ASME B16.22. Joints shall be brazed, except joints in drain lines may be soldered.

b) Insulation shall be not less than 2 in. thick, suitable for continuous service temperature of not less than 250°F. Insulation shall be factory-molded, closed-cell polyurethane foam of not less than 2.5 lbs/ft3 density. Insulation shall be waterproofed with an extruded rigid Type II virgin polyvinylchloride, with minimum wall thickness of 0.06 in. through 4 in. outside diameter (od), 0.09 in. through 6-3/5 in. od, and 0.1 in. through 10¾ in. od. Fitting covers shall be fabricated from same materials and thickness as adjacent pipe cooling according to the manufacturer's directions.

g. Grooved Pipe Couplings and Fittings

1. Grooved pipe couplings and fittings shall not be used on space heating hot water pipes.

2. Couplings shall have a housing, fabricated in two or more parts, of black, ungalvanized malleable iron castings. Coupling gasket shall be molded synthetic rubber conforming to ASTM D2000. Coupling bolts shall be oval-neck, track-head type, with hexagonal heavy nuts conforming to ASTM A183.

3. All pipe fittings used with couplings shall be fabricated of black, ungalvanized malleable iron castings. Where a manufacturer's standard-size malleable iron fitting pattern is not available, approved fabricated fittings may be used.

4. Fittings shall be fabricated from Schedule 40 or ¾ in. wall ASTM A53, Grade B seamless steel pipe; long radius seamless welding fittings with wall thickness to match pipe, conforming to ASTM A234M and ASME B16.9.

2.2 PIPING SPECIALTIES

a. Air Separator

1. Air separated from converter discharge water shall be ejected by a reduced-velocity device vented to the compression tank.

2. Air separator shall be carbon steel, fabricated, tested, and stamped in conformance with ASME-16 for service pressures not less than 125 psi.

b. Air Vents

1. Manual air vents shall be 0.4 in. globe valves.

2. Automatic air vents on pumps, mains, and where indicated shall be

of ball-float construction. Vent inlet shall be not less than ¾ in., and the outlet shall be not less than 0.3 in. Orifice shall be 0.1 in. Trim shall be corrosion-resistant steel conforming to ASTM A480M. Vent shall be fitted with try-cock. Vent shall discharge air at any pressure to 189 psi. Outlet shall be copper tube routed.

c. Compression Tank

1. Compression tank shall be designed, fabricated, tested and stamped for a working pressure of not less than 125 psi in accordance with ASME-16. Tank shall be hot-dip galvanized after fabrication to produce not less than 0.10 lbs/ft2 of single-side surface.

2. Tank accessories shall include red-lined gage-glass complete with glass protectors and shutoff valves, air charger and drainer, and manual vent.

d. Dielectric Connections - Dissimilar pipe metals shall be electrically insulated from each other by couplings, unions, or flanges commercially manufactured for that purpose and rated for the service pressure and temperature.

e. Flexible Pipe

1. Flexible pipe vibration and pipe noise eliminators shall be constructed of wire-reinforced chloroprene-impregnated cloth and cord materials and shall be flanged. Flanges shall be backed with ferrous-metal backing rings. Nonmetallic exterior surfaces of the flexible pipe shall be coated with an acid- and oxidation-resistant chlorosulphinated polyethylene. Flexible pipe shall be rated for continuous duty at 131 psi and 250°F.

2. Unit pipe lengths, face-to-face, shall be not less than the following:

INSIDE DIAMETER (IN.)	UNIT PIPE LENGTH, FT.
To 2½ , inclusive	1
3 to 4, inclusive	1½
5 to 12, inclusive	2

f. Flexible Metallic Pipe

1. Flexible pipe shall be the bellows-type with wire braid cover and shall be designed, constructed, and rated in accordance with ASME B31.3.

2. Working pressure minimum rating shall be 100 psi at 300°F.

3. Minimum burst pressure shall be four times working pressure at 300°F. Bellows material shall be AISI 300 series corrosion-resistant steel. Braid shall be AISI 300 series corrosion-resistant steel wire.

4. Threaded end connections shall be hex-collared Schedule 40, AISI 300 series corrosion-resistant steel conforming to ASTM A312M.

5. Flanged end connection rating and materials shall conform to

specifications for system primary-pressure rating.

g. Flexible Metal Steam Hose

1. Hose shall be bellows type with wire braid cover and shall be designed, constructed, and rated in accordance with ASME B31.3.

2. Working steam pressure rating shall be 125 psi at 500°F.

3. Minimum burst pressure shall be nine times working steam pressure at 300°F.

4. Bellows material shall be AISI 300 series corrosion-resistant steel. Braid shall be AISI 300-series corrosion-resistant steel wire.

5. Threaded end connections shall be hex-collared Schedule 40, AISI 300 series corrosion-resistant steel conforming to ASTM A312M.

6. Flanged end connection rating and materials shall conform to specifications for system primary-pressure rating.

h. Pressure Gages

1. Pressure gages shall conform to ANSI B40.1 and to requirements specified herein. Pressure gages shall be Type I, (for air, steam, and water) Class 1 (pressure). Pressure-gage size shall be 3½ in. nominal diameter. Case shall be corrosion-resistant steel, conforming to any of the AISI 300 series of ASTM A6M, with an ASM No.4 standard commercial polish or better. Gages shall be equipped with adjustable red marking pointer and damper-screw adjustment in inlet connection. Service-pressure reading shall be at midpoint of gage range. Gages shall be equipped with gage isolators. Gages shall have dual (metric/English) scales.

2. For steam piping, gages shall be fitted with black steel siphons and steam service pressure-rated gage cocks or valves.

i. Sight-Flow Indicators - Sight-flow indicators for pressure service on 3 in. and smaller shall be constructed of bronze with specially treated single- or double-glass sight windows and shall have a bronze, nylon, or tetrafluoroethylene rotating flow indicator mounted on an AISI Type 304 corrosion-resistant steel shaft. Body may have screwed or flanged end. Assembly shall be pressure- and temperature-rated for the applied service. Flapper flow-type indicators are not acceptable.

j. Thermometers - Thermometers shall conform to ASTM E1. Thermometers shall be industrial pattern Type I, except red organic-liquid-filled, Class 3 (well-threaded and seal-welded). Thermometers installed 6 ft or higher above the floor shall have an adjustable angle body. Scale shall be not less than 7 in. long. Case face shall be manufactured from manufacturer's standard polished aluminum or AISI 300 series polished corrosion-resistant steel. Thermometer range shall be as indicated and shall have dual (metric/English) scales. Thermometers shall be provided with nonferrous separable wells. Lagging extension to accommodate insulation thickness shall be provided.

k. Pump Suction Strainers

1. Strainer body shall be cast iron, rated for not less than 25 psi at 100°F, with flanges conforming to ASME B16.1, Class 125. Strainer construction shall be such that there is a machined surface joint between body and basket that is normal to the centerline of the basket.

2. Minimum ratio of open area of each basket to pipe area shall be 3 to 1. Basket shall be AISI 300 series corrosion-resistant steel wire mesh with perforated backing.

3. Mesh shall be capable of retaining particles larger than 0.04 in., with a pressure drop across the strainer body of not more than 104 psf when the basket is two-thirds dirty at maximum system flow rate. Reducing fittings from strainer-flange size to pipe size shall be provided.

4. A differential-pressure gage fitted with a two-way brass cock shall be provided across the strainer.

5. Manual air vent cocks shall be provided in cap of each strainer.

l. Line Strainers, Water Service

1. Strainers shall be Y-type with removable basket. Strainers in sizes 2 in. and smaller shall have screwed ends. In sizes 2½ in. and larger, strainers shall have flanged ends. Body working-pressure rating shall exceed maximum service pressure of system in which installed by at least 50 percent. Body shall have cast-in arrows to indicate direction of flow. Strainer bodies fitted with screwed screen retainers shall have straight threads and shall be gasketed with nonferrous metal. Strainer bodies 2½ in. and larger fitted with bolted-on screen retainers shall have offset blowdown holes. Strainers larger than 2½ in. shall be fitted with manufacturer's standard ball-type blowdown valve. Body material shall be cast bronze conforming to ASTM B62. Where system material is nonferrous, metal strainer body material shall be nonferrous metal.

2. Minimum free-hole area of strainer element shall be not less than 3.4 times the internal area of connecting piping. Strainer screens shall have perforations not exceeding 0.045 in. Strainer screens shall have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material shall be AISI Type 304 corrosion-resistant steel.

m. Line Strainers, Steam Service

1. Strainers shall be Y-type with removable strainer element.

2. Body end connections shall be flanged for valves larger than 2 in., unless butt weld ends are specified. Screwed end shall be used for sizes 2 in. and under to suit specified piping system end connection and maintenance requirements.

3. Strainers located in tunnels, trenches, manholes, and valve pits shall have welded end connections.

4. Body working steam pressure rating shall be the same as the primary valve rating for system in which strainer is installed,

except where welded end materials requirements result in higher pressure ratings. Body shall have integral cast or forged arrows to indicate direction of flow. Strainer bodies shall be provided with blowdown valves that have discharge end plugged with a solid metal plug. Closure assembly shall be made with tetrafluoroethylene tape. Bodies fitted with bolted-on screen retainers shall have offset blowdown holes.

5. Body materials shall be cast steel conforming to ASTM A216M, Grade WCB. Minimum free-hole area of strainer element shall be equal to not less than 3.4 times the internal area of connecting piping. Strainer screens shall have perforations not exceeding 24 psf or equivalent wire mesh. Strainer screens shall have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material shall be AISI Type 304 corrosion-resistant steel, and shall be fitted with backup screens where necessary to prevent collapse.

n. Bearings

1. Bearing Data - The contractor shall provide to the government the bearing manufacturer and part number for all bearings used in all rotating equipment supplied under this contract. The information shall be included on the sectional drawings for each bearing location.

2. Operating Data - The required equipment data the contractor shall provide the government under this contract shall include the operating speed for constant speed units and the normal operating speed range for variable speed equipment.

3. Gearbox - The contractor shall provide to the government the type and number of teeth on each gear used in the gearbox and the input and output speeds and gear ratios. This information shall be included on the sectional drawings which must be to scale and be specific to gear location.

2.3 VALVES

a. Ball and Butterfly Valves

1. Ball valves shall conform to MSS SP-72. Valves shall be rated for service at not less than 176 psi at 200°F. Valve bodies in sizes 2 in. and smaller shall be screwed-end connection type constructed of Class A copper alloy. Valve bodies in sizes 2½ in. and larger shall be flanged-end connection type. Balls and stems of valves 2 in. and smaller shall be manufacturer's standard with hard chrome plating finish. Balls and stems of valves 2½ in. and larger shall be manufacturer's standard Class C corrosion-resistant steel alloy with hard chrome plating. Balls of valves 6 in. and larger may be Class D with 900 Brinell hard chrome plating. Valves shall be suitable for flow from either direction, and shall seal equally tight in either direction. Valves with ball seals held in place by spring washers are not acceptable. Valves shall have adjustable packing glands. Seats and seals shall be tetrafluoroethylene.

2. Butterfly valves shall conform to MSS SP-67. Valves shall be wafer type for mounting between specified flanges, and shall be

rated for 150 psi shutoff and nonshock working pressure. Bodies shall be cast ferrous metal conforming to ASTM A126, Class B, and to ASME B16.1 for body wall thickness. Seats and seals shall be of the resilient elastomer type designed for field removal and replacement.

b. Drain, Vent, and Gage Cocks

1. Drain, vent, and gage cocks shall be lever handle, ground key type, with washer and screw, constructed of polished ASTM B62 bronze, and rated 125 psi wsp. End connections shall be rated for specified service.

2. Pump vent cocks, and where spray control is required, shall be UL umbrella-hood type, constructed of manufacturer's standard polished brass. Cocks shall be 0.590 in. male, end threaded, and rated at not less than 125 psi at 225°F.

c. Gate Valves (GAV)

1. Gate valves DN50 and smaller shall conform to MSS SP-72. Valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated shall be union-ring bonnet, screwed-end type. Packing shall be made of non-asbestos type materials. Valves shall be rising stem type.

2. Gate valves 2½ in. and larger shall be Type I, (wedge disk, tapered seats, steam rated); Class I (125 psi steam-working pressure at 352°F saturation); and Class 125, wog (nonshock), conforming to MSS SP-70 and to requirements specified herein. Valves shall be flanged, with bronze trim and outside screw and yoke (OS&Y) construction. Packing shall be made of non-asbestos type materials.

d. Globe and Angle Valves (GLV-ANV)

1. Globe and angle valves DN50 and smaller shall be 125 psi, conforming to MSS SP-72 and to requirements specified herein. Valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated shall be union-ring bonnet, screwed-end type. Disc shall be free to swivel on the stem in all valve sizes. Composition seating-surface disc construction may be substituted for all metal-disc construction. Packing shall be made of non-asbestos type materials. Disk and packing shall be suitable for pipe service installed.

2. Globe and angle valves 2½ in. and larger shall be cast iron with bronze trim. Valve bodies shall be cast iron conforming to ASTM A126, Class A, as specified for Class 1 valves under MSS SP-70. Valve ends shall be flanged in conformance with ASME B16.1. Valve construction shall be outside screw and yoke (OS&Y) type. Packing shall be made of non-asbestos type materials.

e. Standard Check Valves (SCV)

1. Standard check valves in sizes 2 in. and smaller shall be 125 psi swing check conforming to MSS SP-72, except as otherwise specified. Lift checks (lift check horizontal) and 125 psi, conforming to MSS SP-72, shall be provided where indicated.

Swing-check pins shall be nonferrous and suitably hard for the service. Discs shall be composition type. Swing-check angle of closure shall be manufacturer's standard unless a specific angle is needed.

2. Check valves in sizes 2½ in. and larger shall be cast iron, bronze trim, swing type. Valve bodies shall be cast iron, conforming to ASTM A126, Class A. Valve ends shall be flanged in conformance with ASME B16.1. Swing-check pin shall be AISI Type 304 or approved equal corrosion-resistant steel. Angle of closure shall be manufacturer's standard unless a specific angle is needed. Valves shall have bolted and gasketed covers.

f. Nonslam Check Valves (NSV)

1. Check valves at pump discharges in sizes 2 in. and larger shall be nonslam or silent-check type. Valve disc or plate shall close before line flow can reverse to eliminate slam and water-hammer due to check-valve closure.

2. Valve shall be rated for 200 psi maximum nonshock pressure at 151°F in sizes to 12 in. Valves shall be fitted with flanges conforming to ASME B16.1. Valve body may be cast iron conforming to ASTM A278M, Class 40 or equivalent strength ductile iron. Disks shall be corrosion-resistant steel. Pins, springs, and miscellaneous trim shall be manufacturer's standard corrosion-resistant steel. Disk and shaft seals shall be Buna-N elastomer tetrafluoroethyle-ne.

2.4 PUMPS

a. The contractor shall provide to the government the following information on all pumps supplied under the contract:

- -- Number of pump stages
- -- Number of pump vanes per stage
- -- Number of gear teeth for each pump gear
- -- Type of impeller or gear(s)
- -- Rotating speed
- -- Number of volutes
- -- Number of diffuser vanes

b. General Pump Requirements - This specification includes design, construction, installation, and performance features of centrifugal pumps. Pumps shall conform to HI-01, ISO 5199 and ISO 2858 standards for centrifugal pumps, and to requirements specified herein. Pumps shall conform to performance criteria as shown on the drawings and or the equipment schedule.

c. Pump Balancing - Pump impeller assemblies shall be statically and dynamically balanced to ISO 1940/1-1986 G2.5. Correction planes needed for additional weight mass for balancing shall be determined by using a calibrated and certified balancing machine capable of identifying the magnitude and angular position of any unbalance of the impeller.

d. Pump Bearings and Lubrication

1. Bearings shall be heavy-duty ball or roller type and shall have an L-10 rated life of not less than 20,000 hours in accordance with

AFBMA 9 or AFBMA 11.

2. Bearings for hot-water service shall be oil-flood lubricated. Oils sumps shall be fitted with 4 ounces constant lever sight oilers and positive means of sump drainage and condensate detection. Provisions shall include FM-approved brass cocks connected to lowest part of bearing sump.

3. Sampling Points - The contractor shall install sampling points and lines in accordance with Method No. 1 published in ISO 4021:1992 titled Hydraulic Fluid Power - Particulate Particle Contamination Analysis - extraction of fluid samples from lines of an operating system, as follows: For Reservoirs and Non-Pressurized Systems - A 1/8" stainless steel line and ball valve is placed in the side of the oil sump or tank. The line shall be located as close to the midpoint of the structure as feasible. In addition, the sample line shall extend internally to and as close to the center of the tank as possible.

e. Pump Protection - Before any pump is operated, sumps and piping systems shall cleaned and flushed to remove all particles larger than 0.04 inches or larger than one-half of the smallest pump axial or radial clearance, whichever is smaller. Permanent and temporary pipeline strainers shall be in place and shall be cleaned frequently to prevent cavitation. Temporary strainers shall not be removed until after system acceptance, unless otherwise approved.

f. Pump Alignment - Before attempting alignment, the contractor shall demonstrate that the load does not have any load/force imposed by the piping system. Minimum alignment values (below) are for pump and driver at normal running temperatures. Value must be compensated for thermal growth. Limited movement of the pump and driver (commonly known as bolt-bound) must be corrected to ensure alignment capabilities. Hold down bolts shall not be undercut in order to perform adjustments.

1. Shims shall be commercially die-cut, without seams or folds and be made of corrosion resistant stainless steel. No more than three shims shall be used at any single point.

2. Units with drive motors over 15 hp shall have alignment jack bolts installed.

TABLE 1. Coupled Shaft Alignment Tolerance Values

Soft Foot:

Motor Speed (RPM)	Maximum movement
All	<0.0508 mm at each foot

For short couplings:

Motor Speed (RPM)	Parallel Offset	Angularity (in./10 in.)
<1000	0.005 in.	0.015 in.
1200	0.004 in.	0.010 in.
1800	0.003 in.	0.005 inc.
3600	0.002 in.	0.003 in.

7200	0.010 in.	0.002 in.

g. Vibration Analyzer

1. The contractor shall use an FFT analyzer to measure vibration levels. It shall have the following characteristics: dynamic range greater than 72db; a minimum of 400 line resolution; a frequency response range of 5Hz-10KHz (300 - 600000 cpm); the capacity to perform ensemble averaging; the capability to use Hanning window; auto-ranging frequency amplitude; a minimum amplitude accuracy over the selected frequency range of + or - 20% or = or - 1.5dB.

2. An accelerometer , either stud-mounted or mounted using a rare earth, low mass magnet and sound disk (or finished surface) shall be used with the FFT analyzer to collect data. The mass of the accelerometer and its mounting shall have minimal influence on the frequency response of the system over the selected measurement range.

h. Vibration Data - Vibration data shall be collected in the axial, vertical, and horizontal direction for each pump bearing.

TABLE ## MAXIMUM ALLOWABLE VIBRATION LEVELS FOR POSITIVE DISPLACEMENT AND CENTRIFUGAL PUMPS

LINE-AMPLITUDE BAND LIMITS

BAND	FREQUENCY RANGE (CPM)	VELOCITY (INCH/SEC - PEAK)
1	0.3 x RPM 0.8 x RPM	0.04
2	0.8 x RPM 1.2 x RPM	0.075
3	1.2 x RPM 3.5 x RPM	0.04
4	3.5 x RPM 120,000 CPM	0.03

2.5 CENTRIFUGAL COMPRESSORS

a. The contract shall provide to the government the following information on all centrifugal compressors supplied under this contract.

-- Compressor Type
-- Number of compressor sections
-- Number of blades per section
-- Number of diffusers
-- Number of vanes per diffuser
-- Number of gear teeth on drive gear
-- Number of driven shafts
-- Number of gear teeth per driven shaft
-- Rotating speed of each rotor
-- Lubricating Oil Information, viscosity grade in ISO units,

AGMA or SAE classification and identification of all additives
-- Grease lubricant information, type of base stock, NLGI number, type and percent of thickener, dropping point, and base oil viscosity range in SUS

b. Products - Compressor shall conform to performance criteria as shown on the drawings and or the equipment schedule.

2.6 FANS

a. The contractor shall provide to the government the following information on all fans supplied under this contract:

-- Type of fan or blower
-- Number of rotating fan blades/vanes
-- Number of stationary fan blades/vanes
-- Rotating speed(s)

b. The contractor shall provide to the government the following additional information if the fans/air handlers are belt driven:

-- Number of belts
-- Belt lengths
-- Diameter of the drive sheave at the drive pitch line
-- Diameter of the driven sheave at the drive pitch line

c. For all fans supplied under the contract, the contractor shall ensure sufficient access to the fan is present to allow for cleaning and in-place balancing of the fan.

d. Fans shall be propeller type, of corrosion-resistant construction, and shall be statically and dynamically balanced to ISO 1940/1-1986, G2.5.

e. Fans shall conform to performance criteria as shown on the drawings and or the equipment schedule.

f. Vibration Data - Vibration data shall be collected in the axial, vertical, and horizontal direction for each motor bearing. Two narrowband spectra for each data collection point shall be obtained in the following manner: For all machines regardless of operating speed, a 5 to 500 Hz spectrum with a minimum of 400 lines of resolution shall be obtained. An additional spectrum of 5 to 2500 Hz or 5 to 5000 Hz shall be acquired for machines operating at or below 1800 RPM or greater than 1800 RPM, respectively.

g. Vibration shall conform to the following table:

TABLE # MAXIMUM ALLOWABLE VIBRATION LEVELS FOR FANS

BAND	FREQUENCY RANGE	VELOCITY LINE AMPLITUDE BAND LIMITS (INCH/SEC PEAK)	
1	0.3 x RPM min - 0.8 x RPM fan	0.04	DIRECT COUPLED
		0.075	BELT DRIVE
2	0.8 x RPM fan - 1.2 x RPM fan/motor	0.075	

3	1.2 x RPM fan/motor - 3.5 x RPM fan/motor	0.04
4	3.5 x RPM fan/motor - to Fmax = 60,000 CPM	0.03

		ACCELERATION BAND LIMITED OVERALL AMPLITUDE LIMITS (g's PEAK)
1	0.3 x RPM min - to Fmax = 120,000 CPM	0.5

RPM min = Lowest system speed (e.g. Belt speed if Belt Driven, Fan speed if direct drive coupled
RPM fan/motor = Fan or motor speed whichever is greater (IN/SEC)

2.7 MOTORS

a. The contractor shall provide to the government the following information on all electric motors rated over 7.5 hp and those specified to meet a special vibration class in accordance with NEMA MG-1.

   -- Motor type
   -- Bearing information
   -- Resistance
   -- Winding Inductance
   -- Cooling fan blades
   -- Number of rotors
   -- Number of rotor bars
   -- Number of stator slots
   -- SCR firing sequence

b. Factory Test - Electrical tests shall consist of winding resistance, insulation resistance, and high potential tests. Certified copies of Factory test results shall be submitted to the government for approval prior to shipment from factory. Previous test reports on identical motors are not acceptable for these tests.

c. Equipment

   1. Design, fabrication, testing and performance of motors shall be in accordance with NEMA MG 1 and ISO 1940/1.

   2. Motors shall conform to performance criteria as shown on the drawings and or the equipment schedule.

   3. Allowable balance limits shall be in accordance with ISO 1940/1.

   4. Motors shall have factory-sealed ball bearings with an L-10 rated life of not less than (80,000) hours in accordance with AFBMA 9 or AFBMA 11. Motors with weatherproof/waterproof enclosures shall have permanent accelerometers installed in the horizontal, vertical and axial directions. The enclosure shall have a penetration installed to enable the accelerometer cables to be routed to outside the enclosure. A data collection box shall be mounted to the outside of the motor enclosure in a location that is easily accessible. Data collection box shall be rated NEMA 4R

or NEMA 6X, non-metallic sealed NEMA Standard boxes.

d. Installation - Motors shall be bolt mounted. Motor feet shall be coplanar within 0.001 inch. Base mounting points shall be accessible and adjustable to enable machine alignment. Motors over (15) hp shall have alignment jack bolts installed to enable alignment.

e. Alignment - Before attempting alignment, the contractor shall demonstrate that the load does not have any load/force imposed by the piping system. Minimum alignment values (below) are for motor and load running at normal running temperatures. Value must be compensated for thermal growth. Limited movement of the motor or load (commonly known as bolt-bound) must be corrected to ensure alignment capabilities. Hold down bolts shall not be undercut in order to perform adjustments. Shims shall be commercially die-cut, without seams or folds and be made of corrosion resistant stainless steel. No more than three shims shall be used at any single point.

TABLE 1. Coupled Shaft Alignment Tolerance Values

Soft Foot:

Motor Speed (RPM)	Maximum movement
All	<0.0508 mm at each foot

For short couplings:

Motor Speed (RPM)	Parallel Offset	Angularity (in./10 in.)
<1000	0.005 in.	0.015 in.
1200	0.004 in.	0.010 in.
1800	0.003 in.	0.005 in.
3600	0.0.002 in.	0.003 in.
7200	0.0.10 in.	0.002 in.

f. Electrical Tests

1. Perform continuity tests on all phases.

2. Perform insulation resistance and polarization index test on each phase of motor. Insulation tests on 480-volt motors shall be conducted using a 1000-volt insulation test set. Insulation tests on motors rated less than 480-volts shall be conducted using 500-volt insulation test set.

3. Test data shall include the location and identification of motors and megohm reading versus time. Test data shall be recorded at 15, 30, 45 seconds and 1 minute increments thereafter up to 10 minutes. Megohm readings shall not be less than 25 megohms for each phase and each phase reading shall be within 10 percent of the other two.

4. Calculate the polarization index of each phase by dividing the 10 minute reading by the 1 minute reading. The polarization index shall be greater than 1.25. Any values lower shall be rejected and the motor returned to the factory.

g. Vibration Analyzer

1. The contractor shall use an FFT analyzer to measure vibration levels. It shall have the following characteristics: dynamic range greater than 72db; a minimum of 400 line resolution; a frequency response range of 5Hz-10KHz (300 - 600000 cpm); the capacity to perform ensemble averaging; the capability to use Hanning window; auto-ranging frequency amplitude; a minimum amplitude accuracy over the selected frequency range of + or - 20% or = or - 1.5dB.

2. An accelerometer , either stud-mounted or mounted using a rare earth, low mass magnet and sound disk (or finished surface) shall be used with the FFT analyzer to collect data. The mass of the accelerometer and its mounting shall have minimal influence on the frequency response of the system over the selected measurement range.

h. Vibration Data

1. Vibration data shall be collected in the axial, vertical, and horizontal direction for each motor bearing.

2. Two narrowband spectra for each data collection point shall be obtained in the following manner: For all machines regardless of operating speed, a 5 to 500 Hz spectrum with a minimum of 400 lines of resolution shall be obtained. An additional spectrum of 5 to 2500 Hz or 5 to 5000 Hz shall be acquired for machines operating at or below 1800 RPM or greater than 1800 RPM, respectively.

3. Vibration limits shall conform to the following:

TABLE 9.1A MAXIMUM ALLOWABLE VIBRATION LEVELS FOR ELECTRIC MOTORS
FRACTIONAL AND INTEGRAL HORSEPOWER AC/DC MOTORS

VELOCITY LINE-AMPLITUDE BAND LIMITS

BAND	FREQUENCY RANGE (CPM)	STANDARD (INCH/SEC - PEAK)
1	0.3 x RPM - 0.8 x RPM	0.04
2	0.8 x RPM - 1.2 x RPM	0.075
3	1.2 x RPM - 3.5 x RPM	0.04
4	3.5 x RPM - 8.5 x RPM	0.03
5	8.5 x RPM - 60,000 CPM	0.03
6	60,000 CPM - 120,000 CPM	0.03

i. Leveling of Equipment Upon Installation - The contractor shall level all installed rotating electrical and mechanical machinery. After installation, the equipment shall not exceed a maximum slope of the base and the frame of 0.001 inch per foot. The contractor shall report to the government the type and accuracy of the instrument used for measuring the level; e.g., a 12-inch machinist's level graduated to 0.0002 inch per foot.

2.8 MISCELLANEOUS MATERIALS

a. Bituminous Coating

1. Bituminous coating shall be a solvent cutback, heavybodied

material to produce not less than a 0.01 in. dry-film thickness in one coat, and shall be as recommended by the manufacturer to be compatible with factory-applied coating and rubber joints.

2. For previously coal-tar coated and uncoated ferrous surfaces underground, bituminous coating shall be solvent cutback coal-tar type conforming to MS MIL-C-18480.

b. Bolting - Flange and general purpose bolting shall be hex-head and shall conform to ASTM F568, Class 4.8 or above (bolts, for flanged joints in piping systems where one or both flanges are cast iron). Heavy hex-nuts shall conform to ASTM A563M. Square-head bolts and nuts are not acceptable. Threads shall be coarse-thread series.

c. Elastomer Calk - Polysulfide- or polyurethane-base elastomer calking material shall be two-component type conforming to ASTM C920.

d. Escutcheons

1. Escutcheons shall be manufactured from nonferrous metals and shall be chrome-plated except when AISI 300 series corrosion-resistant steel is provided. Metals and finish shall conform to ASME A112.19.2M.

2. Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing, and one-piece of split-pattern type elsewhere. Escutcheons shall have provisions consisting of setscrews for maintaining a fixed position against a surface.

e. Flashing

1. Sheet lead shall conform to ASTM B749, Grade B (intended for use in laboratories and shops in general application).

2. Sheet copper shall conform to ASTM B370 and shall be of not less than 1 lbs/ft2 mass.

f. Flange Gaskets - Compressed non-asbestos sheet conforming to ASTM F104, Type 7-P1161A, coated on both sides with graphite or similar lubricant, with nitrile composition, binder rated 750°F.

g. Grout - Shrink-resistant grout shall be premixed and packaged metallic-aggregate, mortar-grouting compound conforming to ASTM C404 and ASTM C476, with the following properties:

1. Tensile strength ASTM C190 1900 psi, minimum

2. Compressive strength ASTM C109 14,000 psi, minimum

3. Shrinkage, linear 0.3 percent, maximum

4. Water absorption ASTM C67 0.1 percent, maximum

5. Bond strength to steel in shear 1001, minimum

h. Pipe Thread Compounds - Tetrafluoroethylene tape 0.002 in. to 0.003 in. thick shall be used in potable and process water and in chemical systems for pipe sizes to and including 1 in. Tetrafluoroethylene

dispersions and other suitable compounds may be used for all other applications upon approval; however, no lead-containing compounds may be used in potable water systems.

2.9 SUPPORTING ELEMENTS

a. Necessary piping systems and equipment supporting elements shall be provided including, but not limited to, building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and spring-cushion, variable, or constant supports. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures and natural and other external forces normal to this facility without damage to supporting element system or to work being supported.

b. Supporting elements shall be UL listed and conform to ASME B31.3, FM P7825, FS FF-S-325, MSS SP-58, and MSS SP-69 except as noted.

c. Attachments welded to pipe shall be made of materials identical to that of pipe or materials accepted as permissible raw materials by referenced code or standard specification.

d. Supporting elements exposed to weather shall be hot-dip galvanized. Materials shall be of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process. Supporting elements in contact with copper tubing shall be electroplated with copper.

e. Type designations specified herein are based on MSS SP-58 and MSS SP-69. Masonry anchor group-, type-, and style-combination designations shall be in accordance with FS FF-S-325. Support elements, except for supplementary steel, shall be cataloged, load rated, commercially manufactured products.

f. Building Structure Attachments

1. Anchor Devices, Concrete and Masonry

a) (1) Group I - Shield, expansion (lead, bolt and stud anchors)
(2) Group II - Shield, expansion (bolt anchors)
Type 2 - Machine bolt expansion shield anchors
Class 2 - Open-end expansion shield anchors
Style 1 - Single-end expansion shield anchors
Style 2 - Double-end expansion shield anchors
(3) Group III - Shield, expansion (self-drilling tubular expansion shell bolt anchors)
(4) Group VIII - Anchors, expansion (nondrilling)

b) Cast-in, floor mounted, equipment anchor devices shall provide adjustable positions.

c) Masonry anchor devices shall be built-in.

d) Powder-actuated anchoring devices shall not be used to support any mechanical systems components.

2. Beam Clamps

a) Beam clamps shall be center-loading Type 21, 28, 29, 30, UL listed, cataloged and load-rated commercially manufactured product.

b) When it is not possible to use center-loading beam clamps, eccentric-loading beam clamps, Type 20 may be used for piping sizes DN50 and less. For pipe sizes over 2 in., provide two counterbalancing clamps per point of pipe support. Where more than one rod is used per point of pipe support, rod diameter shall be determined in accordance with referenced standards.

3. C-Clamps - C-clamps shall not be used.

g. Horizontal Pipe Attachments

1. Single Pipes

a) Piping in sizes to and including 2 in. shall be supported by Type 6 solid malleable iron pipe rings, except that split-band-type rings may be used in sizes up to DN25.

b) Piping in sizes above 2 in. through 8 in. inclusive shall be supported by Type 1 attachments.

c) Type 1 and Type 6 assemblies shall be used on vapor-sealed insulated piping, and shall have an inside diameter larger than pipe being supported to provide adequate clearance during pipe movement.

d) Use Type 12 devices with double-bolted angle-iron wall or fixture clips in pipe chases to support fixture supply piping.

e) Where thermal movement of a point in a piping system would cause a hanger rod to deflect more than 4 degrees from the vertical or where a horizontal point movement exceeds ½ in., pipe rolls as indicated in details shall be used.

f) Type 40 shields shall be used on insulated piping. Area of the supporting surface shall be such that compression deformation of insulated surfaces does not occur. Longitudinal and transverse shield edges shall be rolled away from the insulation.

g) Insulated piping without vapor barrier on roll supports shall be provided with Type 39a saddles for pipe sizes to 12 in. and Type 39b for pipe sizes 12 in. and larger.

h) Spring supports shall be as indicated.

2. Parallel Pipes - Trapeze hangers fabricated from approved structural steel shapes, with U-bolts, shall be used in congested areas and where multiple pipe runs occur. Structural steel shapes shall conform to supplementary steel requirements or be of commercially available, proprietary design, rolled steel.

h. Vertical Pipe Attachments

1. Vertical pipe attachments shall be Type 8.

2. Shop drawing data shall include complete fabrication and attachment details of any spring supports.

i. Hanger Rods and Fixtures

1. Only circular cross section rod hangers may be used to connect building structure attachments to pipe support devices. Pipe, straps, or bars of equivalent strength shall be used for hangers only where approved.

2. Turnbuckles, swing eyes, and clevises shall be provided as required by support system to accommodate temperature change, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

j. Supplementary Steel - Where it is necessary to frame structural members between existing members or where structural members are used instead of commercially rated supports, such supplementary steel shall be designed and fabricated in accordance with AISC S328.

k. Copper Tubing and Pipe Supports - Metal surfaces in contact with copper tubing or pipe shall be copper-plated or plastic-coated. Support surfaces shall have large contact areas to prevent point loading with consequent cutting.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

a. Piping systems shall be fabricated and installed in accordance with ASME B31.3, MSS SP-69, and AWS WHB-2.

b. Connections between steel piping and copper piping shall be electrically isolated from each other with dielectric unions or flanges with flange insulating kit rated for the service.

c. Final connections to equipment shall be made with unions for sizes up to 2 in. and flanges for sizes 2½ in. and above, provided every 98 ft of straight run. Unions shall be provided in the line downstream of screwed- and welded-end valves.

d. Pipe ends shall be reamed before joint connections are made.

e. Screwed joints shall be made up with tetrafluoroethylene joint compound or tape, and not more than three threads shall show after joint is made up.

f. Joint compounds shall be applied to the male thread only, and care shall be exercised to prevent compound from reaching the unthreaded interior of the pipe.

g. Screwed unions, welded unions, or bolted flanges shall be provided wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system for maintenance.

h. Piping systems shall be securely supported with due allowance for thrust forces, thermal expansion and contraction, and shall not be subjected to mechanical, chemical, vibrational or other damage as specified in ASME B31.3.

i. Field welded joints shall conform to AWS WHB-2, ASME B31.3, and ASME-17.

j. Piping systems butt weld joints shall be made without backing rings. Joint configuration shall conform to ASME B16.25.

k. Cutting of metallic piping shall be by wheel cutters or other machines designed specifically for that purpose. Electric-arc and oxyacetylene cutting is not permitted.

l. Precautions shall be taken during installation of flexible pipe and hose including flushing/purging with water, steam, and compressed air to preclude bellows failure due to pipe line debris lodged in bellows. Installation shall conform to manufacturer's instructions.

m. Assemble flanged joints with appropriate flanges, gaskets, and bolting. Make clearance between flange faces such that connections can be gasketed and bolted tightly without imposing undue strain on piping system. Make flange faces parallel and bores concentric; gasket centered on flange faces without projecting into bore. Lubricate bolting with oil and graphite before assembly to ensure uniform bolt stressing. Draw up flange bolts and tighten in staggered sequence so as to prevent unequal gasket compression and deformation of flanges. After piping system has been tested and is in service at its maximum temperature, retighten bolting to achieve minimum gasket seating stress recommended by gasket manufacturer. Use only ASME B31.3 studs with nuts. Disassemble flange joints that fail pressure tests, correct the problem, then reassemble with new gaskets, studs, and nuts.

n. Cut copper tubing or joints square and remove burrs with cutting and reaming tools. Clean inside surfaces of fittings and outside surfaces of tubes in joint area with steel wool before assembly of joint. Apply joint flux, solder, and heat source as recommended by manufacturer so as to provide proper capillary action to fill socket space and to achieve 100 percent shear-line strength. Valves in copper piping - screwed ends with end adapters to suit mechanical connections, unless solder jointing is specified or indicated for a given application. Remake copper joints that fail pressure tests with new materials, including pipe or tubing fittings and filler metal.

3.2 VALVES

a. Valves shall be provided in piping mains and all branches and at equipment where indicated and as specified.

b. Valves shall be provided to permit isolation of branch piping and each equipment item from the balance of the system.

c. Riser and downcomer drains above piping shutoff valves in piping 2½ in. and larger shall be provided. Shutoff valve body shall be tapped and fitted with a ½ in. plugged globe valve.

d. Valves unavoidably located in furred or other normally inaccessible places shall be provided with adequately sized access panels approved for the location.

3.3 SUPPORTING ELEMENTS INSTALLATION

a. Supporting elements shall be provided in accordance with the referenced codes and standards.

b. Piping shall be supported from building structure. No piping shall be supported from roof deck or from other equipment such as pipe, duct, or cable tray.

c. Anchorage of piping and equipment shall be in accordance with Section 15000, General Mechanical.

3.4 PENETRATIONS

a. Effective sound stopping and adequate operating clearance shall be provided to prevent structure contact where piping penetrates walls, floors, or ceilings into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces shall include space above ceilings where no special acoustic treatment of ceiling is provided. Penetrations shall be finished to be compatible with surface being penetrated. Seal exterior wall sleeves watertight, using mechanically expandable chloroprene inserts with mastic sealed metal components.

b. Sound stopping and vapor-barrier sealing of pipe shafts and large floor and wall openings shall be accomplished by packing to high density with properly supported fibrous-glass insulation or, where ambient or surface temperatures do not exceed 120°F, by foaming-in-place with self-extinguishing, 2 lbs/ft3 density polyurethane foam to a depth not less than 6 in. Foam shall be finished with a rasp. Vapor barrier shall be not less than 0.1 in. thick vinyl coating applied to visible and accessible surfaces. Where pipe passes through fire-rated partitions, use only UL rated assemblies for required fire rating.

3.5 SLEEVES

a. Sleeves shall be provided where piping passes through roofs, masonry, concrete walls and floors.

b. Sleeves passing through steel decks shall be continuously welded or brazed to the deck.

c. Sleeves that extend through floors, roofs, load bearing walls, and fire barriers shall be continuous and fabricated form Schedule 40 steel pipe, with welded anchor lugs. All other sleeves shall be formed by molded linear polyethylene liners or similar materials that are removable. Diameter of sleeves shall be sufficiently large to accommodate pipe, insulation, and jacketing without touching the sleeve, and shall provide a minimum 0.4 in. clearance. Sleeve size shall accommodate mechanical and thermal motion of pipe to preclude transmission of vibration to walls and the generation of noise.

d. Space between a pipe, bare or insulated, and the inside of a pipe sleeve or a construction surface penetration shall be packed solid with a mineral fiber conforming to FS HH-I-558, Form B, Type 1 (flexible blanket), Class 8, (451°F to 1000°F). This packing shall be provided wherever the piping passes through firewalls, equipment room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction surface penetrations occur between conditioned and unconditioned spaces, the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction surface penetration shall be filled with an elastomer calk

to a depth of ½ in. Surfaces to be calked shall be oil- and grease-free.

e. Exterior wall sleeves shall be calked watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed metal components.

3.6 ESCUTCHEONS

Escutcheons shall be provided at all penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, escutcheons shall be provided on both sides of the partition. Where suspended ceilings are installed, plates shall be provided at the underside only of such ceilings. For insulated pipes, the plates shall be sufficiently large to fit around the insulation. Escutcheons shall be chrome-plated in occupied spaces and of size sufficient to effectively conceal openings in building construction. Escutcheons shall be firmly attached with setscrews.

3.7 FLASHINGS

Flashings shall be provided at penetrations of building boundaries by mechanical systems and related work.

3.8 UNDERGROUND PIPING INSTALLATION

a. Before being lowered into a trench, piping shall be cleaned, visually inspected for apparent defects, and tapped with a hammer to audibly detect hidden defects.

b. Suspect cast-ferrous piping shall be further inspected by painting with kerosene on external surfaces to reveal cracks.

c. Defective materials found shall be distinctly marked using a road-traffic quality yellow paint; defective material shall be promptly removed from the site.

d. Where conduit passes through walls below grade and ground floor slab, pass conduit through pipe sleeves larger than conduit and make watertight with expansion plugs. Where pipe penetrates earth or concrete grade, ensure that 300 mm minimum of corrosion-protected pipe is exposed to view.

e. After conduit has been inspected, and not less than 48 hours before being lowered into a trench, external surfaces of cast ferrous conduit shall be coated with a compatible bituminous coating for protection against brackish ground water. Application shall be single coat, in accordance with the manufacturer's instructions, to result in a dry-film thickness of not less than 0.01 in.

f. Perform excavation and backfill operations as specified in Section 02200, Site Preparation and Earthwork. Excavations shall be dry and clear of extraneous materials when pipe is being laid.

g. Cutting of piping shall be by wheel cutters or other machines designed specifically for that purpose. Electric-arc and oxyacetylene cutting are not permitted.

h. Laying of pipe shall begin at the low point of a system. When in final

acceptance position, pipe shall be true to the grades and alignment indicated, with unbroken continuity of invert. Blocking and wedging are not permitted.

i. Bell or grooved ends of piping shall point upstream.

j. Changes in direction of drainage piping shall be made with long sweep fittings.

k. Necessary socket clamping, piers, bases, anchors, and thrust blocking shall be provided. Rods, clamps, and bolting shall be protected with a coating of bitumen.

l. Underground piping below supported or suspended slabs shall be supported from the slab with a minimum of two supports per length of pipe. Supports shall be protected with a coating of bitumen.

m. On excavations that occur near and below building footings, the backfilling material shall consist of 2176 psi cured compressive-strength concrete poured or pressure-grouted up to the level of the footing.

n. Vertical downspouts; soil, waste, and vent stacks; water risers; and similar work shall be properly supported on approved piers at the base and provided with approved structural supports attached to building construction.

o. Metallic piping laid underground - Wrap in polyethylene. After pressure testing and before backfilling, thoroughly clean joints and valves and wrap or cover with heat-shrink tubing. Then test coated and wrapped pipe and valves with an electric holiday detector operating at 10 kV to 15 kV. Repair defects by clipping back coatings to bare metal and recoating as specified for original work, to the satisfaction of the COR.

p. Non-metallic underground piping shall have a copper tracer wire attached to the pipe.

q. Valves - Install where indicated, set plumb, and centered on valves. Where feasible, locate valves outside traffic areas. Carefully tamp soil around each valve box to a distance of 4 ft on all sides of the box, or to undisturbed trench face if less than 4 ft. Protect valve boxes located in roads or sidewalks by a concrete slab as indicated.

3.9 DISINFECTION

Water piping, including valves, fittings, and other devices, shall be disinfected with a solution of chlorine and water. Solution shall contain not less than 50 parts per million (ppm) of available chlorine. Solution shall be held for not less than 8 hours, after which the solution shall contain not less than 10 ppm of available chlorine or the piping shall be redisinfected. After successful sterilization, the piping shall be thoroughly flushed before placing into service. Flushing shall be complete when the flush water contains less than 0.5 ppm of available chlorine. Water for disinfection will be furnished by the Government. Contractor shall be responsible for approved disposal of contaminated flush water.

-- End of Section --

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COMMON PIPING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for standard basic mechanical work.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	Steel Construction Manual

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	Specification for Filler Metals for Brazing and Braze Welding
AWS WHB-2.9	Welding Handbook; Volume 2, Welding Processes, Part 1

ASME INTERNATIONAL (ASME)

ASME A112.19.2	Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals
ASME B16.1	Gray Iron Threaded Fittings; Classes 25, 125 and 250
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.22	Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.25	Standard for Buttwelding Ends
ASME B16.26	Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	Malleable Iron Threaded Fittings, Classes 150 and 300

ASME B16.39	Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.3	Process Piping
ASME B36.10M	Standard for Welded and Seamless Wrought Steel Pipe
ASME B40.100	Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	BPVC Section IX-Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A105	Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A106/A106M	Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A126	Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A183	Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A197	Standard Specification for Cupola Malleable Iron
ASTM A216	Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A234	Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A278	Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 degrees F (350 degrees C)
ASTM A312	Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A480	Standard Specification for General

	Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A563M	Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A6	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A74	Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM B117	Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM B32	Standard Specification for Solder Metal
ASTM B370	Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B749	Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products
ASTM B88	Standard Specification for Seamless Copper Water Tube
ASTM C109/C109M	Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C404	Standard Specification for Aggregates for Masonry Grout
ASTM C476	Standard Specification for Grout for Masonry
ASTM C553	Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C564	Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C67	Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM D 2000	Standard Classification System for Rubber

	Products in Automotive Applications
ASTM E 1	Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM F 104	Standard Classification System for Nonmetallic Gasket Materials
ASTM F 568M	Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-125	Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves
MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-67	Butterfly Valves
MSS SP-69	Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)
MSS SP-70	Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-85	Gray Iron Globe & Angle Valves Flanged and Threaded Ends

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-C-18480	Coating Compound, Bituminous, Solvent, Coal-Tar Base

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1922	Shield, Expansion (Caulking Anchors, Single Lead)
CID A-A-1923	Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
CID A-A-1924	Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors
CID A-A-1925	Shield Expansion (Nail Anchors)
CID A-A-55614	Shield, Expansion (Non-Drilling Expansion

	Anchors)
CID A-A-55615	Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors

1.3 GENERAL REQUIREMENTS

Submit Material, Equipment, and Fixture Lists for pipes, valves and specialties including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information. Provide a complete list of construction equipment to be used.

Submit Coordination Drawings for pipes, valves and specialties showing coordination of work between different trades and with the structural and architectural elements of work. Detail all drawings sufficiently to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Indicate on drawings where conflicts or clearance problems exist between various trades.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixture Lists for construction equipment to be used.

SD-02 Shop Drawings

Submit the following for pipes, valves and specialties showing conformance with the referenced standards contained within this section.

Record Drawings
Connection Diagrams
Coordination Drawings
Fabrication Drawings

Submit Installation Drawings for pipes, valves and specialties in accordance with the paragraph entitled, "Pipe Installation," of this section.

SD-03 Product Data

Submit equipment and performance data for the following items consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

Submit Manufacturer's catalog data for the following items:

Pipe and Fittings
Piping Specialties
Valves
Miscellaneous Materials
Supporting Elements

1.5 QUALITY ASSURANCE

1.5.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.6 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 Type BCS, Black Carbon Steel

Pipe 1/8 through 10 inches shall be Schedule 40 seamless, conforming to ASTM A53, Type S (seamless) or ASTM A106, Grade B. Grade A should be used for permissible field bending, in both cases.

Pipe 12 through 24 inches shall be 0.375-inch wall seamless black carbon steel, conforming to ASTM A53, Type S (seamless) or ASTM A106, Grade B.

Fittings 2 inches and under shall be 150-pounds per square inch, working steam pressure (wsp) banded black malleable iron screwed, conforming to ASTM A197 and ASME B16.3.

Unions 2 inches and under shall be 250 pounds per square inch, wsp female, screwed, black malleable iron with brass-to-iron seat, and ground joint, conforming to ASME B16.39.

Fittings 2-1/2 inches and over shall be Steel butt weld, conforming to ASTM A234 and ASME B16.9 to match pipe wall thickness.

Flanges 2-1/2 inches and over shall be 150-pound forged-steel conforming to ASME B16.5, welding neck to match pipe wall thickness.

2.1.2 Type BCS-125, 125-psi Service

Pipe 1/8 through 1-1/2 inches shall be Schedule 40 steam, Schedule 80 condensate, furnace butt weld, black carbon steel, conforming to ASTM A53, Type F (furnace butt welded, continuous welded) or ASTM A106, Grade B and ASME B36.10M.

Pipe 2 through 10 inches shall be Schedule 40 steam, Schedule 80 condensate, seamless or electric-resistance welded black carbon steel, conforming to ASTM A53 Type S (seamless) or ASTM A106, Grade B and ASME B36.10M.

Pipe 12 through 24 inches shall be 0.375-inch wall, seamless welded black carbon steel, conforming to ASTM A53 Type S or ASTM A106, Grade B and ASME B36.10M.

Fittings 2 inches and under shall be 150-psig wsp banded black malleable iron screwed, conforming to ASTM A197 and ASME B16.3.

Fittings 2-1/2 inches and over shall be wall thickness to match pipe, long radius butt weld, black carbon steel, conforming to ASTM A234, Grade WPB and ASME B16.9.

Flanges 2-1/2 inches and over shall be 150-pound, forged carbon-steel welding neck, with raised face or flat face and concentric serrated finish, conforming to ASTM A105 and ASME B16.5.

2.1.3 Type GCS, Galvanized Carbon Steel

Pipe 1/2 through 10 inches, and where indicated shall be Schedule 40 seamless or electric-resistance welded galvanized steel conforming to ASTM A53, Type S or ASTM A106, Grade B.

Pipe 12 inches and over shall be 0.375-inch wall, seamless, galvanized steel, conforming to ASTM A53, Grade B or ASTM A106, Grade B.

Fittings 2 inches and under shall be 150-psigwsp banded galvanized malleable iron screwed, conforming to ASTM A197 and ASME B16.3.

Unions 2 inches and under shall be 150-psig wsp female, screwed, galvanized malleable iron with brass-to-iron seat and ground joint.

Fittings 2-1/2 inches and over shall be 125-psig wsp cast-iron flanges and flanged fittings, conforming to ASTM A126, Class A and ASME B16.1.

Conform grooved pipe couplings and fittings shall conform to paragraph entitled, "Grooved Pipe Couplings and Fittings."

Contractor has the option of using 150-psig wsp banded galvanized malleable iron screwed fittings, conforming to ASTM A197 and ASME B16.3.

2.1.4 Type GCS-DWV, Galvanized Steel Drain, Waste and Vent

Pipe (all sizes) shall be Schedule 40 seamless galvanized carbon steel, conforming to ASTM A53, Grade A or ASTM A106, Grade B.

Furnace butt weld pipe is acceptable for sizes less than 2 inches.

Risers 3 inches and larger shall be Type CISP-DWV.

Fittings shall be galvanized, screwed, cast iron, recessed pattern drainage fittings, conforming to ASTM A126.

Use long radius fittings wherever space permits. Short-turn tees, branches, and ells may be used for vent piping and connections of branch lines to battery fixtures, except wall-hung water closets.

2.1.5 Type CISP-DWV, Cast-Iron Drain, Waste and Vent

Provide soil pipe drain, waste, and vent bell-and-spigot type pipe cast iron, conforming to ASTM A74. Caulk and lead all joints in lines where

necessary to provide proper leaktight support and alignment; other-wise joints may be two-gasket system type chloroprene, conforming to ASTM C564. Pipe class shall be extra heavy (CISP-DWV-XH).

2.1.6 Type CPR, Copper

2.1.6.1 Type CPR-A, Copper Above Ground

Tubing 2 inches and under shall be seamless copper tubing, conforming to ASTM B88, Type L (hard-drawn for all horizontal and all exposed vertical lines, annealed for concealed vertical lines).

Fittings 2 inches and under shall be 150-psigwsp wrought-copper solder joint fittings conforming to ASME B16.22.

Unions 2 inches and under shall be 150-psig wsp wrought-copper solder joint, conforming to ASME B16.22.

Solder must be 60-40 tin-antimony, alloy Sb-5, conforming to ASTM B32.

2.1.6.2 Type CPR-U, Copper Under Ground

Provide Type K seamless copper tube piping, conforming to ASTM B88. Socket-joint fittings shall be wrought copper, conforming to ASME B16.22. Fittings for connection to corporation cocks shall be cast bronze, flared-type, conforming to ASME B16.26. Joints shall be brazed.

2.1.6.3 Type CPR-INS, Copper Under Ground Insulated

Provide insulated Type K seamless copper tube piping conforming to ASTM B88. Socket-joint fittings shall be wrought copper, conforming to ASME B16.22. Joints shall be brazed.

Provide insulation not less than 2 inches thick, suitable for continuous service temperatures of not less than 250 degrees F. Insulation shall be factory-molded, closed-cell polyurethane foam of not less than 2.5 pounds per cubic foot density. Insulation shall be waterproofed with an extruded rigid Type II virgin polyvinylchloride, with minimum wall thickness of 60 mils through 4 inches outside diameter, 85 mils through 6.625 inches and 110 mils through 12.750 inches. Provide fitting covers fabricated from the same materials and thickness as adjacent pipe covering according to the manufacturer's directions.

2.1.7 Grooved Pipe Couplings and Fittings

Provide housing for all couplings, fabricated in two or more parts, of black, ungalvanized malleable iron castings. Coupling gasket shall be molded synthetic rubber, conforming to ASTM D 2000. Coupling bolts shall be oval-neck, track-head type, with hexagonal heavy nuts conforming to ASTM A183.

Fabricate all pipe fittings used with couplings of black, ungalvanized malleable iron castings. Where a manufacturer's standard-size malleable iron fitting pattern is not available, approved fabricated fittings may be used.

Fabricate fittings from Schedule 40 or 0.75-inch wall ASTM A53, Grade B or ASTM A106, Grade B seamless steel pipe; long radius seamless welding fittings with wall thickness to match pipe, conforming to ASTM A234 and

ASME B16.9.

2.2 PIPING SPECIALTIES

2.2.1 Air Separator

Air separated from converter discharge water shall be ejected by a reduced-velocity device vented to the compression tank.

Air separator shall be carbon steel, designed, fabricated, tested, and stamped in conformance with ASME BPVC SEC VIII D1 for service pressures not less than 125 psi.

2.2.2 Air Vents

Manual air vents shall be 3/8-inch globe valves.

Automatic air vents on pumps, mains, and where indicated shall be of ball-float construction. Vent inlet shall be not less than 3/4-inch ips and the outlet not less than 1/4-inch ips. Orifice shall be 1/8 inch. Provide corrosion-resistant steel trim conforming to ASTM A480. Vent shall be fitted with try-cock. Vent shall discharge air at any pressure up to 150 psi. Outlet shall be copper tube routed.

2.2.3 Compression Tank

Provide compression tank designed, fabricated, tested, and stamped for a working pressure of not less than 200 psi in accordance with ASME BPVC SEC VIII D1. Tank shall be hot-dip galvanized after fabrication to produce not less than 1.5 ounces of zinc coating per square foot of single-side surface.

Tank accessories shall include red-lined gage-glass complete with glass protectors and shutoff valves, air charger and drainer, and manual vent.

2.2.4 Dielectric Connections

Dissimilar pipe metals shall be electrically insulated from each other by couplings, unions, or flanges commercially manufactured for that purpose and rated for the service pressure and temperature.

2.2.5 Flexible Pipe

Flexible pipe vibration and pipe noise eliminators shall be constructed of wire-reinforced chloroprene-impregnated cloth and cord materials and they shall be flanged. Provide all flanges backed with ferrous-metal backing rings. Nonmetallic exterior surfaces of the flexible pipe shall be coated with an acid- and oxidation-resistant chlorosulphinated polyethylene. Flexible pipe shall be rated for continuous duty at 130 psi and 250 degrees F.

Unit pipe lengths, face-to-face, shall be not less than the following:

INSIDE DIAMETER	UNIT PIPE LENGTH
To 2-1/2 inches, inclusive	12 inches
3 to 4 inches, inclusive	18 inches

INSIDE DIAMETER	UNIT PIPE LENGTH
5 to 12 inches, inclusive	24 inches

2.2.6 Flexible Metallic Pipe

Flexible pipe shall be the bellows-type with wire braid cover and designed, constructed, and rated in accordance with the applicable requirements of ASME B31.3.

Working pressure minimum rating shall be 100 psi at 300 degrees F.

Minimum burst pressure shall be four times working pressure at 300 degrees F. Bellows material shall be AISI Type 316L corrosion-resistant steel. Braid shall be AISI 300 series corrosion-resistant steel wire.

Threaded end connections shall be hex-collared Schedule 40, AISI Type 316L corrosion-resistant steel, conforming to ASTM A312.

Flanged end connection rating and materials shall conform to specifications for system primary-pressure rating.

2.2.7 Flexible Metal Steam Hose

Hose shall be bellows type with wire braid cover and designed, constructed, and rated in accordance with the applicable requirements of ASME B31.3.

Working steam pressure rating shall be 125 psi at 500 degrees F.

Minimum burst pressure shall be nine times working steam pressure at 300 degrees F.

Bellows material shall be AISI Type 316L corrosion-resistant steel. Braid shall be AISI Type 300-series corrosion-resistant steel wire.

Threaded end connections shall be hex-collared Schedule 40, AISI Type 316L corrosion-resistant steel, conforming to ASTM A312.

Flanged end connection rating and materials shall conform to specifications for system primary-pressure rating.

2.2.8 Pressure Gages

Pressure gages shall conform to ASME B40.100 and to requirements specified herein. Pressure-gage size shall be 3-1/2 inches nominal diameter. Case shall be corrosion-resistant steel, conforming to any of the AISI 300 series of ASTM A6, with an ASM No. 4 standard commercial polish or better. Equip gages with adjustable red marking pointer and damper-screw adjustment in inlet connection. Service-pressure reading shall be at midpoint of gage range. All gages shall be Grade B or better and be equipped with gage isolators.

Fit steam gages with black steel syphons and steam service pressure-rated gage cocks or valves.

2.2.9 Sight-Flow Indicators

Sight-flow indicators for pressure service on 3-inch ips and smaller shall be constructed of bronze with specially treated single- or double-glass

sight windows and have a bronze, nylon, or tetrafluoroethylene rotating flow indicator mounted on an AISI Type 304 corrosion-resistant steel shaft. Body may have screwed or flanged end. Assembly shall be pressure- and temperature-rated for the applied service. Flapper flow-type indicators are not acceptable.

2.2.10 Sleeve Couplings

Sleeve couplings for plain-end pipe shall consist of one steel middle ring, two steel followers, two chloroprene or Buna-N elastomer gaskets, and the necessary steel bolts and nuts.

2.2.11 Thermometers

Thermometers shall conform to ASTM E 1, except for being filled with a red organic liquid. Thermometers shall be an industrial pattern armored glass model, (well-threaded and seal-welded). Thermometers installed 6 feet or higher above the floor shall have an adjustable angle body. Scale shall be not less than 7 inches long. Case face shall be manufactured from manufacturer's standard polished aluminum or AISI 300 series polished corrosion-resistant steel. Thermometer range shall be -5° to 215°F. Provide thermometers with nonferrous separable wells. Provide lagging extension to accommodate insulation thickness.

2.2.12 Pump Suction Strainers

Strainer body shall be cast iron, rated for not less than 25 psig at 100 degrees F, with flanges conforming to ASME B16.1, Class 125. Strainer construction shall be such that there is a machined surface joint between body and basket that is normal to the centerline of the basket.

Minimum ratio of open area of each basket to pipe area shall be 3 to 1. Basket shall be AISI 300 series corrosion-resistant steel wire mesh with perforated backing.

Mesh shall be capable of retaining all particles larger than .04 inch, with a pressure drop across the strainer body of not more than 0.5 psi when the basket is two-thirds dirty at maximum system flow rate. Reducing fittings from strainer-flange size to pipe size shall be provided.

A differential-pressure gage fitted with a two-way brass cock shall be provided across the strainer.

Provide manual air vent cocks in cap of each strainer.

2.2.13 Line Strainers, Water Service

Strainers shall be Y-type with removable basket. Strainers in sizes 2-inch ips and smaller shall have screwed ends. In sizes 2-1/2-inch ips and larger, strainers shall have flanged ends. Body working-pressure rating shall exceed maximum service pressure of system in which installed by at least 50 percent. Body shall have cast-in arrows to indicate direction of flow. All strainer bodies fitted with screwed screen retainers shall have straight threads and gasketed with nonferrous metal. Strainer bodies 2-1/2-inches and larger, fitted with bolted-on screen retainers, shall have offset blowdown holes. All strainers larger than2-1/2-inches shall be fitted with manufacturer's standard ball-type blowdown valve. Body material shall be cast bronze conforming to ASTM B62. Where system material is nonferrous, metal strainer body material shall be nonferrous

metal.

Minimum free-hole area of strainer element shall be equal to not less than 3.4 times the internal area of connecting piping. Strainer screens shall have perforations not to exceed 0.045-inch. Strainer screens shall have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material shall be AISI Type 304 corrosion-resistant steel.

2.3 VALVES

2.3.1 Ball and Butterfly Valves

Ball valves shall conform to MSS SP-72 shall be rated for service at not less than 175 psig at 200 degrees F. Valve bodies in sizes 2 inches and smaller shall be screwed-end connection-type constructed of Class A copper alloy. Valve bodies in sizes 2-1/2 inches and larger shall be flanged-end connection type, constructed of Class D, E, or F material. Balls and stems of valves 2 inches and smaller shall be manufacturer's standard with hard chrome plating finish. Balls and stems of valves 2-1/2 inches and larger shall be manufacturer's standard Class C corrosion-resistant steel alloy with hard chrome plating. Balls of valves 6 inches and larger may be Class D with 900 Brinell hard chrome plating. Valves shall be suitable for flow from either direction and shall seal equally tight in either direction. Valves with ball seals held in place by spring washers are not acceptable. All valves shall have adjustable packing glands. Seats and seals shall be tetrafluoroethylene.

Butterfly valves shall conform to MSS SP-67. Valves shall be wafer type for mounting between specified flanges and shall be rated for 150-psig shutoff and nonshock working pressure. Bodies shall be cast ferrous metal conforming to ASTM A126, Class B, and to ASME B16.1 for body wall thickness. Seats and seals shall be of the resilient elastomer type designed for field removal and replacement.

2.3.2 Drain, Vent, and Gage Cocks

Drain, vent, and gage cocks shall be lever handle, ground key type, with washer and screw, constructed of polished ASTM B62 bronze, and rated 125-psi wsp. End connections shall be rated for specified service pressure.

Pump vent cocks, and where spray control is required, shall be UL umbrella-hood type, constructed of manufacturer's standard polished brass. Cocks shall be 1/2-inch ips male, end threaded, and rated at not less than 125 psi at 225 degrees F.

2.3.3 Gate Valves (GAV)

Gate valves 2 inches and smaller shall conform to MSS SP-72. Valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated shall be union-ring bonnet, screwed-end type. Make packing of non-asbestos type materials. Valves shall be rising stem type.

Gate valves 2-1/2 inches and larger, shall be Type I, (solid wedge disc, tapered seats, steam rated); Class 125 125-psig steam-working pressure at 353 degrees F saturation; and 200-psig, wog (nonshock), conforming to MSS SP-70 and to requirements specified herein. Valves shall be flanged, with bronze trim and outside screw and yoke (OS&Y) construction. Make packing of non-asbestos type materials.

2.3.4 Globe and Angle Valves (GLV-ANV)

Globe and angle valves 2 inches and smaller, shall be 125-pound, 125-psi conforming to MSS SP-85 and to requirements specified herein. Valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated shall be union-ring bonnet, screwed-end type. Disc shall be free to swivel on the stem in all valve sizes. Composition seating-surface disc construction may be substituted for all metal-disc construction. Make packing of non-asbestos type materials. Disk and packing shall be suitable for pipe service installed.

Globe and angle valves 2-1/2 inches and larger, shall be cast iron with bronze trim. Valve bodies shall be cast iron conforming to ASTM A126, Class A, as specified for Class 1 valves under MSS SP-70. Valve ends shall be flanged in conformance with ASME B16.1. Valve construction shall be outside screw and yoke (OS&Y) type. Make packing of non-asbestos type materials.

2.3.5 Standard Check Valves (SCV)

Standard check valves in sizes 2 inches and smaller shall be 125-psi swing check conforming to MSS SP-71, except as otherwise specified. Provide lift checks where indicated. Swing-check pins shall be nonferrous and suitably hard for the service. Discs shall be composition type. Swing-check angle of closure shall be manufacturer's standard unless a specific angle is needed.

Check valves in sizes 2-1/2 inches and larger shall be cast iron, bronze trim, swing type. Valve bodies shall be cast iron, conforming to ASTM A126, Class A. Valve ends shall be flanged in conformance with ASME B16.1. Swing-check pin shall be AISI Type or approved equal corrosion-resistant steel. Angle of closure shall be manufacturer's standard unless a specific angle is needed. Valves shall have bolted and gasketed covers.

2.3.6 Nonslam Check Valves (NSV)

Check valves at pump discharges in sizes 2 inches and larger shall be nonslam or silent-check type conforming to MSS SP-125. Valve disc or plate shall close before line flow can reverse to eliminate slam and water-hammer due to check-valve closure. Valve shall be Class 125 rated for 200-psi maximum, nonshock pressure at 150 degrees F in sizes to 12 inches. Valve body may be cast iron, conforming to ASTM A278, Class 40 or equivalent strength ductile iron. Disks shall be manufacturer's standard corrosion-resistant steel. Pins, springs, and miscellaneous trim shall be manufacturer's standard corrosion-resistant steel. Disk and shaft seals shall be Buna-N elastomer tetrafluoroethylene.

2.4 MISCELLANEOUS MATERIALS

2.4.1 Bituminous Coating

Bituminous coating shall be a solvent cutback, heavy-bodied material to produce not less than a 12-mil dry-film thickness in one coat, and shall be as recommended by the manufacturer to be compatible with factory-applied coating and rubber joints.

For previously coal-tar coated and uncoated ferrous surfaces underground, bituminous coating shall be solvent cutback coal-tar type, conforming to

MIL-C-18480.

2.4.2 Bolting

Flange and general purpose bolting shall be hex-head and must conform to ASTM F 568M, Class 4.8 or above (bolts, for flanged joints in piping systems where one or both flanges are cast iron). Heavy hex-nuts shall conform to ASTM A563. Square-head bolts and nuts are not acceptable. Threads shall be coarse-thread series.

2.4.3 Elastomer Caulk

Polysulfide- or polyurethane-base elastomer caulking material shall be two-component type, conforming to ASTM C920.

2.4.4 Escutcheons

Escutcheons shall be manufactured from nonferrous metals and chrome-plated except when AISI 300 series corrosion-resistant steel is provided. Metals and finish shall conform to ASME A112.19.2.

Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing, and one-piece of split-pattern type elsewhere. All escutcheons shall have provisions consisting of setscrews for maintaining a fixed position against a surface.

2.4.5 Flashing

Sheet lead shall conform to ASTM B749, (intended for use in laboratories and shops in general application).

Sheet copper shall conform to ASTM B370 and be of not less than 16 ounces per square foot weight.

2.4.6 Flange Gaskets

Compressed non-asbestos sheet, conforming to ASTM F 104, coated on both sides with graphite or similar lubricant, with nitrile composition, binder rated to 750 degrees F.

2.4.7 Grout

Shrink-resistant grout shall be a premixed and packaged metallic-aggregate, mortar-grouting compound conforming to ASTM C404 and ASTM C476.

Tensile strength		1,900 psi, minimum
Compressive strength	ASTM C109/C109M	14,000 psi, minimum
Shrinkage, linear		0.00012 inch per inch, maximum
Water absorption	ASTM C67	0.1 percent, maximum
Bond strength to		1,000 psi, minimum steel in shear minimum

2.4.8 Pipe Thread Compounds

Use tetrafluoroethylene tape not less than 2 to 3 mils thick in potable and

process water and in chemical systems for pipe sizes to and including 1-inch ips. Tetrafluoroethylene dispersions and other suitable compounds shall be used for all other applications upon approval by the COR; however, no lead-containing compounds shall be used in potable water systems.

2.5 SUPPORTING ELEMENTS

Provide all necessary piping systems and equipment supporting elements, including but not limited to: building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and spring-cushion, variable, or constant supports. All supporting elements shall be suitable for stresses imposed by systems pressures and temperatures and natural and other external forces normal to this facility without damage to supporting element system or to work being supported.

Supporting elements shall conform to requirements of ASME B31.3, MSS SP-58, and MSS SP-69 except as noted.

Attachments welded to pipe shall be made of materials identical to that of pipe or materials accepted as permissible raw materials by referenced code or standard specification.

Supporting elements exposed to weather shall be hot-dip galvanized or stainless steel. Materials shall be of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process. Supporting elements in contact with copper tubing shall be electroplated with copper.

Type designations specified herein are based on MSS SP-58 and MSS SP-69. Masonry anchor group-, type-, and style-combination designations shall be in accordance with CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925 , CID A-A-55614, and CID A-A-55615. Support elements, except for supplementary steel, shall be cataloged, load rated, commercially manufactured products.

2.5.1 Building Structure Attachments

2.5.1.1 Anchor Devices and Concrete

Anchor devices shall conform to CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925 , CID A-A-55614, and CID A-A-55615

Cast-in, floor mounted, equipment anchor devices shall provide adjustable positions.

Powder-actuated anchoring devices shall not be used to support any mechanical systems components.

2.5.1.2 Beam Clamps

Beam clamps shall be center-loading MSS SP-58 Type 21, 28, 29, 30.

When it is not possible to use center-loading beam clamps, eccentric-loading beam clamps, MSS SP-58 Type 20 may be used for piping sizes 2 inches and less and for piping sizes 2 through 10 inches provided two counterbalancing clamps are used per point of pipe support. Where more than one rod is used per point of pipe support, rod diameter shall be

determined in accordance with referenced standards.

2.5.1.3 C-Clamps

Do not use C-clamps.

2.5.2 Horizontal Pipe Attachments

2.5.2.1 Single Pipes

Support piping in sizes to and including 2-inch ips by MSS SP-58 Type 6 solid malleable iron pipe rings, except that split-band-type rings shall be used in sizes up to 1-inch ips.

Support piping in sizes through 8-inch ips inclusive by MSS SP-58 Type 1 attachments.

MSS SP-58 Type 1 and Type 6 assemblies shall be used on vapor-sealed insulated piping and shall have an inside diameter larger than pipe being supported to provide adequate clearance during pipe movement.

Where thermal movement of a point in a piping system 4 inches and larger would cause a hanger rod to deflect more than 4 degrees from the vertical or where a horizontal point movement exceeds 1/2 inch, MSS SP-58 type pipe rolls shall be used.

Support piping in sizes larger than 8-inch ips with MSS SP-58 type pipe rolls.

MSS SP-58 Type 40 shields shall be used on all insulated piping. Area of the supporting surface shall be such that compression deformation of insulated surfaces does not occur. Longitudinal and transverse shield edges shall be rolled away from the insulation.

Provide insulated piping without vapor barrier on roll supports with MSS SP-58 Type 39 saddles.

Spring supports shall be as indicated.

2.5.3 Vertical Pipe Attachments

Vertical pipe attachments shall be MSS SP-58 Type 8.

Shop drawing data shall include complete fabrication and attachment details of any spring supports.

2.5.4 Hanger Rods and Fixtures

Only circular cross section rod hangers shall be used to connect building structure attachments to pipe support devices. Pipe, straps, or bars of equivalent strength shall be used for hangers only where approved by the COR.

Turnbuckles, swing eyes, and clevises shall be provided as required by support system to accommodate temperature change, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

2.5.5 Supplementary Steel

Where it is necessary to frame structural members between existing members

or where structural members are used in lieu of commercially rated supports, design and fabricate such supplementary steel in accordance with AISC 325.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

Fabricate and install piping systems in accordance with ASME B31.3, MSS SP-69, and AWS WHB-2.9.

Connections between steel piping and copper piping shall be electrically isolated from each other with dielectric or unions rated for the service.

Make final connections to equipment with unions provided every 100 feet of straight run. Provide unions in the line downstream of screwed- and welded-end valves.

Ream all pipe ends before joint connections are made.

Screwed joints shall be made up with specified joint compound and not more than three threads shall show after joint is made up.

Apply joint compounds to the male thread only and exercise care to prevent compound from reaching the unthreaded interior of the pipe.

Provide screwed unions, welded unions, or bolted flanges wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system for maintenance.

Securely support piping systems with due allowance for thrust forces, thermal expansion and contraction, and shall not be subjected to mechanical, chemical, vibrational or other damage as specified in ASME B31.3.

Field welded joints shall conform to the requirements of the AWS WHB-2.9, ASME B31.3, and ASME BPVC SEC IX.

Make piping systems butt weld joints with backing rings. Backing ring materials shall be compatible with materials being joined. Joint configuration shall conform to ASME B16.25.

Take all necessary precautions during installation of flexible pipe and hose including flushing and purging with water, steam, and compressed air to preclude bellows failure due to pipe line debris lodged in bellows. Installation shall conform to manufacturer's instructions.

3.2 VALVES

Provide valves in piping mains and all branches and at equipment where indicated and as specified.

Provide valves to permit isolation of branch piping and each equipment item from the balance of the system.

Riser and downcomer drains above piping shutoff valves in piping 2-1/2 inches and larger shall be provided. Tap and fit shutoff valve body with a 1/2-inch plugged globe valve.

Valves unavoidably located in furred or other normally inaccessible places

shall be provided with access panels adequately sized for the location and located so that concealed items may be serviced, maintained, or replaced.

3.3 SUPPORTING ELEMENTS INSTALLATION

Provide supporting elements in accordance with the referenced codes and standards.

Support piping from building structure. No piping shall be supported from roof deck or from other pipe.

Piping shall run parallel with the lines of the building. Space and install piping and components so that a threaded pipe fitting may be removed between adjacent pipes and so that there shall be no less than 1/2 inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Hangers on different adjacent service lines running parallel with each other shall be arranged to be in line with each other and parallel to the lines of the building.

3.4 PENETRATIONS

Effective sound stopping and adequate operating clearance shall be provided to prevent structure contact where piping penetrates walls, floors, or ceilings into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces shall include space above ceilings where no special acoustic treatment of ceiling is provided. Penetrations shall be finished to be compatible with surface being penetrated.

Sound stopping and vapor-barrier sealing of pipe shafts and large floor and wall openings shall be accomplished by packing to high density with properly supported fibrous-glass insulation or, where ambient or surface temperatures do not exceed 120 degrees F, by foaming-in-place with self-extinguishing, 2-pound density polyurethane foam to a depth not less than 6 inches. Foam shall be finished with a rasp. Vapor barrier shall be not less than 1/8-inch thick vinyl coating applied to visible and accessible surfaces.

3.5 SLEEVES

Provide sleeves where piping passes through roofs, masonry, concrete walls and floors.

Sleeves passing through steel decks shall be continuously weldedor brazed to the deck.

Sleeves that extend through floors, roofs, load bearing walls, and fire barriers shall be continuous and fabricated from Schedule 40 steel pipe, with welded anchor lugs. All other sleeves shall be formed by molded linear polyethylene liners or similar materials that are removable. Diameter of sleeves shall be large enough to accommodate pipe, insulation, and jacketing without touching the sleeve and shall provide a minimum 3/8-inch clearance. Sleeve size must accommodate mechanical and thermal motion of pipe to preclude transmission of vibration to walls and the generation of noise.

Space between a pipe, bare or insulated, and the inside of a pipe sleeve or a construction surface penetration shall be packed solid with a mineral

fiber conforming to ASTM C553 Type V (flexible blanket), (to 1,000 degrees F). Provide this packing wherever the piping passes through firewalls, equipment room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction surface penetrations occur between conditioned and unconditioned spaces, the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction surface penetration shall be filled with an elastomer caulk to a depth of 1/2 inch. All surfaces to be calked shall be oil- and grease-free.

Exterior wall sleeves shall be calked watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed metal components.

3.6 ESCUTCHEONS

Provide escutcheons at all penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, provide escutcheons on both sides of the partition. Where suspended ceilings are installed, provide plates at the underside only of such ceilings. For insulated pipes, the plates shall be large enough to fit around the insulation. Escutcheons shall be chrome-plated in all occupied spaces and of size sufficient to effectively conceal openings in building construction. Firmly attach escutcheons with setscrews.

3.7 FLASHINGS

Provide flashings at penetrations of building boundaries by mechanical systems and related work.

3.8 UNDERGROUND PIPING INSTALLATION

Prior to being lowered into a trench, all piping shall be cleaned, visually inspected for apparent defects, and tapped with a hammer to audibly detect hidden defects.

Suspect cast-ferrous piping shall be further inspected by painting with kerosene on external surfaces to reveal cracks.

Distinctly mark defective materials found using a road-traffic quality yellow paint; promptly remove defective material from the site.

After conduit has been inspected, and not less than 48 hours prior to being lowered into a trench, all external surfaces of cast ferrous conduit shall be coated with a compatible bituminous coating for protection against brackish ground water. Application shall be single coat, in accordance with the manufacturer's instructions, to result in a dry-film thickness of not less than 12 mils.

Excavations shall be dry and clear of extraneous materials when pipe is being laid.

Cutting of piping shall be by wheel cutters or other machines designed specifically for that purpose. Electric-arc and oxyacetylene cutting will not be permitted.

Laying of pipe shall begin at the low point of a system. When in final acceptance position, it shall be true to the grades and alignment

indicated, with unbroken continuity of invert. Blocking and wedging will not be permitted.

Bell or grooved ends of piping shall point upstream.

Make changes in direction with long sweep fittings.

Necessary socket clamping, piers, bases, anchors, and thrust blocking shall be provided. Protect rods, clamps, and bolting with a coating of bitumen.

Underground piping below supported or suspended slabs shall be supported from the slab with a minimum of two supports per length of pipe. Protect supports with a coating of bitumen.

On excavations that occur near and below building footings, the backfilling material shall consist of 2,000-psi cured compressive-strength concrete poured or pressure-grouted up to the level of the footing.

Vertical downspouts; soil, waste, and vent stacks; water risers; and similar work shall be properly supported on approved piers at the base and provided with approved structural supports attached to building construction.

3.9 DISINFECTION

Water piping, including all valves, fittings, and other devices, shall be disinfected with a solution of chlorine and water. Solution shall contain not less than 50 parts per million (ppm) of available chlorine. Hold solution for a period of not less than 8 hours, after which the solution must contain not less than 10 ppm of available chlorine or the piping shall be redisinfected. After successful sterilization, thoroughly flush the piping before placing into service. Flushing shall be complete when the flush water contains less than 0.5 ppm of available chlorine. Water for disinfected will be furnished by the Government. Contractor shall be responsible for approved disposal of contaminated flush water in accordance with written instructions received from the Environmental authority having jurisdiction through the COR and all Local, State and Federal Regulations.

-- End of Section --

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SECTION 23 05 48.00 40

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for vibration-isolation systems for air-conditioning equipment.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S2.71	Guide to the Evaluation of Human Exposure to Vibration in Buildings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE HVAC APP IP HDBK	HVAC Applications Handbook, I-P Edition

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB PROCEDURAL STANDARDS	Procedural Standards for TAB (Testing, Adjusting and Balancing) Environmental Systems

1.3 GENERAL REQUIREMENTS

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section to the extent applicable.

Section 23 05 15 COMMON PIPING FOR HVAC applies to work specified in this section to the extent applicable.

All vibration-control apparatus must be the product of a single manufacturing source, where possible. Human exposure levels should be considered using ASA S2.71 and NEBB PROCEDURAL STANDARDS.

Scheduled isolation mounting is in inches and is a minimum static deflection.

Spans referred to mean longest bay dimension.

Determine exact mounting sizes and number of isolators by the isolator manufacturer based on equipment that will be installed. Check equipment revolutions per minute (rpm) and spring deflections to verify that resonance cannot occur.

Five working days prior to commencement of installation, submit installation drawings for vibration isolator systems including equipment and performance requirements.

Indicate for vibration isolator systems, overall physical features, dimensions, ratings, service requirements, and weights of equipment.

Within ten working days of Contract Award, submit equipment and performance data for vibration isolator systems including equipment base design; inertia-block mass relative to support equipment weight; spring loads and free, operating, and solid heights of spring; spring diameters; nonmetallic isolator loading and deflection; disturbing frequency; natural frequency of mounts; deflection of working member; and anticipated amount of physical movement at the reference points.

Ensure data includes the following:

a. Mountings

b. Bases

c. Isolators

d. Floor-Mounted Piping

e. Vertical Piping

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation Drawings

SD-03 Product Data

Equipment and Performance Data

Isolators

SD-06 Test Reports

Type of Isolator

Type of Base

Allowable Deflection

Measured Deflection

PART 2 PRODUCTS

2.1 TYPE OF VIBRATION-ISOLATION PROVISIONS

Design for vibration isolation using ASHRAE HVAC APP IP HDBK, Chapter 37, as applicable to the following sections.

Submit test reports for testing vibration isolation for each type of isolator and each type of base, and meet referenced standards contained within this section. Include in test reports allowable deflection and measured deflection also meeting referenced standards within this section.

2.1.1 Materials

Rubber must be natural rubber. Elastomer must be chloroprene. Shore A durometer measurement of both materials and range between 40 and 60.

Ensure weather-exposed metal vibration-isolator parts are corrosion protected. Chloroprene coat springs.

2.1.2 Mountings

Provide the following mountings:

Type A: Composite pad, with 0.25-inch thick elastomer top and bottom layers, molded to contain a pattern with nonslip characteristics in all horizontal directions. Elastomer loading must not exceed 40 pounds per square inch (psi). Minimum overall thickness must be 1 inch. Maximum deflections up to 0.25-inch are allowed.

Type B: Double rubber-in-shear or elastomer-in-shear with molded-in steel reinforcement in top and bottom. Maximum deflections up to 0.50 inch are allowed.

Type C: Free-standing laterally stable open-spring type for deflections over 0.50 inch, with built-in bearing and leveling provisions, 0.25-inch thick Type A base elastomer pads, and accessories. Outside diameter of each spring must be equal to or greater than 0.9 times the operating height of the spring under rated load.

Type D: Partially housed type, containing one or more vertically restrained springs with at least 0.50 inch clearance maintained around springs, with adjustable limit stops, 0.25-inch thick Type A base elastomer pads, and accessories.

Type F: Combination spring and rubber-in-shear or elastomer-in-shear steel framed for hanger-rod mounting. Minimum total static deflection must be 1 inch.

2.1.3 Bases

Provide the following bases:

Type U: Unit isolators without rails, structural-steel bases, or inertia blocks.

Type S: Structural-steel bases common to a supported assembly, made from welded-joint mill-rolled structural steel with closed-perimeter

configuration, isolators attached to outrigger supports.

Height of steel members must be sufficient to provide stiffness required to maintain equipment manufacturer's recommended alignment and duty efficiency of power-transmission components. Height of steel member must not result in member deflection at midpoint of unsupported span of more than 1/1,440th of the span between isolators. Minimum height must be 5 inches.

Type CIB: Concrete inertia blocks must be common to the entire assembly, and have welded-joint construction, mill-rolled structural-steel perimeters, welded-in No. 4 reinforcing bars 8 inches on center each way near the bottom of the block, outrigger-isolator mounting provisions, anchor bolts, and be filled with 3,000 psi cured-strength concrete.

Configuration of inertia bases must be rectangular to accommodate equipment supported.

Minimum thickness of inertia base, in addition to providing suitable mass, must be sufficient to provide stiffness to maintain equipment manufacturer's recommended alignment and duty efficiency of power-transmission components. Minimum thickness must be sufficient to result in base deflection at midpoint of unsupported span of not more than 1/1,440th of the span between isolators. Minimum thickness, the preceding requirements not withstanding, must be 8 percent of the longest base dimension.

Pumps with flexible couplings must not have inertia bases less than 8 inches thick.

Minimum mass of concrete inertia block must be equal in weight to supported equipment.

2.2 PIPE AND DUCT VIBRATION ISOLATION

Type G: Provide isolators with in-series contained steel springs and preformed chloroprene-elastomer elements for connecting to building-structure attachments. Load devices by supported system during operating conditions to produce a minimum spring and elastomer static deflection of 1 inch and 3/8 inch, respectively.

Type H: Provide isolators with contained chloroprene-elastomer elements for connecting to building-structure attachments. Load devices by supported system during operating conditions to produce a minimum elastomer static deflection of 3/8 inch.

Type J: Provide isolators with elastomers mounted on floor-supported columns or directly on the floor. Load devices by supported system during operating conditions to produce a minimum elastomer static deflection of 3/8 inch.

2.2.1 Floor-Mounted Piping

Type K: Provide isolators with springs mounted on floor-supported columns or directly on the floor. Load devices by supported system during operating conditions to produce a minimum spring static deflection of 1 inch.

2.2.2 Vertical Piping

Type L: Provide isolators which are pipe base-support devices with one or more contained steel springs. Load devices by supported system during operating conditions to produce a minimum static deflection of 1 inch. Equip devices with precompression and vertical-limit features, as well as a minimum 1/4-inch thick elastomer sound pad and isolation washers, for mounting to floor.

Type M: Isolators must be elastomer mounted baseplate and riser pipe-guide devices. Elastomer elements must be contained double acting, and elastomers under rated load must have a minimum static deflection of 3/8 inch. Size isolator to accommodate thermal insulation within the stationary guide ring.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment in accordance with manufacturer's recommendations.

Structural steel bases, and concrete inertia blocks must be raised not less than 1 inch above the floor and be level when equipment supported is under operating load.

Ensure vibration-isolation installation and deflection testing after equipment start-up is directed by a competent representative of the manufacturer.

3.2 TESTS AND REPORTS

Ensure vibration-isolation devices are deflection tested. Submit test reports in accordance with paragraph entitled, "Submittal Procedures," substantiating that all equipment has been isolated as specified and that minimum specified deflections have been met. Make all measurements in the presence of the COR.

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SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for testing, adjusting, and balancing (TAB) of heating, ventilating, and air-conditioning (HVAC) air and water distribution systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 203	Field Performance Measurements of Fan Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 62.1	Ventilation for Acceptable Indoor Air Quality
ASHRAE HVAC APP IP HDBK	HVAC Applications Handbook, I-P Edition
ASHRAE HVAC APP SI HDBK	HVAC Applications Handbook, SI Edition

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	National Standards for Total System Balance
AABC MN-4	Test and Balance Procedures

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB MASV	Procedural Standards for Measurements and Assessment of Sound and Vibration
NEBB PROCEDURAL STANDARDS	Procedural Standards for TAB (Testing,

	Adjusting and Balancing) Environmental Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1143	HVAC Air Duct Leakage Test Manual, 1st Edition
SMACNA 1780	HVAC Systems - Testing, Adjusting and Balancing, 3rd Edition
SMACNA 1858	HVAC Sound And Vibration Manual - First Edition

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

40 CFR 82	Protection of Stratospheric Ozone

1.3 WORK DESCRIPTION

The work includes duct air leakage testing (DALT) and testing, adjusting, and balancing (TAB) of new and existing heating, ventilating, and cooling (HVAC) air and water distribution systems including equipment and performance data, ducts, and piping which are located within, on, under, between, and adjacent to buildings, including records of existing conditions.

Perform TAB in accordance with the requirements of the TAB procedural standard recommended by the TAB trade association that approved the TAB Firm's qualifications. Comply with requirements of AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 (TABB) as supplemented and modified by this specification section. All recommendations and suggested practices contained in the TAB procedural standards are considered mandatory.

Conduct DALT and TAB of the indicated existing systems and equipment and submit the specified DALT and TAB reports for approval. Conduct DALT testing in compliance with the requirements specified in SMACNA 1143, except as supplemented and modified by this section. Conduct DALT and TAB work in accordance with the requirements of this section.

1.3.1 Air Distribution Systems

Test, adjust, and balance systems (TAB) in compliance with this section. Obtain COR's written approval before applying insulation to exterior of air distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.2 Water Distribution Systems

TAB systems in compliance with this section. Obtain COR's written approval before applying insulation to water distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. At Contractor's option and with COR's written approval, the piping systems may be insulated before systems are TAB'd.

Terminate piping insulation immediately adjacent to each flow control valve, automatic control valve, or device. Seal the ends of pipe insulation and the space between ends of pipe insulation and piping, with

waterproof vapor barrier coating.

After completion of work under this section, insulate the flow control valves and devices as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.3 TAB SCHEMATIC DRAWINGS

Show the following information on TAB Schematic Drawings:

a. A unique number or mark for each piece of equipment or terminal.

b. Air quantities at air terminals.

c. Air quantities and temperatures in air handling unit schedules.

d. Water quantities and temperatures in thermal energy transfer equipment schedules.

e. Water quantities and heads in pump schedules.

f. Water flow measurement fittings and balancing fittings.

g. Ductwork Construction and Leakage Testing Table that defines the DALT test requirements, including each applicable HVAC duct system ID or mark, duct pressure class, duct seal class, and duct leakage test pressure. This table is included in the file for Graphics for Unified Facilities Guide Specifications: http://www.wbdg.org/ccb/NAVGRAPH/graphtoc.pdf

The Testing, Adjusting, and Balancing (TAB) Specialist must review the Contract Plans and Specifications and advise the COR of any deficiencies that would prevent the effective and accurate TAB of the system, including records of existing conditions. The TAB Specialist must provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

Submit three copies of the TAB Schematic Drawings and Report Forms to the COR, no later than 21 days prior to the start of TAB field measurements.

1.3.4 Related Requirements

Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEMS applies to work specified in this section.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Records of Existing Conditions

TAB Firm

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms

SD-03 Product Data

Equipment and Performance Data

SD-06 Test Reports

Design review report

Pre-Final DALT report

Final DALT report

SD-07 Certificates

Independent TAB agency and personnel qualifications

1.5 QUALITY ASSURANCE

1.5.1 Independent TAB Agency and Personnel Qualifications

To secure approval for the proposed agency, submit information certifying that the TAB agency is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including design, furnishing equipment, or construction. Further, submit the following, for the agency, to COR for approval:

a. Independent AABC or NEBB or TABB TAB agency:

TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification; or TABB certification number and expiration date of current certification.

TAB team supervisor: Name and copy of AABC or NEBB or TABB TAB supervisor certificate and expiration date of current certification.

TAB team field leader: Name and documented evidence that the team field leader has satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

TAB team field technicians: Names and documented evidence that each field technician has satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

Current certificates: Registrations and certifications are current, and valid for the duration of this contract. Renew Certifications which expire prior to completion of the TAB work, in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification are not to perform TAB work on this contract.

b. TAB Team Members: TAB team approved to accomplish work on this contract are full-time employees of the TAB agency. No other personnel is allowed to do TAB work on this contract.

c. Replacement of TAB team members: Replacement of members may occur if

each new member complies with the applicable personnel qualifications and each is approved by the COR.

1.5.2 TAB Standard

Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard are considered mandatory. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practical, to satisfy the Contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations.

All quality assurance provisions of the TAB Standard such as performance guarantees are part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures must be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are considered mandatory, including the latest requirements of ASHRAE 62.1.

1.5.3 Qualifications

1.5.3.1 TAB Firm

The TAB Firm must be either a member of AABC or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications.

Certification must be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor must immediately notify the COR and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm will be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor.

1.5.3.2 TAB Specialist

The TAB Specialist must be either a member of AABC,an experienced technician of the Firm certified by the NEBB, or a Supervisor certified by the TABB. The certification must be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, immediately notify the COR and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist will be considered invalid if the TAB Specialist loses its

certification prior to Contract completion and must be performed by the approved successor.

1.5.4 Test Reports

1.5.4.1 Data from DALT Field Work

Report the data for the Pre-final DALT Report and Certified Final DALT Report in compliance the following requirements:

a. Report format: Submit report data on Air Duct Leakage Test Summary Report Forms as shown on Page 6-2 of SMACNA 1143. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Include node numbers in the completed report forms to identify each duct section. The TAB supervisor must review and certify the report.

b. The TAB supervisor must include a copy of all calculations prepared in determining the duct surface area of each duct test section. In addition,provide the ductwork air leak testing (DALT) reports with a copy(s) of the calibration curve for each of the DALT test orifices used for testing.

c. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Instruments must have been calibrated within one year of the date of use in the field. Instrument calibration must be traceable to the measuring standards of the National Institute of Standards and Technology.

d. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

1.5.4.2 Certified TAB Reports

Submit:

a. Report format: Submit the completed pre-field data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed and certified by the TAB supervisor. Bind the report with a waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data must be typewritten. Handwritten report forms or report data are not acceptable.

b. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded. Include in the TAB report continuous time versus temperature recording data of wet and dry bulb temperatures for the rooms, or zones, as designated in the following list:

    1. Measure and compile data on a continuous basis for the period in which TAB work affecting those rooms is being done.

    2. Measure and record data only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems

controls operating in fully automatic mode.

3. Data may be compiled using direct digital controls trend logging where available. Otherwise, temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls must be fully operational a minimum of 24 hours in advance of commencing data compilation. Include the specified data in the report.

c. System Diagrams: Provide updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations. Use a key numbering system on the diagram which identifies each outlet contained in the outlet airflow report sheets.

d. Static Pressure Profiles: Report static pressure profiles for air duct systems. Report static pressure data for all supply, return, relief, exhaust and outside air ducts for the systems listed. Include the following in the static pressure report data, in addition to AABC/NEBB/TABB required data:

1. Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.

2. Report static pressure drop across chilled water coils, DX coils, hot water coils, steam coils, electric resistance heating coils and heat reclaim devices installed in unit cabinetry or the system ductwork.

3. Report static pressure drop across outside air, return air, and supply air automatic control dampers, both proportional and two-position, installed in unit cabinetry.

4. Report static pressure drop across air filters, acoustic silencers, moisture eliminators, air flow straighteners, air flow measuring stations or other pressure drop producing specialty items installed in unit cabinetry, or in the system ductwork. Examples of these specialty items are smoke detectors, white sound generators, RF shielding, wave guides, security bars, blast valves, small pipes passing through ductwork, and duct mounted humidifiers.

   Do not report static pressure drop across duct fittings provided for the sole purpose of conveying air, such as elbows, transitions, offsets, plenums, manual dampers, and branch takes-offs.

5. Report static pressure drop across outside air and relief/exhaust air louvers.

6. Report static pressure readings of supply air, return air, exhaust/relief air, and outside air in duct at the point where these ducts connect to each air moving unit and also at the following locations:

   Main Duct: Take readings at four locations along the full length of the main duct, 25 percent, 50 percent, 75 percent, and 100 percent of the total duct length.

   Floor Branch Mains: Take readings at floor branch mains served by

a main duct vertical riser.

Branch Main Ducts: Take readings at branch main ducts.

VAV Terminals: Take readings at inlet static pressure at VAV terminal box primary air branch ducts.

VAV Terminals, Fan Powered: Take readings at fan discharge and inlet static pressures for series and parallel fan powered VAV terminal boxes.

e. Duct Traverses: Report duct traverses for main and branch main supply, return, exhaust, relief and outside air ducts. This includes all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency must evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pilot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane."

f. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings must provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

g. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

h. Performance Curves: The TAB Supervisor must include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.

i. Calibration Curves: The TAB Supervisor must include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturi's and flow orifices TAB'd on the job.

1.6 PROJECT/SITE CONDITIONS

1.6.1 DALT and TAB Services to Obtain Existing Conditions

Conduct DALT and TAB of the indicated existing systems and equipment and submit the specified DALT and TAB reports for approval. Conduct this DALT and TAB work in accordance with the requirements of this section.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 DALT PROCEDURES

3.1.1 Ductwork To Be DALT'd

From each duct system indicated as subject to DALT, the COR will randomly select sections of each completed duct system for testing by the Contractor's TAB Firm. The sections selected will not exceed 20 percent of the total measured linear footage of duct systems indicated as subject to DALT. Sections of duct systems subject to DALT will include 20 percent of main ducts, branch main ducts, branch ducts and plenums for supply, return, exhaust, and plenum ductwork.

It is acceptable for an entire duct system to be DALT'd instead of disassembling that system in order to DALT only the 20 percent portion specified above.

3.1.2 DALT Testing

Perform DALT on the HVAC duct sections of each system as selected by the COR. Use the duct class, seal class, leakage class and the leak test pressure data indicated on the drawings, to comply with the procedures specified in SMACNA 1143.

In spite of specifications of SMACNA 1143 to the contrary, DALT ductwork of construction class of 3-inch water gauge static pressure and below if indicated to be DALT'd. Complete DALT work on the COR selected ductwork within 48 hours after the particular ductwork was selected for DALT. Separately conduct DALT work for large duct systems to enable the DALT work to be completed in 48 hours.

3.1.3 Pre-final DALT Report

After completion of the DALT work, prepare a Pre-final DALT Report. The Pre-final DALT report shall provide the basis for the Final DALT Report.

TAB supervisor shall review, approve and sign the Pre-Final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the COR that the field check of the Pre-Final DALT Report data can commence.

After completion of the DALT work, prepare a Pre-final DALT Report using the reporting forms specified. TAB team to furnish data required by those data report forms. Prepare the report neatly and legibly; the Pre-final DALT report is the basis for the Final DALT Report. TAB supervisor must review and certify the Pre-final DALT Report and submit this report within one day of completion of DALT field work. Verbally notify the COR that the field check of the Pre-final DALT Report data can commence.

3.1.4 Quality Assurance - COR DALT Field Acceptance Testing

In the presence of the COR and TAB team field leader, verify for accuracy Pre-final DALT Report data selected by the COR. For each duct system, this acceptance testing shall be conducted on a maximum of 50 percent of the duct sections DALT'd.

Further, if any data on the Pre-final DALT report form for a given duct section is out-of-tolerance, then field acceptance testing shall be

conducted on data for one additional duct section, preferably in the same duct system, in the presence of the COR.

3.1.5 Additional COR Field Acceptance Testing

If any of the duct sections checked for a given system are determined to have a leakage rate measured that exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction class and sealant class, terminate data checking for that section. The associated Pre-final DALT Report data for the given duct system will be disapproved. Make the necessary corrections and prepare a revised Pre-final DALT Report. Reschedule a field check of the revised report data with the COR.

3.1.6 Certified Final DALT Report

On successful completion of all field checks of the Pre-final DALT Report data for all systems, the TAB Supervisor is to assemble, review, certify and submit the Final DALT Report to the COR for approval.

3.1.7 Prerequisite for TAB Field Work

Do not commence TAB field work prior to the completion and approval, for all systems, of the Final DALT Report.

3.2 TAB PROCEDURES

3.2.1 TAB Field Work

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents.

That is, comply with the the requirements of AABC MN-1 and AABC MN-4, NEBB PROCEDURAL STANDARDS, NEBB MASV, or SMACNA 1780 (TABB) and SMACNA 1858 (TABB),except as supplemented and modified by this section.

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. Conduct TAB work, including measurement accuracy, and sound measurement work in conformance with the AABC MN-1 and AABC MN-4, or SMACNA 1780 (used by TABB) and SMACNA 1858 sound measurement procedures, except as supplemented and modified by this section. The only water flow and air flow reporting which can be deferred until the Season 2 is that data which would be affected in terms of accuracy due to outside ambient conditions.

3.2.2 Preliminary Procedures

Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field work. TAB engineer is to locate, in the field, test ports required for testing. It is the responsibility of the sheet metal contractor to provide and install test ports as required by the TAB engineer.

3.2.3 TAB Air Distribution Systems

3.2.3.1 Air Handling Units

Air handling unit systems including fans coils, ducts, plenums, mixing

boxes, terminal units, variable air volume boxes, and air distribution devices for supply air, return air, outside air, mixed air relief air, and makeup air.

3.2.3.2 Rooftop Air Conditioning

Rooftop air conditioning systems including fans, coils, ducts, plenums, and air distribution devices for supply air, return air, and outside air.

3.2.3.3 Heating and Ventilating Units

Heating and ventilating unit systems including fans, coils, ducts, plenums, roof vents, registers, diffusers, grilles, and louvers for supply air, return air, outside air, and mixed air.

3.2.4 TAB Water Distribution Systems

3.2.4.1 Chilled Water

Chilled water systems including chillers, condensers, cooling towers, pumps, coils, system balance valves and flow measuring devices.

For water chillers, report data as required by AABC, NEBB and TABB standard procedures, including refrigeration operational data.

3.2.4.2 Heating Hot Water

Heating hot water systems including boilers, hot water converters (e.g., heat exchangers), pumps, coils, system balancing valves and flow measuring devices.

3.2.5 TAB Work on Performance Tests Without Seasonal Limitations

3.2.5.1 Performance Tests

In addition to the TAB proportionate balancing work on the air distribution systems and the water distribution systems, accomplish TAB work on the HVAC systems which directly transfer thermal energy. TAB the operational performance of the heating systems and cooling systems.

3.2.5.2 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. Record these temperatures at beginning and at the end of data taking.

3.2.6 Workmanship

Conduct TAB work on the HVAC systems until measured flow rates are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. This TAB work includes adjustment of balancing valves, balancing dampers, and sheaves. Further, this TAB work includes changing out fan sheaves and pump impellers if required to obtain air and water flow rates specified or indicated. If, with these adjustments and equipment changes, the specified or indicated design flow rates cannot be attained, contact the COR for direction.

3.2.7 Deficiencies

Strive to meet the intent of this section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph entitled "Workmanship," provide written notice as soon as possible to the Contractor and the COR describing the deficiency and recommended correction.

Responsibility for correction of installation deficiencies is the Contractor's. If a deficiency is in equipment design, call the TAB team supervisor for technical assistance. Responsibility for reporting design deficiencies to Contractor is the TAB team supervisor's.

3.2.8 TAB Reports

Additional requirements for TAB Reports are specified in Appendix B REPORTS - DALT and TAB.

After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and certification, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms is to be furnished by the TAB team. Except as approved otherwise in writing by the COR, the TAB work and thereby the TAB report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph entitled "Workmanship."

3.2.9 Quality Assurance - COR TAB Field Acceptance Testing

3.2.9.1 TAB Field Acceptance Testing

During the field acceptance testing, verify, in the presence of the COR, random selections of data (water, air quantities, air motion, recorded in the TAB Report. Points and areas for field acceptance testing are to be selected by the COR. Measurement and test procedures are the same as approved for TAB work for the TAB Report.

Field acceptance testing includes verification of TAB Report data recorded for the following equipment groups:

Group 1: All chillers, boilers, return fans, computer room units, and air handling units (rooftop and central stations).

Group 2: 25 percent of the VAV terminal boxes and associated diffusers and registers.

Group 3: 25 percent of the supply diffusers, registers, grilles associated with constant volume air handling units.

Group 4: 25 percent of the return grilles, return registers, exhaust grilles and exhaust registers.

Group 5: 25 percent of the supply fans, exhaust fans, and pumps.

Further, if any data on the TAB Report for Groups 2 through 5 is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, additional group data verification is required in the presence of the COR. Verify TAB Report data for one additional piece of equipment in that group. Continue this additional group data verification until

out-of-tolerance data ceases to be found.

3.2.9.2 Additional COR TAB Field Acceptance Testing

If any of the acceptance testing measurements for a given equipment group is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, terminate data verification for all affected data for that group. The affected data for the given group will be disapproved. Make the necessary corrections and prepare a revised TAB Report. Reschedule acceptance testing of the revised report data with the COR.
Further, if any data on the TAB Report for a given field acceptance test group is out-of-tolerance, then field test data for one additional field test group as specified herein. Continue this increase field test work until out-of-tolerance data ceases to to be found. This additional field testing is up and above the original 25 percent of the of reported data entries to be field tested.

If there are no more similar field test groups from which to choose, additional field testing from another, but different, type of field testing group must be tested.

3.2.9.3 Prerequisite for Approval

Compliance with the field acceptance testing requirements of this section is a prerequisite for the final COR approval of the TAB Report submitted.

3.3 MARKING OF SETTINGS

Upon the final TAB work approval, permanently mark the settings of HVAC adjustment devices including valves, gauges, splitters, and dampers so that adjustment can be restored if disturbed at any time. Provide permanent markings clearly indicating the settings on the adjustment devices which result in the data reported on the submitted TAB report.

3.4 MARKING OF TEST PORTS

The TAB team is to permanently and legibly mark and identify the location points of the duct test ports. If the ducts have exterior insulation, make these markings on the exterior side of the duct insulation. Show the location of test ports on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

-- End of Section --

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SECTION 23 07 00

THERMAL INSULATION FOR MECHANICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for field applied thermal insulation on HVAC and plumbing systems located within, on, under, and adjacent to buildings; above and below ground.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - IP	Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE 90.2	Energy Efficient Design of Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A580	Standard Specification for Stainless Steel Wire
ASTM B209	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C1126	Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM C1136	Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation

ASTM C1290	Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
ASTM C1427	Specification for Preformed Flexible Cellular Polyolefin Thermal Insulation in Sheet and Tubular Form
ASTM C1534	Standard Specification for Flexible Polymeric Foam Sheet Insulation Used as a Thermal and Sound Absorbing Liner for Duct Systems
ASTM C195	Standard Specification for Mineral Fiber Thermal Insulating Cement
ASTM C449	Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C533	Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM C534	Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C547	Standard Specification for Mineral Fiber Pipe Insulation
ASTM C552	Standard Specification for Cellular Glass Thermal Insulation
ASTM C553	Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C591	Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C592	Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM C610	Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation
ASTM C612	Mineral Fiber Block and Board Thermal Insulation
ASTM C647	Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C665	Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

ASTM C795	Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C916	Standard Specification for Adhesives for Duct Thermal Insulation
ASTM C920	Standard Specification for Elastomeric Joint Sealants
ASTM C921	Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM E 2231	Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics
ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 96	Standard Test Methods for Water Vapor Transmission of Materials
ASTM E2336	Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems

FM GLOBAL (FM)

FM APP GUIDE	Approval Guide http://www.approvalguide.com/

GREENGUARD ENVIRONMENTAL INSTITUTE (GEI)

GEI	Greenguard Standards for Low Emitting Products

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 2758	Paper - Determination of Bursting Strength

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-69	Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds	National Commercial & Industrial Insulation Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 90B	Standard for the Installation of Warm Air

Heating and Air Conditioning Systems

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	Scientific Certification Systems (SCS)Indoor Advantage

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-24179	Adhesive, Flexible Unicellular-Plastic Thermal Insulation
MIL-A-3316	Adhesives, Fire-Resistant, Thermal Insulation

UNDERWRITERS LABORATORIES (UL)

UL 723	Test for Surface Burning Characteristics of Building Materials
UL 94	Standard for Tests for Flammability of Plastic Materials for Parts in Devices and Appliances

1.3 SYSTEM DESCRIPTION

1.3.1 General

Provide field-applied insulation and accessories on mechanical systems as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated.

1.3.2 Surface Burning Characteristics

Unless otherwise specified, insulation shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. Flame spread, and smoke developed indexes, shall be determined by ASTM E 84 or UL 723. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Test specimens shall be prepared and mounted according to ASTM E 2231. Insulation materials located exterior to the building perimeter are not required to be fire rated.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Certification
Pipe Insulation Systems
Duct Insulation Systems

SD-08 Manufacturer's Instructions

Pipe Insulation Systems
Duct Insulation Systems

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualification

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.5.2 Sustainable Design Certification

Product shall be third party certified by GEI Greenguard Indoor Air Quality Certified, SCS Scientific Certification Systems Indoor Advantage or equal. Certification shall be performed annually and shall be current.

1.6 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The COR may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means. Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material. Insulation packages and containers shall be asbestos free.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit a complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories including adhesives, sealants and jackets for each mechanical system requiring insulation shall be included. The product data must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. Materials furnished under this section shall be submitted together in a booklet and in conjunction with the MICA plates booklet (SD-02). Annotate the product data to indicate which MICA plate is applicable. Provide insulation systems in accordance with the approved MICA National Insulation Standards plates as supplemented by this specification. Provide field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems and piping systems which are located within, on, under, and adjacent to buildings; and for plumbing systems. Insulation shall be CFC and HCFC free.

2.2 MATERIALS

Provide insulation that meets or exceed the requirements of ASHRAE 90.1 ASHRAE 90.2. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C795 requirements. Calcium silicate shall not be used on chilled or cold water systems. Materials shall be asbestos

free and conform to the following: Flexible Elastomeric: Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive. Comply with ASTM C534, Type I, Grade 1, for tubular materials and Type II, Grade 1, for sheet materials. Provide product recognized under UL 94 and listed in FM APP GUIDE.

2.2.1 Adhesives

2.2.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C916, Type I.

2.2.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C195.

2.2.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. Lagging adhesives shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. Adhesive shall be MIL-A-3316, Class 1, and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or Class 2 for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations for pipe and duct insulation. Submit and display, after approval of materials, actual sections of installed systems, properly insulated in accordance with the specification requirements. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. The COR will inspect display sample sections at the jobsite. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

a. Pipe Insulation Display Sections: Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric waterways and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services.

b. Duct Insulation Display Sections: Display sample sections for rigid and flexible duct insulation used on the job. A temporary covering shall be used to enclose and protect display sections for duct insulation exposed to weather.

2.2.2 Contact Adhesive

Adhesives may be any of, but not limited to, the neoprene based, rubber based, or elastomeric type that have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation shall be used to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance with safe installation practices. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179, Type II, Class I. Provide product recognized under UL 94 and listed in FM APP GUIDE.

2.2.3 Caulking

ASTM C920, Type S, Grade NS, Class 25, Use A.

2.2.4 Corner Angles

2.2.4.1 General

Nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum shall be ASTM B209, Alloy 3003, 3105, or 5005.

2.2.4.2 Fittings

Fabricated Fittings are the prefabricated fittings for flexible elastomeric pipe insulation systems. Together with the flexible elastomeric tubes, they provide complete system integrity for retarding heat gain and controlling condensation drip from chilled-water and refrigeration systems. Flexible elastomeric, fabricated fittings provide thermal protection (0.25 k) and condensation resistance (0.05 Water Vapor Transmission factor).

2.2.5 Finishing Cement

ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must comply with ASTM C795.

2.2.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth, with 20X20 maximum mesh size, and glass tape shall have maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces/square yard. Elastomeric Foam Tape: Black vapor-retarder foam tape with acrylic adhesive containing an anti-microbial additive.

2.2.7 Staples

Outward clinching type ASTM A167, Type 304 or 316 stainless steel.

2.2.8 Jackets

2.2.8.1 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 by 0.016 inch aluminum matching jacket material. Bands for insulation below ground shall be 3/4 by 0.020 inch thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

2.2.8.2 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

2.2.8.3 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive, greater than 3 plies standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive); with 0.0000 permeability when tested in accordance with ASTM E 96; heavy duty, white or natural; and UV resistant. Flexible Elastomeric exterior foam with factory applied, UV Jacket made with a cold weather acrylic adhesive. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and excellent WVT.

2.2.9 Vapor Retarder Required

ASTM C921, Type I, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require factory applied jackets are mineral fiber, cellular glass, polyisocyanurate, and phenolic foam. Insulation materials that do not require jacketing are flexible elastomerics. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.2.9.1 White Vapor Retarder All Service Jacket (ASJ)

Standard reinforced fire retardant jacket for use on hot/cold pipes, ducts, or equipment. Vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

2.2.9.2 Vapor Retarder/Vapor Barrier Mastic Coatings

a. The vapor barrier shall be self adhesive (minimum 2 mils adhesive, 3 mils embossed) greater than 3 plies standard grade, silver, white, black and embossed white jacket for use on hot/cold pipes. Less than 0.02 permeability when tested in accordance with ASTM E 96. Meeting UL 723 or ASTM E 84 flame and smoke requirements; UV resistant.

b. The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type. All other application and service properties shall be in accordance with ASTM C647.

2.2.9.3 Laminated Film Vapor Retarder

ASTM C1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable. Vapor retarder shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84. Flexible Elastomeric exterior foam with factory applied UV Jacket. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and excellent WVT.

2.2.9.4 Vapor Barrier

The vapor barrier shall be greater than 3 ply self adhesive laminate -white vapor barrier jacket- superior performance (less than 0.0000 permeability when tested in accordance with ASTM E 96). Vapor barrier shall meet UL 723 or ASTM E 84 25 flame and 50 smoke requirements; and UV resistant. Minimum burst strength 185 psi in accordance with ISO 2758. Tensile strength 68 lb/inch width (PSTC-1000). Tape shall be as specified for laminated film vapor barrier above.

2.2.10 Vapor Retarder Not Required

ASTM C921, Type II, Class D, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable. Jacket shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.2.11 Wire

Soft annealed ASTM A580 Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.2.12 Insulation Bands

Insulation bands shall be 1/2 inch wide; 26 gauge stainless steel.

2.2.13 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene

rubber type, or the butyl type of sealants. Sealants shall have a maximum moisture vapor transmission of 0.02 perms, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.3 PIPE INSULATION SYSTEMS

Insulation materials shall conform to Table 1. Insulation thickness shall be as listed in Table 2 and meet or exceed the requirements of ASHRAE 90.2. Pipe insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.3.1 Aboveground Cold Pipeline (-30 to 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications, shall be as follows:

a. Cellular Glass: ASTM C552, Type II, and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

b. Flexible Elastomeric Cellular Insulation: ASTM C534, Grade 1, Type I or II. Type II shall have vapor retarder/vapor barrier skin on one or both sides of the insulation.

c. Phenolic Insulation: ASTM C1126, Type III. Phenolic insulations shall comply with ASTM C795 and with the ASTM C665 paragraph Corrosiveness. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

d. Polyisocyanurate Insulation: ASTM C591, type I. Supply the insulation with manufacturer's recommended factory-applied vapor retarder/vapor barrier. Insulation with pre-applied adhesive shall not be used.

e. Flexible Polyolefin Cellular Insulation: ASTM C1427, Grade 1 Type I or II.

f. Mineral Fiber Insulation with Integral Wicking Material (MFIWM): ASTM C547. Install in accordance with manufacturer's instructions.

2.3.2 Aboveground Hot Pipeline Above 60 deg. F

Insulation for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

a. Mineral Fiber: ASTM C547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.

b. Calcium Silicate: ASTM C533, Type I indoor only, or outdoors above 250 degrees F pipe temperature. Supply insulation with the manufacturer's recommended factory-applied jacket/vapor barrier.

c. Cellular Glass: ASTM C552, Type II and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.

d. Flexible Elastomeric Cellular Insulation: ASTM C534, Grade 1, Type I or II to 220 degrees F service.

e. Phenolic Insulation: ASTM C1126 Type III to 250 degrees F service shall comply with ASTM C795. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

f. Perlite Insulation: ASTM C610

g. Polyisocyanurate Insulation: ASTM C591, Type 1, to 300 degrees F service. Supply the insulation with manufacturer's recommended factory applied jacket/vapor barrier.

h. Flexible Polyolefin Cellular Insulation: ASTM C1427, Grade 1 Type I or II to 200 degrees F.

2.3.3 Below-ground Pipeline Insulation

For below-ground pipeline insulation the following requirements shall be met.

2.3.3.1 Cellular Glass

ASTM C552, type II.

2.3.3.2 Polyisocyanurate

ASTM C591, Type 1, to 300 degrees F.

2.4 DUCT INSULATION SYSTEMS

2.4.1 Duct Insulation

Provide factory-applied elastomeric insulation with identification of installed thermal resistance (R) value and out-of-package R value.

2.4.1.1 Rigid Insulation

Rigid mineral fiber in accordance with ASTM C612, Class 2 (maximum surface temperature 400 degrees F), 3 pcf average, 1-1/2 inch thick, Type IA, IB, II, III, and IV.

2.4.1.2 Blanket Insulation

Blanket flexible mineral fiber insulation conforming to ASTM C553, Type 1, Class B-3, 3/4 pcf nominal, 2.0 inches thick or Type II up to 250 degrees F. Also ASTM C1290 Type III may be used. Alternately, minimum thickness may be calculated in accordance with ASHRAE 90.1.

2.4.2 Duct Insulation Jackets

2.4.2.1 All-Purpose Jacket

Provide insulation with insulation manufacturer's standard reinforced fire-retardant jacket with or without integral vapor barrier as required by the service. In exposed locations, provide jacket with a white surface suitable for field painting.

2.4.2.2 Metal Jackets

a. Aluminum Jackets: ASTM B209, Temper H14, minimum thickness of 27 gauge (0.016 inch), with factory-applied polyethylene and kraft paper

moisture barrier on inside surface. Provide smooth surface jackets for jacket outside dimension 8 inches and larger. Provide corrugated surface jackets for jacket outside dimension 8 inches and larger. Provide stainless steel bands, minimum width of 1/2 inch.

2.4.2.3 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive minimum 2 mils adhesive less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive), heavy duty white or natural).

2.4.3 Weatherproof Duct Insulation

Provide and weatherproofing as specified in manufacturer's instruction. Multi-ply, Polymeric Blend Laminate Jacketing: Construction of laminate designed to provide UV resistance, high puncture, tear resistance and excellent WVT.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

3.1.2 Firestopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING. The protection of ducts at point of passage through firewalls must be in accordance with NFPA 90A and/or NFPA 90B. All other penetrations, such as piping, conduit, and wiring, through firewalls must be protected with a material or system of the same hourly rating that is listed by UL, FM, or a NRTL.

3.2 PIPE INSULATION SYSTEMS INSTALLATION

Install pipe insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder/barrier, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

a. Pipe used solely for fire protection.

b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.

c. Sanitary drain lines.

d. Air chambers.

e. Adjacent insulation.

f. ASME stamps.

g. Access plates of fan housings.

h. Cleanouts or handholes.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

a. Pipe insulation shall be continuous through the sleeve.

b. An aluminum jacket or vapor barrier/weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 ply standard grade, silver, white, black and embossed with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.

c. Where pipes penetrate interior walls, the aluminum jacket or vapor barrier/weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 plies standard grade, silver, white, black and embossed shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.

d. Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

e. Where penetrating waterproofed floors, the aluminum jacket shall extend

from below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.

f. Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 2 inches beyond the interior surface of the wall.

g. Where penetrating roofs, pipe shall be insulated as required for interior service to a point flush with the top of the flashing and sealed with vapor retarder coating. The insulation for exterior application shall butt tightly to the top of flashing and interior insulation. The exterior aluminum jacket shall extend 2 inches down beyond the end of the insulation to form a counter flashing. The flashing and counter flashing shall be sealed underneath with caulking.

h. For hot water pipes supplying lavatories or other similar heated service that requires insulation, the insulation shall be terminated on the backside of the finished wall. The insulation termination shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. Glass tape seams shall overlap 1 inch. The annular space between the pipe and wall penetration shall be caulked with approved fire stop material. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 3/8 inches.

i. For domestic cold water pipes supplying lavatories or other similar cooling service that requires insulation, the insulation shall be terminated on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). The insulation shall be protected with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch. The coating shall extend out onto the insulation 2 inches and shall seal the end of the insulation. The annular space between the outer surface of the pipe insulation and the wall penetration shall be caulked with an approved fire stop material having vapor retarder properties. The pipe and wall penetration shall be covered with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 3/8 inches.

3.2.1.3 Pipes Passing Through Hangers

Insulation, whether hot or cold application, shall be continuous through hangers.

3.2.1.4 Pipe Insulation Material and Thickness

TABLE 1				
Insulation Material for Piping				
Material	Specification	Type	Class	VR/VB Req'd
Chilled Water (Supply & Return, Dual Temperature Piping, 40 F nominal)				
Cellular Glass	ASTM C552	II	2	No
Flexible Elastomeric Cellular	ASTM C534	I		No
Faced Phenolic Foam	ASTM C1126	III		Yes
Polyisocyanurate	ASTM C591	I		Yes
Mineral Fiber with Wicking Material	ASTM C547	I		Yes

TABLE 1				
Insulation Material for Piping				
Material	Specification	Type	Class	VR/VB Req'd
Heating Hot Water Supply & Return				
Mineral Fiber	ASTM C547	I	1	No
Calcium Silicate	ASTM C533	I		No
Cellular Glass	ASTM C552	II	2	No
Faced Phenolic Foam	ASTM C1126	III		Yes
Perlite	ASTM C610			No
Polyisocyanurate	ASTM C591	I		No
Flexible Elastomeric Cellular	ASTM C534	I	2	No

TABLE 1				
Insulation Material for Piping				
Material	Specification	Type	Class	VR/VB Req'd
Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping				
Polyisocyanurate	ASTM C591	I		Yes
Cellular Glass	ASTM C552	II	2	No
Flexible Elastomeric Cellular	ASTM C534	I		No
Faced Phenolic Foam	ASTM C1126	III		Yes
Flexible Polyolefin Cellular	ASTM C1427	I		No

TABLE 1				
Insulation Material for Piping				
Material	Specification	Type	Class	VR/VB Req'd
Hot Domestic Water Supply & Recirculating Piping (Max 200				
Mineral Fiber	ASTM C547	I	1	No
Cellular Glass	ASTM C552	II	2	No
Flexible Elastomeric Cellular	ASTM C534	I		No
Faced Phenolic Foam	ASTM C1126	III		Yes
Polyisocyanurate	ASTM C591	I		No

TABLE 1				
Insulation Material for Piping				
Material	Specification	Type	Class	VR/VB Req'd
Refrigerant Suction Piping (35 degrees F nominal)				
Flexible Elastomeric Cellular	ASTM C534	I		No
Cellular Glass	ASTM C552	II	1	Yes
Faced Phenolic Foam	ASTM C1126	III		Yes
Polyisocyanurate	ASTM C591	I		Yes
Horizontal Roof Drain Leaders (Including Underside of Roof Drain Fittings)				

TABLE 1				
Insulation Material for Piping				
Material	Specification	Type	Class	VR/VB Req'd
Polyisocyanurate	ASTM C591	I		Yes
Flexible Elastomeric Cellular	ASTM C534	I		No
Faced Phenolic Foam	ASTM C1126	III		Yes
Cellular Glass	ASTM C552	III		Yes
Condensate Drain Located Inside Building				
Polyisocyanurate	ASTM C591	I		Yes
Cellular Glass	ASTM C552	II	2	No
Flexible Elastomeric Cellular	ASTM C534	I		No
Faced Phenolic Foam	ASTM C1126	II		Yes

TABLE 1				
Insulation Material for Piping				
Material	Specification	Type	Class	VR/VB Req'd
Note: VR/VB = Vapor Retarder/Vapor Barrier				

TABLE 2						
Piping Insulation Thickness (inch)						
Service						
	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
Chilled Water (Supply & Return, Dual Temperature Piping, 40 Degrees F nominal)						
	Cellular Glass	1.5	2	2	2.5	3
	Faced Phenolic Foam	1	1	1	1.5	2

TABLE 2						
Piping Insulation Thickness (inch)						
Service						
	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
	Polyisocyanurate	1	1	1	1	1
	Mineral Fiber with Wicking Material	1	1.5	1.5	2	2
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Chilled Water (Supply & Return, Dual Temperature Piping, 40 Degrees F nominal)						
	Cellular Glass	1.5	1.5	1.5	1.5	2
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
	Faced Phenolic Foam	1	1	1	1	1.5
	Mineral Fiber with Wicking Material	1	1.5	1.5	2	2
Heating Hot Water Supply & Return, Heated Oil (Max 250 F)						
	Mineral Fiber	1.5	1.5	2	2	2
	Calcium Silicate	2.5	2.5	3	3	3

TABLE 2						
Piping Insulation Thickness (inch)						
Service						
	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
	Cellular Glass	2	2.5	3	3	3
	Perlite	2.5	2.5	3	3	3
	Polyisocyanurate	1	1	1.5	1.5	1.5
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping						
	Cellular Glass	1.5	1.5	1.5	1.5	1.5
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
	Faced Phenolic Foam	1	1	1	1	1
	Polyisocyanurate	1	1	1	1	1
Hot Domestic Water Supply & Recirculating Piping (Max 200 F)						
	Mineral Fiber	1	1	1	1.5	1.5

TABLE 2						
Piping Insulation Thickness (inch)						
Service						
	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
	Cellular Glass	1.5	1.5	1.5	2	2
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
	Polyisocyanurate	1	1	1	1	1.5
Refrigerant Suction Piping (35 degrees F nominal)						
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
	Cellular Glass	1.5	1.5	1.5	1.5	1.5
	Faced Phenolic Foam	1	1	1	1	1
Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel						
	Flexible Elastomeric Cellular	0.5	0.5	0.5	0.5	0.5
Horizontal Roof Drain Leaders (Including Underside of Roof Drain Fittings)						
	Cellular Glass	1.5	1.5	1.5	1.5	1.5

TABLE 2						
Piping Insulation Thickness (inch)						
Service						
	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
	Faced Phenolic Foam	1	1	1	1	1
	Polyisocyanurate	1	1	1	1	1
Condensate Drain Located Inside Building						
	Cellular Glass	1.5	1.5	1.5	1.5	1.5
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
	Faced Phenolic Foam	1	1	1	1	1

3.2.2 Aboveground Cold Pipelines

The following cold pipelines for minus 30 to plus 60 degrees F, shall be insulated in accordance with Table 2 except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted. This includes but is not limited to the following:

a. Make-up water.

b. Horizontal and vertical portions of interior roof drains.

c. Refrigerant suction lines.

d. Chilled water.

e. Air conditioner condensate drains.

3.2.2.1 Insulation Material and Thickness

Insulation thickness for cold pipelines shall be determined using Table 2.

3.2.2.2 Factory or Field applied Jacket

Insulation shall be covered with a factory applied vapor retarder jacket/vapor barrier or field applied seal welded PVC jacket or greater than 3 ply laminated self-adhesive vapor barrier/weatherproofing jacket - less than 0.0000 permeability, standard grade, sliver, white, black and embossed for use with Mineral Fiber, Cellular Glass or Phenolic Foam Insulated Pipe. Insulation inside the building, to be protected with an aluminum jacket or greater than 3-ply vapor barrier/weatherproofing self-adhesive product, less than 0.0000 permeability, standard grade, Embossed Silver, White & Black, shall have the insulation and vapor retarder jacket installed as specified herein.

3.2.2.3 Insulation for Fittings and Accessories

a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow'.

3.2.3 Aboveground Hot Pipelines

3.2.3.1 General Requirements

All hot pipe lines above 60 degrees F, except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted, shall be insulated in accordance with Table 2. This includes but is not limited to the following:

a. Domestic hot water supply & re-circulating system.

c. Condensate & compressed air discharge.

d. Hot water heating.

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type I jacket or field applied aluminum where required or seal welded PVC.

3.2.3.2 Insulation for Fittings and Accessories

a. General. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant. Insulation shall be marked showing the location of unions, strainers, check valves and other components that would otherwise be hidden from view by the insulation.

b. Precut or Preformed. Precut or preformed insulation shall be placed around all fittings and accessories. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity.

c. Rigid Preformed. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, a laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability (greater than 3 ply, standard grade, silver, white, black and embossed aluminum jacket or PVC jacket shall be applied. PVC jacketing requires no factory-applied jacket beneath it, however an all service jacket shall be applied if factory applied jacketing is not furnished. Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION in PART 3.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with caulking while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an un-insulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 60 degrees F shall be sealed with a moisture retarder.

3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof laminated self-adhesive (minimum 2 mils adhesive, 3 mils

embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed, and UV resistant.

3.2.4.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.3 DUCT INSULATION SYSTEMS INSTALLATION

3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with Table 4.

Table 4 - Minimum Duct Insulation (inches)	
Cold Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5
Warm Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5

3.3.2 Insulation and Vapor Retarder/Vapor Barrier for Cold Air Duct

Insulation and vapor retarder/vapor barrier shall be provided for the following cold air ducts and associated equipment.

a. Supply ducts.

b. Return air ducts.

c. Plenums.

d. Ducts exposed to weather.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf, and rigid type where exposed, minimum density 3 pcf. Insulation for both concealed or exposed round/oval ducts shall be flexible type, minimum density 3/4 pcf or a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered. Insulation for all exposed ducts shall be provided with either a white, paint-able, factory-applied Type I jacket or a field applied vapor retarder/vapor barrier jacket coating finish as specified, the total field applied dry film thickness shall be approximately 1/16 inch. Insulation on all concealed duct shall be provided with a factory-applied Type I or II vapor retarder/vapor barrier jacket. Duct insulation shall be continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate

formation. Duct insulation and vapor retarder/vapor barrier shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and grills. Vapor retarder/vapor barrier materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 23 00 00 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.3.2.1 Installation on Concealed Duct

a. For rectangular, oval or round ducts, flexible insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder/vapor barrier jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.

e. Where mechanical fasteners are used, self-locking washers shall be installed and the pin trimmed and bent over.

f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating or PVDC adhesive tape greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating.. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.2.2 Installation on Exposed Duct Work

a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches. Mechanical fasteners shall be as corrosion resistant as G60 coated galvanized steel, and shall indefinitely sustain a 50 lb tensile dead load test perpendicular to the duct wall.

b. Duct insulation shall be formed with minimum jacket seams. Each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder/barrier jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and the pin trimmed and bent over.

d. Joints in the insulation jacket shall be sealed with a 4 inch wide strip of tape. Tape seams shall be sealed with a brush coat of vapor retarder coating.

e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.

f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a brush coat of vapor retarder coating.

g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf, attached as in accordance with MICA standards.

3.3.3 Insulation for Warm Air Duct

Insulation and vapor barrier shall be provided for the following warm air ducts and associated equipment:.

a. Supply ducts.

b. Return air ducts.

c. s exposed to weather.

Insulation for rectangular ducts shall be flexible type where concealed, and rigid type where exposed. Insulation on exposed ducts shall be provided with a white, paint-able, factory-applied Type II jacket, or finished with adhesive finish. Flexible type insulation shall be used for round ducts, with a factory-applied Type II jacket. Insulation on concealed duct shall be provided with a factory-applied Type II jacket. Adhesive finish where indicated to be used shall be accomplished by applying two coats of adhesive with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings. Duct insulation shall terminate at fire dampers and flexible connections.

3.3.3.1 Installation on Concealed Duct

a. For rectangular, oval and round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts 24 inches and larger, insulation shall be secured to the bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corner.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.

d. The insulation shall be impaled on the mechanical fasteners where used. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type hangers.

e. Self-locking washers shall be installed where mechanical fasteners are used and the pin trimmed and bent over.

f. Insulation jacket shall overlap not less than 2 inches at joints and the lap shall be secured and stapled on 4 inch centers.

3.3.3.2 Installation on Exposed Duct

a. For rectangular ducts, the rigid insulation shall be secured to the duct by the use of mechanical fasteners on all four sides of the duct, spaced not more than 16 inches apart and not more than 6 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger and a minimum of one row for each side of duct less than 12 inches.

b. Duct insulation with factory-applied jacket shall be formed with minimum jacket seams, and each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projection is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over the projection. Jacket shall

be continuous across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, insulation and jacket shall be carried over the projection.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and pin trimmed and bent over.

d. Joints on jacketed insulation shall be sealed with a 4 inch wide strip of tape and brushed with vapor retarder coating.

e. Breaks and penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with adhesive and stapled.

f. Insulation terminations and pin punctures shall be sealed with tape and brushed with vapor retarder coating.

g. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation, minimum density of 3/4 pcf attached by staples spaced not more than 16 inches and not more than 6 inches from the degrees of joints. Joints shall be sealed in accordance with item "d." above.

3.3.4 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, ducts shall be insulated as specified for cold air duct.

3.3.5 Duct Exposed to Weather

3.3.5.1 Installation

Ducts exposed to weather shall be insulated and finished as specified for the applicable service for exposed duct inside the building. After the above is accomplished, the insulation shall then be further finished as detailed in the following subparagraphs.

3.3.5.2 Round Duct

Laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - Less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply, heavy duty, white and natural) membrane shall be applied overlapping material by 3 inches no bands or caulking needed - see manufacturer's recommended installation instructions. Aluminum jacket with factory applied moisture retarder shall be applied with the joints lapped not less than 3 inches and secured with bands located at circumferential laps and at not more than 12 inch intervals throughout. Horizontal joints shall lap down to shed water and located at 4 or 8 o'clock position. Joints shall be sealed with caulking to prevent moisture penetration. Where jacketing abuts an un-insulated surface, joints shall be sealed with caulking.

3.3.5.3 Fittings

Fittings and other irregular shapes shall be finished as specified for rectangular ducts.

3.3.5.4 Rectangular Ducts

Two coats of weather barrier mastic reinforced with fabric or mesh for outdoor application shall be applied to the entire surface. Each coat of weatherproof mastic shall be 1/16 inch minimum thickness. The exterior shall be a metal jacketing applied for mechanical abuse and weather protection, and secured with screws.

3.3.5.5 Insulation for Hot Equipment

Insulation shall be furnished on equipment handling media above 60 degrees F including the following:

a. Converters.

b. Heat exchangers.

c. Hot water generators.

d. Water heaters.

-- End of Section --

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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

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SECTION 23 09 33.00 40

ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for controls and instrumentation for air handling equipment.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

TIA/EIA 862	Building Automation Systems Cabling Standard for Commercial Buildings

ISA - INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ISA 75	Valves
ISA 96	Actuators
ISA 20	Specification Forms
ISA 5	Documentation
ISA 99	Control System Security
ISA 101	Human Factors
ISA 18	Alarm Management
ISA 105	Commissioning

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.3	CSMA/CD (Ethernet-Based) LAN

UNDERWRITERS LABORATORIES (UL)

UL 916	Standard for Energy Management Equipment

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1	Standard for Industrial Control and Systems: General Requirements
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

1.3 SYSTEM DESCRIPTION

The NASA-Ames Facilities Management Control System (FMCS) is the only site-wide control system recognized by Ames. Its purpose is to provide for the remote control and monitoring of HVAC and other institutional equipment, and for the monitoring of critical environments Center-wide.

The FMCS is the only system recognized by the Ames Security Dispatch Office for alarm condition response, other than fire and security alarms, only alarms received on the FMCS will warrant notification of on-site and off-site personnel and/or dispatching maintenance/repair personnel 24 hours a day.

1.3.1 SYSTEM COMPONENTS

The FMCS at Ames is a configuration of Siemens Apogee hardware and software. The system front end is a Microsoft Windows based Server running Siemens Apogee software. The system also has multiple clients running Siemens Apogee software. Alarms under the FMCS are received by the Apogee server and in turn by the workstations attached to the server. The FMCS uses real time dynamic graphic displays for monitoring, control, report generation, and alarm acknowledgment functions.

a. Current System Layout

1. The FMCS utilizes networks of digital programmable controllers located in buildings around the Center. The controller configuration in each building is dependent on the monitoring and control requirements. The controllers share information with all the other controllers on the network and the server. The controller point and program databases are entered, deleted, or modified through operator workstations attached to the server.

2. Currently the FMCS is configured with four RS-485 communications trunks. FMCS panel types include Stand-Alone Control Units (SCU), Modular Building Controllers (MBC), Remote Building Controllers (RBC), and PXC Modular and Compact Controllers that interface with the server. The panels communicate via Apogee Protocol II. Secondary tier panels include Digital Point Unit (DPU), Multipoint Unit (MPU), Terminal Equipment Controller (TEC), and Bus Interface Modules (BIM). There are over 100 panels on the FMCS main Trunk lines with a combined control/monitoring task of over 6,000 physical points.

1.3.2 System Requirements

Provide automatic temperature control systems that are complete in all

details and that include all necessary accessories to maintain conditions indicated or specified.

Provide low-voltage electric automatic temperature control systems. As far as practical, provide control equipment that is the product of a single automatic control systems manufacturer. Provide automatic control systems components not the product of the control system manufacturer that are approved for use with the control system as indicated.

Provide automatically controlled valves to control environment that are furnished by the automatic control systems manufacturer. Control valve actuators must be compatible with automatic control systems manufacturer's equipment.

Provide automatically controlled dampers, independent of dampers integral with manufactured air-handling units, furnished by the automatic control systems manufacturer. Use a damper manufacturer that is licensed to display the AMCA seal. Damper actuators must be compatible with automatic control systems manufacturer's equipment.

Provide dual-duct system mixing boxes and air-mixing valve operators that are furnished by the automatic control systems manufacturer. Air-mixing valve operators must be compatible with automatic control systems manufacturer's equipment.

Submit Fabrication Drawings for control and instrumentation systems consisting of fabrication and assembly details to be performed in the factory.

Submit Operating Instructions for control and instrumentation consisting of standard operating procedures including startup, shutdown, prescribed periodic maintenance requirements, and emergency operation.

1.4 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors. Control panels shall not be located in areas which are not readily accessible.

Prior to making access to any existing Building Automation Control Panels or tying in any new Building Automation Control Panels the contractor must first contact the FMCS Operation Controls Center to gain access.

1.5 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Provide motors, controllers, disconnects and contactors that conform to and have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors are not permitted. Provide controllers and contactors that have a maximum of 120 volt control circuits, and have auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, include the cost of additional electrical service and related work under the section that specified that motor or equipment. Provide power wiring and conduit for field installed equipment under and conforming to the

requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

Intelligent controls which incorporate direct communications integration into the FMCS Field Panels shall whenever possible be compatible with the Siemens Apogee P1 FLN communication protocol. If other communications protocols are to be used (i.e. MODBUS, BACnet, etc.) a complete control scheme shall be provided and shall include memory maps and command interfaces in order to provide for complete integration. The Contractor shall be responsible for development of any new applications not currently available in the Siemens application library.

Interfaces to magnetic across the line controllers to the FMCS control panels must be isolated through an isolation relay or relays to provide "START" and "STOP" functionality.

PART 2 PRODUCTS

2.1 GENERAL

All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 MATERIALS AND EQUIPMENT

Materials shall be new, the best of their respective kinds without imperfections or blemishes, and shall not be damaged in any way. Used equipment shall not be used in any way for the permanent installation except where Drawings or Specifications specifically allow existing materials to remain in place.

2.3 UNIFORMITY

To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer.

2.4 CONTROL COMPONENTS

2.4.1 Temperature Sensors

Provide temperature sensors, sensor transmitters, and controller output signals that are directly proportional to the variations in the measured variable. Provide linearity that is within plus or minus 1/2 percent for a 200-degree-F span, and plus or minus 1/2 percent for a 50-degree-F span, throughout the scale range.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
QAA2072.WNU	Siemens	20-120oF Room temp sensor 4-20ma o/p
533-376-4	Siemens	4" Duct Air Temperature Fixed Point Sensor 20-120oF 4-20ma o/p
533-376-8	Siemens	8" Duct Air Temperature Fixed Point Sensor 20-120oF 4-20ma o/p
533-376-18	Siemens	18" Duct Air Temperature Fixed Point Sensor 20-120oF 4-20ma o/p
535-490-18	Siemens	18" Duct Air Temperature Averaging Sensor 20-120oF 4-20ma o/p
536-768	Siemens	Outside Air Temperature Sensor
536-767-25	Siemens	Immersion Temp Sensor 2.5" Probe

		30o-250oF 4-20ma o/p
536-767-40	Siemens	Immersion Temp Sensor 4.0" Probe 30o-250oF 4-20ma o/p
536-767-60	Siemens	Immersion Temp Sensor 6.0" Probe 30o-250oF 4-20ma o/p
536-780	Siemens	Surface Mount Temp Sensor 30o-250oF 4-20ma o/p

2.4.2 Humidity Sensors

Provide humidity sensors, sensor transmitters, and controller output signals that are directly proportional to the variations in the measured variable. Provide linearity that is within plus or minus 5 percent for a 100-percent relative humidity span. Provide element that is capable of withstanding 98 percent relative humidity without loss of calibration when humidity sensor is duct-mounted downstream from a cooling coil.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
QFA2001	Siemens	Room Humidity Sensor 0-100% 4-20ma o/p
QFM2101	Siemens	Duct Humidity Sensor 4-20ma o/p
QFA3101	Siemens	Outdoor Humidity Sensor 4-20ma o/p

2.4.3 Space Thermostats

2.4.3.1 Electrical Control

Provide low-voltage type space thermostat with non-setback/setup or setback/setup temperature control for cooling only, heating only or cooling and heating. Provide thermostat that conforms to NEMA DC 3, and is as indicated.

2.4.4 Building Static-Pressure Transmitter

Provide a double-bell, differential type building static-pressure transmitter with temperature compensation. Provide scale range of -/+0.25 inch water gage (wg), and sensitivity within plus or minus .005 inch wg. Provide transmitter that transmits an electronic or pneumatic signal to an indicating receiver with a matched scale range.

Provide a total system accuracy of not less than 0.4%.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
26412R5WD11T1C	Siemens	Differential Press Sensor w/transducer 0-2.5"wc 4-20ma o/p
2641R25WB11T1C	Siemens	Differential Press Sensor w/transducer +/-.25"wc 4-20ma o/p

2.4.5 Pressure Transmitter

Provide the indicating type pressure transmitters for gas, liquid, or steam service. Provide transmitter range suitable for system operating characteristics. Provide output that is proportional to system pressure and is electronic or pneumatic. Provide indicating receiver with a matched scale range.

Provide total system accuracy that is not less than +/-0.3 percent of system range.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
7MF15644BA003EA1	Siemens	Press Sensor 0-10 psi 4-20ma o/p
7MF15644BB003EA1	Siemens	Press Sensor 0-15 psi 4-20ma o/p
7MF15644BD003EA1	Siemens	Press Sensor 0-20 psi 4-20ma o/p
7MF15644BE003EA1	Siemens	Press Sensor 0-30 psi 4-20ma o/p
7MF15644BF003EA1	Siemens	Press Sensor 0-60 psi 4-20ma o/p
7MF15644BG003EA1	Siemens	Press Sensor 0-100 psi 4-20ma o/p
7MF15644CA003EA1	Siemens	Press Sensor 0-150 psi 4-20ma o/p
7MF15644CB003EA1	Siemens	Press Sensor 0-200 psi 4-20ma o/p
7MF15644CD003EA1	Siemens	Press Sensor 0-300 psi 4-20ma o/p

2.4.6 Remote Pressure Transmitter

Provide pressure sensors for gas, liquid, or steam service remote indication that are pressure-to-current type. Provide direct current output and power supply that is compatible with the remote readout indicator.

2.4.7 Remote Element Instruments

Provide remote element instruments that have sufficient length of capillary to mount the instrument on the control panel in an accessible location. Provide excess capillary that is coiled and concealed. Provide armored capillary where indicated.

2.4.8 Airflow Switches

Provide UL approved airflow switches, with pressure range of 0.12 to 10 inches wg, and electrical rating of 110 volts ac, 10 ampere and 3/4 horsepower ac pilot duty.

2.4.9 Pneumatic Relays

Provide positive-acting direct relays.

2.4.10 Switches

Provide switches as indicated.

Provide adjustable switches with indicating plates and accessible adjustment. Calibrate and mark minimum-positioning switches that control dampers in percent of maximum airflow determined by airflow test.

2.4.11 Voltage to Pneumatic Transducers

Provide transducers capable of operation utilizing a 20 - 30 VAC 60 HZ power and 20 - 30 psi control air and capable of providing a proportional 3 - 15 psi output signal with a 0-10VDC input control signal. Linearity of +/- 1%. Transducer shall be equipped with a pressure gauge to indicate output pressure accuracy within 2% of total scale range in middle portion of scale and 3% elsewhere.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
CP-8511-024	Kele	Voltage to pressure transducer
PXP2.3LG	Automation Components, Inc.	Voltage to pressure transducer

2.5 CONTROL SYSTEM VALVE AND DAMPER OPERATORS

2.5.1 Operators

Provide motor operators that provide smooth proportional control under operating conditions normal to the system.

Provide spring-return operators for two-position control.

Provide spring returns on reversible operators where required for fail-safe operation.

For operators operating in sequence with other operators, provide operators that have adjustable operating ranges and set points.

Provide operators that have sufficient power on closeoff to provide tight sealing against maximum system pressures.

Provide operators that close valves and dampers to fail-safe position indicated.

2.5.2 Dampers

Provide dampers that are equipped with operators of sufficient power to control dampers, without flutter or hunting, through the entire operating range at air velocities at least 20 percent greater than maximum design velocity.

2.5.3 Pneumatic Operators

Provide positioners where two or more operators are controlled from the same controller, and where indicated. Mount positioners directly on the driven device. Provide feedback from the stem or rod through a pilot spring. Provide adjustable starting point from 3 to 8 psi. Provide adjustable operating span from 5 to 13 psi.

2.5.4 Electric Operators

Provide reversible type electric motor operators for modulating control.

Provide split-phase type electric motor operators with oil-immersed gear train. Provide motor that has ample capacity to handle applied loads under operating conditions normal to the system. Heat locations where temperatures fall below minimum operating temperature of operator.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
GMA163.1P	Siemens	62 lb-in damper actuator 0-10VDC modulating
GCA161.1P	Siemens	142 lb-in damper actuator 0-10VDC modulating

2.6 HARDWARE

The controllers shall only be manufactured by Siemens, and shall be of the Apogee System product line. This includes the PXC Modular, PXC Compact or Modular Building Controller (MBC), which is the basic element for every building configuration.

2.6.1 PXC Modular

The PXC Modular (Programmable Controller - Modular) is an integral part of the APOGEE Automation System. It is a high performance, modular Direct Digital Control (DDC) supervisory field panel.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
PXC100-PE96.A	Siemens	PXC Modular, RS-485 or Ethernet ALN, TX-I/O Support, 96 FLN nodes, APOGEE Firmware

2.6.2 TX-I/O Modules

TX-I/O Modules are modular expansion I/O consisting of an electronics module and terminal base. The electronics modules perform A/D or D/A conversion, signal processing, and point monitoring and command output through communication with the PXC Modular. The terminal bases provide for termination of field wiring and connection of a self-forming bus.

a. PXC Modular Expansion Module provides the hardware connection for Field Level Network (FLN) devices. Using the Triple RS-485 Expansion Module, the PXC Modular supports up to three RS-485 networks of Field Level Network devices.

   Standard Products used at NASA Ames

Part Number	Manufacturer	Description
PXX-485.3	Siemens	PXC Modular Expansion Module

b. 16 Digital Input Modules are dedicated to monitoring 16 digital input points. They monitor status signals from normally open (NO) or normally closed (NC), latched voltage free/dry contacts. The first 8 bits of the 16 points on the TXM1.16D module may be used as pulse counters up to 10 Hz. Each input point has a green LED for status indication.

   Standard Products used at NASA Ames

Part Number	Manufacturer	Description
TXM1.16D	Siemens	Digital Input Module

c. Digital Output Modules provide six NO or NC (form C), maintained or pulsed, voltage free/dry contacts. The contacts are rated for a maximum of 250 Vac at 4A. Each I/O point has a green LED for status indication.

   Standard Products used at NASA Ames

Part Number	Manufacturer	Description
TXM1.6RM	Siemens	Digital Output Module

d. Super Universal Modules allow each of their 8 points to be individually software configured as digital input, analog input, or analog output to best meet the specific application needs.

   Standard Products used at NASA Ames

Part Number	Manufacturer	Description
TXM1.8X-ML	Siemens	Super Universal Module

e. TX-I/O Power Supply generates 24 Vdc at 1.2A to power TX-I/O modules and peripheral devices.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
TXS1.12F4	Siemens	TX-I/O Power Supply

f. Bus Connection Module transfers 24 Vac at 4A to power TX-I/O modules and peripheral devices.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
TXS1.EF4	Siemens	Bus Connection Module

g. P1 Bus Interface Module (P1 BIM) provides P1 FLN communication and power for TX-I/O modules. It does not contain application or control for the TX-I/O modules.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
TXB1.P1	Siemens	P1 Bus Interface Module

2.6.3 PXC Compact

The PXC Compact Series (Programmable Controller-Compact) is a high-performance Direct Digital Control (DDC) supervisory equipment controller, which is an integral part of the APOGEE Automation System.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
PXC36-PEF.A	Siemens	PXC Compact, 36 point, Ethernet/ IP or RS-485 ALN, Island Bus, P1 FLN

2.7 HARDWARE

The controllers shall only be manufactured by Siemens, and shall be of the Apogee System product line. This includes the PXC Modular, PXC Compact or Modular Building Controller (MBC), which is the basic element for every building configuration.

2.7.1 PXC Modular

The PXC Modular (Programmable Controller - Modular) is an integral part of the APOGEE Automation System. It is a high performance, modular Direct Digital Control (DDC) supervisory field panel.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
PXC100-PE96.A	Siemens	PXC Modular, RS-485 or Ethernet ALN, TX-I/O Support, 96 FLN nodes, APOGEE Firmware

2.7.2 TX-I/O Modules

TX-I/O Modules are modular expansion I/O consisting of an electronics module and terminal base. The electronics modules perform A/D or D/A conversion, signal processing, and point monitoring and command output through communication with the PXC Modular. The terminal bases provide for termination of field wiring and connection of a self-forming bus.

a. PXC Modular Expansion Module provides the hardware connection for Field

Level Network (FLN) devices. Using the Triple RS-485 Expansion Module, the PXC Modular supports up to three RS-485 networks of Field Level Network devices.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
PXX-485.3	Siemens	PXC Modular Expansion Module

b. 16 Digital Input Modules are dedicated to monitoring 16 digital input points. They monitor status signals from normally open (NO) or normally closed (NC), latched voltage free/dry contacts. The first 8 bits of the 16 points on the TXM1.16D module may be used as pulse counters up to 10 Hz. Each input point has a green LED for status indication.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
TXM1.16D	Siemens	Digital Input Module

c. Digital Output Modules provide six NO or NC (form C), maintained or pulsed, voltage free/dry contacts. The contacts are rated for a maximum of 250 Vac at 4A. Each I/O point has a green LED for status indication.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
TXM1.6RM	Siemens	Digital Output Module

d. Super Universal Modules allow each of their 8 points to be individually software configured as digital input, analog input, or analog output to best meet the specific application needs.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
TXM1.8X-ML	Siemens	Super Universal Module

e. TX-I/O Power Supply generates 24 Vdc at 1.2A to power TX-I/O modules and peripheral devices.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
TXS1.12F4	Siemens	TX-I/O Power Supply

f. Bus Connection Module transfers 24 Vac at 4A to power TX-I/O modules and peripheral devices.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
TXS1.EF4	Siemens	Bus Connection Module

g. P1 Bus Interface Module (P1 BIM) provides P1 FLN communication and power for TX-I/O modules. It does not contain application or control for the TX-I/O modules.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
TXB1.P1	Siemens	P1 Bus Interface Module

2.7.3 PXC Compact

The PXC Compact Series (Programmable Controller-Compact) is a

high-performance Direct Digital Control (DDC) supervisory equipment controller, which is an integral part of the APOGEE Automation System.

Standard Products used at NASA Ames

Part Number	Manufacturer	Description
PXC36-PEF.A	Siemens	PXC Compact, 36 point, Ethernet/IP or RS-485 ALN, Island Bus, P1 FLN.

PART 3 EXECUTION

3.1 INSTALLATION

Install control components using qualified control and instrumentation specialists working under the direction of the manufacturer's representative.

Provide Listing of Product Installations for controls and instrumentation systems.

a. Installation work will be coordinated with the FMCS System Manager.

b. When hardware is ready to be tied into FMCS network, the FMCS Operation Center shall be contacted.

3.1.1 Hardware

a. All installations will occur at the NASA-Ames Research Center. Software installations shall occur at the FMCS Host computer.

b. Persons performing the installations shall have the following qualifications pertaining to the work they will provide:

   1. For Hardware - At least two years of experience installing Direct Digital Control (DDC) equipment, including two projects in which Siemens Building Automation systems were installed.

   2. For Software - At least one year of experience installing Siemens Apogee System software, including three projects in which Graphics, point database and PPCL files were installed on a networked Apogee system.

   3. Personnel must be approved to work on the FMCS by the FMCS System Manager before installation.

c. Installations will be accomplished with the rest of the FMCS remaining on-line. Any work that may interface with day-to-day operations by NASA-Ames personnel assigned to the FMCS shall be scheduled with the FMCS System Manager before starting work.

d. All FMCS Panels shall be equipped with proper surge protection.

e. New panels shall be connected in a 4-wire true daisy-chain scheme to the existing FMCS P2 trunk network. No T-tap is allowed for adding new panels into the network. New panel addressing shall be approved by the FMCS System Manager before the start of work. If new panels are installed in facilities where the ARCLAN exists panels shall be connected to the SCADANet (VLAN on ARCLAN).

f. Power Requirements - FMCS panels will be placed on dedicated circuits

on the EMERGENCY POWER DISTRIBUTION SYSTEM and separate from any other building equipment.

g. Multiple FMCS panels may be placed on one circuit that supplies each panel with the design power requirements of 3 A ac at 120 V ac.

h. Control transformers for Digital Output Points in FMCS panels and FIP equipment may be placed on circuit with FMCS panels (as long as power requirements are met).

i. The Contractor shall place labels on FMCS panels and control transformers indicating circuit breaker location.

j. A three-wire, earth ground circuit is required for FMCS panels. The ground wire shall be attached to the ground bus at the circuit breaker panel. Grounding by the conduit alone is not acceptable.

k. Device Wiring - Digital Output Points will be wired "Normally Closed" for equipment that will run in the event of a FMCS panel failure.

l. Alarmable Digital Input points shall be wired "Normally Closed" for their non-alarming state unless approved otherwise by the FMCS System Manager.

m. Analog Input and Telecommunications wiring will use white wire leads for positive terminals and black for common or signal terminals if Belden 8760 is used. If other colors are to be used, coordinate wiring convention with FMCS System Manager.

n. Wiring shall be labeled and a listing of wire assignments given to the FMCS System Manager at completion of installation.

o. Wiring shall be continuous with no splices.

3.1.2 SOFTWARE

a. All programming including, but not limited to, point database entry, graphic display entry, and PPCL control programming will be accomplished at the operator console in Building 510, Room 108A, FMCS Control Room, NASA-Ames Research Center, Moffett Field, California.

b. Point Database Files.

1. Cabinet addressing assignments for new FMCS Panels will be made by the FMCS System Manager.

2. Every point that has a physical termination shall be entered into the FMCS point database. Every point that does not have a physical termination (Virtual Point) but is required for operation shall be entered into the system. Alarm configuration and destinations will also be entered if the point is alarmable. For point naming convention see section 3.7 b.

3. Any alarmable or commandable point shall appear on a dynamic graphic display. The graphic display will be diagrammatic of the equipment or space being monitored/controlled new building installations will require a package of graphics including the building footprint graphic and subsystem graphics. Subsystem graphics of air handlers, cooling plants, cooling towers, and

heating plants will have the outside air temperature displayed.

c. PPCL control programming shall be fully commented, explaining what each group of related program lines is doing, especially if a predefined Equipment Sequence of Operation is being programmed. All FMCS Panel programs will be optimized to minimize unnecessary network communications between the server and other FMCS Panels on the network. Points involved in the program will be listed and defined at the beginning of the program. PPCL files written to control/monitor physical points shall reside in the same panel as the points. Subroutines should be used only when many redundant program lines would be needed otherwise. Communication across trunks though the Apogee server is prohibited.

3.2 CONTROL- AND INSTRUMENT-AIR TUBING INSTALLATION

Conceal tubing, except in mechanical rooms or areas where other piping is exposed.

Neatly nest multiple tube runs.

Mechanically attach tubing to supporting surfaces. Supporting adhesives are not acceptable. See additional requirements under Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT.

Purge tubing with dry, oil-free compressed air to rid system of impurities generated during joint making and installation and to remove atmospheric moisture before connecting control instruments.

3.2.1 Copper Tubing

Cut tubing with mechanical joints square and remove burrs. Do not work-harden copper surfaces. Cut off or anneal tube ends by heating and air cooling in accordance with the manufacturer's instructions.

Cut copper tubing for solder joints square and remove burrs. Clean inside surfaces of fittings and outside surfaces of tubes in joint area before assembly of joint. Apply joint flux, filler material, and heat source in accordance with the manufacturer's instructions. Provide valves in copper piping that have screwed ends with end adaptors to suit mechanical connections, unless solder jointing is otherwise indicated. Remake copper joints that fail pressure tests with new materials, including pipe or tubing fittings and filler metal.

Use hard-drawn copper tubing in all exposed areas. Use hard drawn or annealed tubing where tubing is concealed.

Provide wrought-copper solder-joint type fittings for supply system copper tubing except at connection to apparatus where using specified brass mechanical and ips thread-adapter fittings. Tool-made bends in copper tubing are acceptable in lieu of fittings.

Provide copper tubing horizontal supports for less than three tubes that are rigid 1- by 3/8 inch metal channel and are proprietary metal tube race for three or more tubes.

3.2.2 Plastic Tubing

Use plastic tubing, sheathed, except as otherwise indicated, in lieu of, or

in conjunction with, copper tubing upon prior approval, provided:

Tubing is not exposed to ultraviolet light or continuous ambient temperatures in excess of 120 degrees F at any point along run.

Tubing is free from danger of mechanical damage and readily accessible for replacement with a minimum of tools and without need to remove plaster, furring, equipment, or similar permanent construction.

Tubing is enclosed within conduit or control panel cabinets, or is concealed behind control panels.

Provide color coded or number coded plastic tubing, installed inside or behind control panels. Neatly tie and support tubing. Neatly fasten flexible connections bridging the cabinet and cabinet door along the hinge side and protect against abrasion.

Run plastic tubing, in mechanical rooms or in spaces where copper tubing is exposed, within adequately supported metal raceways or in metallic or plastic electric conduit.

Use multiple-tube plastic harness or sheathing in place of single plastic tubes where a number of plastic tubes run to the same point, unless such use is otherwise prohibited.

Use fittings for plastic tubing in accordance with the manufacturer's instructions.

Provide terminal single lines made of hard-drawn copper tubing, except that where the run is less than 12 inches, use plastic tubing.

3.3 VIBRATION ISOLATION

To prevent vibration, isolate controllers by location or by mounting devices supplied by the equipment manufacturer.

Install tubing and conduit to prevent the transmission of equipment vibration. Mount single tube runs in aircraft-type clamps containing an elastomer insert, preventing contact with ducting or air handling unit housing, casing, or enclosure. Provide multiple runs that conform to the same isolation requirements, but submit mounting details for approval. Refer to Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT for vibration isolation considerations.

3.4 FIELD QUALITY CONTROL

Perform PT&I tests and provide submittals as specified in Section 01 86 12.07 40 RELIABILITY CENTERED ACCEPTANCE FOR MECHANICAL SYSTEMS.

Perform Test reports in accordance with referenced standards in this section.

After the inspection has been completed, check systems for continuity.

After completion of control and instrument piping, test and adjust control equipment in terms of design, function, systems balance, and performance, and otherwise make ready for air handling systems acceptance tests. Provide data showing set points and final adjustments of controls.

After air handling system acceptance and after the systems have operated in normal service for 2 weeks, check the adjustment on instruments and devices. Correct items found to be out of order. When air handling systems are in specified operating condition and when all other pertinent specifications requirements have been met, automatic temperature-control systems are acceptable.

Test pneumatic systems in accordance with ISA 7.0.01. Provide system pressure that does not exceed 30 psig.

Provide equipment to check the calibration of instruments. Recalibrate or replace instruments not in calibration.

3.5 OPERATOR TRAINING

Provide written operating instructions and not less than 8 hours of operator training.

Provide classroom and field instructions in operation and maintenance of systems equipment where required by the technical provisions. If operational requirements require the use of special tools or software to make access to controls training will provide hands on training with the tools or software. Training will also cover all required preventive maintenance required for the equipment. Direct these services using the manufacturer's factory trained personnel or qualified representative. Give the COR a minimum of 7 calendar days written notice of scheduled instructional services. Make instructional materials belonging to the manufacturer or vendor available to the COR.

3.6 SPECIAL TOOLS AND SOFTWARE

Provide special tools as required for the operation and adjustment of controllers, instruments, or other control system devices. If adjustments, calibration or routine maintenance requires the use of Software, that is not already in the possession of the government, the Contractor will provide a minimum of 1 copy the required software. This will include any special software required to setup, program or adjust equipment.

3.7 OPERATION AND MAINTENANCE

Provide Operation and Maintenance Manuals that are consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions.

a. Wiring Methods

All wiring shall be run in rigid or flexible conduit, metallic tubing, or in covered metal raceways.

Signal wiring shall be twisted shield pair. Digital signals shall have shields grounded at the signal source; analog signals shall have their shields grounded in the panel.

Conduit fittings and junction box covers shall be painted blue.

b. Signal Naming Convention

Naming convention at NASA AMES SYSTEM NAME

Since all NASA Buildings start with 2 it is dropped and the first two letters of the SYSTEM NAME are used to designate the building.

A - 0
B - 1
C - 2
D - 3
E - 4
F - 5
G - 6
H - 7
I - 8
J - 9

If a building is an Annex to an existing building the first letter of the SYSTEM NAME will be as follows:

K - 0
L - 1
M - 2
N - 3
O - 4
P - 5
Q - 6
R - 7
S - 8
T - 9

Examples: N240A SYSTEM NAME starts with OA
N233A SYSTEM NAME starts with ND

The remaining 4 to 6 digits are used as a descriptor

232 Hot Water Pump 2 Proof would be
DCHWP2
232 AHU 1 SAT
DCA1ST

c. Name

The point name is an English description of the point function. Point names start with the building number to which they are associated followed by a description.

232 AHU 1 SAT

d. Descriptor

The Descriptor starts with an alarm priority code: C for Critical Alarms, M for Maintenance Alarms and 0 for non-alarming point. This is followed by the SYSTEM NAME. The final part of the descriptor is the point type: LDI (logical digital in), LDO (logical digital out), LAI (logical analog in), LAO (logical analog out), VDI (virtual digital in), VDO (virtual digital out), VAI (virtual analog in) and VAO (virtual analog out).

232 AHU 1 SAT
C.DCA1ST.LAI

-- End of Section --

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DIVISION 26 - ELECTRICAL

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SECTION 26 00 00.00 20

BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for electrical general requirements, complete.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM D 709	Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	National Electrical Safety Code
IEEE C57.12.28	Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ADDITIONAL SUBMITTALS INFORMATION

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

1.4.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.4.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.5 QUALITY ASSURANCE

1.5.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the COR. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of CEC and NFPA 70 unless more stringent requirements are specified or indicated.

1.5.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same

class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.5.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.7 POSTED OPERATING INSTRUCTIONS

Provide principal items of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.8 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.9 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment

enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.10 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, CEC and NFPA 70, and requirements specified herein.

1.11 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with equipment or system. When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instructions to acquaint the operating personnel with the changes or modifications.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements specified in the technical sections.

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in the section specifying the associated electrical equipment.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

-- End of Section --

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SECTION 26 05 00.00 40

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for common to all electrical sections.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM D 709	Laminated Thermosetting Materials

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 480	Toggle Switches

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.12.28	Standard for Pad-Mounted Equipment - Enclosure Integrity
IEEE C57.12.29	Standard for Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments
IEEE Stds Dictionary	IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1	Accessible and Usable Buildings and Facilities

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI Z535.1	American National Standard for Safety--Color Code

ANSI/NEMA FB 1	Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
ANSI/NEMA OS 1	Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
ANSI/NEMA OS 2	Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA KS 1	Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA PB 1	Panelboards
NEMA RN 1	Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA VE 1	Standard for Metal Cable Tray Systems
NEMA WD 1	Standard for General Color Requirements for Wiring Devices
NEMA WD 6	Wiring Devices Dimensions Specifications

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1	Standard for Flexible Metal Conduit
UL 1242	Standard for Electrical Intermediate Metal Conduit -- Steel
UL 489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 506	Specialty Transformers
UL 6	Electrical Rigid Metal Conduit-Steel

UL 797	Electrical Metallic Tubing -- Steel
UL 870	Standard for Wireways, Auxiliary Gutters, and Associated Fittings

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Stds Dictionary.

b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

c. Vertical assembly: A vertical assembly is a pole, tower or other such support, mounting hardware, arms, brackets and the load. Load can be a luminaire, siten, loudspeaker or other device. All components of a vertical assembly will be rated by the manufacturer to withstand 85 mph wind loading.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixture Lists for the following:

Conduits, Raceway sand Fittings

Wire and Cable

Splices and Connectors

Switches

Receptacles

Outlets, Outlet Boxes, and Pull Boxes

Circuit Breakers

Panelboards

Lamps and Lighting Fixtures

Dry-Type Distribution Transformers

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

Conduits, Raceway sand Fittings

Wire and Cable

Splices and Connectors

Switches

Receptacles

Outlets, Outlet Boxes, and Pull Boxes

Circuit Breakers

Panelboards

Lamps and Lighting Fixtures

Dry-Type Distribution Transformers

Spare Parts

Certification

Submittal for vertical assemblies will be reviewed by a licensed Mechanical, Civil or Structural Engineer to determine that the entire assembly will withstand 85 mph wind loading.

SD-06 Test Reports

Continuity Test

Phase-Rotation Tests

Insulation Resistance Test

SD-08 Manufacturer's Instructions

Submit Manufacturer's Instructions.

1.5 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

1.6 PREVENTION OF CORROSION

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS. Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal,

protect by approved fittings and treatment. Ferrous metals such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous spare parts not of corrosion-resistant steel shall be hot-dip galvanized except where other equivalent protective treatment is specifically approved in writing.

1.7 GENERAL REQUIREMENTS

Submit material, equipment, and fixture lists for the following items showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Submit manufacturer's instructions including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

Submit certification required to install equipment components and system packages.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.

c. Safety precautions.

d. The procedure in the event of equipment failure.

e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and be secured to prevent easy removal or peeling.

1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall

be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

PART 2 PRODUCTS

2.1 MATERIALS

Materials and equipment to be provided shall be the standard cataloged products of manufacturers regularly engaged in the manufacture of the products.

2.1.1 Rigid Steel Conduit

Rigid steel conduit shall comply with UL 6 and be galvanized by the hot-dip process. Rigid steel conduit shall be polyvinylchloride (PVC) coated in accordance with NEMA RN 1, where underground and in corrosive areas, or must be painted with bitumastic.

Fittings for rigid steel conduit shall be threaded.

Gaskets shall be solid. Conduit fittings with blank covers shall have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Covers shall have captive screws and be accessible after the work has been completed.

2.1.2 Electrical Metallic Tubing (EMT)

EMT shall be in accordance with UL 797 and be zinc coated steel. Couplings and connectors shall be zinc-coated, raintight, gland compression with insulation throat. Crimp, spring, or setscrew type fittings are not acceptable.

2.1.3 Flexible Metallic Conduit

Flexible metallic conduit shall comply with UL 1 and be galvanized steel.

Fittings for flexible metallic conduit shall be specifically designed for such conduit.

Provide liquidtight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Specifically design fittings for liquidtight flexible metallic conduit for such conduit.

2.1.4 Intermediate Metal Conduit

Intermediate metal conduit shall comply with UL 1242 and be galvanized.

2.1.5 Rigid Nonmetallic Conduit

Rigid nonmetallic conduit shall comply with NEMA TC 2 and NEMA TC 3 with wall thickness not less than Schedule 40.

2.1.6 Wireways and Auxiliary Gutters

Wireway and auxiliary gutters shall be a minimum 4- by 4 inch trade size conforming to UL 870.

2.1.7 Surface Raceways and Assemblies

Surface metal raceways and multi-outlet assemblies shall conform to CEC and NFPA 70. Receptacles shall conform to NEMA WD 1, Type 5-20R.

2.1.8 Cable Trays

Provide ladder type cable trays conforming to NEMA VE 1.

2.2 WIRE AND CABLE

Conductors installed in conduit shall be copper 600-volt type THHN/THWN. All conductors AWG No. 8 and larger, shall be stranded.

Flexible cable shall be Type SO and contain a grounding conductor with green insulation.

Conductors installed in plenums shall be marked plenum rated.

Cable between variable frequency drives (VFD's) and motors shall be selected to maximize power transfer, reduce voltage amplification, reduce noise, and suppress over-voltages. Refer to VFD and motor manufacturer's recommendations.

2.3 SPLICES AND CONNECTORS

Make all splices in AWG No. 8 and smaller with approved indentor crimp-type connectors and compression tools.

Make all splices in AWG No. 6 and larger with indentor crimp-type connectors and compression tools or bolted clamp-type connectors. Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

2.4 SWITCHES

2.4.1 Safety Switches

Safety switches shall comply with NEMA KS 1, and be the heavy-duty type with enclosure, voltage, current rating, number of poles, and fusing as indicated. Switch construction shall be such that, when the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device shall be coinproof and be so constructed that an external tool shall be used to open the cover. Make provisions to lock the handle in the "OFF" position, but the switch shall not be capable of being locked in the "ON" position.

Provide switches of the quick-make, quick-break type. Approve terminal lugs for use with copper conductors.

Safety color coding for identification of safety switches shall conform to ANSI Z535.1.

2.4.2 Toggle Switches

Toggle switches shall comply with EIA 480, control incandescent, mercury, and fluorescent lighting fixtures and be of the heavy duty, general purpose, noninterchangeable flush-type.

Toggle switches shall be commercial grade toggle type, two-position devices rated 20 amperes at 277 volts, 60 hertz alternating current (ac) only.

All toggle switches shall be products of the same manufacturer.

2.5 RECEPTACLES

Receptacles shall be commercial grade, 20A, 125 VAC, 2-pole, 3-wire duplex conforming to NEMA WD 6, NEMA 5-20R.

2.6 OUTLETS, OUTLET BOXES, AND PULL BOXES

Outlet boxes for use with conduit systems shall be in accordance with ANSI/NEMA FB 1 and ANSI/NEMA OS 1 and be not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

2.7 PANELBOARDS

Lighting and appliance branch circuit panelboards shall be the circuit-breaker type in accordance with NEMA PB 1. Bolt circuit breakers to the bus. Plug-in circuit breakers are not acceptable. Buses shall be copper of the rating indicated, with main lugs or main circuit breaker as indicated. Provide all panelboards for use on grounded ac systems with a full-capacity isolated neutral bus and a separate grounding bus bonded to the panelboard enclosure. Panelboard enclosures shall be NEMA 250, Type 1, in accordance with NEMA PB 1. Provide enclosure fronts with latchable hinged doors.

Door-in-door hinged cover construction is preferred as long as the out door that exposes the panel interior can be opened 9only by removing four screws, one in each of the four corners. Knurled knobs that don't require tools to open the outer door will not be acceptable.

2.8 CIRCUIT BREAKERS

Circuit-breaker interrupting rating shall be not less than those indicated and in no event less than 42,000 and 22,000 amperes root-mean-square (rms) symmetrical at 208 and 480 volts, respectively. Multipole circuit breakers shall be the common-trip type with a single handle. Molded case circuit breakers shall be bolt-on type conforming to UL 489.

2.9 LAMPS AND LIGHTING FIXTURES

Manufacturers and catalog numbers shown are indicative of the general type desited and are not intended to restrict the selection to fixtures of any particular manufacturer. Fixtures with the same salient features and equivalent light distribution and brightness characteristics, of equal finish and quality, are acceptable. Provide lamps of the proper type and wattage for each fixture.

Ballasts shall be high power factor and be energy efficient. Ballasts shall have a Class P terminal protective device for 277-volt operation as indicated and be rapid-start fluorescent. Ballasts shall be "A" sound

rated. Fluorescent lamps shall be standard reduced wattage type.

High intensity discharge (HID) lighting fixtures shall have prewired integral ballasts and cast aluminum housings complete with tempered glass lenses suitable for installation in damp or wet locations. Provide fixtures and lamps.

2.10 DRY-TYPE DISTRIBUTION TRANSFORMERS

General purpose dry-type transformers with windings 600 volts or less shall be two-winding, 60 hertz, self-cooled in accordance with UL 506. Windings shall have a minimum of two 2-1/2-percent taps above and below nominal voltage.

PART 3 EXECUTION

3.1 CONDUITS, RACEWAYS AND FITTINGS

Conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Do not install crushed or deformed conduit. Avoid trapped conduit runs where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or be replaced.

Conduit and raceway runs concealed in or behind walls, above ceilings, or exposed on walls and ceilings 5 feet or more above finished floors and not subject to mechanical damage may be electrical metallic tubing (EMT).

3.1.1 Rigid Steel Conduit

Make field-made bends and offsets with approved hickey or conduit bending machine. Conduit elbows larger than 2-1/2 inches shall be long radius.

Provide all conduit stubbed-up through concrete floors for connections to free-standing equipment with the exception of motor-control centers, cubicles, and other such items of equipment, with a flush coupling when the floor slab is of sufficient thickness. Otherwise,provide a floor box set flush with the finished floor. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor.

3.1.2 Electrical Metallic Tubing (EMT)

EMT shall be grounded in accordance with CEC and NFPA 70, using pressure grounding connectors especially designed for EMT.

3.1.3 Flexible Metallic Conduit

Use flexible metallic conduit to connect recessed fixtures from outlet boxes in ceilings, transformers, and other approved assemblies.

Bonding wires shall be used in flexible conduit as specified in CEC and NFPA 70, for all circuits. Flexible conduit shall not be considered a ground conductor.

Electrical connections to vibration-isolated equipment shall be made with

flexible metallic conduit.

Liquidtight flexible metallic conduit shall be used in wet and oily locations and to complete the connection to motor-driven equipment.

3.1.4 Intermediate Conduit

Make all field-made bends and offsets with approved hickey or conduit bending machine. Use intermediate metal conduit only for indoor installations.

3.1.5 Rigid Nonmetallic Conduit

Rigid PVC conduit shall be direct buried.

A green insulated copper grounding conductor shall be in conduit with conductors and be solidly connected to ground at each end. Grounding wires shall be sized in accordance with CEC and NFPA 70.

3.1.6 Wireway and Auxiliary Gutter

Straight sections and fittings shall be bolted together to provide a rigid, mechanical connection and electrical continuity. Dead ends of wireways and auxiliary gutters shall be closed. Plug all unused conduit openings.

Wireways for overhead distribution and control circuits shall be supported at maximum 5-foot intervals.

Auxiliary gutters used to supplement wiring spaces for equipment not contained in a single enclosure shall contain no switches, overcurrent devices, appliances, or apparatus and be not more than 30 feet long.

3.1.7 Surface Raceways and Assemblies

Surface raceways shall be mounted plumb and level, with the base and cover secured. Minimum circuit run shall be three-wire with one wire designated as ground.

3.1.8 Cable Trays

Support cable trays from ceiling hangers, equipment bays, or floor or wall supports. Cable trays may be mounted on equipment racks. Provide support when the free end extends beyond 3 feet. Maximum support spacing shall be 6 feet. Trays 10-inches wide or less shall be supported by one hanger. Trays greater than 10-inches wide shall be supported by two hangers. Bond cable trays at splices.

3.2 WIRING

Feeder and branch circuit conductors shall be color coded as follows:

CONDUCTOR	208Y/120V	480Y/277V
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow

CONDUCTOR	208Y/120V	480Y/277V
Neutral	White	White
Equipment Grounds	Green or Bare	Green or Bare

Conductors up to and including AWG No. 2 shall be manufactured with colored insulating materials. Conductors larger than AWG No. 2 shall have ends identified with color plastic tape in outlet, pull, or junction boxes.

Splice in accordance with the CEC and NFPA 70. Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Terminal and conductor identification shall match as indicated.

Where several feeders pass through a common pullbox, the feeders shall be tagged to clearly indicate the electrical characteristics, circuit number, and panel designation.

3.3 SAFETY SWITCHES

Securely fasten switches to the supporting structure or wall, utilizing a minimum of four 1/4 inch bolts. Do not use sheet metal screws and small machine screws for mounting. Do not mount switches in an inaccessible location or where the passageway to the switch may become obstructed. Mounting height shall be 5 feet above floor level, when possible. Label switch with panel and circuit number that supplies it.

3.4 WIRING DEVICES

3.4.1 Wall Switches and Receptacles

Install wall switches and receptacles so that when device plates are applied, the plates will be aligned vertically to within 1/16 inch.

Ground terminal of each flush-mounted receptacle shall be bonded to the outlet box with an approved green bonding jumper when used with dry wall type construction.

3.4.2 Device Plates

Device plates for switches that are not within sight of the loads controlled shall be suitably engraved with a description of the loads.

Device plates and receptacle cover plates for receptacles other than 125-volt, single-phase, duplex, convenience outlets shall be suitably marked, showing the circuit number, voltage, frequency, phasing, and amperage available at the receptacle. Required marking shall consist of a self-adhesive label having 1/4 inch embossed letters.

Device plates for convenience outlets shall be similarly marked indicating the supply panel and circuit number.

3.5 BOXES AND FITTINGS

Furnish and install pullboxes where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right-angle bends shall have a pullbox installed at a convenient intermediate location. Label boxes with panel and circuit(s)

that supply it.

Securely mount boxes and enclosures to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

Mounting height of wall-mounted outlet and switch boxes, measured between the bottom of the box and the finished floor, shall be in accordance with ICC/ANSI A117.1 and as follows:

LOCATION	MOUNTING HEIGHT
Receptacles in offices	18 inches
Receptacles in corridors	18 inches
Receptacles in shops and laboratories	48 inches
Receptacles in rest rooms	48 inches
Switches for light control	48 inches

3.6 LAMPS AND LIGHTING FIXTURES

Install new lamps of the proper type and wattage in each fixture. Securely fasten fixtures and supports to structural members and install parallel and perpendicular to major axes of structures.

3.7 PANELBOARDS

Securely mount panelboards so that the top operating handle does not exceed 72-inches above the finished floor. Do not mount equipment within 36 inches of the front of the panel. Directory card information shall be complete and legible.

3.8 DRY-TYPE DISTRIBUTION TRANSFORMERS

Connect dry-type transformers with flexible metallic conduit.

Mount all dry-type transformers on vibration isolators in accordance with Section 23 05 48.00 40 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT.

3.9 IDENTIFICATION PLATES AND WARNINGS

Furnish and install identification plates for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, door bells, pilot lights, disconnect switches, manual starting switches, and magnetic starters. Process control devices and pilot lights shall have identification plates.

Furnish identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. Circuits 480 volts and above shall have conspicuously located warning signs in accordance with OSHA requirements.

3.10 PAINTING

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks shall be thoroughly cleaned and painted as specified in Section 09 90 00 PAINTS AND COATINGS or Section 09 96 00 HIGH-PERFORMANCE COATINGS.

3.11 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Submit Test Reports in accordance with referenced standards in this section.

After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

Contractor shall provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices shall be used to isolate the circuits under test.

Perform insulation-resistance test on each field-installed conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values shall not be less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable. For circuits with conductor sizes 8AWG and smaller insulation resistance testing is not required.

Perform continuity test to insure correct cable connection (i.e correct phase conductor, grounded conductor, and grounding conductor wiring) end-to end. Any damages to existing or new electrical equipment resulting from contractor mis-wiring will be repaired and re-verified at contractor's expense. All repairs shall be approved by the CO prior to acceptance of the repair.

Conduct phase-rotation tests on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment clockwise, facing the source. Label phase rotation on rotating equipment covers.

Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the CO.

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SECTION 26 05 48.00 10

SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for seismic protection of electrical equipment, conduit, and exterior utilities.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325	Steel Construction Manual

ASTM INTERNATIONAL (ASTM)

ASTM E 580/E 580M	Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	Minimum Design Loads for Buildings and Other Structures
CBC	California Building Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1598	Luminaires

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the electrical equipment and systems listed below.

1.3.2 Electrical Equipment

Electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

Control Panels	Air Handling Units
Pumps with Motors	Switchgear
Light Fixtures	Transformers
Motor Control Centers	Storage Racks
Switchboards (Floor Mounted)	Solar Heating Units

1.3.3 Contractor Designed Bracing

Submit copies of the Design Calculations with the Drawings. Calculations shall be approved, certified, stamped and signed by a Registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace. Design the bracing in accordance with UFC 3-310-04 and additional data furnished by the COR. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. UFC 3-310-04 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using UFC 3-310-04 are based on strength design; therefore, AISC 325 shall be used for the design.

1.3.4 Conduits Requiring No Special Seismic Restraints

Seismic restraints may be omitted from electrical conduit less than 2-1/2 inches trade size. All other interior conduit, shall be seismically protected as specified.

1.4 EQUIPMENT REQUIREMENTS

Submit detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail, indicating thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction. Submit copies of the design calculations with the detail drawings. Calculations shall be stamped by a California registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.4.1 Rigidly Mounted Equipment

Specific items of equipment to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in ASCE 7. Each item of rigid electrical equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

Engine-Generators
Transformers
Switch Boards and Switch Gears
Motor Control Centers

Free Standing Electric Motors

1.4.2 Nonrigid or Flexibly-Mounted Equipment

Specific items of equipment to be furnished shall be constructed and assembled to resist a horizontal lateral force of 2.2 times the operating weight of the equipment at the vertical center of gravity of the equipment.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting Fixtures in Buildings
Equipment Requirements

SD-03 Product Data

Lighting Fixtures in Buildings
Equipment Requirements
Contractor Designed Bracing

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 SWAY BRACES FOR CONDUIT

Conduit shall be braced as for an equivalent weight pipe in accordance with Section 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

3.2 LIGHTING FIXTURES IN BUILDINGS

Lighting fixtures and supports shall conform to the following:

3.2.1 Pendant Fixtures

Pendant fixtures shall conform to the requirements of UFC 3-310-04.

3.2.2 Ceiling Attached Fixtures

3.2.2.1 Recessed Fluorescent Fixtures

Recessed fluorescent individual or continuous-row mounted fixtures shall be supported by a seismic-resistant suspended ceiling support system built in accordance with Section 09 51 00 ACOUSTICAL CEILINGS. Seismic protection for the fixtures shall conform to the requirements of ASCE 7. Recessed lighting fixtures not over 56 pounds in weight may be supported by and attached directly to the ceiling system runners using screws or bolts, number and size as required by the seismic design. Fixture accessories, including louvers, diffusers, and lenses shall have lock or screw attachments.

3.2.2.2 Surface-Mounted Fluorescent Fixtures

Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system built in accordance with Section 09 51 00 ACOUSTICAL CEILINGS. Seismic protection for the fixtures shall conform to the requirements of ASCE 7.

3.2.3 Assembly Mounted on Outlet Box

A supporting assembly, that is intended to be mounted on an outlet box, shall be designed to accommodate mounting features on 4 inch boxes, plaster rings, and fixture studs.

3.2.4 Wall-Mounted Emergency Light Unit

Attachments for wall-mounted emergency light units shall be designed and secured for the worst expected seismic disturbance at the site.

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SECTION 26 05 71.00 40

LOW VOLTAGE OVERCURRENT ELECTRICAL DEVICES

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for circuit breakers, fuses, motor controls, and control devices.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C39.1	Requirements for Electrical Analog Indicating Instruments

ASTM INTERNATIONAL (ASTM)

ASTM A167	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A48/A48M	Standard Specification for Gray Iron Castings
ASTM D 877	Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 443	NARM Standard for Solid State Relays Service

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C37.17	Standard for Trip Devices for AC and General-Purpose DC Low-Voltage Power Circuit Breakers
IEEE C37.90	Standard for Relays and Relay Systems Associated With Electric Power Apparatus
IEEE C57.13	Standard Requirements for Instrument

	Transformers
IEEE C63.2	Standard for Electromagnetic Noise and Field Strength Instrumentation, 10 Hz to 40 GHz - Specifications
IEEE C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

IPC - ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES (IPC)

IPC D330	Design Guide Manual

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1	Electric Meters Code for Electricity Metering
ANSI C78.23	American National Standard for Incandescent Lamps - Miscellaneous Types
NEMA 107	Methods of Measurement of Radio Influence Voltage (RIV) of High-Voltage Apparatus (inactive)
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 3	Molded Case Circuit Breakers and Their Application
NEMA FU 1	Low Voltage Cartridge Fuses
NEMA ICS 1	Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	Enclosures

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 20	General-Use Snap Switches
UL 489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 50	Enclosures for Electrical Equipment,

Non-environmental Considerations

UL 508 Industrial Control Equipment

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Product Data Submittals

Prior to the beginning of construction, submit manufactures equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details.

Fuses
Motor Control
Instrument Transformers
Enclosures
Circuit Breakers
Control Devices
Time Switches
Protective Relays
Indicating Instruments
Indicating Lights

SD-02 Shop Drawings

Submit Connection Diagrams and Fabrication Drawings for the following items in accordance with paragraph entitled, "General Requirements," of this section.

Submit Installation drawings for the following items in accordance with the paragraph entitled, "Installation," of this section.

Control Devices
Protective Devices

SD-07 Certificates

Submit certificates for Circuit Tests on similar motor-control or submit motor-circuit protector (MCP) units under actual conditions in lieu of factory tests on the actual units provided. Also include dielectric tests.

SD-08 Manufacturer's Instructions

Submit manufacturer's instructions for the following items, including special provisions required to install equipment components and system packages. Provide detail on resistance impedances, hazards and safety precautions within the special notices.

Control Devices
Protective Devices

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for the following equipment:

Manual Motor Controllers
Magnetic Motor Controllers
Combination Motor Controllers
Circuit Breakers
Time Switches
Protective Relays
Indicating Instruments

1.4 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Connection Diagrams showing the relations and connections of control devices and protective devices by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit Fabrication Drawings for control devices and protective devices consisting of fabrication and assembly details to be performed in the factory.

PART 2 PRODUCTS

2.1 MOTOR CONTROL

Conform to NEMA ICS 1, NEMA ICS 2, and UL 508 for motor controllers. Provide controllers that have thermal overload protection in each phase.

2.1.1 Manual Motor Controllers

Provide full-voltage, manually operated manual motor controllers for the control and protection of single-phase 60-hertz ac fractional-horsepower squirrel-cage induction motors.

Provide single-throw, single- or double-pole, three-position controllers rated at not more than 1 horsepower at 115- and 230-volts single phase. Include a supporting base or body of electrical insulating material with enclosed switching mechanism, yoke, thermal overload relay, and terminal connectors. Provide controllers that clearly indicate operating condition: on, off, or tripped.

Provide toggle- or key-operated type manual motor controllers as indicated and arrange so that they are lockable with a padlock in the "OFF" position.

Provide recessed manual motor controllers for single-speed, fractional-horsepower squirrel-cage induction motors, that include a single controller and indicating light in a 4-inch square wall outlet box, for flush-wiring devices with matching corrosion-resistant steel flush cover plate. Provide surface-mounted manual motor controllers for single-speed, fractional-horsepower squirrel cage induction motors that include a single controller and indicating light in a NEMA 250, Type 1 (indoor) and Type 3R (outdoor) general-purpose enclosure.

Provide recessed and surface-mounted manual motor controllers for two-speed, fractional-horsepower squirrel-cage induction motors, that include two

controllers, two indicating lights, and a selector switch in a multiple-gang wall outlet box for flush-wiring devices, with matching corrosion-resistant steel flush-cover plate. Provide surface-mounted manual motor controllers for two-speed fractional-horsepower squirrel-cage induction motors, that include two controllers, two indicating lights, and a selector switch in a NEMA 250, Type 1 (indoor) and Type 3R (outdoor) general-purpose enclosure.

2.1.2 Magnetic Motor Controllers

2.1.2.1 Full-Voltage Controllers

Provide full-voltage, full magnetic devices in accordance with NEMA ICS 1, NEMA ICS 2, and UL 508for magnetic motor controllers for the control and protection of single- and three-phase, 60-hertz, squirrel-cage induction motors.

Provide operating coil assembly that operates satisfactorily between 85 and 110 percent of rated coil voltage. Provide 120 volts, 60 hertz motor control circuits.

Provide controller with two normally open and two normally closed auxiliary contacts rated per NEMA ICS 1 and NEMA ICS 2 in addition to the sealing-in contact for control circuits.

Provide solderless pressure wire terminal connectors for line-and load-connections to controllers.

Include three manual reset thermal overload devices for overcurrent protection, one in each pole of the controller. Provide thermal overload relays of melting-alloy or bimetallic nonadjustable type with continuous current ratings and service-limit current ratings, and with a plus or minus 15 percent adjustment to compensate for ambient operating conditions.

Provide an externally operable manual-reset button to re-establish control power to the holding coil of the electromagnet. After the controller has tripped from overload, ensure that resetting the motor-overload device does not restart the motor.

Provide enclosure in accordance with NEMA 250, Type 1 (indoor) and Type 3R (outdoor).

2.1.2.2 Reduced-Voltage Starters

Conform to the requirements for full-voltage controllers for reduced-voltage starters, except for voltage, and to the following additional requirements.

Fully protect the motor during all phases of motor starting with an overload device in each motor leg. Rate starter contacts to withstand the switching surges during selector to full voltage. Provide starter that contains the necessary sensing and timing devices to monitor motor operation and select the correct time for selector to full voltage.

Adequately ventilate resistors and autotransformers used for starting. Ventilate solid-state starters for starting cycles as well as any follow-on restart-run cycles. Operate external control circuits or solid-state starters at a maximum of 120 volts ac.

For solid-state starters, provide adjustable starting torque from 0 to 50 percent of applied voltage, minimum. Provide autotransformer starters with a minimum of three taps above 50 percent reduced voltage.

2.1.3 Combination Motor Controllers

Following requirements are in addition to the requirements specified for magnetic motor controller:

Provide combination motor controllers for the control and protection of single-and three-phase 60-hertz alternating-current squirrel-cage induction motors with branch-circuit disconnecting and protective devices in accordance with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

For combination motor controllers include magnetic motor controllers and molded-case circuit breakers or motor circuit protectors (MCP) in metal enclosures in accordance with NEMA 250 or motor-control center draw-out assemblies with control-power transformers, selector switches, pushbuttons, and indicating lights as follows:

Provide full-voltage, full-magnetic devices as specified in this section under paragraph entitled, "Remote-Control Station Enclosures." for magnetic motor controllers and enclosures.

Provide thermal-magnetic breakers as specified in paragraph entitled, "Manual Motor Controllers." for molded-case circuit breakers. Manufacturer's standard MCP may be used in lieu of molded-case circuit breakers.

Provide control-power transformers 120-volt ac maximum, selector switches, pushbuttons, and pilot lights as required.

Identify combination motor controllers with identification plates affixed to front cover of the controller.

2.1.3.1 Nonreversing Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For nonreversing combination motor controllers for the control and protection of single-speed squirrel-cage induction motors, include a magnetic controller with molded-case circuit breaker or MCP with selector switch or start/stop pushbutton and indicating light in the cover of the enclosure.

Provide rating of single-speed full-voltage magnetic controllers for nonplugging and nonjogging duty in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide wiring and connections for full-voltage single-speed magnetic controllers in accordance with NEMA ICS 1 and NEMA ICS 2.

2.1.3.2 Reversing Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For reversing combination motor controllers for the control and protection

of single-speed squirrel-cage induction motors, include two interlocked magnetic controllers with molded-case circuit breaker or MCP, with selector switch or forward/reverse/stop pushbutton and two indicating lights in the cover of the enclosure. Indicate with indicating lights the forward and reverse running connection of the motor controller.

Provide rating of single-speed full-voltage magnetic controllers for plug-stop, plug-reverse, or jogging duty in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide wiring and connections for full-voltage single-speed magnetic controllers in accordance with NEMA ICS 1 and NEMA ICS 2.

2.1.3.3 Two-Speed Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For two-speed combination motor controllers for the control and protection of single- and two-winding, two-speed, three-phase, squirrel-cage induction motors, include two magnetic controllers with molded-case circuit breaker or MCP, with selector switch or fast/slow/stop pushbutton and two indicating lights in the cover of the enclosure. Indicate with indicating lights the high- and low-speed running connection of the motor controller.

Provide rating of three-phase, two-speed, full-voltage, magnetic controllers for nonplugging and nonjogging duty for constant- and variable-torque motors in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide rating of three-phase, two-speed, full-voltage, magnetic controllers for nonplugging and nonjogging duty for constant-horsepower motors in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide rating of three-phase, two-speed, full-voltage, magnetic controllers for plug-stop, plug-reverse, or jogging duty for constant-torque, variable-torque, and constant horsepower motors in accordance with NEMA ICS 1 and NEMA ICS 2.

2.2 INSTRUMENT TRANSFORMERS

Comply with the interference requirements listed below, measured in accordance with IEEE C63.2, IEEE C63.4, and NEMA 107 for Instrument transformers.

Insulation Class, kV	Basic Insulation Level, kV	Preferred Nominal System Voltage, kV	Test Voltage for Potential Transformers, kV	Test Voltage for Current Transformers, kV	Radio Influence Voltage Level, Microvolts Dry Type	Radio Influence Voltage Level, Microvolts Oil Filled
0.6	10	.....	.....	0.76	250	250
1.2	30	0.208 0.416 0.832 1.04	0.132 0.264 0.528 0.66	0.76	250	250
2.5	45	2.40	1.52	1.67	250	250

Insulation Class, kV	Basic Insulation Level, kV	Preferred Nominal System Voltage, kV	Test Voltage for Potential Transformers, kV	Test Voltage for Current Transformers, kV	Radio Influence Voltage Level, Microvolts Dry Type	Radio Influence Voltage Level, Microvolts Oil Filled
5.0	60	4.16 4.80	2.64 3.04	3.34	250	250
8.7	75	7.20 8.32	4.57 5.28	5.77	250	250
15L or 15H	95-110	12.00 12.47 14.40	7.62 7.92 9.14	9.41	1000	250
25	150	23.00	14.60	15.70	2500	650
34.5	200	34.50	21.90	23.0	....	650
46	250	46.00	29.20	29.30	....	1250
69	350	69.00	43.80	44.00	....	1250
92	450	92.00	58.40	58.40	....	2500
115	550	115.00	73.40	73.40	....	2500
138	650	138.00	88.00	88.00	....	2500

2.2.1 Current Transformers

Provide current transformers that conform to IEEE C57.13 for installation in metal-clad switchgear. Use standard 5A secondary transformer.

Provide wound,bushing, bar, window type transformers, as shown on the drawings.

Provide transformers that have single or double secondary winding as shown on the drawings.

Provide transformers that are complete with secondary short-circuiting device.

For window-type current transformers, provide indoor dry type construction with secondary current ratings as indicated with specified burden, frequency, and accuracy.

2.2.2 Potential Transformers

For potential transformers, conform to IEEE C57.13 for installation in metal-clad switchgear. Use standard 120-volt secondary transformers.

Provide transformers that have single, tapped, double secondary, as shown on the drawings.

Provide burden, frequency, and accuracy as required.

For disconnecting potential transformers with integral fuse mountings and current-limiting fuses, provide indoor dry type two-winding construction with primary and secondary voltage ratings as required.

2.3 ENCLOSURES

2.3.1 Equipment Enclosures

Provide enclosures for equipment in accordance with NEMA 250.

Contain equipment installed in clean, dry, indoor locations in a NEMA Type 1, general-purpose sheet-steel enclosure.

Contain equipment installed in wet locations in a NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosure, constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 for Type 4 enclosures.

Contain equipment installed in unprotected outdoor locations in NEMA Type 3R weather-resistant sheet steel enclosures that are splashproof, weatherproof, sleetproof, and moisture resistant.

Contain equipment installed in industrial locations in a NEMA Type 12 industrial use, sheet-steel enclosure, constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

Contain equipment installed in Class I, Division I, Group A, B, C, and D, hazardous locations, in NEMA Type 7 enclosures approved for the specific flammable gas or vapor that is possibly present under normal operating conditions.

Contain equipment installed in Class II, Division I, Group E, F and G, hazardous locations, in NEMA Type 9 enclosures approved for use where combustible dust is possibly present under normal operating conditions.

Fabricate sheet-steel enclosures from uncoated carbon-steel sheets of commercial quality, with box dimensions and thickness of sheet steel in accordance with UL 50.

Fabricate steel enclosures from corrosion-resistant, chromium-nickel steel sheet conforming to ASTM A167 Type 300 series with ASM No. 4 general-purpose polished finish, with box dimensions and thickness of sheet steel in accordance with UL 50.

Provide cast-iron enclosures from gray-iron castings conforming to ASTM A48/A48M with tensile-strength classification recognized as suitable for the application. Provide cast metal enclosures that are not less than 1/8-inch thick at every point, of greater thickness at reinforcing ribs and door edges, and not less than 1/4-inch thick at tapped holes for conduits.

2.3.2 Remote-Control Station Enclosures

Provide remote-control station enclosures for pushbuttons, selector switches, and indicating lights in accordance with the appropriate articles of NEMA ICS 6 and NEMA 250.

Contain remote-control stations installed in lean, dry, indoor locations in NEMA Type 1 general-purpose, sheet-steel enclosures. Contain recessed remote-control stations in standard wall outlet boxes with matching corrosion-resistant steel flush cover plate.

Contain remote-control stations installed in unprotected outdoor locations in NEMA type 3R weather-resistant sheet steel enclosures that are splashproof, weatherproof, sleetproof and moisture resistant.

Contain remote-control stations installed in wet locations in NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosures constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 and NEMA 250 for Type 4 enclosures.

Contain remote-control stations installed in wet locations in NEMA Type 4 watertight, cast-iron enclosures, constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 and NEMA 250 for Type 4 enclosures.

Contain remote-control stations installed in dry noncombustible dust-laden atmospheres in NEMA Type 12 dusttight, cast-iron enclosures with gaskets or their equivalent to prevent the entrance of dust.

Contain remote-control stations installed in industrial locations in NEMA Type 12 industrial-use, sheet-steel enclosures, constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

Contain remote-control stations installed in industrial locations in NEMA Type 12 industrial-use, cast-iron enclosures, constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

Contain remote-control stations installed in Class I, Division I, Group A, B, C, and D, hazardous locations in NEMA Type 7 enclosures, approved for the specific flammable gas or vapor which is possibly present under normal operating conditions.

Contain remote-control stations installed in Class II, Division I, Group E, F and G, hazardous locations in NEMA Type 9 enclosures, approved for use where combustible dust is possibly present under normal operating conditions.

Fabricate sheet-steel enclosures from uncoated carbon-steel sheets of commercial quality, with box dimensions and thickness of sheet steel in accordance with UL 50.

Fabricate steel enclosures from corrosion-resistant, chromium-nickel steel sheet, conforming to ASTM A167, Type 300 series with ASM No. 4 general-purpose polished finish, with box dimensions and thickness of sheet steel in accordance with UL 50.

Provide cast-iron enclosures of gray-iron castings, conforming to ASTM A48/A48M, with tensile-strength classification recognized as suitable for this application. Provide cast metal enclosures that are not less than 1/8-inch thick at every point, of greater thickness at reinforcing ribs and door edges not less than 1/4 inch thick at tapped holes for conduit.

Install remote-control stations with the centerline 66 inches above the finished floor.

2.4 CIRCUIT BREAKERS

Provide circuit breakers that conform to UL 489, and NEMA AB 3.

2.4.1 Molded-Case Circuit Breakers

Provide molded case, manually operated, trip-free, circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection as required. Completely enclose circuit breakers in a molded case, with the calibrated sensing element factory-sealed to prevent tampering.

Locate thermal-magnetic tripping elements in each pole of the circuit breaker, and provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit protection. Provide instantaneous magnetic tripping element, that is adjustable and accessible from the front of the breaker on frame sizes larger than 100 amperes.

Size breaker as required for the continuous current rating of the circuit. Provide breaker class as required.

Provide sufficient interrupting capacity of the panel and lighting branch circuit breakers, to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Provide circuit breaker interrupting capacities that conform to NEMA AB 3.

Provide the common-trip type multipole circuit breakers having a single operating handle and a two-position on/off indication. Provide circuit breakers with temperature compensation for operation in an ambient temperature of 104 degrees F. Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied. Interrupting ratings may have selective type tripping (time delay, magnetic, thermal, or ground fault).

Provide phenolic composition breaker body capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.

Provide circuit breakers used for meter circuit disconnects that meet the applicable requirements of CEC and NFPA 70 and that are of the motor-circuit protector type.

For circuit breakers used for service disconnection, provide an enclosed circuit-breaker type with external handle for manual operation. Provide sheet metal enclosures with a hinged cover suitable for surface mounting.

2.4.2 Enclosed Molded-Case Circuit Breakers

For enclosed circuit breakers, provide thermal-magnetic molded-case circuit breakers in surface-mounted, nonventilated enclosures conforming to the appropriate articles of NEMA 250 and UL 489.

Provide enclosed circuit breakers in nonhazardous locations as follows:

Contain circuit breakers installed inclean, dry, indoor locations in NEMA Type 1, general purpose sheet steel enclosures.

Contain circuit breakers installed in unprotected outdoor locations, in NEMA Type 3R, weather-resistant sheet steel enclosures that are splashproof, weatherproof, sleetproof, and moisture resistant.

Contain circuit breakers installed in wet locations, in NEMA Type 4, watertight corrosion-resistant sheet steel enclosures constructed to

prevent entrance of water.

Contain circuit breakers installed in dry, noncombustible dust-laden atmospheres in NEMA Type 5, dusttight corrosion-resistant sheet steel enclosures, with gaskets or their equivalent to prevent the entrance of dust.

Contain circuit breakers installed in industrial locations in NEMA Type 12, industrial-use sheet steel enclosures, constructed to prevent the entrance of dust, lint, fibers and flyings, and oil and coolant seepage.

Fabricate steel enclosures from corrosion-resistant steel sheet, conforming to ASTM A167, 300 series corrosion-resistant steel, with box dimensions and thickness of sheet steel in accordance with UL 50.

2.5 FUSES

Provide a complete set of fuses for all switches and switchgear. Rate fuses that have a voltage rating of not less than the circuit voltage.

Make no change in continuous-current rating, interrupting rating, and clearing or melting time of fuses unless written permission has first been secured.

Provide nonrenewable cartridge type fuses for ratings 30 amperes, 125 volts or less. Provide renewable cartridge type fuses for ratings above 30 amperes 600 volts or less with time-delay dual elements, except where otherwise indicated. Conform to NEMA FU 1 for fuses.

Install special fuses such as extra-high interrupting-capacity fuses, fuses for welding machines, and capacitor fuses where required. Plug fuses are not permitted.

Label fuses showing UL class, interrupting rating, and time-delay characteristics, when applicable. Additionally, clearly list fuse information on equipment drawings.

Provide porcelain fuse holders when field-mounted in a cabinet or box. Do not use fuse holders made of such materials as ebony asbestos, Bakelite, or pressed fiber for field installation.

2.6 CONTROL DEVICES

2.6.1 Magnetic Contactors

Provide magnetic contactors in accordance with NEMA ICS 1 and NEMA ICS 2 as required for the control of low-voltage, 60-hertz, tungsten-lamp loads, fluorescent-lamp loads, resistance-heating loads, and the primary windings of low-voltage transformers.

Provide core-and-coil assembly that operates satisfactorily with coil voltage between 85 and 110 percent of its voltage rating.

Provide contactor that is designed with a normally open holding circuit auxiliary contact for control circuits, with a rating in accordance with NEMA ICS 1 and NEMA ICS 2.

Furnish solderless pressure wire terminal connectors, or make available for line-and-load connections to contactors in accordance with NEMA ICS 1 and

NEMA ICS 2.

Provide magnetic contactors with a rating in accordance with NEMA ICS 1and NEMA ICS 2.

2.6.2 Control-Circuit Transformers

Provide control-circuit transformers within the enclosure of magnetic contactors and motor controllers when the line voltage is in excess of 120 volts. Provide encapsulated dry type, single-phase, 60-hertz transformer, with a 120-volt (or 24-volt) isolated secondary winding.

Do not provide a transformer with a rated primary voltage less than the rated voltage of the controller, or a rated secondary current less than the continuous-duty current of the control circuit.

Provide voltage regulation of the transformer such that, with rated primary voltage and frequency, the secondary voltage is not less than 95 percent nor more than 105 percent of rated secondary voltage.

Provide source of supply for control-circuit transformers at the load side of the main disconnecting device. Protect secondary winding of the transformer and control-circuit wiring against overloads and short circuits, with fuses selected in accordance with NEMA ICS 6. Ground secondary winding of the control-circuit transformer in accordance with NEMA ICS 6.

2.6.3 Magnetic Control Relays

Provide magnetic control relays for energizing and de-energizing the coils of magnetic contactors or other magnetically operated devices, in response to variations in the conditions of electric control devices in accordance with NEMA ICS 1, and NEMA ICS 2.

Provide core-and-coil assembly that operates satisfactorily with coil voltages between 85 and 110 percent of their voltage rating.

Provide relays that are designed to accommodate normally open and normally closed contacts.

Provide 120-volt, 60-hertz, Class AIB magnetic control relays with a continuous contact rating of 10 amperes, and with current-making and -breaking ability in accordance with NEMA ICS 1 and NEMA ICS 2, two normally open and two normally closed.

2.6.4 Pushbuttons and Switches

2.6.4.1 Pushbuttons

For pushbuttons for low-voltage ac full-voltage magnetic controllers, provide heavy-duty oiltight NEMA 250, Type 12, momentary-contact devices rated 600 volts, with pilot light, and with the number of buttons and the marking of identification plates as shown. Furnish pushbutton color code in accordance with NEMA ICS 6.

Provide pushbuttons that are designed with normally open, circuit-closing contacts; normally closed circuit-opening contacts; and two-circuit normally open and normally closed circuit-closing and -opening contacts. Provide pushbutton-contact ratings in accordance with NEMA ICS 1 and

NEMA ICS 2 with contact designation A600.

Identify pushbuttons in remote control stations with identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the identification plate.

2.6.4.2 Selector Switches

Provide heavy-duty oiltight maintained-contact selector switches for low-voltage control circuits, with the number of positions and the marking of identification plates in accordance with NEMA ICS 1 and NEMA ICS 2.

Identify selector switches in remote control stations with engraved identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the identification plate.

2.6.4.3 Ammeter Selector Switches

Provide rotary multistage snap-action type ammeter selector switches for switchgear in accordance with UL 20 with silver-plated contacts rated for 600 volts ac or dc. Provide a manually operated, four-position selector switch rated for 600 volts, 20 amperes, minimum, and designed to permit current readings on each bus of the main bus from a single indicating instrument. Mount ammeter switch on the hinged front panel of the switchgear compartment and completely isolate it from high-voltage circuits, with engraved escutcheon plate.

Provide an oval type selector switch handle.

2.6.4.4 Voltmeter Selector Switches

Provide rotary snap-action type voltmeter selector switches for switchgear in accordance with UL 20 with silver-plated contacts rated for 600 volts ac or dc. Provide manually operated, four-position switch designed to permit voltage readings on each phase of the main bus from a single indicating instrument. Mount voltmeter switch on the hinged front panel of the switchgear compartment and completely isolate from high-voltage circuits, and with engraved escutcheon plate.

Provide an oval type selector switch handle.

2.6.4.5 Miscellaneous Switches

Provide float, limit, door, pressure, proximity, and other types of switches in accordance with IPC D330 and of the types and classes indicated.

2.7 TIME SWITCHES

Provide time switches for the control of tungsten-lamp loads, fluorescent-lamp loads, resistive-heating loads, motors, and magnetically operated devices, consisting of a motor-driven time dial and switch assembly in a NEMA 250, Type 1 general-purpose enclosure.

Provide motor drives consisting of 120-volt, single-phase, 60-hertz, heavy-duty, self-starting synchronous motors, directly connected to the time dial through a geartrain operating mechanism. Provide a spring-wound stored-energy source of reserve power that will automatically operate the mechanism for a period of not less than 12 hours in case of electric power

failure. Provide spring that automatically rewinds electrically in not more than 3 hours of time after electric power is restored.

Include a heavy-duty general-purpose precision snap-action switch in accordance with UL 20 for switch mechanism, with provision for a manual "OFF" and "ON" operation of the switch.

Provide time switches for the control of 120/240-volt, 2- and 3-wire, single-phase, 60-hertz circuits and 120/208-volt, three-phase, 4-wire, 60-hertz circuits, with a continuous-current tungsten-lamp load rating of 35 amperes.

Provide 24-hour time dials with adjustable on and off trippers for repetitive switching operations at the same time each day. Calibrate dial in 15-minute intervals over a 24-hour period around its circumference. Provide dial that makes one revolution in the 24-hour period of time. Make provision to defeat the switching operation over weekends or up to 6 preselected calendar days each week. Provide time dials that have a minimum "ON" time setting of not more than 20 minutes, and are fully adjustable upward in 15-minute intervals of time throughout each day.

Provide 7-day type time dials with adjustable on and off trippers for programmed switching operations for each day in the week. Provide dial that makes one revolution in the 7-day period of time not more than 2 1/2 hours, and is fully adjustable upward in 2-hour intervals of time throughout each day. Calibrate dial in 2-hour intervals for each day and for each day in the week around its circumference.

Provide astronomic type time dials which automatically change settings each day, in accordance with the seasonal time changes in sunrise and sunset. Provide astronomic type dials that have adjustable on and off trippers, for repetitive switching operations at solar time each day and each day in the year and that make one revolution in a 24-hour period of time. Provide time dials that are designed to operate in the "ON" position at sunset and be fully adjustable upward in 15-minute intervals of time throughout each day, and that indicate the day and month of the year. Calibrate dial in 15-minute intervals over a 24-hour period of time around its circumference. Make provision to defeat the switching operation over weekends or up to 6 preselected calendar days each week.

2.8 PROTECTIVE RELAYS

2.8.1 Overcurrent Relays

Conform to IEEE C37.90 for overcurrent relays.

For protection against phase and ground faults, provide nondirectional removable microprocessor-based overcurrent relays with built-in testing facilities designed for operation on the dc or ac control circuit indicated.

Provide ground-fault overcurrent relays with short-time inverse time characteristics with adjustable current tap range as required.

Provide phase-fault overcurrent relays with varied inverse-time characteristics with adjustable current tap range as required, and indicating instantaneous-trip attachments with adjustable current range as required.

Semiflush-mount case with matching cover to the hinged instrument panel.

Provide solid-state static-type trips for low-voltage power circuit breakers in accordance with EIA 443 and IEEE C37.17.

Provide a trip unit that employs a combination of discreet components and integrated circuits to provide the time-current protection functions required in a modern selectively coordinated distribution system.

Provide complete system selective coordination by utilizing a combination of the following time-current curve-shaping adjustments: ampere setting; long-time delay; short-time pickup; short-time delay; instantaneous pickup; and ground fault.

Provide switchable or easily defeatable instantaneous and ground fault trips.

Make all adjustments using non-removable, discrete step, highly reliable switching plugs for precise settings. Provide a sealable, transparent cover over the adjustments to prevent tampering.

Furnish trip devices with three visual indicators to denote the automatic tripping mode of the breaker including: overload; short circuit; and ground fault.

Wire trip unit to appropriate terminals whereby an optional remote automatic trip accessory can be utilized to provide the same indication.

Make available for use a series of optional automatic trip relays for use with the trip unit to provide remote alarm and lockout circuits.

Provide all trip units with test jacks for in-service functional testing of the long-time instantaneous and ground fault circuits using a small hand-held test kit.

2.8.2 Directional Overcurrent Relays

Provide directional overcurrent relays in accordance with IEEE C37.90.

For directional overcurrent relays for protection against reverse-power faults, provide microprocessor-based relays with adjustable time-delay and instantaneous trip attachments. Provide removable type relays with inverse-time directional and overcurrent units with built-in testing facilities.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.8.3 Reclosing Relays

For reclosing relays, conform to IEEE C37.90.

Design reclosing relays to reclose circuit breakers that have tripped from overcurrent. Provide device that automatically recloses the breaker at adjustable time intervals between reclosures and then locks out the breaker in the open position if the fault persists. If the fault disappears after any reclosure, the circuit breaker remains closed and the reclosing relay resets automatically and is ready to start a new sequence of operation.

Provide removable microprocessor-basedreclosing relays with built-in testing facilities. Arrange contacts for one instantaneous reclosure and

two subsequent reclosures at 15 and 45 seconds, respectively.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.8.4 Undervoltage Relays

For undervoltage relays conform to IEEE C37.90.

Provide three-phase microprocessor-based undervoltage relays, including inverse timing with adjustable high- and low-voltage contacts and calibrated scale for protection against loss of voltage, undervoltage, and overvoltage. Provide relays that are removable with built-in testing facilities and that are suitable for operation on 120-volt ac circuits, with contacts that are suitable for operation on dc or ac control circuits.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.9 INDICATING INSTRUMENTS

2.9.1 Ammeters

For ammeters, conform to ANSI C39.1.

Provide switchboard indicating ammeters of approximately 4-1/2 inches square with 250-degree scale and recessed cases suitable for flush mounting. Furnish white dials with black figures and black pointers. Mount instruments on the hinged front panel of the switchgear compartment completely isolated from high-voltage circuits. Provide standard 5-ampere type meter for a zero to full-scale normal movement, 60 hertz.

2.9.2 Voltmeters

For voltmeters, conform to ANSI C39.1.

Provide a switchboard indicating voltmeters that is approximately 4-1/2-inches square with 250-degree scale and recessed cases suitable for flush mounting. Furnish white dials with black figures and black pointers. Mount instruments on the hinged front panel of the switchgear compartment completely isolated from high-voltage circuits. Provide standard 120-volt type voltmeter for a zero to full-scale normal movement, 60 hertz.

2.9.3 Watt-Hour Meters/Wattmeters

For watt-hour meters, wattmeters, and pulse initiation meters, conform to ANSI C12.1.

Provide three-phase digital-type switchboard wattmeters for use with instrument transformers with two stators, each equipped with a current and potential coil. Provide meter that is rated for 5 amperes at 120 volts and is suitable for connection to three-phase, 3- and 4-wire circuits. Provide instrument complete with potential indicating lamps, light-load and full-load adjustments, phase balance, power-factor adjustments, four-dial clock register, ratchets to prevent reverse rotation, and built-in testing facilities.

Provide pulse initiating meters for use with demand meters or pulse recorders, that are suitable for use with mechanical or electrical pulse initiators. Provide mechanical load imposed on the meter by the pulse

initiator that is within the limits of the pulse meter. Provide load as constant as practical throughout the entire cycle of operation to ensure accurate meter readings. Provide pulse initiating meter that is capable of measuring the maximum number of pulses at which the pulse device is nominally rated. Consider pulse initiating meter to be operating properly when a kilowatt hour check indicates that the demand meter kilowatthours are within limits of the watthour meter kilowatthours.

Locate pulse initiating meters such that components sensitive to moisture and temperature conditions are minimized. Take precautions to protect sensitive electronic metering circuitry from electromagnetic and electrostatic induction.

Furnish removable meters with draw out test plug and furnish contact devices to operate remote impulse-totalizing graphic demand meters.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.9.4 Graphic Demand Meters

For impulse-totalizing graphic demand meters, conform to ANSI C12.1.

Provide impulse-totalizing graphic demand meters that are suitable for use with switchboard watt-hour meters and that include a two-circuit totalizing relay, cyclometer for cumulative record of impulses, four-dial totalizing kilowatt-hour register, synchronous motor for timing mechanism, torque motor, and chart drive. Provide a positive chart-drive mechanism consisting of chart spindles and drive sprockets that maintains the correct chart speed for roll strip charts. Provide instrument that records as well as indicates on clearly legible graph paper, the 15-minute integrated kilowatt demand of the totalized system.

Furnish the motive power for advancing the register and pen-movement mechanism with a torque motor. Provide capillary pen containing a 1-month ink supply. Provide a 31-day continuous record of operation roll charts.

Semi-flush mount case with matching cover to the hinged instrument panel.

2.9.5 Specialty-Type Meters

For specialty meters, conform to ANSI C39.1. Specialty-type meters are panel meters applicable to specific situations, such as pyrometers and dc parameter meters that conform to the panel layout specified. Provide meter scales that are not less than 180 degrees. Do not use edgewise meters for circuit current and voltage measurements.

2.10 FACTORY TESTING

Perform factory tests on control and low voltage protective devices in accordance with the manufacturer's recommendations.

Conduct short-circuit tests in accordance with Section 2 of NEMA ICS 1.

2.11 INDICATING LIGHTS

2.11.1 General-Purpose Type

For indicating lights, provide oiltight instrument devices with threaded base and collar for flush-mounting, translucent convex lens, candelabra

screw-base lampholder, and 120-volt, 6-watt, Type S-6 incandescent lamp in accordance with ANSI C78.23. Provide indicating lights color coded in accordance with NEMA ICS 6.

Provide indicating lights in remote-control stations when pushbuttons and selector switches are out of sight of the controller.

2.11.2 Switchboard Indicating Lights

For switchboard indicating lights, provide the manufacturer's standard transformer type units 120-volt input utilizing low-voltage lamps and convex lenses of the colors indicated. Provide indicating lights that are capable of being relamped from the switchboard front. Indicating lights utilizing resistors in series with the lamps are not permitted except in direct-current control circuits. Provide lights that have a press-to-test feature.

2.12 FINISH

Protect metallic materials against corrosion. Provide equipment with the standard finish by the manufacturer when used for most indoor installations. For harsh indoor environments (any area subjected to chemical and/or abrasive action), and all outdoor installations, refer to Section 09 96 00 HIGH-PERFORMANCE COATINGS.

PART 3 EXECUTION

3.1 INSTALLATION

Install Control devices and protective devices that are not factory installed in equipment, in accordance with the manufacturer's recommendations and field adjusted and operation tested. Conform to CEC and NFPA 70, NEMA ICS 1 and NEMA ICS 2 requirements for installation of control and protective devices.

3.2 FIELD TESTING

Demonstrate to operate as indicated control and protective devices not factory installed in equipment.

Verify tap settings and ratios of instrumentation potential, and current transformers.

Perform dielectric tests on insulating oil in oil circuit breakers before the breakers are energized. Test oil in accordance with ASTM D 877, and provide breakdown voltage that is not less than 25,000 volts. Provide manufacturer certification that the oil contains no PCB's, and affix a label to that effect on each breaker tank and on each oil drum containing the insulating oil.

Field adjust reduced-voltage starting devices to obtain optimum operating conditions. Provide test meters and instrument transformers that conform to ANSI C12.1 and IEEE C57.13.

Do not energize control and protective devices until recorded test data has been approved. Provide final test reports with a cover letter/sheet

clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

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SECTION 26 08 00

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SECTION 26 08 00

APPARATUS INSPECTION AND TESTING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for electrical inspection and testing.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

1.3 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to this section with additions and modifications specified herein.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Acceptance tests and inspections

SD-07 Certificates

Qualifications of organization, and lead engineering technician

Acceptance test and inspections procedure

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled "Acceptance Tests and Inspections" herein. Organization shall be

independent of the supplier, manufacturer, and installer of the equipment. The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

a. Submit name and qualifications of organization. Organization shall have been regularly engaged in the testing of electrical materials, devices, installations, and systems for a minimum of 5 years. The organization shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.

b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

1.5.2 Acceptance Tests and Inspections Reports

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

1.5.3 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. COR shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

a. Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION

b. Section 26 36 23.00 20 AUTOMATIC TRANSFER SWITCHES

c. Section 26 33 53.00 20 UNINTERRUPTIBLE POWER SUPPLY (UPS)

3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present when equipment tested by the organization is initially energized and placed in service.

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SECTION 26 09 23.00 40

LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for lighting control devices for use with interior and exterior lighting systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

GREEN SEAL (GS)

GS-12	Occupancy Sensors

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA LM-48	Guide for Testing the Calibration of Locking-Type Photoelectric Control Devices Used in Outdoor Applications

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

RCBEA GUIDE	NASA Reliability Centered Building and Equipment Acceptance Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C136.10	American National Standard for Roadway and Area Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles--Physical and Electrical Interchangeability and Testing
NEMA ICS 1	Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	Enclosures

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 20	General-Use Snap Switches
UL 773	Standard for Plug-In, Locking Type Photocontrols for Use with Area Lighting
UL 773A	Standard for Nonindustrial Photoelectric Switches for Lighting Control
UL 98	Enclosed and Dead-Front Switches

1.3 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit Installation Drawings for light-sensitive, occupancy sensitive and motion sensitive control devices in accordance with the manufacturer's recommended instructions for installation.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Submit manufacturer's catalog data for Photoconductive Control Devices.

Submit Installation Drawings for Light-Sensitive Control Devices in accordance with paragraph entitled, "General Requirements," of this section.

Dimming ballast controls

Light Level Sensor

Dimmer Switch

Lighting Contactor

Time Switch

Photocell Switch

Occupancy Sensors

Motion Sensors

SD-06 Test Reports

Submit test reports for System Operation Tests in the presence of the COR.

SD-08 Manufacturer's Instructions

Submit operational instructions for Light-Sensitive Control Devices consisting of the manufacturer's recommended procedures for operation.

SD-10 Operation and Maintenance Data

Lighting Control System, Data Package 5

1.5 PREDICTIVE TESTING AND INSPECTION TECHNOLOGY REQUIREMENTS

This section contains systems and/or equipment components regulated by NASA's Reliability Centered Building and Equipment Acceptance Program. This program requires the use of Predictive Testing and Inspection (PT&I) technologies in conformance with RCBEA GUIDE to ensure building equipment and systems installed by the Contractor have been installed properly and contain no identifiable defects that shorten the design life of a system and/or its components. Satisfactory completion of all acceptance requirements is required to obtain Government approval and acceptance of the Contractor's work.

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

PART 2 PRODUCTS

2.1 PHOTOCONDUCTIVE CONTROL DEVICES

Provide photoconductive control devices in accordance with UL 773. Control lighting luminaries in banks by a single photo-control element mounted within each bank or individually by photo control elements mounted on or adjacent to the heads of the luminaries. Provide physically and electrically interchangeable light sensitive control devices with three-pole, 3-wire locking plug and receptacle connections to the line, load, and neutral conductors of the lighting circuit.

Provide photoconductive control devices for natural daylight and darkness control of incandescent, fluorescent, and outdoor lighting luminaries including a photoconductive cell, thermal actuator, and snap-action switch in a weatherproof housing. Provide a control device which is, when attached to its mounting, weatherproof and constructed to exclude beating rain, snow, dust, and insects and capable of withstanding 96 percent relative humidity at 122 degrees F for 48 hours under operating conditions.

Submit operation and maintenance data,Lighting Control System, Data Package 5, in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein, showing all light fixtures, control modules, control zones, occupancy sensors,motion sensors, light level sensors, power packs, dimming ballasts, schematic diagrams and all interconnecting control wire, conduit, and associated hardware.

2.1.1 Photoconductive Limit Settings

Provide device which turns on within the limits of plus 100 to minus 50 percent of its setting, over a range of input voltage from 105 to 130 volts at rated frequency and ambient temperature, and at rated voltage and frequency over a range of temperature from minus 85 to 122 degrees F, with

relative humidities up to 96-percent throughout the temperature range.

Adjust the device to operate within the limits of 0.8 to 1.2 foot-candles, but also capable of calibration of the turn-on light level over a minimum range from 0.5 to 3.0 foot-candles, and adaptable for calibration up to 10 foot-candles. Ratio of turn-off light level to turn-on light level is not to exceed 5.

2.1.2 Device Rating and Accuracy

Rate the devices at 120 or 277 volts, 60 hertz, with rated ambient temperature of 77 plus or minus 41 degrees F

Maintain instrument accuracy by proper calibration in accordance with IESNA LM-48.

2.2 TIME CONTROL SWITCHES

Install switches with not less than four 1/4 inch bolts. The use of sheet metal screws is not allowed.

Provide with a time delay in excess of 5 seconds as an available option.

2.3 MANUAL AND SAFETY SWITCHES

Provide Astronomic dial type arranged to turn "ON" at sunset, and turn "OFF" at sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide a switch having automatically wound spring mechanism or battery backed electronic clock to maintain accurate time for a minimum of 7 hours following a power failure, with a time switch with a manual on-off bypass switch. Provide surface mounted housing for the time switch, type NEMA 1 (indoor) or NEMA 3R (outdoor) enclosure conforming to NEMA ICS 6.

Provide switch mechanism consisting of a heavy-duty general-purpose precision snap-acting switch, single-pole, single-throw, with a minimum rating of 1,000-watts incandescent-lamp load and 1,200-volt-amperes reactive for vapor-lamp load at rated voltage and frequency suitable for operation on a 277 volt, 60 Hz, single-phase system. Provide with a selector switch having a minimum of three positions: ON, OFF, and AUTOMATIC. Use the automatic position when photoelectric or timer control is desited. Interface the selector switch with the lighting system magnetic contactor to control system activity.

Provide switches conforming to UL 98. Provide switch construction of the quick-make, quick-break type, such that a screwdriver is required to open the switch door when the switch is on, with blades visible when the door is open. Coordinate terminal lugs with the wire size.

2.4 DIMMING BALLAST CONTROLS

The single slide dimming ballast control dimmer with on/off control, compatible with the ballast and control the ballast light output over the full dimming range, which are approved by the ballast manufacturer.

2.5 LIGHT LEVEL SENSOR

Provide UL listed light level sensor capable of detecting changes in ambient lighting levels, with a dimming range of 20 percent to 100 percent,

minimum, and designed for use with dimming ballast and voltage system to which they are connected. Provide with sensor capable of controlling 40 electronic dimming ballast, minimum, with a sensor light level adjustable with a set level range from 10 to 100 footcandles, minimum. Provide a sensor with a bypass function to electrically override sensor control.

2.6 INCANDESCENT DIMMER SWITCH

UL 20, single-pole, 600 watt, 120 volt ac, full-range rotary on-off type with built-in electromagnetic interference filter.

2.7 LIGHTING CONTACTOR

Provide NEMA ICS 2, electrically or mechanically held contactor Rate contactor as indicated. Provide in NEMA 1 (indoor) or NEMA 3R (outdoor) enclosure conforming to NEMA ICS 6. Provide contactor with silver alloy double-break contacts and coil clearing contacts for mechanically held contactor requiring no arcing contacts. Provide contactor with hand-off-automatic selector switch.

2.8 TIME SWITCH

Provide astronomic dial type or electronic type, arranged to turn "ON" at sunset and turn "OFF" at predetermined time between 8:30 p.m. and 2:30 a.m. or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide switch having automatically wound spring mechanism or capacitor, to maintain accurate time for a minimum of 7 hours following power failure. Provide time switch with a manual on-off bypass switch. Surface mount the housing for the time switch, NEMA 1 (indoor) or NEMA 3R (outdoor) enclosure conforming to NEMA ICS 6.

2.9 PHOTOCELL SWITCH

Provide photocell switch conforming to UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated 277 volts ac, 60 Hz with single pole double-throw (spdt) contacts for mechanically held contactors rated 1000 watts designed to fail to the ON position. Provide switch which turns on at or below 3 footcandles and off at 4 to 10 footcandles. Provide time delay to prevent accidental switching from transient light sources. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Provide switch:

a. Integral to the luminary, rated 1000W minimum. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition.

b. In a U.V. stabilized polycarbonate housing with swivel arm and adjustable window slide, rated 1800 VA, minimum.

c. In a high-impact-resistant, noncorroding and nonconductive molded plastic housing with a locking-type receptacle conforming to ANSI C136.10, rated 1800 VA, minimum.

d. In a cast weatherproof aluminum housing with adjustable window slide, rated 1800 VA, minimum.

2.10 OCCUPANCY SENSORS

Provide UL listed occupancy sensor complying with GS-12. Design occupancy sensors and power packs to operate on the voltage indicated. Provide sensors and power packs with circuitry that only allows load switching at or near zero current crossing of supply voltage, with mounting as indicated. Provide sensor with an LED occupant detection indicator, adjustable sensitivity, and adjustable delayed-off time range of 5 minutes to 15 minutes. Provide color matching the adjacent wall plates as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM wall mounted sensors, and white ceiling mounted sensors. Provide ceiling mounted sensors with 360 degree coverage unless otherwise indicated.

a. Provide crystal controlled ultrasonic sensor which does not cause detection interference between adjacent sensors.

b. Provide infrared sensors with a daylight filter, and a fresnel lens that is applicable to space to be controlled.

c. Ultrasonic/Infrared Combination Sensor

d. Microwave and audiophonic sensors.

   1. Occupancy detection to turn lights on requires both ultrasonic and infrared sensor detection, such that the lights remain on if either the ultrasonic or infrared sensor detects movement. Provide infrared sensor with a lens selected for indicated usage and daylight filter to prevent short wavelength infrared interference. Provide crystal controlled ultrasonic sensor frequency.

2.11 EQUIPMENT IDENTIFICATION

2.11.1 Manufacturer's Nameplate

Provide each item of equipment with a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in an inconspicuous place; the nameplate of the distributing agent is not acceptable.

2.11.2 Labels

Provide labeled control devices, clearly marked for operation of specific lighting functions according to type.

Make markings related to control device type clear and locate to be readily visible to service personnel, but unseen from normal viewing angles when devices are in place.

Provide labels which are easy to read when standing next to the equipment and durable to match the life of the equipment to which they are attached. Refer to the FEMP guidelines for lighting at http:\\www.eere.energy.gov.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Photoconductive Control Devices

Install photoconductive control devices in accordance with the manufacturer's installation instructions.

3.1.2 Time Control Switches

Install switches with not less than four 1/4 inch bolts. The use of sheet metal screws is not allowed.

3.1.3 Manual and Safety Switches

Coordinate terminal lugs with the wire size. Securely fasten switches to the supporting structure or wall using not less than four 1/4 inch bolts. The use of sheet metal screws is not allowed.

3.1.4 Magnetic Contactors

Provide magnetic contactors mechanically held, electrically operated, conforming to NEMA ICS 1 and NEMA ICS 2, suitable for 480 volts, 3 phase, 60 Hz, with coil voltage of 277 volts. Provide with maximum continuous ampere rating and number of poles as indicated on drawings. Provide enclosures for contactors mounted indoors conforming to NEMA ICS 6, Type 1. Provide each contactor with a spare, normally open auxiliary contact.

Coordinate terminal lugs with the wire size. Securely fasten switches to the supporting structure or wall using not less than four 1/4 inch bolts. The use of sheet metal screws is not allowed.

3.2 FIELD TESTING

Perform PT&I tests and provide submittals as specified in Section 01 86 26.07 40 RELIABILITY CENTERED ACCEPTANCE FOR ELECTRICAL SYSTEMS.

Demonstrate that photoconductive control devices operate satisfactorily in the presence of the COR.

Perform System Operation Tests in accordance with referenced standards in this section.

-- End of Section --

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SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for procurement, installation, and testing of electrical wiring systems for construction projects.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM B1	Standard Specification for Hard-Drawn Copper Wire
ASTM B8	Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 709	Laminated Thermosetting Materials

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	The Authoritative Dictionary of IEEE Standards Terms
IEEE 81	Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE C2	National Electrical Safety Code

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.1	Electric Meters Code for Electricity Metering
ANSI C12.7	Requirements for Watthour Meter Sockets
ANSI C80.1	American National Standard for Electrical Rigid Steel Conduit (ERSC)
ANSI C80.3	American National Standard for Electrical Metallic Tubing (EMT)
ANSI C80.5	American National Standard for Electrical Rigid Aluminum Conduit
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA BU 1.1	General Instructions for Proper Handling, Installation, Operation and Maintenance of Busway Rated 600 V or Less
NEMA FU 1	Low Voltage Cartridge Fuses
NEMA ICS 1	Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 3	Medium-Voltage Controllers Rated 2001 to 7200 V AC
NEMA ICS 4	Terminal Blocks
NEMA ICS 6	Enclosures
NEMA KS 1	Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA MG 1	Motors and Generators
NEMA MG 10	Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	Energy Management Guide for Selection and Use of Single Phase Motors
NEMA RN 1	Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	Standard for Dry-Type Transformers for General Applications
NEMA TC 14	Standard for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings

NEMA TC 2	Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	Standard for Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA TP 1	Guide for Determining Energy Efficiency for Distribution Transformers
NEMA VE 1	Standard for Metal Cable Tray Systems
NEMA WD 1	Standard for General Color Requirements for Wiring Devices
NEMA WD 6	Wiring Devices Dimensions Specifications
NEMA Z535.4	American National Standard for Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code
NFPA 70E	Standard for Electrical Safety in the Workplace
NFPA 780	Standard for the Installation of Lightning Protection Systems

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA J-STD-607	Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications
TIA-568-C.1	Commercial Building Telecommunications Cabling Standard
TIA-569	Commercial Building Standard for Telecommunications Pathways and Spaces

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1910.147	Control of Hazardous Energy (Lock Out/Tag Out)

UNDERWRITERS LABORATORIES (UL)

UL 1	Standard for Flexible Metal Conduit
UL 1010	Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations
UL 1063	Machine-Tool Wires and Cables
UL 1242	Standard for Electrical Intermediate Metal Conduit -- Steel

UL 1449	Surge Protective Devices
UL 1561	Dry-Type General Purpose and Power Transformers
UL 1569	Standard for Metal-Clad Cables
UL 1660	Liquid-Tight Flexible Nonmetallic Conduit
UL 1699	Arc-Fault Circuit-Interrupters
UL 198M	Standard for Mine-Duty Fuses
UL 20	General-Use Snap Switches
UL 2043	Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces
UL 360	Liquid-Tight Flexible Steel Conduit
UL 4	Standard for Armored Cable
UL 4248	UL Standard for Safety Fuseholders
UL 44	Thermoset-Insulated Wires and Cables
UL 467	Grounding and Bonding Equipment
UL 486A-486B	Wire Connectors
UL 486C	Splicing Wire Connectors
UL 489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	Attachment Plugs and Receptacles
UL 5	Surface Metal Raceways and Fittings
UL 50	Enclosures for Electrical Equipment, Non-environmental Considerations
UL 506	Specialty Transformers
UL 508	Industrial Control Equipment
UL 510	Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	Metallic Outlet Boxes
UL 514B	Conduit, Tubing and Cable Fittings
UL 514C	Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

UL 5A	Nonmetallic Surface Raceways and Fittings
UL 6	Electrical Rigid Metal Conduit-Steel
UL 651	Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL 67	Standard for Panelboards
UL 674	Electric Motors and Generators for Use in Division 1 Hazardous (Classified) Locations
UL 698	Industrial Control Equipment for use in Hazardous (Classified) Locations
UL 6A	Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel
UL 719	Nonmetallic-Sheathed Cables
UL 797	Electrical Metallic Tubing -- Steel
UL 817	Standard for Cord Sets and Power-Supply Cords
UL 83	Thermoplastic-Insulated Wires and Cables
UL 845	Motor Control Centers
UL 854	Standard for Service-Entrance Cables
UL 857	Busways
UL 869A	Reference Standard for Service Equipment
UL 870	Standard for Wireways, Auxiliary Gutters, and Associated Fittings
UL 877	Standard for Circuit Breakers and Circuit-Breaker Enclosures for Use in Hazardous (Classified) Locations
UL 886	Standard for Outlet Boxes and Fittings for Use in Hazardous (Classified) Locations
UL 943	Ground-Fault Circuit-Interrupters
UL 984	Hermetic Refrigerant Motor-Compressors

1.3 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

Busway

Motor control centers

SD-03 Product Data

Receptacles

Circuit breakers

Motors

Submittals shall include performance and characteristic curves.

SD-06 Test Reports

600-volt wiring test

Grounding system test

Ground-fault receptacle test

Motors

SD-09 Manufacturer's Field Reports

Transformer factory tests

SD-10 Operation and Maintenance Data

Electrical Systems, Data Package 5

Motors

Submit operation and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein.

1.5 QUALITY ASSURANCE

1.5.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the COR. Equipment, materials, installation, and

workmanship shall be in accordance with the mandatory and advisory provisions of CEC and NFPA 70 unless more stringent requirements are specified or indicated.

1.5.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 MAINTENANCE

1.6.1 Electrical Systems

Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. This shall include:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 SEISMIC REQUIREMENTS

Seismic details shall conform to Section 26 05 48.00 10, SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials, equipment, and devices shall, as a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of CEC and NFPA 70.

2.2 SURFACE RACEWAY

2.2.1 Surface Metal Raceway

UL 5, two-piece painted steel, totally enclosed, snap-cover type. Provide multiple outlet-type raceway with grounding-type receptacle where indicated. Receptacles shall be as specified herein and shall be spaced a minimum of one every 18 inches. Alternate receptacles shall be wired on different circuits.

2.2.2 Surface Nonmetallic Raceway

UL 5A, nonmetallic totally enclosed, snap-cover type. Provide multiple outlet-type raceway with grounding-type receptacle where indicated. Receptacles shall be as specified herein and shall be spaced minimum of one every 18 inches.

2.3 BUSWAY

NEMA BU 1.1, UL 857. Buses shall be copper. Busways shall be rated as indicated, and shall include integral or internal ground bus. Short circuit rating shall be as indicated. Busway systems shall be suitable for use indoors. Enclosures shall be steel. Hardware shall be plated or otherwise protected to resist corrosion. Joints shall be one-bolt type with through-bolts, which can be checked for tightness without de-energizing system. Maximum hot spot temperature rise at any point in busway at continuous rated load shall not exceed 55 degrees C above maximum ambient temperature of 40 degrees C in any position. Provide internal barriers to prevent movement of superheated gases. Contractor shall coordinate proper voltage phasing of entire bus duct system, for example where busway interfaces with transformers, switchgear, switchboards, motor control centers, and other system components.

2.3.1 Feeder Busways

Provide ventilated, except that concealed and vertical busways within 6 feet of floors shall be unventilated, low-impedance busway. Bus bars shall be fully covered with insulating material, except at stabs. Entire busway system shall be polarized.

2.3.2 Plug-In Busways

Unventilated type. Plug-in units shall be circuit breaker-type Bus bars shall be covered with insulating material throughout, except at joints and other connection points. A hook stick of suitable length shall be provided for operating plug-in units from the floor.

2.4 OPEN TELECOMMUNICATIONS CABLE SUPPORT

2.4.1 Open Top Cable Supports

Provide open top cable supports in accordance with UL 2043. Open top cable supports shall be as indicated.

2.4.2 Closed Ring Cable Supports

Provide closed ring cable supports in accordance with UL 2043. Closed ring cable supports shall be as indicated.

2.5 MOTORS

NEMA MG 1. Hermetic-type sealed motor compressors shall also comply with UL 984. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as specified by the driven equipment supplier. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters. Motors for operation on 208-volt, 3-phase circuits shall have terminal voltage rating of 200 volts, and those for operation on 480-volt, 3-phase circuits shall have terminal voltage rating of 460 volts. Motors shall be designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating. Unless otherwise indicated, motors rated 1 HP and above shall be continuous duty type.

Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.

2.5.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors shall be high efficiency types corresponding to the applications listed in NEMA MG 11. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.5.2 Premium Efficiency Polyphase Motors

Polyphase motors shall be selected based on high efficiency characteristics relative to typical characteristics and applications as listed in NEMA MG 10. In addition, continuous rated, polyphase squirrel-cage medium induction motors shall meet the requirements for premium efficiency electric motors in accordance with NEMA MG 1, including the NEMA full load efficiency ratings. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.5.3 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors

from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

2.5.4 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment, and motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to equipment as specified herein. Power wiring and conduit shall conform to the requirements specified herein. Control wiring shall be provided under, and conform to the requirements of the section specifying the associated equipment.

2.6 MOTOR CONTROL CENTERS

UL 845, NEMA ICS 2. Unless otherwise specified on the drawings, wiring shall be Class I, Type B, in NEMA Type1 (indoors) or 3R (outdoors) enclosure. Provide control centers suitable for operation on a 3-phase, 60 Hz system at the voltage and short-circuit current ratings shown on the drawings. Arrange busing so that control center can be expanded from both ends. Interconnecting wires shall be copper. Terminal blocks shall be plug-in-type so that controllers may be removed without disconnecting individual control wiring.

2.6.1 Bus Systems

Provide the following bus systems. Power bus shall be braced to withstand fault current of 65,000 amperes rms symmetrical. Wiring troughs shall be isolated from horizontal and vertical bus bars.

2.6.1.1 Horizontal and Main Buses

Main bus shall be copper, silver-plated enclosed in isolated compartment at top of each vertical section. Main bus shall be isolated from wire troughs, starters, and other areas.

2.6.1.2 Vertical Bus

Vertical bus shall be copper, silver-plated. Vertical bus shall be enclosed in flame-retardant, polyester glass "sandwich."

2.6.1.3 Ground Bus

Copper ground bus shall be provided full width of motor control center and shall be equipped with necessary lugs.

2.6.2 Motor Disconnecting Devices and Controllers

Shall comply with Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES.

2.6.3 Space Heaters

Space heaters shall be provided where indicated on the drawings and shall be controlled using an adjustable 50 to 90 degrees F thermostat, magnetic contactor, and a molded-case circuit breaker and a 480-120 volt single-phase transformer. The space heaters shall be 250-watt, 240 volt

strip elements operated at 120 volts and shall be supplied from the motor control center bus The contactors shall be open type, electrically-held, rated 30 amperes, 2-pole, with 120-volt ac coils.

2.7 LOCKOUT REQUIREMENTS

Provide disconnecting means capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147. Mechanical isolation of machines and other equipment shall be in accordance with requirements of Division 23, "Mechanical."

2.8 GROUNDING AND BONDING EQUIPMENT

2.8.1 Ground Rods

UL 467. Ground rods shall be copper-clad steel, with minimum diameter of 3/4 inch and minimum length of 10 feet.

2.9 HAZARDOUS LOCATIONS

Electrical materials, equipment, and devices for installation in hazardous locations, as defined by CEC and NFPA 70, shall be specifically approved by Underwriters' Laboratories, Inc., or Factory Mutual for particular "Class," "Division," and "Group" of hazardous locations involved. Boundaries and classifications of hazardous locations shall be as indicated. Equipment in hazardous locations shall comply with UL 877 for circuit breakers, UL 886 for outlet boxes and fittings, UL 1010 for receptacles, UL 674 for motors, and UL 698 for industrial controls.

2.10 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test and the additional requirements as specified herein. Interior and exterior steel surfaces of equipment enclosures shall be thoroughly cleaned and then receive a rust-inhibitive phosphatizing or equivalent treatment prior to painting. Exterior surfaces shall be free from holes, seams, dents, weld marks, loose scale or other imperfections. Interior surfaces shall receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice. Exterior surfaces shall be primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish. Equipment located indoors shall be ANSI Light Gray, and equipment located outdoors shall be ANSI Dark Gray. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces, shall conform to requirements of CEC and NFPA 70 and IEEE C2 and to requirements specified herein.

3.1.1 Hazardous Locations

Work in hazardous locations, as defined by CEC and NFPA 70, shall be

performed in strict accordance with CEC and NFPA 70 for particular "Class," "Division," and "Group" of hazardous locations involved. Provide conduit and cable seals where required by CEC and NFPA 70. Conduit shall have tapered threads.

3.1.2 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures shall be labeled and identified as such.

3.1.2.1 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by CEC and NFPA 70, each enclosure, new and existing, shall be labeled as one of several enclosures containing service entrance disconnect devices. Label, at minimum, shall indicate number of service disconnect devices housed by enclosure and shall indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure, shall be provided only as permitted by CEC and NFPA 70.

3.1.3 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by CEC and NFPA 70 to be installed otherwise. Grounding conductor shall be separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Shared neutral, or multi-wire branch circuits, are not permitted with arc-fault circuit interrupters. Minimum conduit size shall be 3/4 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings shall be made with metal conduit in fire-rated shafts. Metal conduit shall extend through shafts for minimum distance of 6 inches. Conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors shall be firestopped.

3.1.3.1 Pull Wire

Install pull wires in empty conduits. Pull wire shall be plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.4 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit a minimum of 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.

3.1.4.1 Service Entrance Conduit, Underground

PVC, Type-EPC 40, galvanized rigid steel or steel IMC. Underground portion shall be encased in minimum of 3 inches of concrete and shall be installed minimum 18 inches below slab or grade.

3.1.4.2 Underground Conduit Other Than Service Entrance

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid, or IMC, steel conduit before rising through floor slab. Plastic coating shall extend minimum 6 inches above floor.

3.1.4.3 Conduit Installed Under Floor Slabs

Conduit run under floor slab shall be located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.1.4.4 Conduit Through Floor Slabs

Where conduits rise through floor slabs, curved portion of bends shall not be visible above finished slab.

3.1.4.5 Conduit Installed in Concrete Floor Slabs

Rigid steel; steel IMC; or PVC, Type EPC-40, unless indicated otherwise. Locate so as not to adversely affect structural strength of slabs. Install conduit within middle one-third of concrete slab. Space conduits horizontally not closer than three diameters, except at cabinet locations. Curved portions of bends shall not be visible above finish slab. Increase slab thickness as necessary to provide minimum one inch cover over conduit. Where embedded conduits cross building and/or expansion joints, provide suitable watertight expansion/deflection fittings and bonding jumpers. Expansion/deflection fittings shall allow horizontal and vertical movement of raceway. Conduit larger than one inch trade size shall be parallel with or at right angles to main reinforcement; when at right angles to reinforcement, conduit shall be close to one of supports of slab. Where nonmetallic conduit is used, raceway shall be converted to plastic coated rigid steel or plastic coated steel IMC before rising above floor, unless specifically indicated.

3.1.4.6 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.4.7 Conduit Support

Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Load applied to fasteners shall not exceed one-fourth proof test load. Fasteners attached to concrete ceiling shall be vibration resistant and shock-resistant. Holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints shall not cut main reinforcing bars. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction,

run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems shall be supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Installation shall be coordinated with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Support exposed risers in wire shafts of multistory buildings by U-clamp hangers at each floor level and at 10 foot maximum intervals. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.4.8 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.4.9 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by CEC and NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Locknuts shall have sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by CEC and NFPA 70.

3.1.4.10 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size shall be 3/4 inch diameter. Provide liquidtight flexible conduit in wet and damp locations and in fire pump rooms for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.1.5 Busway Installation

Installation shall comply at minimum with CEC and NFPA 70. Install busways parallel with or at right angles to ceilings, walls, and structural members. Support busways at 5 foot maximum intervals, and brace to prevent lateral movement. Hinges provided on risers shall be fixed type; spring-type are unacceptable. Provide flanges where busway makes penetrations through walls and floors, and seal to maintain smoke and fire ratings. Provide waterproof curb where busway riser passes through floor. Seal gaps with fire-rated foam and calk. Provide expansion joints, but only where bus duct crosses building expansion joints. Provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.6 Cable Tray Installation

Install and ground in accordance with CEC and NFPA 70. Install cable trays parallel with or at right angles to ceilings, walls, and structural members. Support in accordance with manufacturer recommendations but at not more than 6 foot intervals. Adjacent cable tray sections shall be bonded together by connector plates of an identical type as the cable tray sections. For grounding of cable tray system provide No. 2 AWG bare copper wire throughout cable tray system, and bond to each section. Terminate cable trays 10 inches from both sides of smoke and fire partitions. Conductors run through smoke and fire partitions shall be installed in 4 inch rigid steel conduits with grounding bushings, extending 12 inches beyond each side of partitions. Seal conduit on both ends to maintain smoke and fire ratings of partitions. Penetrations shall be firestopped. Provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.7 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 feet above floors and walkways, or when installed in hazardous areas and when specifically indicated. Boxes in other locations shall be sheet steel. Each box shall have volume required by CEC and NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures shall be minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; fixtures shall be readily removable for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. Threaded studs driven in by powder charge and provided with lockwashers and nuts or nail-type nylon anchors may be used in lieu of wood screws, expansion shields, or machine screws. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.7.1 Boxes

Boxes for use with raceway systems shall be minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets shall be minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet. Mount outlet boxes flush in finished walls.

3.1.7.2 Pull Boxes

Construct of at least minimum size required by CEC and NFPA 70 of code-gauge galvanized sheet steel, and compatible with nonmetallic raceway systems, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.7.3 Extension Rings

Extension rings are not permitted for new construction. Use only on existing boxes in concealed conduit systems where wall is furred out for new finish.

3.1.8 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controller and disconnecting switches so height of operating handle at its highest position is maximum 78 inches above floor. Mount lighting switches and handicapped telecommunications stations 48 inches above finished floor. Mount receptacles and telecommunications outlets 18 inches above finished floor, unless otherwise indicated. Wall-mounted telecommunications outlets shall be mounted at height 60 inches above finished floor or as indicated. Mount other devices as indicated. Measure mounting heights of wiring devices and outlets in non-hazardous areas to center of device or outlet. Measure mounting heights of receptacle outlet boxes in the hazardous area to the bottom of the outlet box.

3.1.9 Mineral Insulated, Metal Sheathed (Type MI) Cable Installation

Mineral-insulated, metal-sheathed cable system, Type MI, may be used in lieu of exposed conduit and wiring. Conductor sizes shall be not less than those indicated for the conduit installation. Cables shall be fastened within 12 inches of each turn or offset and at 33 inches maximum intervals. Make cable terminations in accordance with CEC and NFPA 70 and cable manufacturer's recommendations. Single-conductor cables of a circuit, having capacities of more than 50 amperes, shall terminate in a single box or cabinet opening. Individual conductors in all outlets and cabinets shall be color-coded.

3.1.10 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, color coding shall be by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, color coding shall be by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves.

3.1.10.1 Marking Strips

White or other light-colored plastic marking strips, fastened by screws to each terminal block, shall be provided for wire designations. The wire numbers shall be made with permanent ink. The marking strips shall be reversible to permit marking both sides, or two marking strips shall be furnished with each block. Marking strips shall accommodate the two sets of wire numbers. Each device to which a connection is made shall be

assigned a device designation in accordance with NEMA ICS 1 and each device terminal to which a connection is made shall be marked with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, additional wire and cable designations for identification of remote (external) circuits shall be provided for the Government's wire designations. Prints of the marking strips drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.1.11 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.12 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.13 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings with fire stopping and penetration seals having fire-resistance properties not less than the penetrated structure..

3.1.14 Grounding and Bonding

Provide In accordance with CEC and NFPA 70. Ground exposed, non-current-carrying metallic parts of electrical equipment, access flooring support system, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telecommunications system grounds, and neutral conductor of wiring systems. Make ground connection at main service equipment, and extend grounding conductor to point of entrance of metallic water service. Make connection to water pipe by suitable ground clamp or lug connection to plugged tee. If flanged pipes are encountered, make connection with lug bolted to street side of flanged connection. Supplement metallic water service grounding system with additional made electrode in compliance with CEC and NFPA 70. Make ground connection to driven ground rods on exterior of building. Interconnect all grounding media in or on the structure to provide a common ground potential. This shall include lightning protection, electrical service, telecommunications system grounds, as well as underground metallic piping systems. Interconnection to the gas line shall be made on the customer's side of the meter. Use main size lightning conductors for interconnecting these grounding systems to the lightning protection system. In addition to the requirements specified herein, provide telecommunications grounding in accordance with TIA J-STD-607. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with

correct operation of fault protection.

3.1.14.1 Ground Rods

Provide cone pointed ground rods. The resistance to ground shall be measured using the fall-of-potential method described in IEEE 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, additional rods not less than 6 feet on centers, or if sectional type rods are used, additional sections may be coupled and driven with the first rod. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the COR who will decide on the number of ground rods to add.

3.1.14.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, by exothermic weld or compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make compression connections using a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

3.1.14.3 Ground Bus

A copper ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical electrical equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment. For raised floor equipment rooms in computer and data processing centers, a minimum of 4, one at each corner, ground buses shall be provided and connected to the building grounding system. Connections shall be bolted type in lieu of thermoweld, so they can be changed as required by additions and/or alterations.

3.1.14.4 Resistance

Maximum resistance-to-ground of grounding system shall not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact COR for further instructions.

3.1.14.5 Telecommunications System

Provide telecommunications grounding in accordance with the following:

a. Telecommunications Grounding Busbars: Provide a telecommunications main grounding busbar (TMGB) in the telecommunications entrance

facility. The TMGB shall be as close to the electrical service entrance grounding connection as practicable. Provide a telecommunications grounding busbar (TGB) in all other telecommunications rooms and telecommunications equipment rooms. The TGB shall be as close to the telecommunications room panelboard as practicable, when equipped. Where a panelboard for telecommunications equipment is not installed in the telecommunications room, the TGB shall be located near the backbone cabling and associated terminations. In addition, the TGB shall be placed to provide for the shortest and straightest routing of the grounding conductors. Where a panelboard for telecommunications equipment is located within the same room or space as a TGB, that panelboard's alternating current equipment ground (ACEG) bus (when equipped) or the panelboard enclosure shall be bonded to the TGB. Telecommunications grounding busbars shall be installed to maintain clearances as required by CEC and NFPA 70 and shall be insulated from its support. A minimum of 2 inches separation from the wall is recommended to allow access to the rear of the busbar and the mounting height shall be adjusted to accommodate overhead or underfloor cable routing.

b. Telecommunications Bonding Conductors: Provide main telecommunications service equipment ground consisting of separate bonding conductor for telecommunications, between the TMGB and readily accessible grounding connection of the electrical service. Grounding and bonding conductors should not be placed in ferrous metallic conduit. If it is necessary to place grounding and bonding conductors in ferrous metallic conduit that exceeds3 feet in length, the conductors shall be bonded to each end of the conduit using a grounding bushing or a No. 6 AWG conductor, minimum. Provide a telecommunications bonding backbone (TBB) that originates at the TMGB extends throughout the building using the telecommunications backbone pathways, and connects to the TGBs in all telecommunications rooms and equipment rooms. The TBB conductors shall be installed and protected from physical and mechanical damage. The TBB conductors should be installed without splices and routed in the shortest possible straight-line path. The bonding conductor between a TBB and a TGB shall be continuous. Where splices are necessary, the number of splices should be a minimum and they shall be accessible and located in telecommunications spaces. Joined segments of a TBB shall be connected using exothermic welding, irreversible compression-type connectors, or equivalent. All joints shall be adequately supported and protected from damage. Whenever two or more TBBs are used within a multistory building, the TBBs shall be bonded together with a grounding equalizer (GE) at the top floor and at a minimum of every third floor in between. The TBB and GE shall not be connected to the pathway ground, except at the TMGB or the TGB.

c. Telecommunications Grounding Connections: Telecommunications grounding connections to the TMGB or TGB shall utilize listed compression two-hole lugs, exothermic welding, suitable and equivalent one hole non-twisting lugs, or other irreversible compression type connections. All metallic pathways, cabinets, and racks for telecommunications cabling and interconnecting hardware located within the same room or space as the TMGB or TGB shall be bonded to the TMGB or TGB respectively. In a metal frame (structural steel) building, where the steel framework is readily accessible within the room; each TMGB and TGB shall be bonded to the vertical steel metal frame using a minimum No. 6 AWG conductor. Where the metal frame is external to the room and readily accessible, the metal frame shall be bonded to the TGB or TMGB with a minimum No. 6 AWG conductor. When practicable because of shorter

distances and, where horizontal steel members are permanently electrically bonded to vertical column members, the TGB may be bonded to these horizontal members in lieu of the vertical column members. All connectors used for bonding to the metal frame of a building shall be listed for the intended purpose.

3.1.15 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications but shall be provided under the section specifying the associated equipment.

3.1.16 Elevator

Provide circuit to line terminals of elevator controller, and disconnect switch on line side of controller, outlet for control power, outlet receptacle and work light at midheight of elevator shaft, and work light and outlet receptacle in elevator pit.

3.1.17 Government-Furnished Equipment

Contractor shall rough-in for Government-furnished equipment and shall make connections to Government-furnished equipment to make equipment operate as intended, including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

3.1.18 Repair of Existing Work

Repair of existing work, demolition, and modification of existing electrical distribution systems shall be performed as follows:

3.1.18.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.1.18.2 Existing Concealed Wiring to be Removed

Existing concealed wiring to be removed shall be disconnected from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3.1.18.3 Removal of Existing Electrical Distribution System

Removal of existing electrical distribution system equipment shall include equipment's associated wiring, including conductors, cables, exposed conduit, surface metal raceways, boxes, and fittings, as indicated.

3.1.18.4 Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Existing circuits of equipment shall remain energized. Circuits which are to remain

but were disturbed during demolition shall have circuits wiring and power restored back to original condition.

3.1.19 Surge Protective Devices

Connect the surge protective devices in parallel to the power source, keeping the conductors as short and straight as practically possible.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

3.4 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS. Where field painting of enclosures for panelboards, load centers or the like is specified to match adjacent surfaces, to correct damage to the manufacturer's factory applied coatings, or to meet the indicated or specified safety criteria, provide manufacturer's recommended coatings and apply in accordance to manufacturer's instructions.

3.5 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give COR 5 working days notice prior to each test.

3.5.1 Devices Subject to Manual Operation

Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

3.5.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance shall be 250,000 ohms.

3.5.3 Ground-Fault Receptacle Test

Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

3.5.4 Grounding System Test

Test grounding system to ensure continuity, and that resistance to ground is not excessive. Test each ground rod for resistance to ground before making connections to rod; tie grounding system together and test for resistance to ground. Make resistance measurements in dry weather, not

earlier than 48 hours after rainfall. Submit written results of each test to COR, and indicate location of rods as well as resistance and soil conditions at time measurements were made.

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SECTION 26 29 23

VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for variable frequency drive for motors rated up to 575 volts, for use on electric power systems of 600 volts or less, 50/60 hertz.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 519	Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
IEEE C62.41.1	Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	Standard for Industrial Control and Systems: General Requirements
NEMA ICS 6	Enclosures
NEMA ICS 7	Adjustable-Speed Drives

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-461	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 489	Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 508C	Power Conversion Equipment

1.3 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM apply to this section with additions and modifications specified herein.

1.4 SYSTEM DESCRIPTION

1.4.1 Performance Requirements

1.4.1.1 Electromagnetic Interference Suppression

Computing devices, as defined by 47 CFR 15, MIL-STD-461 rules and regulations, shall be certified to comply with the requirements for class A computing devices and labeled as set forth in part 15.

1.4.1.2 Electromechanical and Electrical Components

Electrical and electromechanical components of the Variable Frequency Drive (VFD) shall not cause electromagnetic interference to adjacent electrical or electromechanical equipment while in operation.

1.4.2 Electrical Requirements

1.4.2.1 Power Line Surge Protection

IEEE C62.41.1 and IEEE C62.41.2, IEEE 519 Control panel shall have surge protection, included within the panel to protect the unit from damaging transient voltage surges. Surge arrestor shall be mounted near the incoming power source and properly wired to all three phases and ground. Fuses shall not be used for surge protection.

1.4.2.2 Sensor and Control Wiring Surge Protection

I/O functions as specified shall be protected against surges induced on control and sensor wiring installed outdoors and as shown. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

a. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Schematic diagrams

Interconnecting diagrams

Installation drawings

Submit drawings for government approval prior to equipment construction or integration. Modifications to original drawings made during installation shall be immediately recorded for inclusion into the as-built drawings.

SD-03 Product Data

Variable frequency drives

Wires and cables

Equipment schedule

Include data indicating compatibility with motors being driven.

SD-06 Test Reports

VFD Test

Performance Verification Tests

Endurance Test

SD-08 Manufacturer's Instructions

Installation instructions

SD-09 Manufacturer's Field Reports

VFD Factory Test Plan

Factory test results

SD-10 Operation and Maintenance Data

Variable frequency drives, Data Package 4

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Provide service and maintenance information

including preventive maintenance, assembly, and disassembly procedures. Include electrical drawings from electrical general sections. Submit additional information necessary to provide complete operation, repair, and maintenance information, detailed to the smallest replaceable unit. Include copies of as-built submittals. Provide routine preventative maintenance instructions, and equipment required. Provide instructions on how to modify program settings, and modify the control program. Provide instructions on drive adjustment, trouble-shooting, and configuration. Provide instructions on process tuning and system calibration.

1.6 QUALITY ASSURANCE

1.6.1 Schematic Diagrams

Show circuits and device elements for each replaceable module. Schematic diagrams of printed circuit boards are permitted to group functional assemblies as devices, provided that sufficient information is provided for government maintenance personnel to verify proper operation of the functional assemblies.

1.6.2 Interconnecting Diagrams

Show interconnections between equipment assemblies, and external interfaces, including power and signal conductors. Include for enclosures and external devices.

1.6.3 Installation Drawings

Show floor plan of each site, with V.F.D.'s and motors indicated. Indicate ventilation requirements, adequate clearances, and cable routes.

1.6.4 Equipment Schedule

Provide schedule of equipment supplied. Schedule shall provide a cross reference between manufacturer data and identifiers indicated in shop drawings. Schedule shall include the total quantity of each item of equipment supplied. For complete assemblies, such as VFD's, provide the serial numbers of each assembly, and a sub-schedule of components within the assembly. Provide recommended spare parts listing for each assembly or component.

1.6.5 Installation instructions

Provide installation instructions issued by the manufacturer of the equipment, including notes and recommendations, prior to shipment to the site. Provide operation instructions prior to acceptance testing.

1.6.6 Factory Test Results

Document test results and submit to government within 7 working days after completion of test.

1.7 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.8 WARRANTY

The complete system shall be warranted by the manufacturer for a period of one year, or the contracted period of any extended warrantee agreed upon by the contractor and the Government, after successful completion of the acceptance test. Any component failing to perform its function as specified and documented shall be repaired or replaced by the contractor at no additional cost to the Government. Items repaired or replaced shall be warranted for an additional period of at least one year from the date that it becomes functional again, as specified in the FAR CLAUSE 52.246-21.

1.9 MAINTENANCE

1.9.1 Spare Parts

Manufacturers provide spare parts in accordance with recommended spare parts list.

1.9.2 Maintenance Support

During the warranty period, the Contractor shall provide on-site, on-call maintenance services by Contractor's personnel on the following basis: The service shall be on a per-call basis with 36 hour response. Contractor shall support the maintenance of all hardware and software of the system. Various personnel of different expertise shall be sent on-site depending on the nature of the maintenance service required. Costs shall include travel, local transportation, living expenses, and labor rates of the service personnel while responding to the service request. The provisions of this Section are not in lieu of, nor relieve the Contractor of, warranty responsibilities covered in this specification. Should the result of the service request be the uncovering of a system defect covered under the warranty provisions, all costs for the call, including the labor necessary to identify the defect, shall be borne by the Contractor.

PART 2 PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES (VFD)

Provide frequency drive to control the speed of induction motor(s). The VFD shall include the following minimum functions, features and ratings.

a. Input circuit breaker per UL 489 with a minimum symmetrical interrupting capacity of 42,000 Amps at 208 Volts or 22,000 Amps at 480 Volts, and door interlocked external operator.

b. A converter stage per UL 508C shall change fixed voltage, fixed frequency, ac line power to a fixed dc voltage. The converter shall utilize a full wave bridge design incorporating diode rectifiers. Silicon Controlled Rectifiers (SCR) are not acceptable. The converter shall be insensitive to three phase rotation of the ac line and shall not cause displacement power factor of less than .95 lagging under any speed and load condition.

c. An inverter stage shall change fixed dc voltage to variable frequency, variable voltage, ac for application to a standard NEMA design B squirrel cage motor. The inverter shall be switched in a manner to produce a sine coded pulse width modulated (PWM) output waveform.

d. The VFD shall be capable of supplying 120 percent of rated full load current for one minute at maximum ambient temperature.

e. The VFD shall be designed to operate from a 480 or 208 volt, plus or minus 10 percent, three phase, 60 Hz supply, as shown on the drawings, and control motors with a corresponding voltage rating.

f. Acceleration and deceleration time shall be independently adjustable from one second to 60 seconds.

g. Adjustable full-time current limiting shall limit the current to a preset value which shall not exceed 120 percent of the controller rated current. The current limiting action shall maintain the V/Hz ratio constant so that variable torque can be maintained. Short time starting override shall allow starting current to reach 175 percent of controller rated current to maximum starting torque.

h. The controllers shall be capable of producing an output frequency over the range of 3 Hz to 60 Hz (20 to one speed range), without low speed cogging. Over frequency protection shall be included such that a failure in the controller electronic circuitry shall not cause frequency to exceed 110 percent of the maximum controller output frequency selected.

i. Minimum and maximum output frequency shall be adjustable over the following ranges: 1) Minimum frequency 3 Hz to 50 percent of maximum selected frequency; 2) Maximum frequency 40 Hz to 60 Hz.

j. The controller efficiency at any speed shall not be less than 96 percent.

k. The controllers shall be capable of being restarted into a motor coasting in the forward direction without tripping.

l. Protection of power semiconductor components shall be accomplished without the use of fast acting semiconductor output fuses. Subjecting the controllers to any of the following conditions shall not result in component failure or the need for fuse replacement:

    1. Short circuit at controller output

    2. Ground fault at controller output

    3. Open circuit at controller output

    4. Input undervoltage

    5. Input overvoltage

    6. Loss of input phase

    7. AC line switching transients

    8. Instantaneous overload

    9. Sustained overload exceeding 115 percent of controller rated current

    10. Over temperature

11. Phase reversal

m. Solid state motor overload protection shall be included such that current exceeding an adjustable threshold shall activate a 60 second timing circuit. Should current remain above the threshold continuously for the timing period, the controller will automatically shut down.

n. A slip compensation circuit shall be included which will sense changing motor load conditions and adjust output frequency to provide speed regulation of NEMA B motors to within plus or minus 0.5 percent of maximum speed without the necessity of a tachometer generator.

o. The VFD shall be factory set for manual restart after the first protective circuit trip for malfunction (overcurrent,undervoltage, overvoltage or overtemperature) or an interruption of power. The VFD shall be capable of being set for automatic restart after a selected time delay. If the drive faults again within a specified time period (adjustable 0-60 seconds), a manual restart will be required.

p. The VFD shall include external fault reset capability. All the necessary logic to accept an external fault reset contact shall be included.

q. Provide critical speed lockout circuitry to prevent operating at frequencies with critical harmonics that cause resonant vibrations. The VFD shall have a minimum of three user selectable bandwidths.

r. Provide the following operator control and monitoring devices mounted on the front panel of the VFD:

1. Manual speed potentiometer.

2. Hand-Off-Auto (HOA) switch.

3. Power on light.

4. Drive run power light.

5. Local display.

s. Provide properly sized NEMA rated by-pass and isolation contactors to enable operation of motor in the event of VFD failure. Mechanical and electrical interlocks shall be installed between the by-pass and isolation contactors. Provide a selector switch and transfer delay timer.

2.2 ENCLOSURES

Provide equipment enclosures conforming to NEMA 250, NEMA ICS 7, NEMA ICS 6.

2.3 WIRES AND CABLES

All wires and cables shall conform to NEMA 250, NEMA ICS 7, CEC and NFPA 70.

2.4 NAMEPLATES

Nameplates external to NEMA enclosures shall conform with the requirements of Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS.

Nameplates internal to enclosures shall be manufacturer's standard, with the exception that they must be permanent.

2.5 SOURCE QUALITY CONTROL

2.5.1 VFD Factory Test Plan

To ensure quality, each VFD shall be subject to a series of in-plant quality control inspections before approval for shipment from the manufacturer's facilities. Provide test plans and test reports.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment in accordance with the approved manufacturer's printed installation drawings, instructions, wiring diagrams, and as indicated on project drawings and the approved shop drawings. A field representative of the drive manufacturer shall supervise the installation of all equipment, and wiring.

3.2 FIELD QUALITY CONTROL

Specified products shall be tested as a system for conformance to specification requirements prior to scheduling the acceptance tests. Contractor shall conduct performance verification tests in the presence of Government representative, observing and documenting complete compliance of the system to the specifications. Contractor shall submit a signed copy of the test results, certifying proper system operation before scheduling tests.

3.2.1 VFD Test

A proposed test plan shall be submitted to the COR at least 20 working days prior to proposed testing for approval. The tests shall conform to NEMA ICS 1, NEMA ICS 7, and all manufacturer's safety regulations. The Government reserves the right to witness all tests and review any documentation. The Contractor shall inform the Government at least 14 working days prior to the dates of testing. Contractor shall provide video tapes, if available, of all training provided to the Government for subsequent use in training new personnel. All training aids, texts, and expendable support material for a self-sufficient presentation shall be provided, the amount of which to be determined by the COR.

3.2.2 Performance Verification Tests

"Performance Verification Test" plan shall provide the step by step procedure required to establish formal verification of the performance of the VFD. Compliance with the specification requirements shall be verified by inspections, review of critical data, demonstrations, and tests. The Government reserves the right to witness all tests, review data, and request other such additional inspections and repeat tests as necessary to ensure that the system and provided services conform to the stated requirements. The contractor shall inform the Government 10 working days prior to the date the test is to be conducted.

3.2.3 Endurance Test

Immediately upon completion of the performance verification test, the

endurance test shall commence. The system shall be operated at varying rates for not less than 192 consecutive hours, at an average effectiveness level of .9998, to demonstrate proper functioning of the complete PCS. Continue the test on a day-to-day basis until performance standard is met. During the endurance test, the contractor shall not be allowed in the building. The system shall respond as designed.

3.3 DEMONSTRATION

3.3.1 Training

Coordinate training requirements with the COR.

3.3.1.1 Instructions to Government Personnel

Provide the services of competent instructors who will give full instruction to designated personnel in operation, maintenance, calibration, configuration, and programming of the complete control system. Orient the training specifically to the system installed. Instructors shall be thoroughly familiar with the subject matter they are to teach. The Government personnel designated to attend the training will have a high school education or equivalent. The number of training days of instruction furnished shall be as specified. A training day is defined as eight hours of instruction, including two 15-minute breaks and excluding lunch time; Monday through Friday. Provide a training manual for each student at each training phase which describes in detail the material included in each training program. Provide one additional copy for archiving. Provide equipment and materials required for classroom training. Provide a list of additional related courses, and offers, noting any courses recommended. List each training course individually by name, including duration, approximate cost per person, and location of course. Unused copies of training manuals shall be turned over to the Government at the end of last training session.

3.3.1.2 Operating Personnel Training Program

Provide one 2 hour training session at the site at a time and place mutually agreeable between the Contractor and the Government. Provide session to train 4 operation personnel in the functional operations of the system and the procedures that personnel will follow in system operation. This training shall include:

a. System overview

b. General theory of operation

c. System operation

d. Alarm formats

e. Failure recovery procedures

f. Troubleshooting

3.3.1.3 Engineering/Maintenance Personnel Training

Accomplish the training program as specified. Training shall be conducted on site at a location designated by the Government. Provide a one day training session to train 4 engineering personnel in the functional

operations of the system. This training shall include:

a. System overview

b. General theory of operation

c. System operation

d. System configuration

e. Alarm formats

f. Failure recovery procedures

g. Troubleshooting and repair

h. Maintenance and calibration

i. System programming and configuration

-- End of Section --

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DIVISION 26 - ELECTRICAL

SECTION 26 33 53.00 20

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SECTION 26 33 53.00 20

UNINTERRUPTIBLE POWER SUPPLY (UPS)

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for static UPS to provide continuous ac power to critical loads and/or to improve the quality of ac power to critical loads. The covered range of UPS units is between 10kVA and 750kVA 3-phase systems only. Single phase systems are not addressed. This specification covers UPS with electro-chemical batteries. Electro-mechanical (stored energy) UPS are not addressed.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S1.4	Specification for Sound Level Meters (ASA 47)

ASTM INTERNATIONAL (ASTM)

ASTM B173	Standard Specification for Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors
ASTM D 709	Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	The Authoritative Dictionary of IEEE Standards Terms
IEEE 450	Recommended Practice for Maintenance, Testing, and Replacement of Vented Lead-Acid Batteries for Stationary Applications
IEEE C2	National Electrical Safety Code
IEEE C57.110	Recommended Practice for Establishing Liquid-Filled and Dry-Type Power and Distribution Transformer Capability When

	Supplying Nonsinusoidal Load Currents
IEEE C62.41.1	Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 9001	Quality Management Systems- Requirements

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA PE 1	Uninterruptible Power Systems (UPS) Specification and Performance Verification

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1449	Surge Protective Devices
UL 1778	Uninterruptible Power Systems

1.3 RELATED REQUIREMENTS

Section 26 08 00 APPARATUS INSPECTION AND TESTING applies to this section, with the additions and modifications specified herein.

1.4 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

UPS Drawings

UPS Installation

SD-03 Product Data

UPS Module

Submittal shall include manufacturer's information for each component, device, and accessory provided.

Factory Testing

UPS System

SD-06 Test Reports

Work Plan

Factory Test Plan

Performance Test Plan

Factory Tests

Performance Tests Report

Factory Tests Report

SD-09 Manufacturer's Field Reports

Initial Inspection and Tests

Performance Tests

SD-10 Operation and Maintenance Data

UPS Operation and Maintenance, Data Package 5

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein.

SD-11 Closeout Submittals

Installation

1.6 PERFORMANCE REQUIREMENTS

1.6.1 Normal Operation

The UPS module rectifier/charger shall convert the incoming ac input power to dc power for the inverter and for float charging the battery. The inverter shall supply ac power to the critical load continuously. Inverter output shall be synchronized with the bypass ac power source, provided that the bypass ac power source is within the specified voltage and frequency range.

1.6.2 Emergency Operation (Loss or deviation of AC Input Power)

Whenever the ac input power source deviates from the specified tolerances or fails completely, the inverter shall draw its power from the battery system and shall supply AC power to the critical load without any interruption or switching. The battery shall continue to supply power to the inverter for the specified protection time or until return of ac input source. At the same time, an alarm shall sound to alert operating personnel and a trouble signal shall be sent over the communication network, allowing startup of a secondary power source or orderly shutdown of the critical load.

1.6.3 Return of AC Input Power Source

When stable ac input power source returns the rectifier/charger shall resume operation and shall simultaneously supply the inverter with dc power and recharge the battery. This shall be an automatic function and shall cause no disturbance to the critical load.

1.6.4 Failure of AC Input Power to Return

Should the ac input power fail to return before the battery voltage reaches the discharge limit, the UPS system shall disconnect from the critical load to safeguard the battery.

1.6.5 Transfer to Bypass AC Power Source

When the UPS controller senses an overload or degradation of the inverter output, the bypass switch shall automatically transfer the critical load from the inverter output to the bypass ac power source without an interruption of power. If the bypass ac power source is outside of specified tolerance limits, the UPS and the critical load shall shut down.

1.6.6 Retransfer to Inverter

The static bypass switch shall be capable of automatically retransferring the load back to the inverter output after the inverter output has returned to normal conditions. Retransfer shall only occur if the two sources are synchronized.

1.6.7 UPS Bypass Maintenance

Manual closure of the maintenance bypass switch shall transfer the critical load from the inverter output to the bypass ac power source without disturbing the critical load bus. UPS module shall be capable of manual return to normal operation after completion of maintenance.

1.6.8 Battery Maintenance

The battery protective device shall provide the means of disconnecting the battery from the rectifier/charger and inverter for maintenance. The UPS module shall continue to function and meet the performance criteria specified except for the battery back-up time function.

1.7 QUALITY ASSURANCE

The manufacturer shall have a documented quality assurance program including:

a. Inspections of incoming parts, modular assemblies and final product.

b. Final test procedure for the product including proof of performance specifications.

c. On-site test procedure shall include an inspection of controls and indicators after installation of the equipment.

d. ISO 9001 quality certification.

1.7.1 UPS Drawings

Detail drawings consisting of a complete list of equipment and materials, manufacturer's descriptive and technical literature, battery sizing calculations per IEEE 485, installation instructions, single-line diagrams, ladder-type schematic diagrams, elevations, layout drawings, and details required to demonstrate that the system has been coordinated and will function properly as a unit.

1.7.2 UPS Installation

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. Submittals shall include the nameplate data, size, and capacity. Submittals shall also include applicable federal, military, industry, and technical society publication references.

1.7.3 Work Plan

Submit 6 copies of schedules of dates for factory tests, installation, field tests, and operator training for the UPS system. Furnish a list of instrumentation equipment for factory and field test reports.

1.7.4 Factory Test Plan

Submit 6 copies of factory test plans and procedures at least 15 working days prior to the tests being conducted. Provide detailed description of test procedures, including test equipment and setups, to be used to ensure the UPS meets the performance specification and explain the test methods to be used. As a minimum, the test procedures shall include the test required under the paragraph entitled "Factory Testing."

1.7.5 Performance Test Plan

Submit 6 copies of test plans and procedures at least 10 working days prior to the start of field tests. Provide detailed description and dates and times scheduled for performance of tests, and detailed description of test procedures, including test equipment (list make and model and provide functional description of the test instruments and accessories) and setups of the tests to be conducted to ensure the UPS meets the performance specification. Explain the test methods to be used. As a minimum, the test procedures shall include the tests required under the paragraph entitled "Performance Tests."

1.7.6 Factory Tests Report

Submit 6 copies of factory test report within 30 working days after completion of tests. Receive approval of test prior to shipping unit. Factory test reports shall be signed by an official authorized to certify on behalf of the UPS manufacturer of that the system meets specified requirements in accordance with the requirements set forth in paragraph entitled "Factory Testing". Test reports in shall be in booklet form tabulating factory tests and measurements performed, upon completion and testing of the installed system. Reports shall state the Contractor's name and address, the name of the project and location, and list the specific requirements which are being certified.

1.7.7 Performance Tests Report

Submit report of test results as specified by paragraph entitled "Performance Tests" within 10 working days after completion of tests. Field test reports shall be signed by an official authorized to certify on behalf of the UPS manufacturer that the system meets specified requirements in accordance with the requirements set forth in paragraph entitled "Performance Tests". Test reports in shall be in booklet form tabulating factory tests and measurements performed, upon completion and testing of the installed system. Reports shall state the Contractor's name and address, the name of the project and location, and list the specific requirements which are being certified.

1.7.8 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the COR. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of CEC and NFPA 70 unless more stringent requirements are specified or indicated.

1.7.8.1 Reference Standard Compliance

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association (NEMA), Underwriters Laboratories (UL), and Association of Edison Illuminating Companies (AEIC), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance.

1.7.8.2 Independent Testing Organization Certificate

In lieu of the label or listing, submit a certificate from an independent testing organization, competent to perform testing, and approved by the COR. The certificate shall state that the item has been tested in accordance with the specified organization's test methods and that the item complies with the specified organization's reference standard.

1.7.9 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal

material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section. Equipment shall be supported by a service organization that is, in the opinion of the COR, reasonably convenient to the site.

1.7.9.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.7.9.2 Material and Equipment Manufacturing Date

Products manufactured more than 2 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.8 DELIVERY AND STORAGE

Equipment placed in storage shall be protected from humidity and temperature variations, moisture, water intrusion, dirt, dust, or other contaminants. In harsh environments where temperatures exceed non-operational parameters established within this specification, the equipment storage facility shall be environmentally controlled to ensure temperature parameters are within equipment specification. Documentation of same shall be provided to the Government when storage is implemented.

1.9 PROJECT/SITE CONDITIONS

1.9.1 Environmental Conditions

The UPS and battery system shall be capable of withstanding any combination of the following external environmental conditions without mechanical or electrical damage or degradation of operating characteristics.

a. Operating altitude: Sea level to 3,300 ft. (Systems applied at higher altitudes shall be derated in accordance with the manufacturer's instructions).

b. Non-operating altitude: Sea level to 36,000 ft.

c. Operating ambient temperature range: 32 to 104 degrees F. Range for batteries is 50 to 86 degrees F.

d. Non-operating and storage ambient temperature range: Minus 4 to plus 122 degrees F.

e. Operating relative humidity: 0 to 95 percent, without condensation.

1.9.2 Sound Pressure Levels

Sound pressure levels produced by the UPS, when operating under full rated

load, at a distance of 5 feet in any direction from the perimeter of the unit, shall not exceed 75 dB as measured on the A scale of a Type 1 sound level meter at slow response conforming to ASA S1.4.

1.9.3 Verification of Dimensions

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the COR of any discrepancy before performing the work.

1.10 SPECIAL TOOLS

Provide one set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment.

1.11 OPERATION AND MAINTENANCE MANUALS

1.11.1 Additions to UPS Operation and Maintenance Manuals

In addition to requirements of Data Package 5, include the followings on the actual UPS system provided:

a. An outline drawing, front, top, and side views.

b. Prices for spare parts and supply list.

c. Routine and field acceptance test reports.

d. Date of Purchase.

e. Corrective maintenance procedures.

f. Test measurement levels with specific test points.

1.11.2 Spare Parts

Furnish the following spare parts, of the same material and workmanship, meeting the same requirements, and interchangeable with the corresponding original parts.

a. Fuses: Two of each type and rating.

b. Circuit boards: One circuit board for each critical circuit.

c. Air Filters: One set of filters.

1.12 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 UPS SYSTEM DESCRIPTION

The UPS system shall conform to UL 1778 and shall consist of UPS module, battery system, battery protective device, static bypass transfer switch,

controls and monitoring. Input ac power shall be connected to the normal source ac input of the UPS module. Alternate power source shall be connected to bypass/maintenance bypass. The battery shall be connected to the dc input of the UPS module through the battery protective device. The ac output of the UPS system shall be connected to the critical loads.

2.1.1 Semiconductor Fusing

Power semiconductors shall be fused with fast-acting fuses to prevent cascaded or sequential semiconductor failures. Indicator lamp or display panel denoting blown fuse conditions shall be readily observable by the operator without removing panels or opening cabinet doors.

2.1.2 Control Power

Provide dual control power supplies. Control power shall be derived from two sources, input and output, with automatic selective control. The control power circuit shall have suitable protection, appropriately marked and located in the immediate vicinity of the input protective device.

2.1.3 EMI/RFI Protection

The components and the system shall be designed to minimize the emission of electromagnetic waves that may cause interference with other equipment.

2.1.4 Internal Wiring

Wiring practices, materials, and coding shall be in accordance with the requirements of CEC and NFPA 70, OSHA, and other applicable standards. Wire runs shall be protected in a manner which separates power and control wiring. Control wiring shall be minimum No. 16 AWG extra-flexible stranded copper. Logic-circuit wiring may be smaller. Ribbon cables shall be minimum No. 22 AWG. Control wiring shall have permanently attached wire numbers.

2.1.5 Internal Assembly

The printed circuit board (PCB) subassemblies shall be mounted in pull-out and/or swing-out trays where feasible. Cable connections to the trays shall be sufficiently long to allow easy access to all components. Where not feasible to mount PCB subassemblies in pull-out or swing-out trays, they shall be firmly mounted inside the enclosure. Every PCB subassembly shall be monitored. Self-test and diagnostic circuitry shall be included in the logic circuits such that a fault can be isolated down to the PCB subassembly level.

2.1.6 Cabinets

UPS system shall be installed in cabinets of heavy-duty structure meeting the NEMA PE 1 standards for floor mounting. UPS module cabinet shall be structurally adequate for forklift handling or lifting. Removable lifting eyes shall be provided on top of each cabinet. UPS module cabinet shall have hinged and lockable doors on the front only, with assemblies and components accessible from the front. Doors shall be key lockable. Operating controls shall be located outside the locked doors. Input, output, and battery cables shall be installed through the top or bottom of the cabinet.

2.1.6.1 Cabinet Finish

Equipment cabinet shall be cleaned, primed and painted in the manufacturer's standard colors, in accordance with accepted industry standards. Cabinets shall be labeled in accordance with CEC and NFPA 70 for arc flash hazard with warning sign reading: "Warning-Potential Arc Flash Hazard. Appropriate PPE and Tools Required when working on this equipment" or similar wording.

2.1.6.2 Live Parts (300 Volts and Above)

Live parts (300 volts and above) that are exposed when front access doors are open shall be adequately protected or covered to minimize the chance of accidental contact.

2.1.6.3 Drawout Assemblies

Drawout assemblies weighing 50 lbs or more shall be provided with a means of lifting, either an overhead device or a hoisting device.

2.1.7 Safety

UPS shall be equipped with instruction plates including warnings and cautions, suitably located, and describing any special or important procedures to be followed in operating and servicing the equipment. The control panel display shall also provide warning messages prior to performing a critical function.

2.1.8 UPS System Load Profile

The UPS system shall be compatible with the load characteristics defined in the LOAD PROFILE below and load configuration. Compensation for UPS/load interaction problems resulting from nonlinear loads or transformer and motor inrush shall be provided.

LOAD PROFILE

Type of load: _____.

Size of load: _____kVA, _____Volts, _____Amps.

Switching pattern: (unswitched) (cycled daily) (cycled hourly) (operated by thermostat) (building management system control) (other).

Transient characteristics: inrush current magnitude of _____ times steady state rms current for duration of _____ cycle; range of power factor variation of _____ to _____ lagging; voltage dip of _____ percent.

Steady-state characteristics: _____ power factor.

Special factors: harmonic characteristics - Total Harmonic Distortion _____ percent.

2.2 UPS SYSTEM RATINGS

Unless stated otherwise, the parameters listed are under full output load, with batteries fully charged and floating on the dc bus and with nominal input voltage.

2.2.1 System Capacity

_____ kVA.

2.2.2 Battery Capacity

Discharge time to end voltage: 15 minutes, at 77 degrees F. End voltage at full discharge shall be 1.67 volts per cell. Battery shall be capable of delivering 150 percent of full rated UPS load at initial start-up.

2.2.3 Static Switch

a. At 208V, 22,000 amperes symmetrical interrupting capacity.

b. At 480V, 42,000 amperes symmetrical interrupting capacity.

2.2.4 Module Bus Bracing

a. At 208V, braced for 22,000 amperes symmetrical interrupting capacity.

b. At 480V, braced for 42,000 amperes symmetrical interrupting capacity.

2.2.5 AC Input

a. Voltage _____ volts line-to-line.

b. Number of phases: 3-phase, 3-wire, plus ground.

c. Voltage Range: Plus 10 percent, minus 20 percent, without affecting battery float voltage or output voltage.

d. Frequency: 60 Hz, plus or minus 5 percent.

e. Power walk-in: 20 percent to 100 percent over 10 to 20 seconds.

f. Total harmonic current distortion (THD) reflected into the primary line: 5 percent maximum.

g. Input surge protection: per IEEE C62.41.1 and IEEE C62.41.2.

h. Input power factor: Lagging from 1-100 percent load.

2.2.6 AC Output

a. Voltage _____ volts line-to-line, _____ volts line-to-neutral.

b. Number of phases: 3-phase, 4-wire, plus ground.

c. Voltage regulation:

1. Balanced load: Plus or minus 1.0 percent.

2. 50 percent load imbalance, phase-to-phase: Plus or minus 2 percent.

3. No-load voltage modulation: Plus or minus 1 percent.

4. Voltage drift: Plus or minus 1 percent over any 30 day interval (or length of test) at stated ambient conditions.

d. Voltage adjustment: Plus or minus 5 percent manually.

e. Frequency: 60 Hz.

f. Frequency regulation: Plus or minus 0.1 percent.

g. Frequency drift: Plus or minus 0.1 percent over any 24 hour interval (or length of test) at stated ambient conditions when on internal oscillator.

h. Harmonic content (RMS voltage): Voltage THD shall be a maximum of 2 percent with 100 percent linear load and 5 percent with 100 percent nonlinear load and a crest factor of less than 3 to 1.

i. Load power factor operating range: 1.0 to 0.8 lagging.

j. Phase displacement:

1. Balanced load: Plus or minus 1 degree of bypass input.

2. 50 percent load imbalance phase-to-phase: Plus or minus 3 degrees of bypass input.

k. Wave-form deviation factor: 5 percent at no load.

l. Overload capability (at full voltage) (excluding battery):

1. 125 percent load for 10 minutes.

2. 150 percent load for 60 seconds.

3. 300 percent load for one cycle after which it shall be current limited to 150 percent until fault is cleared or UPS goes to bypass.

2.2.7 Transient Response

2.2.7.1 Voltage Transients

a. 100 percent load step: Plus or minus 5 percent.

b. Loss or return of ac input: Plus or minus 1 percent.

c. Automatic transfer of load from UPS to bypass: Plus or minus 4 percent.

d. Manual retransfer of load from bypass to UPS: Plus or minus 4 percent.

e. Response time: Recovery to 99 percent steady-state condition within 20 milliseconds after any of the above transients.

2.2.7.2 Frequency

a. Transients: Plus or minus 0.6 Hz maximum.

b. Slew Rate: 1.0 Hz maximum per second.

2.2.8 Efficiency

Minimum Efficiency: 90 percent at full load kW and 90 percent at 50 percent load.

2.3 UPS MODULE

2.3.1 General Description

UPS module shall consist of a rectifier/charger unit and a 3-phase inverter unit with their associated transformers, synchronizing equipment, protective devices, surge suppression, and accessories as required for operation.

2.3.1.1 Interchangeability

The subassemblies in one UPS module shall be interchangeable with the corresponding modules within the same UPS, and from one UPS system to another of identical systems.

2.3.2 Rectifier/Charger Unit

Rectifier/charger unit shall be solid state and shall provide regulated direct current to the dc bus, supplying power to the inverter and charging the battery plant.

2.3.2.1 Input Protective Device

Rectifier/charger unit shall be provided with an input protective device. The protective device shall be sized to accept simultaneously the full-rated load and the battery recharge current. The protective device shall be capable of shunt tripping and shall have a symmetrical interrupting rating of 22,000 Amps for 208V input or 42,000 Amps for 480V input. The protective device shall have provision for locking in the "off" position.

2.3.2.2 Surge Protection

A surge suppression device shall be installed at the UPS input to protect against lightning and switching surges. Internal components shall be protected from surges that enter at each ac input connection including main input, static bypass transfer switch, and maintenance bypass/isolation switch. Surge suppressors shall protect internal components according to IEEE C62.41.1 and IEEE C62.41.2, Category B. Surge suppressors shall be UL 1449 approved to fail in "safe" mode.

2.3.2.3 Power Walk-In

Rectifier/charger unit shall be protected by a power walk-in feature such that when ac power is returned to the ac input bus, the total initial power requirement will not exceed 20 percent of the rated full load current. This demand shall increase gradually to 100 percent of the rated full load current plus the battery charging current over the specified time interval.

2.3.2.4 Sizing

Rectifier/charger unit shall be sized for the following two simultaneous operating conditions:

a. Supplying the full rated load current to the inverter.

b. Recharging a fully-discharged battery to 95 percent of rated ampere-hour capacity within ten times the discharge time after normal ac power is restored.

2.3.2.5 Battery Charging Current

a. Primary current limiting: Battery-charging current shall be voltage regulated and current limited. The battery-charging current limit shall be separately adjustable from 2 percent to 25 percent of the maximum discharge current. After the battery is recharged, the rectifier/charger unit shall maintain the battery at full float charge until the next operation under input power failure. Battery charger shall be capable of providing equalizing charge to the battery.

b. Second step current limiting: The rectifier/charger unit shall also have a second-step battery current limit. This second-step current limit shall sense actual battery current and reduce the input power demand for battery recharging to 50 percent (adjustable from 30 percent to 70 percent) of the normal rate without affecting the system's ability to supply full-rated power to the connected load. The second-step current-limit circuit shall be activated by a dry contact signal from the generator set controls and shall prevent normal rate battery recharging until utility power is restored.

2.3.2.6 DC Ripple

Rectifier/charger unit shall minimize ripple current and voltage supplied to the battery; the ripple current into the battery shall not exceed 3 percent RMS of the inverter input rated current; the ripple voltage into the battery shall not exceed 2 percent RMS of the float voltage.

2.3.2.7 DC Voltage Adjustment

Rectifier/charger unit shall have manual means for adjusting dc voltage for battery equalization, to provide voltage within plus 10 percent of nominal float voltage.

2.3.2.8 Battery Isolation Protective Device

Module shall have a dc protective device to isolate the module from the battery system. The protective device size and interrupting rating shall be as required by system capacity and shall incorporate a shunt trip as required by circuit design. The protective device shall have provision for locking in the "off" position.

2.3.3 Inverter Unit

Inverter unit shall be a solid-state device deriving its power from the dc bus (rectifier or battery source) and providing ac power within specified limits to the critical load. Inverter shall utilize microprocessor controlled solid state Pulse Width Modulation (PWM) controlled IGBT power transistor technology to shape the ac output.

2.3.3.1 Output Overload

The inverter shall be able to sustain an overload as specified across its output terminals. The inverter shall not shut off, but shall continue to

operate within rated parameters, with inverse-time overload shutdown protection. If the overload condition persists beyond the rated parameters of the inverter, the inverter shall current limit, load shall be transferred to the bypass source, and the inverter shall disconnect automatically from the critical load bus.

If the bypass source is not available and the overload/fault condition continues, the inverter shall current limit for a limited time as determined by the manufacturer and shall shut down to protect the internal components.

2.3.3.2 Output Frequency Control

The inverter shall normally operate in phase-lock and synchronism with the bypass source. When the bypass source frequency deviates by more than ±0.5 Hz, the internal frequency oscillator shall automatically take control and become the new frequency reference. Upon restoration of the bypass source within the required tolerance, the inverter shall synchronize back with that source at a slew rate not exceeding the specified rate. The oscillator shall be temperature compensated and shall be manually adjustable.

2.3.3.3 Output Protective Device

The output protective device shall be capable of shunt tripping or opening on an applied control signal and shall have the proper frame size and trip rating to supply overload current as specified. External output protective device shall have provision for locking in the "off" position. The inverter output protective device shall work in conjunction with the bypass protective device for both manual and automatic load transfers to and from bypass power.

2.3.4 External Protection

UPS module shall have built-in self-protection against undervoltage, overvoltage, overcurrent and surges introduced on the ac input source and/or the bypass source. The UPS shall also have built-in self-protection against overvoltage and voltage surges introduced at the output terminals by paralleled sources, load switching, or circuit breaker operation in the critical load distribution system.

2.3.5 Internal Protection

UPS module shall be self-protected against overcurrent, sudden changes in output load and short circuits at the output terminals. UPS module shall be provided with output reverse power detection which shall cause the module to be disconnected from the critical load bus when output reverse power is present. UPS module shall have built-in protection against permanent damage to itself and the connected load for predictable types of failure within itself and the connected load. At the end of battery discharge limit, the module shall shut down without damage to internal components.

2.4 STATIC BYPASS TRANSFER CIRCUIT

A static bypass transfer circuit shall be provided as an integral part of the UPS and shall consist of a static switch, made up of two reverse-paralleled SCRs (silicon-controlled rectifiers) per phase conductor, and a bypass protective device or bypass switch, made up of a contactor or motor operated circuit breaker. The bypass protective device shall be in parallel with the static switch. The inverter output

protective device shall disconnect and isolate the inverter from the bypass transfer circuit.

The control logic shall contain an automatic transfer circuit that senses the status of the inverter logic signals and alarm conditions and provides an uninterrupted transfer of the load to the bypass ac power source, without exceeding the transient limits specified herein, when a malfunction occurs in the UPS or when an external overload condition occurs. The power section of the static bypass transfer circuit shall be provided as a plug-in type assembly to facilitate maintenance. The static bypass transfer circuit shall be used to connect the input bypass ac power source to the critical load when required, and shall have the following features:

2.4.1 Uninterrupted Transfer

The static bypass transfer switch shall automatically cause the bypass ac power source to assume the critical load without interruption when the bypass control logic senses one of the following conditions and the UPS inverter output is synchronized to the bypass ac power source:

a. Inverter overload exceeds unit's rating.

b. Battery protection period is expired and bypass is available.

c. System failure.

d. Inverter output undervoltage or overvoltage.

2.4.2 Interrupted Transfer

If an overload occurs and the UPS inverter output is not synchronized to the bypass ac power source, the UPS inverter output shall current-limit for 200 milliseconds minimum. The inverter shall then turn off and an interrupted transfer to the bypass ac power source shall be made.

If the bypass ac power source is beyond the conditions stated below, an interrupted transfer shall be made upon detection of a fault condition:

a. Bypass voltage greater than plus or minus 10 percent from the UPS rated output voltage.

b. Bypass frequency greater than plus or minus 0.5 Hz from the UPS rated output frequency.

c. Phase differential of ac bypass voltage to UPS output voltage greater than plus or minus 3 degrees.

2.4.3 Manual Transfer

It shall be possible to make a manually-initiated static transfer from the system status and control panel. The transfer shall be make-before-break utilizing the bypass switch.

2.4.4 Automatic Uninterrupted Forward Transfer

The static bypass transfer switch shall automatically forward transfer, without interruption after the UPS inverter is turned "on", or after an instantaneous overload-induced reverse transfer has occurred and the load current has returned to less than the unit's 100 percent rating.

2.4.5 Forced Transfer

The control logic circuitry shall provide the means of making a forced or reverse transfer of the static bypass transfer circuit on an interrupted basis. Minimum interruption shall be 200 milliseconds when the UPS inverter is not synchronized to the bypass ac power source.

2.4.6 Overload Ratings

The static bypass transfer switch shall withstand the following overload conditions:

a. 1000 percent of UPS output rating for one cycle.

b. 150 percent of UPS output rating for one minute.

c. 125 percent of UPS output rating for 10 minutes.

2.4.7 Static Switch Disconnect

A static switch disconnect shall be incorporated to isolate the static bypass transfer switch assembly so it can be removed for servicing. The switch shall be equipped with auxiliary contacts.

2.5 MAINTENANCE BYPASS SWITCH

2.5.1 General

A maintenance bypass switch shall be provided as an integral part of the UPS and located within the UPS module or in a matching cabinet adjacent to the UPS cabinet. The maintenance bypass switch shall provide the capability to continuously support the critical load from the bypass AC power source while the UPS is isolated for maintenance. The maintenance bypass switch shall be housed in such a way that service personnel will not be exposed to electrically live parts while maintaining the equipment. Switch shall contain a maintenance bypass protective device and a module isolation protective device.

2.5.2 Load Transfer

The maintenance bypass switch shall provide the capability of transferring the critical load from the UPS static bypass transfer switch to maintenance bypass and then back to the UPS static bypass transfer switch with no interruption to the critical load.

2.6 MODULE CONTROL PANEL

The UPS module shall be provided with a control/indicator display panel. The display panel shall be on the front of the UPS module. Controls, meters, alarms and indicators for operation of the UPS module shall be on this panel. The display panel shall be menu driven for browsing all the screens.

2.6.1 Module Meters

2.6.1.1 Monitored Functions

The following functions shall be monitored and displayed:

a. Input voltage, phase-to-phase (all three phases).

b. Input current (all three phases).

c. Input frequency.

d. Battery voltage.

e. Battery current (charge/discharge).

f. Output voltage, phase-to-phase and phase-to-neutral (all three phases).

g. Output current (all three phases).

h. Output frequency.

i. Output kilowatts.

j. Elapsed time meter to indicate hours of operation, 6 digits.

k. Bypass voltage, phase-to-phase and phase-to-neutral (all three phases).

l. Output kilovars.

m. Output kilowatt hours, with 15-minute demand attachment.

n. Battery temperature.

o. Output Percentage load.

p. Remaining battery time.

2.6.1.2 Meter Construction

The display panel shall display alphanumeric parameters based on true RMS metering with 1 percent accuracy (minimum 4 significant digits).

2.6.2 Module Controls

Module shall have the following controls:

a. Lamp test/reset pushbutton.

b. Alarm test/reset pushbutton.

c. Module input protective device trip pushbutton, with guard.

d. Module output protective device trip pushbutton, with guard.

e. Battery protective device trip pushbutton, with guard.

f. Emergency off pushbutton, with guard.

g. DC voltage adjustment potentiometer, with locking guard.

h. Control power off switch.

i. UPS/bypass transfer selector switch.

j. Static bypass transfer switch enable/disable selector switch.

2.6.3 Module Alarm Indicators

Module shall have indicators for the following alarm items. Any one of these conditions shall turn on an audible alarm and the appropriate summary indicator. Each new alarm shall register without affecting any previous alarm.

a. Input ac power source failure.

b. Input protective device open.

c. Input power out of tolerance.

d. Overload.

e. Overload shutdown.

f. DC overvoltage/shutdown.

g. DC ground fault.

h. Low battery.

i. Battery discharged.

j. Battery protective device open.

k. Blower fan failure.

l. Low battery shutdown.

m. UPS on battery.

n. Equipment overtemperature.

o. Fuse blown (with indication where).

p. Control power failure.

q. Charger off/problem.

r. Inverter fault/off.

s. Emergency power off.

t. External shutdown (remote EPO activated).

u. Critical load on static bypass.

v. Static bypass transfer switch disabled/failure.

w. Inverter output overvoltage.

x. Inverter output undervoltage.

y. Inverter output overfrequency.

z. Inverter output underfrequency.

aa. Bypass source voltage outside limits.

bb. Bypass frequency out of range.

cc. Bypass source to inverter out of synchronization.

dd. Overtemperature shutdown.

ee. Hardware shutdown.

2.6.4 Module Emergency OFF Button

Pressing the emergency off button shall cause the module to be disconnected from the system, via its input protective device, output protective device, and battery protective device. The button shall include a protective cover to prevent unintentional activation.

2.7 SELF-DIAGNOSTIC CIRCUITS

The control logic shall include status indicators for trouble-shooting the control circuits. These indicators shall be mounted on the circuit card edge or face such that they will be visible without repositioning the card, and shall be labeled with the function name.

2.8 COMMUNICATIONS AND DATA ACQUISITION

An RS 232 communications and data acquisition port shall be provided. This port shall allow the system parameters, status, alarm indication and control panel functions specified to be remotely monitored and controlled.

Additionally, a second communication port shall be provided for use with the following:

a. A set of six Form C remote alarm contacts rated at 120V, 0.5A, shall be provided for remote alarm monitoring.

b. Auto-dial modem communication shall be provided to communicate with a remote modem in case an alarm function is active.

c. A SNMP (Simple Network Management Protocol) adapter shall be provided to communicate UPS monitoring via a network or direct connection to a PC.

d. A standard Web Browser adapter shall be provided to remotely view and monitor UPS functions over the Internet.

All the communication ports and contacts shall be capable of simultaneous communication.

2.8.1 Emergency Control Contacts

Provide normally open contacts to signal when power is supplied to the UPS from emergency engine generators or alternate source.

2.9 TEMPERATURE CONTROL

2.9.1 General

Cabinet and enclosure ventilation shall be adequate to ensure that components are operated within their ratings. Forced-air cooled rectifier, inverter, and control unit will be acceptable. The cooling fans shall continue operation if UPS input power is lost. Redundancy shall be provided so that failure of one fan or associated circuit breaker will not cause an overheat condition. Cooling air shall enter the lower front of the cabinets and exhaust at the top. Blower power failure shall be indicated as a visual and audible alarm on the control panel. Air inlets shall have replaceable filters that may be located on the inside of the cabinet doors and shall be easily accessible for replacement.

2.9.2 Blower Power Source

Blower power source shall be internally derived from the input and output sides of UPS module, with automatic transfer arrangement.

2.9.3 Temperature Sensors

Temperature sensors shall be provided to monitor the air temperature. Separate sensors shall monitor the temperature of rectifier and inverter heat sinks. Separate sensors shall also monitor the transformer temperature. Critical equipment over-temperature indication shall start a timer that shall shut down the UPS system if the temperature does not return below the setpoint level recommended by the UPS manufacturer.

2.10 BATTERY SYSTEM

2.10.1 General

Battery system shall contain the battery cells, battery disconnect, battery monitor and cabinet, if required. A storage battery with sufficient ampere-hour rating to maintain UPS output at full capacity for the specified duration shall be provided for each UPS module. The battery shall be of heavy-duty, industrial design suitable for UPS service. The cells shall be provided with flame arrestor vents, intercell connectors and cables, cell-lifting straps, cell-numbering sets, and terminal grease. Intercell connectors shall be sized to maintain terminal voltage within voltage window limits when supplying full load under power failure conditions. Cell and connector hardware shall be stainless steel of a type capable of resisting corrosion from the electrolyte used.

2.10.2 Battery Construction

The battery shall be of the valve-regulated, sealed, non-gassing, recombinant type.

2.10.3 Battery Cabinet

The battery pack assembly shall be furnished in a battery cabinet matching the UPS cabinet. The battery cabinet shall be designed to allow for checking the torque on the connections in the battery system and to provide adequate access for annual housekeeping chores. External wiring interface shall be through the bottom or top of the assembly. A smoke and high temperature alarm shall annunciate detection of either smoke or high temperature within the battery cabinet.

2.10.4 Cell-Terminal Covers

Acid-resistant transparent cell-terminal covers not exceeding 6 feet in length and with vent holes drilled on top where needed shall be provided.

2.10.5 Battery Disconnect

Each battery pack assembly shall have a fused disconnect switch provided in a NEMA 1 enclosure, finished with acid-resistant paint and located in line with the assembly. Switch shall be complete with line side and load side bus bars for connection to battery cells. Switch shall have an external operator that is lockable in the "off" position.

2.10.6 Seismic Requirements

The battery support system shall conform to Section 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

2.10.7 Battery Monitor

A battery monitor shall be provided for each battery pack assembly. At a minimum, this device shall monitor the following parameters:

a. Total system voltage.

b. Ambient room temperature.

c. Total battery discharge cycles with a duration of greater than 30 seconds.

The monitor shall also record the total accumulated discharge minutes and accumulated battery system discharge kW hours.

2.11 FACTORY TESTING

The UPS system shall be factory tested to meet the requirements specified using a test battery (not the battery to be supplied with the system). UPS module shall be factory load tested as an independent assembly with 3-phase ac input power and with battery power for a minimum of 8 hours, with meter readings taken every 30 minutes. Load shall be balanced at rated kVA and rated power factor. Factory tests for the UPS module shall be run under full load, and will be witnessed by the Government. Should a malfunction occur, the problem shall be corrected and the test shall be repeated. As a minimum, the factory tests shall include the parameters described in paragraphs ac Input, ac Output, Transient Response and Efficiency. The tests shall encompass all aspects of operation, such as module failure, static bypass operation, battery failure, input power failure and overload ratings. The COR shall be notified in writing at least 2 weeks before testing. Factory-test time shall not be used for system debugging and/or checkout. Such work shall be done prior to notifying the Government that the system is ready for testing. Factory tests shall be performed during normal business hours. The system shall be interconnected and tested for an additional 8 hours to ensure proper wiring and performance.

2.11.1 Transient Tests

Transient tests shall be conducted using high-speed oscillograph type recorders to demonstrate the operation of the components to the

satisfaction of the Government. These tests shall include 50 percent to 100 percent load changes, manual transfer, manual retransfer, low dc bus initiated transfer and low ac output bus transfer. A recording instrument equipped with an event marker shall be used.

2.11.2 Efficiency Tests

Testing for efficiency shall be performed at zero output up to 100 percent of stated kVA and power factor output in 25 percent steps, with battery fully charged and floating on the dc bus, with nominal input voltage, and with module connected to represent actual operating conditions.

2.12 CABLE LUGS AND TERMINATIONS

2.12.1 Cable Lugs

Provide appropriate compression type lugs on all ac and dc power connections to the UPS system and battery as required. Aluminum or bare copper cable lugs are not suitable.

2.12.2 Terminations

Terminals shall be supplied for making power and control connections. Terminal blocks shall be provided for field wiring terminals. Terminal blocks shall be heavy-duty, strap-screw type. Terminal blocks for field wiring shall be located in one place in each module. Control wiring shall be extended to the terminal block location. No more than two wires shall land on any terminal point. Where control wiring is attached to the same point as power wiring, a separate terminal shall be provided. If bus duct is used, bus stubs shall be provided where bus duct enters cabinets.

2.13 INSPECTION

Inspection before shipment is required. The manufacturer shall notify the Government at least 2 weeks before shipping date so that an inspection can be made.

2.14 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be 1.0 by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

2.15 MANUFACTURER'S NAMEPLATES

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.16 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance

test.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, CEC and NFPA 70, and to requirements specified herein. Provide new equipment and materials unless indicated or specified otherwise.

3.1.1 Control Cable

UPS control wiring shall be installed in individual separate rigid steel conduits, unless connections are made between side by side matching cabinets of UPS. Tag control wires with numeric identification tags corresponding to the terminal strip location to where the wires are connected. In addition to manufacturer's requirements, provide four additional spare conductors between UPS module and remote alarm panel in same conduit. When routing control cables inside UPS module, maintain a minimum 6 inches separation from power cables.

3.1.2 Grounding Conductor

Provide an insulated equipment grounding conductor in feeder and branch circuits. Conductor shall be separate from the electrical system neutral conductor. Ground battery cabinet and battery breaker cabinet with separate equipment grounding conductors to the UPS cabinet.

3.1.3 UPS Output Conductors

Isolate the UPS output conductors from the UPS cabinet to the critical load panels and from other conductors by installing in separate conduit. Isolation shall prevent inductive coupling from other conductors.

3.1.4 DC Power Conductors

When installed in conduits, place dc power conductors from the UPS cabinet to the battery circuit breaker such that each conduit contains an equal number of positive and negative conductors, for example, two positive and two negative conductors in each conduit.

3.1.5 Seismic Protection

The UPS enclosure shall conform to Section 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

3.1.6 Conduit Entries

Conduit entries shall use the available conduit areas shown on manufacturer's installation drawings. Conduit entries shall not be made through the front, side or rear panels of the UPS.

3.1.7 Battery Cabinet Assembly

Installation of battery cabinets shall conform to the manufacturer's instructions.

3.1.8 Battery Installation

Installation of batteries shall conform to the manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

Contractor shall notify COR in writing at least 30 working days prior to completion of the UPS system installation. At this time the Contractor, will schedule the UPS manufacturer's technical representative to inspect the completed installation. The UPS technical representative shall provide instruction for activity personnel as specified in paragraph titled "DEMONSTRATION".

3.2.1 Installation Preparation

The following items shall be completely installed by the Contractor and be operational prior to the arrival of the UPS representative for inspection, unit start-up and testing:

a. Ventilation equipment in the UPS and battery rooms;

b. Battery cabinets and cells;

c. Battery connections, including cell-to-cell connections, with correct polarity;

d. DC power and control connections between UPS and battery circuit breaker, with correct polarity;

e. DC power connection between battery circuit breaker and battery, with correct polarity;

f. Clockwise phase rotation of ac power connections;

g. AC power to rectifier input bus;

h. AC power to UPS bypass input bus;

i. AC power to UPS maintenance bypass circuit breaker;

j. AC power from UPS output to UPS maintenance bypass output circuit breaker;

k. Remote monitors and control wiring;

l. UPS system and battery system properly grounded;

m. Emergency shower and eye wash;

n. Control connections between UPS and emergency engine generator signal contacts;

o. Clean and vacuum UPS and battery room floors, battery cells, and UPS equipment, both inside and outside;

p. Ensure that shipping members have been removed;

q. Provide IEEE 450 battery installation certification.

3.2.2 Initial Inspection and Tests

The UPS technical representative and the COR, in the presence of the Contractor, will inspect the completed installation. The Contractor shall correct construction or installation deficiencies as directed. Perform acceptance checks in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections, performed in accordance with NETA ATS.

a. Visual and mechanical inspection

1. Compare equipment nameplate data with drawings, specifications and approved shop drawings.

2. Inspect physical and mechanical condition. Inspect doors, panels, and sections for paint, dents, scratches, fit, and missing hardware. Inspect the displays for scratches, dark pixels or uneven brightness.

3. Inspect anchorage, alignment, grounding, and required clearances.

4. Verify that fuse sizes and types correspond to drawings.

5. Verify the unit is clean inside and out.

6. Test all electrical and mechanical interlock systems for correct operation and sequencing.

7. Inspect bolted electrical connections for high resistance using one of the following methods:

(a) Use a low-resistance ohmmeter.

(b) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.

(c) Perform thermographic survey.

8. Verify operation of forced ventilation.

9. Verify that vents are clear and new clean filters are installed.

3.2.3 Performance Tests

Provide equipment, test instruments, power, load bank, materials and labor required for tests. COR will witness all tests and the tests shall be subject to his approval. Perform tests in accordance with the manufacturer's recommendations and include the following electrical tests.

3.2.3.1 UPS Unit Performance Tests

Upon completion of battery activation procedures, Contractor shall connect load bank to UPS output. Load bank required shall be determined by the following:

UPS KVA RATING X 0.8 = KW of LOAD BANK

Performance test is to be run under the supervision of the UPS technical representative. UPS unit shall be operated under full load for a minimum of

one hour. Contractor shall be required to operate feeder and bypass power feeder breakers during testing of the UPS.

a. Electrical Tests

1. Perform resistance measurements through bolted connections with a low-resistance ohmmeter.

2. Test static transfer from inverter to bypass and back. Use normal load, if possible.

3. Set free running frequency of oscillator.

4. Test dc undervoltage trip level on inverter input breaker. Set according to manufacturer's published data.

5. Test alarm circuits.

6. Verify synchronizing indicators for static switch and bypass switches.

7. Perform electrical tests for UPS system breakers.

8. Perform electrical tests for UPS system batteries.

b. Test Values

1. Compare bolted connection resistances to values of similar connections.

2. Verify bolt-torque levels.

3. Micro-ohm or millivolt drop values shall not exceed the high levels of the normal range as indicated in the manufacturer's published data. If manufacturer's data is not available, investigate any values which deviate from similar connections by more than 50 percent of the lowest value.

c. Load Test

The installed system shall be load tested for a continuous 24 hour period by means of resistive load banks. The system shall be continuously tested at 1/2 load for 8 hours, 3/4 load for 8 hours and full load for 8 hours. Provide resistive load banks of total kW load of equipment to facilitate startup under load conditions, and to conduct load tests described above. Instrument readings shall be recorded every half hour for the following:

1. Input voltage (all three phases).

2. Input current (all three phases).

3. Input frequency.

4. Battery voltage.

5. Output voltage (all three phases).

6. Output current (all three phases).

7. Output kilowatts.

8. Output frequency.

d. Full Load Burn In Test

The installed system shall undergo an additional full load burn-in period of 24 continuous hours. If a failure occurs during the burn-in period, the tests shall be repeated. Instrument readings shall be recorded every half hour as above. During the burn-in period, the following tests shall be performed:

1. With the UPS carrying maximum continuous design load and supplied from the normal source, switch 100 percent load on and off a minimum of five times within the burn-in period.

2. With the UPS carrying maximum continuous design load and supplied from the emergency source, repeat the switching operations described in step a. Also, verify that the UPS module rectifier charger unit(s) go into the second-step current limit mode.

3. With the UPS carrying maximum continuous design load and operating on battery power, repeat the switching operations described in step a above.

4. Continue operation on battery power for 1 minute, then restore normal power.

The Contractor shall furnish a high-speed dual trace oscillograph to monitor ten or more cycles of the above tests at the ON and OFF transitions and two typical steady-state periods, one shortly after the load is energized (at 30 to 60 seconds) and one after operation has stabilized (at 8 to 10 minutes). Four copies of the traces shall be delivered to the COR.

e. Battery Discharge Test

With the battery fully charged, the system shall undergo a complete battery discharge test to full depletion and a recharge to nominal conditions. Instrument readings shall be recorded every minute during discharge for the following:

1. Battery voltage.

2. Battery current.

3. Output voltage (all three phases).

4. Output current (all three phases).

5. Output kilowatts.

6. Output frequency.

3.2.3.2 Emergency Generator Operation

Test UPS to observe operation with emergency generator service. UPS technical representative shall verify UPS battery current limiting feature functions properly.

3.3 DEMONSTRATION

3.3.1 Instructing Government Personnel

Furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. Provide 8 hours of instruction for personnel. Field training shall be videotaped and the tape shall be left with the COR. A factory training videotape shall be provided as part of the training materials.

3.4 FINAL ADJUSTMENTS

a. Remove load bank and reconnect system for normal operation.

b. Equalize battery.

c. Resume charging battery at normal float voltage.

d. Check battery connections are properly torqued to manufacturer's specifications. Take and record, for cell-to-cell and terminal connections, detailed micro-ohm resistance readings. Remake connections having a resistance of more than 10 percent above the average.

e. All manufacturer's data and operation manuals, which are an integral part of, and shipped with UPS, shall be delivered to COR.

3.5 NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.6 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.7 DISPOSAL

Upon completion of UPS installation and testing, Contractor shall remove and dispose of empty, partially full and excess acid drums, including shipping containers, obsolete batteries, and obsolete UPS modules. Removal shall be accomplished off-base and in conformance with local laws and regulations regarding disposal of hazardous material.

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SECTION 26 36 23.00 20

AUTOMATIC TRANSFER SWITCHES

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for automatic transfer switches intended for use in Emergency Electrical Power Systems meeting requirements of CEC and NFPA 70, NFPA 99, and MIL-HDBK-1191.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1008	Transfer Switch Equipment
UL 508	Industrial Control Equipment

1.3 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, and Section 26 08 00 APPARATUS INSPECTION AND TESTING, apply to this section, with the additions and modifications specified herein.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Automatic Transfer Switch Drawings

SD-03 Product Data

Automatic Transfer Switches

SD-06 Test Reports

Acceptance Checks and Tests

Functional Acceptance Tests

SD-07 Certificates

Proof of Listing

SD-10 Operation and Maintenance Data

Automatic Transfer Switches, Data Package 5

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

1.5 QUALITY ASSURANCE

1.5.1 Proof of Listing

Submit proof of listing by UL 1008.

1.5.2 Automatic Transfer Switch Drawings

Drawings shall include outline, arrangement, and detail drawings. Detail drawings shall include manufacturer's name and catalog number, electrical ratings, total system transfer statement, reduced normal supply voltage at which transfer to the alternate supply is initiated, transfer delay times, short-circuit current rating, wiring diagram, description of interconnections, testing instructions, acceptable conductor type for terminals, tightening torque for each wire connector, and other required UL 1008 markings.

PART 2 PRODUCTS

2.1 AUTOMATIC TRANSFER SWITCHES

Provide four-pole, automatic transfer switches for use in emergency systems in accordance with UL 1008. Each automatic transfer switch shall be rated for total system transfer and have the current and voltage ratings as indicated. The rating of the switch shall be adequate for withstanding the effects of the indicated RMS symmetrical fault current when protected by the indicated overcurrent device without contact welding. The switch operating mechanism shall be electrically operated from the source to which it is transferring, shall have quick-make, quick-break, load break contacts, and shall be mechanically held in both positions. Non-fire pump service transfer switches shall have manual operating means provided for maintenance and servicing accessible only by opening the enclosure. Transfer switches for fire pump service shall have manual operating means externally operable without opening the enclosure. The manual operating means shall affect the opening and closing of the switch contacts at the

same rate of speed as that caused by the automatic operation of the switch. Automatic transfer switches provided with by-pass/isolation switches shall be mounted on a drawout mechanism so that the automatic transfer switch can be removed from the enclosure. The switch enclosure shall comply with UL 508, NEMA Type 1 (indoor) and NEMA Type 3R (outdoor) and shall be equipped with an equipment ground lug.

2.1.1 By-Pass/Isolation Switches

Include by-pass/isolation switches for the indicated automatic transfer switches. Provide by-pass/isolation switches in accordance with UL 1008 that can be used to manually select an available power source to feed load circuits and to permit total isolation of the automatic transfer switch. The by-pass/isolation switch shall be rated for total system transfer and have the same current rating, voltage rating, number of poles, and withstand and closing rating as the associated automatic transfer switch.

2.1.2 Automatic Transfer Switch Controls

2.1.2.1 Controls for Utility-Generator Automatic Transfer Switch

Provide all necessary controls to start the generator set upon loss of the normal (utility) source, transfer the load to the generator set upon reaching rated voltage and frequency, re-transfer the load when the normal (utility) source returns, and stop the generator set.

The switch shall include the following control features.

a. Three-phase normal source voltage sensing circuit with adjustable dropout, 75-93 percent of nominal, and pickup, 85-100 percent of nominal.

b. Engine starting control contacts with adjustable commit-to-start delay circuit, 0.5-6.0 seconds.

c. Voltage/frequency sensing circuit, set for 80 percent of nominal, for enabling load transfer to emergency source.

d. Transfer to emergency source time delay for transfer switches as indicated, adjustable 0-5 minutes.

e. Re-transfer to normal source time delay, adjustable 1-30 minutes.

f. Programmable exerciser to allow automatic starting of the generator set and subsequent load transfer. Exercise periods shall be selectable for 1 to 24 hours per day for 0 to 7 days a week.

g. Adjustable time delay transition or in-phase monitor feature for indicated transfer switches to allow safe transfer of highly inductive loads between two non-synchronized sources.

2.1.2.2 Controls for Generator - Generator Source Automatic Transfer Switch

Provide all necessary controls to start both generator sets upon loss of the normal utility source, transfer the load to the first generator set to reach rated voltage and frequency, shutdown the second generator set upon transferring the load to the first generator set, restarting and transferring the load to the second generator if at any time the first generator set fails, re-transfer the load when the normal (utility) source

returns, and shut down the generator set. The switch shall include the following control features;

a. Engine starting control contacts.

b. Voltage/frequency sensing circuit, set for 80 percent of nominal for enabling load transfer to emergency source.

c. Programmable exerciser time to allow automatic starting of the generator sets and subsequent load transfer to each generator set. Exercise periods shall be selectable for 1 to 24 hours per day for 0 to 7 days a week.

2.1.2.3 Controls for Preferred Utility Source Automatic Transfer Switch

Provide all the necessary controls to transfer the load to the alternate utility source upon loss of the preferred utility source and re-transfer the load to the preferred utility source when the preferred utility source returns. The switch shall include the following control features.

a. Three-phase preferred and alternate source voltage sensing circuit with adjustable dropout, 75-98 percent of nominal, and pick-up, 85-100 percent of nominal.

b. Re-transfer to normal source time delay, adjustable 1-30 minutes.

c. Adjustable time delay transition or in-phase monitor feature for indicated transfer switches to allow safe transfer of highly inductive loads between two non-synchronized sources.

2.1.2.4 Controls for Fire Pump Service Automatic Transfer Switch

Provide the following additional controls features:

a. Phase reversal of the normal source shall initiate transfer to the emergency/alternate source.

2.1.3 Front Panel Devices

Provide devices mounted on cabinet front consisting of:

a. Mode selector switch with the following positions and associated functions;

    1. TEST - Simulates loss of normal/preferred source system operation.

    2. NORMAL - Transfers system to normal/preferred source bypassing re-transfer time delay.

b. Lamps for indicating connected source and normal/preferred source is available.

c. Auxiliary contacts for indicating connected source and normal/preferred source available.

d. Source selector switch with the following positions and associated functions.

    1. Source 1 - Selects Source 1 as the source to which the automatic

transfer switch will transfer if that source is available.

2. Source 2 - Selects source 2 as the source to which the automatic transfer switch will transfer if that source is available.

e. Lamps for indicating that the by-pass/isolation switch is in the "normal by-pass", "alternate by-pass", or "isolated" position.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall conform to the requirements of CEC and NFPA 70 and manufacturer's recommendation.

3.2 PREREQUISITES FOR FUNCTIONAL ACCEPTANCE TESTING

Completion of the following requirements is mandatory prior to scheduling functional acceptance tests for the automatic transfer switch.

3.2.1 Performance of Acceptance Checks and tests

Complete as specified in paragraph entitled "Acceptance Checks and Tests". The Acceptance Checks and Tests shall be accomplished by the Testing organization as described in Section 26 08 00 APPARATUS INSPECTION AND TESTING.

3.2.2 Manufacturers O&M Information

The manufacturers O&M information required by the paragraph entitled "SD-10 Operation and Maintenance Data", shall have been submitted to and approved by the COR.

3.2.3 Test Equipment

All test equipment and instruments shall be on hand prior to scheduling field tests, or subject to COR's approval, evidence shall be provided to show that arrangements have been made to have the necessary equipment and instruments on site prior to field testing.

3.3 FIELD QUALITY CONTROL

Give COR 15 days notice of dates and times scheduled for tests which require the presence of the COR. The COR will coordinate with the using activity and schedule a time that will eliminate or minimize interruptions and interference with the activity operations. The contractor shall be responsible for costs associated with conducting tests outside of normal working hours and with incorporating special arrangements and procedures, including temporary power conditions. The contractor shall provide labor, equipment, apparatus, including test load, and consumables required for the specified tests. Calibration of all measuring devices and indicating devices shall be certified. The test load shall be a cataloged product in accordance with Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS. Perform the following field tests in accordance with the manufacturer's recommendations and include the following visual and mechanical inspections and electrical tests, performed in accordance with NETA ATS.

3.3.1 Automatic Transfer Switch Acceptance Checks and Tests

a. Visual and Mechanical Inspection

1. Compare equipment nameplate data with specifications and approved shop drawings.

2. Inspect physical and mechanical condition.

3. Confirm correct application of manufacturer's recommended lubricants.

4. Verify that manual transfer warnings are attached and visible.

5. Verify tightness of all control connections.

6. Verify tightness of accessible bolted connections by calibrated torque-wrench method. Thermographic survey is not required.

7. Perform manual transfer operation.

8. Verify positive mechanical interlocking between normal and alternate sources.

b. Electrical Tests

1. Measure contact-resistance.

2. Perform insulation-resistance on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole for one minute. Perform tests in both source positions.

3. Verify settings and operations of control devices.

4. Calibrate and set all relays and timers.

3.3.2 Functional Acceptance Tests

Functional Acceptance Tests shall include simulating power failure and demonstrating the following operations for each automatic transfer switch. Contractor shall show by demonstration in service that the automatic transfer switches are in good operating condition, and function not less than five times.

a. Perform automatic transfer tests:

1. Simulate loss of normal/preferred power.

2. Return to normal/preferred power.

3. Simulate loss of emergency power.

4. Simulate all forms of single-phase conditions.

b. Verify correct operation and timing of the following functions:

1. Normal source voltage-sensing relays.

2. Engine start sequence.

3. Time delay upon transfer.

4. Alternate source voltage-sensing relays.

5. Automatic transfer operation.

6. Interlocks and limit switch function.

7. Time delay and retransfer upon normal power restoration.

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INTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for inteiror lighting installations.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM A1008/A1008M	Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardened
ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A368	Standard Specification for Stainless Steel Wire Strand
ASTM A467/A467M	Standard Specification for Machine Coil Chain
ASTM A47/A47M	Standard Specification for Ferritic Malleable Iron Castings
ASTM A580/A580M	Standard Specification for Stainless Steel Wire
ASTM A641/A641M	Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM A653/A653M	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B164	Standard Specification for Nickel-Copper Alloy Rod, Bar, and Wire

ASTM B26/B26M	Standard Specification for Aluminum-Alloy Sand Castings
ASTM B633	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM E 2129	Standard Practice for Data Collection for Sustainability Assessment of Building Products

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

CALIFORNIA ENERGY COMMISSION (CEC and NFPA 70)

CEC and NFPA 70 Title 24	California's Energy Efficiency Standards for Residential and Nonresidential Buildings

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA HB-9	IES Lighting Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	National Electrical Safety Code
IEEE C62.41.1	Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE Stds Dictionary	IEEE Standards Dictionary: Glossary of Terms & Definitions

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI ANSLG C78.41	For Electric Lamps--Guidelines for Low-Pressure Sodium Lamps
ANSI ANSLG C78.42	For Electric Lamps: High-Pressure Sodium Lamps
ANSI C78.1381	American National Standard for Electric Lamps - 250-Watt, 70 Watt, M85 Metal-Halide Lamps
ANSI C82.1	American National Standard for Electric Lamp Ballasts - Line Frequency Fluorescent Lamp Ballasts
ANSI C82.11	American National Standard for High-Frequency Fluorescent Lamp

	Ballasts--Supplements
ANSI C82.2	American National Standard for Lamp Ballasts--Methods of Measurement of Fluorescent Lamp Ballasts
ANSI C82.4	American National Standard for Ballasts for High-Intensity-Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)
ANSI/ANSLG C78.43	American National Standard for Electric Lamps - Single-Ended Metal-Halide Lamps
ANSI/IEC C78.81	American National Standard for Electric Lamps--Double-Capped Fluorescent Lamps--Dimensional and Electrical Characteristics
ANSI/IEC C78.901	American National Standard for Electric Lamps - Single Base Fluorescent Lamps--Dimensional and Electrical Characteristics
ANSI/NEMA C78.LL 1256	Procedures for Fluorescent Lamp Sample Preparation and the Toxicity Characteristic Leaching Procedure (TCLP)
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star	Energy Star Energy Efficiency Labeling System

UNDERWRITERS LABORATORIES (UL)

UL 1029	High-Intensity-Discharge Lamp Ballasts
UL 1598	Luminaries
UL 844	Standard for Luminaries for Use in Hazardous (Classified) Locations
UL 935	Standard for Fluorescent-Lamp Ballasts

1.3 RELATED REQUIREMENTS

Materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Lighting fixtures and accessories mounted on exterior surfaces of

buildings are specified in this section.

1.4 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Stds Dictionary.

b. Average life is the time after which 50 percent has failed and 50 percent has survived under normal conditions.

c. Total harmonic distortion (THD) is the root mean square (RMS) of all the harmonic components divided by the total fundamental current.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Employ the terminology, classifications, and methods prescribed by the IESNA HB-9, as applicable, for the lighting system specified in data, drawings, and reports.

SD-02 Shop Drawings

Submit Fabrication Drawings for the following items consisting of fabrication and assembly details to be performed in the factory.

Commercial Incandescent Lighting Fixtures

Industrial Incandescent Lighting Fixtures

Enclosed and Gasketed Vapor-Tight Fixtures

Incandescent Lamps

Lowering Devices

Submit Installation Drawings for the incandescent lighting fixtures in accordance with the paragraph entitled, "Installation," of this section.

SD-03 Product Data

Fluorescent lighting fixtures

Fluorescent electronic ballasts

Fluorescent electromagnetic ballasts

Fluorescent lamps

High-intensity-discharge (HID) lighting fixtures

HID ballasts

High-pressure sodium (HPS) lamps

Low-pressure sodium lamps

Metal-halide lamps

Incandescent lighting fixtures

Incandescent lamps

Power hook fixture hangers

Electronic dimming ballast

Dimming ballast controls

Light Level Sensor

Energy Efficiency

Submit Equipment and Performance Data for incandescent lighting fixtures in accordance with paragraph entitled, "Related Requirements," of this section.

Submit Manufacturer's catalog data for the following items:

Commercial Incandescent Lighting Fixtures

Industrial Incandescent Lighting Fixtures

Enclosed and Gasketed Vapor-Tight Fixtures

Incandescent Lamps

Lowering Devices

SD-06 Test Reports

Operating test

Submit test results as stated in paragraph entitled "Field Quality Control."

Submit Test reports for Operational Tests on incandescent lighting fixtures in accordance with the paragraph entitled, "Field Testing," of this section.

SD-10 Operation and Maintenance Data

Lighting Control System, Data Package 5

Submit operation and maintenance data in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA and as specified herein, showing all light fixtures, control modules, control zones, occupancy sensors, light level sensors, power packs, dimming ballasts, schematic diagrams and all interconnecting control wire, conduit, and associated hardware.

Operational Service

Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the

project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

1.6 QUALITY ASSURANCE

1.6.1 Fluorescent Electronic Ballasts

Submit ballast catalog data as required in the paragraph entitled "Fluorescent Lamp Electronic Ballasts" contained herein. As an option, submit the fluorescent fixture manufacturer's electronic ballast specification information in lieu of the actual ballast manufacturer's catalog data. Include published specifications and sketches, which cover the information required by the paragraph entitled "Fluorescent Lamp Electronic Ballasts" herein. This information may be supplemented by catalog data if required, containing a list of vendors with vendor part numbers.

1.6.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the COR. Provide equipment, materials, installation, and workmanship in accordance with the mandatory and advisory provisions of CEC and NFPA 70 unless more stringent requirements are specified or indicated.

1.6.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship,which have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period includes applications of equipment and materials under similar circumstances and of similar size, on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6.3.1 Alternative Qualifications

Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.3.2 Material and Equipment Manufacturing Date

Do not use products manufactured more than 3 years prior to date of delivery to site, unless specified otherwise.

1.6.3.3 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. Submit documentation for Energy Star qualifications for equipment provided under this section. Submit data indicating lumens per watt efficiency and color rendition index of light source.

1.7 WARRANTY

Support the equipment items with service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.7.1 Electronic Ballast Warranty

Furnish the electronic ballast manufacturer's warranty, for not less than 5 years from the date of manufacture of the electronic ballast. Ballast assembly in the lighting fixture, transportation, and on-site storage is not to exceed 12 months, thereby permitting 4 years of the ballast 5 year warranty to be in service and energized. State in the warranty that the manufacturer agrees to exchange a malfunctioning ballast and promptly ship the replacement to the using Government facility,said replacement ballast being identical to, or an improvement upon, the original design of the malfunctioning ballast.

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

Provide incandescent lighting fixtures conforming to UL 1598. Provide fixtures in hazardous areas conforming to UL 844.

Furnish lighting fixtures completely assembled with wiring and mounting devices and ready for installation at the locations noted. Design and equip recessed fixtures in suspended ceilings for installation in the type of ceiling in which the fixture is to be installed. Design fixtures to be supported independent of the ceiling. Equip fixtures with the lamps required.

2.2 FLUORESCENT LIGHTING FIXTURES

Provide fluorescent fixtures, conforming to UL 1598 with electronic ballasts unless specifically indicated otherwise.

2.2.1 Fluorescent Lamp Electronic Ballasts

Provide electronic ballasts, meeting as a minimum, the following characteristics:

a. Provide ballasts complying with UL 935, ANSI C82.11, CEC and NFPA 70, and CEC and NFPA 70 Title 24 unless specified otherwise. Provide 100 percent electronic high frequency type ballasts with no magnetic core and coil components, which provide transient immunity as recommended by IEEE C62.41.1 and IEEE C62.41.2. Design ballast for the wattage of the lamps used in the indicated application. Design ballasts to operate on the voltage system to which they are connected.

b. A power factor of 0.95 (minimum).

c. Operates at a frequency of 20,000 Hertz (minimum), and is compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems. Provide ballasts operating at or above 40,000 Hertz where available.

d. Light regulation of plus or minus 10 percent lumen output with a plus or minus 10 percent input voltage regulation. Ensure ballasts have 10 percent flicker (maximum) using any compatible lamp.

e. A ballast factor between 0.85 (minimum) and 1.00 (maximum). Current crest factor - 1.7 (maximum).

f. UL listed Class P with a sound rating of "A."

g. Include circuit diagrams and lamp connections displayed on the ballast.

h. Provide instant start ballasts unless otherwise indicated, with programmed start where indicated. Provide instant start ballasts which operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed.

i. Provide programmed start ballasts for compact fluorescent fixtures.

j. Provide ballasts for T-5 and smaller lamps with end-of-life protection circuits as required by ANSI/IEC C78.81 and ANSI/IEC C78.901 as applicable.

k. Provide ballasts capable of starting and maintaining operation at a minimum of 0 degrees F unless otherwise indicated.

l. Provide electronic ballasts with a full replacement warranty of 5 years from date of manufacture as specified in paragraph entitled "Electronic Ballast Warranty" herein.

2.2.1.1 T-8 Lamp Ballast

a. Total harmonic distortion (THD): 20 percent (maximum).

b. Input wattage.

1. 32 watts (maximum) when operating one F32T8 lamp

2. 62 watts (maximum) when operating two F32T8 lamps

3. 92 watts (maximum) when operating three F32T8 lamps

4. 114 watts (maximum) when operating four F32T8 lamps

c. Ballast efficacy factor.

1. 2.54 (minimum) when operating one F32T8 lamp

2. 1.44 (minimum) when operating two F32T8 lamps

3. 0.93 (minimum) when operating three F32T8 lamps

4. 0.73 (minimum) when operating four F32T8 lamps

d. Provide three and four lamp fixtures with two ballasts per fixture where multilevel switching is indicated.

2.2.1.2 F17T8 Lamp Ballast

Provide F17T8 ballasts with:

a. Total harmonic distortion (THD): 25 percent (maximum).

b. Input wattage:

1. 34 watts (maximum) when operating two F17T8 lamps.

2.2.1.3 T-5 Long Twin Tube Lamp Ballast

a. Total harmonic distortion (THD): No greater than 25 percent when operating one lamp, 15 percent when operating two lamps, and 20 percent when operating three lamps.

b. Input wattage:

1. 45 watts (maximum) when operating one F40 T-5 lamps

2. 74 watts (maximum) when operating two F40 T-5 lamps

3. 105 watts (maximum) when operating three F40 T-5 lamps

c. Provide three and four lamp fixtures with two ballasts per fixture where multilevel switching is indicated.

2.2.1.4 F96T8 Lamp Ballast

a. Total harmonic distortion (THD): No greater than 30 percent when operating one lamp and 20 percent when operating two lamps.

b. Input wattage:

1. 56 watts (maximum) when operating one F96T8 lamps

2. 102 watts (maximum) when operating two F96T8 lamps

2.2.2 Fluorescent Lamp Electronic Dimming Ballast

Provide electronic ballasts meeting as a minimum, the following characteristics:

a. Compliance with ANSI C82.11, UL 935, and CEC and NFPA 70, unless specified otherwise. Provide transient immunity as recommended by IEEE C62.41.1 and IEEE C62.41.2. Ballast dimming capability range - from 100 to 5 percent (minimum range) of light output, flicker free, and starts lamp at any preset light output setting without first having to go to full light output. Design ballast for the wattage of the lamps used in the indicated application. Design ballasts to operate on the voltage system to which they are connected.

b. Power factor of 0.95 (minimum) at full light output, and 0.90 (minimum) over the entire dimming range.

c. Operates at a frequency of 20,000 Hertz (minimum), and is compatible with and not cause interference with the operation of occupancy sensors or other infrared control systems. Provide ballasts operating at or above 40,000 Hertz where available.

d. Ballast factor at full light output is between 0.85 (minimum) and 1.00 (maximum). Current crest factor is 1.7 (maximum).

e. UL listed Class P with a sound rating of "A".

f. Includes circuit diagrams and lamp connections displayed on the ballast.

g. Provide programmed start ballasts. Ballast may operate lamps in a series circuit configuration. Provide series/parallel wiring for programmed start ballasts where available.

h. Provide programmed start ballasts for compact fluorescent fixtures.

i. Ballast is capable of starting and maintaining operation at a minimum of 0 degrees F unless otherwise indicated.

j. Total harmonic distortion (THD): 20 percent (maximum) over the entire dimming range.

k. Provide ballasts for T-5 and smaller lamps with end-of-life protection circuits as required by ANSI/IEC C78.81 and ANSI/IEC C78.901 as applicable.

2.2.2.1 T-8 Lamp Ballast

Input wattage, for indicated lamp quantity is:

a. 35 watts (maximum) when operating one F32T8 lamp.

b. 70 watts (maximum) when operating two F32T8 lamps.

c. 104 watts (maximum) when operating three F32T8 lamps.

2.2.3 Dimming Ballast Controls

Provide slide dimmer ballast controls with on/off control, compatible with the ballast, and capable of controlling the ballast light output over the full dimming range. Provide dimming ballast controls approved by the ballast manufacturer.

2.2.4 Light Level Sensor

UL listed. Provide light level sensor capable of detecting changes in ambient lighting levels, and providing a dimming range of 20 percent to 100 percent, minimum, designed for use with dimming ballast and voltage system to which they are connected. Ensure sensor is capable of controlling 40 electronic dimming ballast, minimum. Provide adjustable light level sensor with a set level range from 10 to 100 foot candles, minimum. Provide sensor with a bypass function to electrically override sensor control.

2.2.5 Fluorescent Electromagnetic Ballasts

UL 935. Provide high power factor type ballasts (0.9 minimum), unless indicated otherwise, designed to operate on the voltage system to which they are connected, Class P and have sound rating "A" unless otherwise noted. Design and construct fixtures and ballasts to limit the ballast case temperature to 195 degrees F when installed in an ambient temperature of 105 degrees F. Provide energy saving electromagnetic ballasts for T-8 and

T-12 lamps. Provide three lamp fixtures with two ballasts per fixture.

2.2.5.1 Electromagnetic Energy-Saving Ballasts

ANSI C82.1. Provide energy-saving fluorescent ballasts of the CBM certified full light output type except where fixtures are provided with low temperature ballasts, with an average input wattage of 40 or less when operating one 32-watt F32T8 lamp 45 or less when operating two 17 watt F17T8 lamps 72 or less when operating two 32 watt F32T8 lamps 109 or less when operating two 59-watt F96T8 lamps tested in accordance with ANSI C82.2 methods. Provide ballasts which are compatible with energy-saving lamps.

2.2.5.2 Electromagnetic Ballasts for Compact Fluorescent Lamps

Provide electromagnetic ballasts for compact fluorescent lamps.

2.2.5.3 Electromagnetic Ballasts for T-5 Long Twin Tube Lamps

Provide electromagnetic ballasts with an average input wattage of 49 or less when operating one 86 or less when operating two 40-watt T-5 long twin tube lamps.

2.2.6 Fluorescent Lamps

a. Provide T-8 rapid start low mercury lamps rated 32 watts (maximum), 2800 initial lumens (minimum), CRI of 75 (minimum), color temperature of 3500 K, with an average rated life of 20,000 hours. Provide low mercury lamps which have passed the EPA Toxicity Characteristic Leachate Procedure (TCLP) for mercury by using the lamp sample preparation procedure described in ANSI/NEMA C78.LL 1256.

b. Provide T-8 rapid start lamp, 17 watt (maximum), nominal length of 24 inches, 1300 initial lumens, CRI of 75 (minimum), color temperature of 3500 K, and an average rated life of 20,000 hours.

c. Provide T-8 instant start lamp, 59 watts (maximum), nominal length of 96 inches, minimum CRI of 75, 5700 initial lumens, color temperature of 3500 K, and average rated life of 15,000 hours.

d. Provide T-12 slim line lamps rated 60 watts (maximum), 5750 initial lumens (minimum), 12,000 hours average rated life.

e. Provide T-5, long twin tube fluorescent lamp, 40 watts (maximum), 3500 K, 22.6 inches maximum length, 20,000 hours average rated life, 3150 initial lumens, CRI of 80 (minimum), 2G11 Type base, 90 to 100 lumens/watt depending on wattage.

f. Provide T-8, U shaped fluorescent lamp, 31 watts maximum, 2600 initial lumens (minimum), 3500 K, 75 CRI (minimum), 20,000 hours average rated life, 1.625 inch leg spacing.

g. Provide compact fluorescent lamps: CRI 80, minimum, 3500 K, 10,000 hours average rated life, and as follows:

   1. T-4, twin tube, rated 5 watt, 250 initial lumens (minimum), 7 watts, 400 initial lumens (minimum), 9 watts, 600 initial lumens (minimum), and 13 watts, 825 initial lumens (minimum), as indicated.

   2. T-4, double twin tube, rated 13 watts, 900 initial lumens

(minimum), 18 watts, 1200 initial lumens (minimum), and 26 watts, 1800 initial lumens (minimum), as indicated.

Average rated life is based on 3 hours operating per start.

2.2.7 Compact Fluorescent Fixtures

Provide compact fluorescent fixtures manufactured specifically for compact fluorescent lamps with ballasts integral to the fixture. Providing assemblies designed to retrofit incandescent fixtures is prohibited except when specifically indicated for renovation of existing fixtures. Provide fixtures using lamps as indicated, with a minimum CRI of 80.

2.2.7.1 Bare Bulb Retrofits

Replace 40-watt incandescent bulbs (495plus lumens) with 11- to 14-watt compact fluorescent bulbs (45 plus lumens per watt). Replace 60-watt incandescent bulbs (900 plus lumens) with 15- to 19-watt compact fluorescent bulbs (60 plus lumens per watt). Replace 75-watt incandescent bulbs (1200 plus lumens) with 20- to 25-watt compact fluorescent bulbs (60 plus lumens per watt). Replace 100-watt incandescent bulbs (1750 plus lumens) with 29-watt or greater compact fluorescent bulbs (60 plus lumens per watt).

2.2.7.2 Reflector Type Bulb Retrofits

Replace 50-watt incandescent bulbs (550 plus lumens) with 17- to 19-watt compact fluorescent bulbs (33 plus lumens per watt). Replace 60-watt incandescent bulbs (675 plus lumens) with 20- to 21-watt compact fluorescent bulbs (40 plus lumens per watt). Replace 75-watt incandescent bulbs (875 plus lumens) with 22-watt or greater compact fluorescent bulbs (40 plus lumens per watt).

2.2.8 Open-Tube Fluorescent Fixtures

Provide with self-locking sockets, or lamp retainers (two per lamp).

2.2.9 Air Handling Fixtures

Provide fixtures used as air handling registers conforming to the requirements of NFPA 90A.

2.2.10 Electromagnetic Interference Filters

Provide in each fluorescent fixture mounted in shielded enclosures where indicated. Provide filters integral to the fixture assembly with one filter per ballast and suppress electromagnetic interference in the AM radio band from 500 to 1700 kHz.

2.3 HIGH-INTENSITY-DISCHARGE (HID) LIGHTING FIXTURES

UL 1598. Provide HID fixtures with tempered glass lenses when using metal-halide lamps.

2.3.1 HID Ballasts

Provide HID ballasts conforming to UL 1029 and ANSI C82.4, with constant wattage autotransformer (CWA) or regulator, high power factor type (minimum 90 percent). Provide single-lamp ballasts which have a minimum starting

temperature of minus minus 22 degrees F. Provide ballasts:

a. Designed to operate on the voltage system to which they are connected.

b. Designed for installation in a normal ambient temperature of 105 degrees F.

c. Constructed so that open circuit operation will not reduce the average life.

Provide high-pressure sodium (HPS) ballasts with a solid-state igniter/starter with an average life in the pulsing mode of 3500 hours at the intended ambient temperature. Igniter case temperature is not to exceed 195 degrees F in any mode.

2.3.2 High-Pressure Sodium (HPS) Lamps

ANSI ANSLG C78.42 wattage as indicated. 150 watt lamps, if required, are 55 volt type.

2.3.2.1 Standby HPS Lamps

Where indicated, provide standby HPS lamps with two arc tubes and an average rated life of 40,000 hours (minimum), and hot restart instant lumen output of 8 percent, minimum, of total light output.

2.3.2.2 Luminary Efficiency Rating (LER)

a. Upward efficiency of 0 percent

1. 150-399 watts: Minimum 58 LER for closed fixture; minimum 68 for open fixture

2. 400-999 watts: Minimum 63 LER for closed fixture; minimum 84 for open fixture

b. Upward efficiency of 1 percent-10 percent

1. 150-399 watts: Minimum 64 LER for closed fixture; minimum 63 for open fixture

2. 400-999 watts: Minimum 82 LER for closed fixture; minimum 89 for open fixture

3. 1000 plus watts: Minimum 109 LER for open fixture

c. Upward efficiency of 11 percent to 20 percent

1. 150-399 watts: Minimum 78 LER for open fixture

2. 400-999 watts: Minimum 94 for open fixture

d. Upward efficiency greater than 20 percent

1. 150-399 watts: Minimum 75 LER for closed fixture; minimum 77 for open fixture

2.3.3 Low-Pressure Sodium Lamps

ANSI ANSLG C78.41.

2.3.4 Metal-Halide Lamps

a. Double-ended, 70 watt, conforming to ANSI C78.1381

b. Single-ended, wattage as indicated, conforming to ANSI/ANSLG C78.43

2.3.4.1 Luminary Efficiency Rating (LER)

a. Upward efficiency of 0 percent

1. 150-399 watts: Minimum 41 LER for closed fixture

2. 400-999 watts: Minimum 53 LER for closed fixture; minimum 59 for open fixture

3. 1000 plus watts: Minimum 77 LER for closed fixture

b. Upward efficiency of 1 percent-10 percent

1. 150-399 watts: Minimum 56 LER for closed fixture

2. 400-999 watts: Minimum 62 LER for closed fixture; minimum 64 for open fixture

3. 1000 plus watts: Minimum 88 LER for open fixture

c. Upward efficiency greater than 20 percent

1. 150-399 watts: Minimum 62 LER for closed fixture; minimum 77 for open fixture

2. 400-999 watts: Minimum 65 LER for closed fixture

2.4 INCANDESCENT LIGHTING FIXTURES

Use of incandescent lamps and fixtures is prohibited, unless specifically indicated otherwise. UL 1598.

2.4.1 Incandescent Lamps

Provide the number, type, and wattage indicated.

2.5 RECESS- AND FLUSH-MOUNTED FIXTURES

Provide type that can be relamped from the bottom, with access to ballast from the bottom, with trim for the exposed surface of flush-mounted fixtures as indicated.

2.6 SUSPENDED FIXTURES

Provide hangers capable of supporting twice the combined weight of fixtures supported by hangers. Provide with swivel hangers to ensure a plumb installation, cadmium-plated steel with a swivel-ball tapped for the conduit size indicated. Provide shock-absorbing type hangers where indicated. Provide hangers which allow fixtures to swing within an angle of

45 degrees. Brace pendants 4 feet or longer provided in shops or hangers to limit swinging. Provide single-unit suspended fluorescent fixtures with twin-stem hangers. Provide multiple-unit or continuous row fluorescent fixtures with tubing or stem for wiring at one point and a tubing or rod suspension provided for each unit length of chassis, including one at each end. Provide rods with a minimum 0.18 inch diameter.

2.7 FIXTURES FOR HAZARDOUS LOCATIONS

In addition to requirements stated herein, provide fixtures for hazardous locations which conform to UL 844 or which have Factory Mutual certification for the class and division indicated.

2.8 POWER HOOK FIXTURE HANGERS

Provide UL listed assembly including through-wired power hook housing, interlocking plug and receptacle, power cord, and fixture support loop. Provide power hook housing of cast aluminum having two 3/4 inch threaded hubs, including support hook with safety screw. Provide fixture support loop of cast aluminum with provisions for accepting 3/4 inch threaded fixture stems. Include with power cord 16 inches of 3 conductor No. 16 Type SO cord.

2.9 AUXILIARY INSTANT-ON SYSTEM

Where indicated, provide UL listed, automatically switched instant-on HID lamp. Lamp is to come on when luminary is initially energized and following a momentary power outage and remain on until HID lamp reaches approximately 60 percent light output. Design wiring for lamp internal to the ballast and independent of the incoming line voltage to the ballast. Provide instant-on HID system as indicated.

2.10 SUPPORT HANGERS FOR LIGHTING FIXTURES IN SUSPENDED CEILINGS

2.10.1 Wires

ASTM A641/A641M, galvanized steel, regular coating, soft temper, 0.1055 inches in diameter (12 gage).

2.10.2 Wires, for Humid Spaces

ASTM A580/A580M, composition 302 or 304, annealed stainless steel 0.1055 inches in diameter (12 gage).

ASTM B164, UNS NO4400, annealed nickel-copper alloy 0.1055 inches in diameter (12 gage).

2.11 EQUIPMENT IDENTIFICATION

2.11.1 Manufacturer's Nameplate

Provide each item of equipment with a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.11.2 Labels

Provide labeled luminaries in accordance with UL 1598 requirements.

Clearly mark all for operation of specific lamps and ballasts according to proper lamp type. Note the following lamp characteristics in the format "Use Only _____":

a. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaries.

b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaries.

c. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaries.

d. ANSI ballast type (M98, M57, etc.) for HID luminaries.

e. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaries.

Provide all markings related to lamp type clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Provide ballasts with clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

2.12 FACTORY APPLIED FINISH

Provide electrical equipment with factory-applied painting systems which , as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

2.13 COMMERCIAL INCANDESCENT LIGHTING FIXTURES

Commercial incandescent lighting fixtures include recessed, surface mounted, and pendant-mounted luminaries.

Provide corrosion-resistant nonferrous metal or sheet steel with corrosion-resistant finish metal parts of fixtures. Do not use solder or self-threading sheet metal screws in the construction of the fixture enclosure.

Equip fixtures rated up to and including 300 watts with medium screw-base lampholders. Equip fixtures rated in excess of 300 watts but not more than 1,500 watts with mogul screw-base lampholders. Provide screw shells of lampholders which are electrically connected to the metal part of lighting fixtures or equipment grounding-circuit conductor.

2.13.1 Surface-Mounted Fixtures

Design the surface-mounted fixtures to be fastened to wall or ceiling flush-mounted outlet boxes. Do not subject combustible ceiling materials to temperatures in excess of 195 degrees F.

2.13.2 Recessed Fixtures

Design recessed fixtures in suspended ceilings for the type of ceiling construction in which the fixture is to be installed. Do not subject combustible ceiling materials to temperatures in excess of 195 degrees F. Where recessed fixtures are supported on suspended ceilings, provide a minimum of four support rods per fixture with no support further than 6 inches from the edge of the fixture. Do not support fixtures by acoustic

panels.

2.13.3 Pendant-Mounted Fixtures

Equip pendant-mounted fixtures with stems, swivel ball-and-socket self-aligning hangers that allow a minimum of a 20-degree angle swing, ceiling canopies, and fixture-hanging devices, made of seamless brass, aluminum, steel, corrosion-resistant steel tubing, or steel conduit not less than 1/2 inch in diameter. Stem length, material, and finish are as noted.

2.14 INDUSTRIAL INCANDESCENT LIGHTING FIXTURES

Provide industrial incandescent lighting fixtures with industrial porcelain-enameled seamless dome reflectors with ventilated necks and hoods tapped for 1/2 inch conduit for swivel suspension pendant mounting. Provide lampholders with medium or mogul bases as applicable, furnished with incandescent lamps having the wattage rating indicated, meeting the requirements of UL 1598. Provide easily detachable reflectors and sockets as a unit, without the use of tools, but arranged so that they cannot inadvertently come loose.

2.15 ENCLOSED AND GASKETED VAPOR-TIGHT FIXTURES

Provide enclosed and gasketed vapor-tight fixtures suitable for wet or damp locations consisting of a cast-aluminum body, cap or matching outlet box, porcelain lampholder, glass enclosing globe, cork gaskets, and cast-aluminum guards for wall, ceiling, or pendant mounting in accordance with UL 1598 and CEC and NFPA 70.

Furnish exposed cast aluminum outlet boxes for wall- and ceiling-mounted fixtures with four tapped hubs 90 degrees apart circumferentially, with three cast-aluminum threaded pipe plugs to fit the tapped holes. Provide boxes with ears or lugs for surface mounting to wall or ceiling. Provide body with mounting screws and gasket to ensure a vapor-tight joint between the body and outlet box.

Concealed outlet boxes for wall- and ceiling-mounted fixtures may be standard sheet metal boxes. Provide fixture body with mounting screws and gasket to ensure a vapor-tight joint between the body and outlet box.

Seal body and cap for pendant-mounted fixtures with a gasket at the joint. Provide cast aluminum cap with top hub tapped for 1/2 inch tapered iron pipe threads.

Furnish cast aluminum exposed outlet boxes for pendant-mounted fixtures with the fixtures with four tapped hubs 90 degrees apart circumferentially, with three cast-aluminum threaded pipe plugs to fit the tapped holes. Supply boxes with ears or lugs for surface mounting to the ceiling. Provide cast aluminum outlet-box covers for concealed and exposed outlet boxes with the center hub tapped for 1/2 inch tapered iron pipe threads. Provide cover and outlet box with mounting screws and gasket to ensure a vapor-tight joint between the cover and outlet box. Also provide 1/2 inch galvanized rigid steel conduit stem.

Provide clear nondiffusing heat-resistant glass enclosing globe molded in one piece into a cylindrical shape with a closed bowl-shaped bottom and an open molded top bead or thread. Make edges of the open end either ground or molded to a smooth, true surface that will ensure a vapor-tight joint

when the globe is fastened to the gasketed body.

Provide a cast-aluminum guard of the same shape as the glass enclosing globe which is affixed to the fixture body with threads or setscrews.

2.16 INCANDESCENT LAMPS

Provide general-purpose lamps, frosted inside. Provide lamps with wattage ratings up to and including 300 watts with medium brass screw bases. Provide lamps with wattage ratings in excess of 300 watts with mogul brass screw bases.

Special-purpose lamps include PAR and R lamps. Provide PAR lamps with clear, molded, heat-resistant, hard-glass bulbs with parabolic, aluminized, inner-bulb wall reflector for spot- or flood-lighting applications. Provide R lamps with clear, soft, blown-glass bulbs with silver-deposited, inner-bulb wall reflector for spot or floodlighting applications. Design lamps for operation on 120 volts.

2.17 LOWERING DEVICES FOR HIGH-BAY LIGHTING FIXTURES

Provide lowering devices for high-bay lighting fixtures consisting of a hand-operated mechanism that will connect, disconnect, raise, and lower the lighting fixture and permit the servicing and maintenance of fixtures and equipment at floor level. Include with lowering device hangers, pulleys, beam clamps or suspension fittings, operating cable, hand chain, and cable and chain fittings.

Provide hanger consisting of a two-piece latching spring-loaded mechanism with an upper and lower separable contact assembly and stem and guide assembly, with cast-aluminum protective housings. Provide contacts for two-pole for single 2-wire circuits and four-pole for 3- and 4-wire circuits rated 15 amperes at 600 volts and 30 amperes at 250 volts ac.

Include with upper contact assembly an integrally mounted corner pulley with threaded hub for electrical-conduit connections and top flange with lugs or ears for mounting.

Include with lower contact assembly fixture adapters and swivel end fittings for anchoring operating cable in the stem of the hanger, with adapters of hot-dip galvanized malleable iron.

Provide open face pulleys with cast-aluminum alloy housings and deep-grooved pulley wheels closely shrouded to prevent lines from becoming wedged between wheel and housing. Design pulleys to be straight through for top and bottom mounted operating cables and corner type as required. Hinge top mounted pulleys, with mounting lugs. Provide fixed bottom mounted pulleys, with mounting lugs. Bolt all pulleys to the supporting structure. Support horizontal runs of operating cable with pulleys located not more than 35-feet apart.

Include with terminal fittings an enclosed lockbox with hub tapped for 3/4 inch conduit, flared conduit end fitting, pulley wheel, locking hooks, and hinged cover with provisions for padlocking.

Provide cast-aluminum alloy lockbox and cover, with the flared conduit end fitting of hot-dip galvanized malleable iron.

Mount wall mounted lockbox not less than 43 inches and not more than 54

inches above the floor at the operating level. Provide pulley designed to permit horizontal pull operation of the lowering device at the operating level.

Provide 1/8 inch diameter operating cable, 7 by 19 stranded, heat- and corrosion-resistant steel aircraft cable with link, cable loops, and serving sleeves. Perform cable with detachable fittings designed for connection to the terminal fittings, conforming to ASTM A368.

Provide hand chains which are separate detachable hand lines to provide means for disconnecting, lowering, raising, and reconnecting fixtures after servicing and maintenance work has been completed. Provide hand chain equal in length to the mounting height of the fixture and equipped with a snap hook for connection to the terminal end of the operating cable, size 4, hot-dip galvanized steel, conforming to ASTM A467/A467M, Class MS machine, straight link, steel chain.

Provide cast-aluminum-alloy housings conforming to ASTM B26/B26M.

Provide malleable-iron fittings conforming to ASTM A47/A47M, and hot-dip galvanized coatings conforming to ASTM A123/A123M.

PART 3 EXECUTION

3.1 INSTALLATION

Ensure all electrical installations conform to IEEE C2, CEC and NFPA 70, and to the requirements specified herein.

3.1.1 Lamps

Deliver lamps of the type, wattage, and voltage rating indicated to the project in the original cartons and installed just prior to project completion. Replace lamps installed and used for working light during construction prior to turnover to the Government if more than 15 percent of their rated life has been used. Test the lamps for proper operation prior to turn-over and replace if necessary with new lamps from the original manufacturer. Provide 10 percent spare lamps of each type from the original manufacturer.

3.1.2 Lighting Fixtures

Set lighting fixtures plumb, square, and level with ceiling and walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturers' directions and approved drawings, in conformance with the requirements of CEC and NFPA 70. Mounting heights specified or indicated are to the bottom of fixture for ceiling-mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before commencing installation and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Independently support recessed and semi-recessed fixtures from the building structure by a minimum of four wires per fixture and located near each corner of each fixture. Ceiling grid clips are not allowed as an alternative to independently supported light fixtures. Independently support round fixtures smaller in size than the ceiling grid from the building structure by a minimum of four wires per fixture spaced approximately equidistant around the fixture. Do not support fixtures by ceiling acoustical panels. Where fixtures of sizes less than the ceiling grid are indicated to be centered in the acoustical panel, support such

fixtures independently and provide at least two 3/4 inch metal channels spanning, and secured to, the ceiling tees for centering and aligning the fixture. Provide wires for lighting fixture support in this section. Lighting fixtures installed in suspended ceilings are to comply with the requirements of Section 09 51 00 ACOUSTICAL CEILINGS.

3.1.3 Suspended Fixtures

Provide suspended fixtures with 45 degree swivel hangers so that they hang plumb and locate with no obstructions within the 45 degree range in all directions. Provide the stem, canopy and fixture capable of a 45 degree swing. Brace pendants, rods, or chains 4 feet or longer excluding fixture, to prevent swaying, using three cables at 120 degree separation. Provide suspended fixtures in continuous rows with internal wireway systems for end to end wiring and properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Use aligning splines on extruded aluminum fixtures to assure hairline joints. Support steel fixtures to prevent "oil-canning" effects. Provide fixture finishes free of scratches, nicks, dents, and warps, and matching the color and gloss specified. Provide pendants finished to match Provide stainless steel air craft cable. Provide canopies finished to match the ceiling and low profile unless otherwise shown. Ensure maximum distance between suspension points is 10 feet or as recommended by the manufacturer, whichever is less.

3.1.4 Ballasts

3.1.4.1 Remote Ballasts

Mount remote type ballasts or transformers, where indicated, in a well ventilated, easily accessible location, within the maximum operating distance from the lamp, as designated by the manufacturer.

3.1.4.2 Electronic Dimming Ballasts

Provide all electronic dimming ballasts, controlled by the same controller, from the same manufacturer. Season or burn all fluorescent lamps on electronic dimming ballast control in at full light output for 100 hours before dimming.

3.2 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Specify painting in Section 09 90 00 PAINTS AND COATINGS.

3.3 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test to show that equipment operates in accordance with requirements of this section.

3.3.1 Electronic Dimming Ballast

Test for full range of dimming capability. Observe for visually detectable flicker over full dimming range.

3.4 FIELD TESTING

Demonstrate that all incandescent lighting fixtures and their accessories,

including lowering devices, operate satisfactorily in the presence of the COR.

Perform operational tests in accordance with referenced standards in this section.

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SECTION 26 52 00.00 40

EMERGENCY LIGHTING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for battery-operated incandescent and emergency lighting units and lamps.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code
NFPA 101	Life Safety Code

UNDERWRITERS LABORATORIES (UL)

UL 924	Standard for Emergency Lighting and Power Equipment

1.3 ADMINISTRATIVE REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

1.3.1 Pre-Installation Meetings

No later than 30 days after contract award, submit installation drawings for the Central Emergency Lighting Systems indicating location of installed fixtures.

Submit Material, Equipment, and Fixture Lists showing manufacturer's style or catalog numbers, specification and drawing reference numbers, sample warranty, and fabrication site location. Also submit manufacturer's catalog data and Certificates of Conformance for the following items:

a. Emergency Lighting Egress Units

b. Emergency Fluorescent Lighting

c. Central Emergency Lighting Systems

d. Accessories

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists
sample warranty

SD-02 Shop Drawings

Central Emergency Lighting Systems

SD-03 Product Data

Emergency Lighting Egress Units
Emergency Fluorescent Lighting
Central Emergency Lighting Systems
Accessories

SD-06 Test Reports

System Operational Tests

SD-07 Certificates

Certificates of Conformance
Warranty

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Furnish emergency lighting units completely assembled with wiring and mounting devices, ready for installation at the locations indicated. Equip fixtures with lamps. Ensure emergency lighting units are suitable for operation on the ac supply circuit to which they are to be electrically connected.

2.1.1 Performance Requirements

Provide emergency lighting units conforming to UL 924 and NFPA 101.

2.2 MANUFACTURED UNITS

2.2.1 Emergency Lighting Egress Units

Provide complete self-contained emergency lighting units with batteries, battery charger, one or more local or remote lamp heads with lamps, under-voltage relay, indicator lights, on/off switch, and test switch, in accordance with UL 924 for Type I (emergency light set), Class I rechargeable storage-battery-powered unit, Style D non-refillable

nickel-cadmium battery, as indicated.

2.2.1.1 Batteries

Provide batteries rated not less than 6-12 volts. Provide batteries with the capacity and rating to supply the lamp load with maintained 87.5 -percent power, minimum, for 1.5 hours, or the battery-lamp combination maintaining 60-percent, minimum, illumination. Provide maintenance-free nickel-cadmium type batteries, with a minimum normal life of 10 years.

2.2.1.2 Battery Charger

Include in battery charger a dry-type full-wave rectifier with two charging rates, one to automatically maintain the battery in a fully charged state under normal conditions and the other to automatically recharge the battery to a fully charged state within 12 hours after continuous discharge of 1-1/2 hours through the connected lampload.

2.2.1.3 Unit Enclosure

Fabricate the unit enclosure from sheet steel not less than 18 gage. Design of cover is to provide access to the battery and battery-charger compartments and have a full-length piano hinge and a latching device. Protect component parts within the enclosure from dust, moisture, and oxidizing fumes from the battery. Coat interior and exterior surfaces of enclosure with a corrosion-resistant gray baked-enamel finish.

2.2.1.4 Lampheads, Lamps, and Indicating Lights

Mount the lampheads on the top of the unit enclosure, or wall mount, except where otherwise indicated and fully adjustable in the horizontal and vertical planes. Provide steel lamp head assembly with nickel or chromium plating. Form the exterior housing of the lamp from nickel or cadmium -plated sheet steel.

Provide sealed-beam type lamps, halogen, rated not less than 12 watts at the specified dc voltage.

Mount an amber "ready-for-use on alternating current" indicating light, a red "recharging on alternating current" indicating light, and a momentary-contact pushbutton test switch on the cover of the unit enclosure. The amber light indicates, when illuminated, that the unit is electrically connected to the normal ac supply source and that the battery is fully charged. The red light indicates, when illuminated, that the battery is being recharged. The momentary-contact pushbutton test switch transfers the unit from normal supply to battery supply and tests operation of equipment under simulated ac source power failure.

2.2.1.5 Relays and Switches

Provide an under-voltage relay of the self-clearing type which automatically connects the lampload to the battery supply upon failure of the alternating current supply. Mount an on-off toggle switch inside the unit enclosure to disconnect the battery from the lampload when the unit is taken out of service for maintenance purposes. The relay energizes when the ac supply falls to 70 percent of normal voltage.

2.2.1.6 Mounting Shelves

Provide emergency lighting units with angle iron mounting shelves and with a protective screen designed by the equipment manufacturer for this purpose. Coat the mounting shelf and screen with a corrosion-resistant finish in accordance with manufacturer's standard practice.

2.2.2 Emergency Fluorescent Lighting

Provide each unit with an automatic power failure device, test switch, pilot light, and fully automatic high/low trickle charger in a self-contained solid-state, temperature-compensated power-pack. Provide sealed-wet or gelled-electrolyte type battery with capacity as required to supply power to provide a minimum of 600 lumens using a 40-watt rapid start lamp. Provide a sealed and maintenance-free battery, with an active life of not less than 10 years under normal operating conditions.

2.2.3 Central Emergency Lighting Systems

Provide a central power system providing emergency power at 277 volts, 60 hertz, for a minimum period of 90 minutes. Design the system to handle surges during loss and recovery of the voltage, and to deliver its full rated output to designated lamp load. Provide batteries for power.

2.2.3.1 Operation

Upon loss of normal supply voltage, design the system to automatically disengage itself from the normal input line, switching to a self-contained inverter with built-in protection when the output is shorted or overloaded. When normal line voltage resumes, the emergency system automatically switches back to normal operation. Size the transfer switch for this function to handle 125 percent of full load. Battery systems are to include self-contained inverters with overload protection.

2.2.3.2 Charger

Provide a completely automatic battery charger, which maintains the batteries in a fully charged condition, and recharges the batteries to full capacity within 24 hours after full discharge in accordance with UL 924.

2.2.3.3 Batteries

Provide sealed nickel-cadmium type batteries, maintenance-free for a period of not less than 10 years under normal operating conditions.

2.2.3.4 Accessories

Provide visual indicators to indicate normal power, inverter power, and battery charger operation. Provide low-voltage test switch to simulate power failure by interrupting the input line, voltage meter, electrolyte level detector to automatically disable the charging circuit in the event of a fault, and low voltage cutoff to prevent extreme battery power dissipation.

2.2.3.5 Enclosure

Provide a free-standing cabinet with floor stand and constructed of 12-gage sheet steel with baked-on enamel finish and locking type latch.

2.2.4 Self-Testing Module

Provide self-testing module for exit signs and emergency lighting equipment which performs the following functions:

a. Continuous monitoring of charger operation and battery voltage with visual indication of normal operation and of malfunction.

b. Monthly discharge cycling of battery with monitoring of transfer circuit function, battery capacity and emergency lamp operation with visual indication of malfunction. Conduct the battery capacity test using a synthetic load.

c. Manual test switch to simulate a discharge test cycle.

d. Provide module with low voltage battery disconnect (LVD) and brown-out protection circuit.

PART 3 EXECUTION

3.1 INSTALLATION

Permanently fix in place the emergency lighting unit and install wiring for each unit in accordance with CEC and NFPA 70. Use the same panel bus or branch circuit as that serving the normal lighting in the area for the branch circuit feeding the unit equipment, and connect ahead of area switches. Keep remotely connected emergency lighting circuit wiring independent of all other wiring and equipment and do not enter the same conduit, cable, box, or cabinet with other wiring unless the fixture is supplied from two sources.

Mount emergency lighting units and remote lamps at a minimum of 7 feet above the finished floor.

3.2 FIELD TESTING

Demonstrate emergency lighting units to operate satisfactorily in the presence of the COR.

Perform and submit System Operational Tests in accordance with referenced standards in this section.

3.3 WARRANTY

Submit warranty, signed by an authorized representative, designating the Government as warrantee, to the COR, 5 days prior to project closeout.

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SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for lighting system requirements for exterior installations.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO LTS-5	Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C1	All Timber Products - Preservative Treatment by Pressure Processes
AWPA C4	Poles - Preservative Treatment by Pressure Processes
AWPA M6	Brands Used on Forest Products

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B108/B108M	Standard Specification for Aluminum-Alloy Permanent Mold Castings
ASTM C1089	Standard Specification for Spun Cast Prestressed Concrete Poles
ASTM E 2129	Standard Practice for Data Collection for

	Sustainability Assessment of Building Products
ASTM G 154	Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA HB-9	IES Lighting Handbook
ANSI/IESNA RP-8-00	American National Standard Practice for Roadway Lighting
IESNA LM-35-02	Approved Method for Photometric Testing of Floorlights Using High Intensity Discharge or Incandescent Filament Lamps
IESNA LM-50-99	Guide for Photometric Measurement of Roadway Lighting Installations
IESNA LM-51-00	Approved Method for the Electrical Photometric Measurements of High Intensity Dischsrge Lamps
IESNA LM-64-01	Guide for the Photometric Measurement of Parking Areas
ANSI/ASHRAE/IE Std 90.1	Energy Standard for Buildings Except Low Rise Residential Buildings

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100	The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI ANSLG C78.41	For Electric Lamps--Guidelines for Low-Pressure Sodium Lamps
ANSI ANSLG C78.42	For Electric Lamps: High-Pressure Sodium Lamps
ANSI C136.13	American National Standard for Roadway Lighting Equipment, Metal Brackets for Wood Poles
ANSI C136.21	American National Standard for Roadway and Area Lighting Equipment - Vertical Tenons Used with Post-Top-Mounted Luminaries
ANSI C136.3	American National Standard for Roadway and Area Lighting Equipment Luminary Attachments
ANSI C78.1381	American National Standard for Electric

	Lamps - 250-Watt, 70 Watt, M85 Metal-Halide Lamps
ANSI C82.4	American National Standard for Ballasts for High-Intensity-Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)
ANSI/ANSLG C78.43	American National Standard for Electric Lamps - Single-Ended Metal-Halide Lamps
NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA C136.10	American National Standard for Roadway and Area Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles--Physical and Electrical Interchangeability and Testing
NEMA C136.20	American National Standard for Roadway and Area Lighting Equipment - Fiber Reinforced Composite (FRC) Lighting Poles
NEMA ICS 2	Standard for Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 6	Enclosures

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	California Electrical Code

Title 24, Part 6California Energy Code

U.S. DEPARTMENT OF AGRICULTURE (USDA)

RUS Bull 345-67	REA Specification for Filled Telephone Cables, PE-39

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star	Energy Star Energy Efficiency Labeling System

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1029	High-Intensity-Discharge Lamp Ballasts
UL 1598	Luminaries
UL 1598C	LED Retrofit Luminaries Conversion Kit
UL 773	Standard for Plug-In, Locking Type Photocontrols for Use with Area Lighting

UL 773A	Standard for Nonindustrial Photoelectric Switches for Lighting Control
UL 8750	LED Equipment for Use in Lighting Products

1.3 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.

b. Average life is the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.

c. Groundline section is that portion between one foot above and 2 feet below the groundline.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Luminary drawings

Poles

SD-03 Product Data

Local/Regional Materials

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Environmental Data

Energy Efficiency

Luminaries

Lamps

Ballasts

Lighting contactor

Time switch

Photocell switch

Concrete poles

Aluminum poles

Steel poles

Fiberglass poles

Brackets

Auxiliary instant-on quartz system

SD-04 Samples

Luminaries

Submit one sample of each luminary type, complete with lamp and ballast. Submit one sample for each item other than luminaries. Sample will be returned to the Contractor for installation in the project work.

SD-05 Design Data

Design Data for luminaries

SD-06 Test Reports

Tests for fiberglass poles

Operating test

Submit operating test results as stated in paragraph entitled "Field Quality Control."

SD-08 Manufacturer's Instructions

Concrete poles

Submit instructions prior to installation.

Fiberglass poles

Submit instructions prior to installation.

SD-10 Operation and Maintenance Data

Operational Service

Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

1.5.1.1 Luminary Drawings

Include dimensions, effective projected area (EPA), accessories, and installation and construction details. Photometric data, including zonal lumen data, average and minimum ratio, aiming diagram, and candlepower distribution data shall accompany shop drawings.

1.5.1.2 Poles

Include dimensions, wind load determined in accordance with AASHTO LTS-5, pole deflection, pole class, and other applicable information. For concrete poles, include: section and details to indicate quantities and position of prestressing steel, spiral steel, inserts, and through holes; initial prestressing steel tension; and concrete strengths at release and at 28 days.

1.5.2 Design Data for Luminaries

a. Distribution data according to IESNA classification type as defined in IESNA HB-9.

b. Computerized horizontal illumination levels in footcandles at ground level, taken every 10 feet. Include average maintained footcandle level and maximum and minimum ratio conforming to ANSI/IESNA RP-8-00.

c. Amount of shielding on luminaries.

1.5.3 Tests for Fiberglass Poles

a. Ultraviolet resistance tests: Perform according to ASTM G 154 using a UV-B lamp having a 313 nanometer wavelength, operated at 130 degrees F, cycling the lamp on for 4 hours and off for 4 hours for a total test period of 1500 hours minimum with the following results:

Fiber exposure:	None
Crazing:	None
Checking:	None
Chalking:	None
Color:	May dull slightly

b. Flexural strength and deflection test: Test loading shall be as a cantilever beam with pole butt as fixed end and a force simulating wind load at the free end.

1.5.4 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the COR. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of CEC and NFPA 70, Title 24, Part 6, and ANSI/ASHRAE/IES Std 90.1 unless more stringent requirements are specified or indicated.

1.5.5 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or

brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.5.5.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.5.5.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.6 DELIVERY, STORAGE, AND HANDLING

1.6.1 Concrete Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation.

1.6.2 Fiberglass Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

1.6.3 Aluminum and Steel Poles

Do not store poles on ground. Support poles so they are at least one foot above ground level and growing vegetation. Do not remove factory-applied pole wrappings until just before installing pole.

1.7 SUSTAINABLE DESIGN REQUIREMENTS

1.7.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

1.7.2 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. Submit documentation for Energy Star qualifications for equipment provided under this section. Submit data indicating lumens per watt efficiency and color rendition index of light source.

1.8 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION, and Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Lighting fixtures and accessories mounted on exterior surfaces of buildings are specified in Section 26 51 00.00 40 INTERIOR LIGHTING.

2.2 LUMINARIES

UL 1598. Provide luminaries as indicated. Provide luminaries complete with lamps of number, type, and wattage indicated. Details, shapes, and dimensions are indicative of the general type desited, but are not intended to restrict selection to luminaries of a particular manufacturer. Luminaries of similar designs, light distribution and brightness characteristics, and of equal finish and quality will be acceptable as approved.

2.2.1 Lamps

2.2.1.1 High-Pressure Sodium (HPS) Lamps

ANSI ANSLG C78.42. Wattage as indicated. HPS lamps shall have average rated life of 16,000 hours (minimum) for 35 watt lamps and 24,000 hours (minimum) for all higher wattage lamps. 150 watt lamps, if required, shall be 55 volt lamps. Lamps shall have Luminary Efficiency Ratings (LER) as follows:

a. Upward efficiency of 0 percent

   1. 150-399 watts: minimum 58 LER for closed fixture; minimum 68 for open fixture

   2. 400-999 watts: minimum 63 LER for closed fixture; minimum 84 for open fixture

b. Upward efficiency of 1 percent - 10 percent

   1. 150-399 watts: minimum 64 LER for closed fixture; minimum 63 for open fixture

   2. 400-999 watts: minimum 82 LER for closed fixture; minimum 89 for open fixture

   3. 1000 plus watts: minimum 109 LER for open fixture

c. Upward efficiency of 11 percent to 20 percent

   1. 150-399 watts: minimum 78 LER for open fixture

   2. 400-999 watts: minimum 94 for open fixture

d. Upward efficiency greater than 20 percent

   150-399 watts: minimum 75 LER for closed fixture; minimum 77 for open fixture

2.2.1.2 Standby HPS Lamps

ANSI ANSLG C78.42. Wattage as indicated. Standby HPS lamps shall have two arc tubes and an average rated life of 40,000 hours (minimum). Hot restart instant lumen output shall be 8 percent, minimum, of total light output. 150 watt lamps, if required, shall be 55 volt type.

2.2.1.3 Low-Pressure Sodium (LPS) Lamps

ANSI ANSLG C78.41.

2.2.1.4 Metal-Halide Lamps

Provide luminaries with tempered glass lens.

a. Double-ended, 70 watt, conforming to ANSI C78.1381

b. Single-ended, wattage as indicated, conforming to ANSI/ANSLG C78.43

Lamps shall have Luminary Efficiency Ratings (LER) as follows:

a. Upward efficiency of 0 percent

    1. 150-399 watts: minimum 41 LER for closed fixture

    2. 400-999 watts: minimum 53 LER for closed fixture; minimum 59 for open fixture

    3. 1000 plus watts: minimum 77 LER for closed fixture

b. Upward efficiency of 1 percent - 10 percent

    1. 150-399 watts: minimum 56 LER for closed fixture

    2. 400-999 watts: minimum 62 LER for closed fixture; minimum 64 for open fixture

    3. 1000 plus watts: minimum 88 LER for open fixture

c. Upward efficiency greater than 20 percent

    1. 150-399 watts: minimum 62 LER for closed fixture; minimum 77 for open fixture

    2. 400-999 watts: minimum 65 LER for closed fixture

2.2.2 Ballasts for High-Intensity-Discharge (HID) Luminaries

UL 1029 and ANSI C82.4, and shall be constant wattage autotransformer (CWA) or regulator, high power-factor type (minimum 90 percent). Provide single-lamp ballasts which shall have a minimum starting temperature of minus 30 degrees C. Ballasts shall be:

a. Designed to operate on voltage system to which they are connected.

b. Constructed so that open circuit operation will not reduce the average life.

HID ballasts shall have a solid-state igniter/starter with an average life

in the pulsing mode of 10,000 hours at the intended ambient temperature. Igniter case temperature shall not exceed 90 degrees C.

2.3 LIGHTING CONTACTOR

NEMA ICS 2, electrically or mechanically held contactor. Rate contactor as indicated. Provide in NEMA enclosure conforming to NEMA ICS 6. Contactor shall have silver alloy double-break contacts and coil clearing contacts for mechanically held contactor and shall require no arcing contacts. Provide contactor with hand-off-automatic selector switch. Contactor shall be hermetically sealed.

2.4 TIME SWITCH

Astronomic dial type or electronic type, arranged to turn "ON" at sunset, and turn "OFF" at predetermined time between 8:30 p.m. and 2:30 a.m. or sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide switch having automatically wound spring mechanism or capacitor, to maintain accurate time for a minimum of 7 hours following power failure. Provide time switch with a manual on-off bypass switch. Housing for the time switch shall be surface mounted, NEMA 1 (indoors) or NEMA 3R (outdoor) enclosure conforming to NEMA ICS 6.

2.5 PHOTOCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated 277 volts ac, 60 Hz with single pole double-throw (spdt) contacts for mechanically held contactors rated 1000 watts designed to fail to the ON position. Switch shall turn on at or below 3 footcandles and off at 4 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Provide switch:

a. In a high-impact-resistant, noncorroding and nonconductive molded plastic housing with a locking-type receptacle conforming to NEMA C136.10 and rated 1800 VA, minimum.

b. In a cast weatherproof aluminum housing with adjustable window slide, rated 1800 VA, minimum.

c. In a U.V. stabilized polycarbonate housing with swivel arm and adjustable window slide, rated 1800 VA, minimum.

d. Integral to the luminary, rated 1000 VA, minimum.

2.6 POLES

Provide poles designed for wind loading of 85 miles per hour determined in accordance with AASHTO LTS-5 while supporting luminaries and all other appurtenances indicated. The effective projected areas of luminaries and appurtenances used in calculations shall be specific for the actual products provided on each pole. Poles shall be embedded or anchor-base type designed for use with underground supply conductors. Poles, other than wood poles, shall have oval-shaped handhole having a minimum clear opening of 2.5 by 5 inches. Handhole cover shall be secured by stainless steel captive screws. Metal poles shall have an internal grounding connection accessible from the handhole near the bottom of each pole.

Scratched, stained, chipped, or dented poles shall not be installed.

2.6.1 Concrete Poles

Provide concrete poles conforming to ASTM C1089. Cross-sectional shape shall be round or multi-sided.

2.6.1.1 Steel Reinforcing

Prestressed concrete pole shafts shall be reinforced with steel prestressing members. Design shall provide internal longitudinal loading by either pretensioning or post tensioning of longitudinal reinforcing members.

2.6.1.2 Tensioned Reinforcing

Primary reinforcement steel used for a prestressed concrete pole shaft shall be tensioned between 60 to 70 percent of its ultimate strength. The amount of reinforcement shall be such that when reinforcement is tensioned to 70 percent of its ultimate strength, the total resultant tensile force does not exceed the minimum section compressive strength of the concrete.

2.6.1.3 Coating and Sleeves for Reinforcing Members

Where minimum internal coverage cannot be maintained next to required core openings, such as handhole and wiring inlet, reinforcing shall be protected with a vaporproof noncorrosive sleeve over the length without the 1/2 inch concrete coverage. Each steel reinforcing member which is to be post-tensioned shall have a nonmigrating slipper coating applied prior to the addition of concrete to ensure uniformity of stress throughout the length of such member.

2.6.1.4 Strength Requirement

As an exception to the requirements of ASTM C1089, poles shall be naturally cured to achieve a 28-day compressive strength of 7000 psi. Poles shall not be subjected to severe temperature changes during the curing period.

2.6.1.5 Shaft Preparation

Completed prestressed concrete pole shaft shall have a hard, smooth, nonporous surface that is resistant to soil acids, road salts, and attacks of water and frost, and shall be clean, smooth, and free of surface voids and internal honeycombing. Poles shall not be installed for at least 15 days after manufacture.

2.6.2 Aluminum Poles

Provide aluminum poles manufactured of corrosion resistant aluminum alloys conforming to AASHTO LTS-5 for Alloy 6063-T6 or Alloy 6005-T5 for wrought alloys and Alloy 356-T4 (3,5) for cast alloys. Poles shall be seamless extruded or spun seamless type with minimum 0.188 inch wall thickness. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Tops of shafts shall be fitted with a round or tapered cover. Base shall be anchor bolt mounted, made of cast 356-T6 aluminum alloy in accordance with ASTM B108/B108M and shall be machined to receive the lower end of shaft. Joint between shaft and base shall be welded. Base cover shall be cast 356-T6 aluminum alloy in accordance with ASTM B108/B108M. Hardware, except anchor bolts, shall be either 2024-T4

anodized aluminum alloy or stainless steel. Aluminum poles and brackets for walkway lighting shall have a uniform satin finish to match fixtures and shall not be painted. Manufacturer's standard provision shall be made for protecting the finish during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

2.6.3 Steel Poles

AASHTO LTS-5. Provide steel poles having minimum 11-gage steel with minimum yield/strength of 48,000 psi and hot-dipped galvanized in accordance with ASTM A123/A123M factory finish. Provide a pole grounding connection designed to prevent electrolysis when used with copper ground wire. Pole shall be anchor bolt mounted type. Poles shall have tapered tubular members, either round in cross section or polygonal. Pole shafts shall be one piece. Poles shall be welded construction with no bolts, rivets, or other means of fastening except as specifically approved. Pole markings shall be approximately 3 to 4 feet above grade and shall include manufacturer, year of manufacture, top and bottom diameters, and length. Base covers for steel poles shall be structural quality hot-rolled carbon steel plate having a minimum yield of 36,000 psi.

2.6.4 Fiberglass Poles

NEMA C136.20. Designed specifically for supporting luminaries and having factory-formed cable entrance and handhole. Resin color shall be as indicated, and pigment shall provide uniform coloration throughout entire wall thickness. Finish surface shall be pigmented polyurethane having a minimum dry film thickness of 1.5 mils. Polyurethane may be omitted if the surface layer of the pole is inherently ultraviolet inhibited. Minimum fiberglass content shall be 65 percent with resin and pigment comprising the other 35 percent material content.

2.7 BRACKETS AND SUPPORTS

ANSI C136.3, ANSI C136.13, and ANSI C136.21, as applicable. Pole brackets shall be not less than 1 1/4 inch secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to luminaries provided, and brackets for use with one type of luminary shall be identical. Brackets for pole-mounted street lights shall correctly position luminary no lower than mounting height indicated. Mount brackets not less than 24 feet above street. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with luminary head.

2.8 POLE FOUNDATIONS

Anchor bolts shall be steel rod having a minimum yield strength of 50,000 psi; the top 12 inches of the rod shall be galvanized in accordance with ASTM A153/A153M. Concrete shall be as specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

2.9 AUXILIARY INSTANT-ON QUARTZ SYSTEM

UL listed, automatically switched instant-on lamp. Quartz lamp shall come on when the luminary is initially energized and immediately after a momentary power outage, and remain on until HID lamp reaches approximately 60 percent light output. Wiring for quartz lamp shall be internal to ballast and independent of incoming line voltage to the ballast. Provide

instant-on quartz system as indicated.

2.10 EQUIPMENT IDENTIFICATION

2.10.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.10.2 Labels

Provide labeled luminaries in accordance with UL 1598 requirements. Luminaries shall be clearly marked for operation of specific lamps and ballasts according to proper lamp type. The following lamp characteristics shall be noted in the format "Use Only _____":

a. Lamp diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and compact fluorescent luminaries.

b. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaries.

c. Start type (preheat, rapid start, instant start) for fluorescent and compact fluorescent luminaries.

d. ANSI ballast type (M98, M57, etc.) for HID luminaries.

e. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaries.

Markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

2.11 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to IEEE C2, CEC and NFPA 70, and to the requirements specified herein.

3.1.1 Concrete Poles

Install according to pole manufacturer's instructions.

3.1.2 Fiberglass Poles

Install according to pole manufacturer's instructions.

3.1.3 Aluminum and Steel Poles

Provide pole foundations with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end. Provide ornamental covers to match pole and galvanized nuts and washers for anchor bolts. Concrete for anchor bases, polyvinyl chloride (PVC) conduit ells, and ground rods shall be as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION. Thoroughly compact backfill with compacting arranged to prevent pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide a permanent vertical position with the bracket arm in proper position for luminary location.

3.1.4 Photocell Switch Aiming

Aim switch according to manufacturer's recommendations. Mount switch on or beside each luminary when switch is provided in cast weatherproof aluminum housing with swivel arm.

3.1.5 GROUNDING

Ground noncurrent-carrying parts of equipment including metal poles, luminaries, mounting arms, brackets, and metallic enclosures as specified in Section 33 71 02.00 20 UNDERGROUND ELECTRICAL DISTRIBUTION. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.1.6 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Painting shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an operating test to show that the equipment operates in accordance with the requirements of this section. Refer to IESNA LM-35-02, IESNA LM-50-09, IESNA LM-51-00, and IESNA LM-64-01.

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SECTION 28 31 76

INTERIOR FIRE ALARM AND MASS NOTIFICATION SYSTEM

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for an integrated fire detection, fire alarm evacuation and mass notification system.Devices and notification appliance equipment shall be listed by UL or FM approved or OSHA recognized NRTL (nationally recognized testing laboratories) http://www.osha.gov/dts/otpca/nrtl/ for the specific purpose for which the items are used. Equipment and devices shall be compatible and operable in all respects with other specified equipment and shall, in no way, impair reliability or operational functions of any existing fire alarm system.

1.2 RELATED SECTIONS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS, applies to this section, with the additions and modifications specified herein. In addition, refer to the following sections for related work and coordination:

Section 21 13 13.00 20 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION
Section 21 30 00 FIRE PUMPS
Section 21 23 00.00 20 WET CHEMICAL FIRE EXTINGUISHING for KITCHEN CABINET
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Section 21 21 03.00 10 WET CHEMICAL FIRE EXTINGUISHING SYSTEM
Section 21 12 00 STANDPIPE SYSTEMS.
Section 08 71 00 DOOR HARDWARE for door release and door unlocking and additional work related to finish hardware.
Sections 14 21 00.00 20 ELECTRIC TRACTION ELEVATORS and 14 24 00 HYDRAULIC ELEVATORS for additional work related to elevators.
Section 07 84 00 FIRESTOPPING for additional work related to firestopping.

1.3 REFERENCES

The publications listed below form a part of this specification to the

extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S3.2	Method for Measuring the Intelligibility of Speech Over Communication Systems (ASA 85)

ASME INTERNATIONAL (ASME)

ASME A17.1/CSA B44	Safety Code for Elevators and Escalators

CALIFORNIA CODE OF REGULATIONS (CCR), Title 24

CEC	California Electrical Code
Part 9	California Fire Code

FM GLOBAL (FM) - FACTORY MUTUAL RESEARCH CORPORATION

FM APP GUIDE	Approval Guide http://www.approvalguide.com/

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 60268-16	Sound System Equipment - Part 16: Objective Rating Of Speech Intelligibility By Speech Transmission Index; Ed 3.0

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41.1	Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
IEEE C62.41.2	Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 7240-16	Fire Detection And Alarm Systems — Part 16: Sound System Control And Indicating Equipment
ISO 7240-19	Fire Detection and Alarm Systems — Part 19: Design, Installation, Commissioning and Service of Sound Systems for Emergency Purposes

NASA PROCEDURAL REQUIREMENT (NPR)

NPR 8719.11	Safety Standard for Fire Protection

NASA TECHNICAL STANDARD (NASA STD

8719.11	Safety Standard for Fire Protection

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

SB 50	Emergency Communications Audio Intelligibility Applications Guide

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 170	Standard for Fire Safety and Emergency Symbols
NFPA 70	National Electrical Code
NFPA 72	National Fire Alarm and Signaling Code
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 1	UL Standard for Safety Flexible Metal Conduit
UL 2	Fire Resistive Directory, Latest Edition
UL 228	Door Closures-Holders, With or Without Integral Smoke Detectors
UL 268	Smoke Detectors for Fire Alarm Systems
UL 268A	Smoke Detectors for Duct Application
UL 464	Standard for Audible Signal Appliances
UL 521	Heat Detectors for Fire Protective Signaling Systems
UL 864	Standard for Control Units and Accessories for Fire Alarm Systems
UL 1480	Standard for Speakers for Fire Alarm, Emergency, and Commercial and Professional Use
UL 1638	Visual Signaling Appliances - Private Mode Emergency and General Utility Signaling
UL 1971	Signaling Devices for the Hearing Impaired
UL 2017	General-Purpose Signaling Devices and Systems

UL Electrical Construction	Electrical Construction Equipment Directory
UL Fire Prot Dir	Fire Protection Equipment Directory

U.S. DEPARTMENT OF DEFENSE (DOD) - UNIFIED FACILITIES CRITERIA (UFC)

UFC 3-600-01	Fire Protection Engineer for Facilities
UFC 3-601-02	Operations and Maintenance: Inspection, Testing, and Maintenance of Fire Protection Systems
UFC 4-021-01	Design and O&M: Mass Notification Systems

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

47 CFR 15	Radio Frequency Devices
47 CFR 90	Private Land Mobile Radio Services

1.4 DEFINITIONS

Wherever mentioned in this specification or on the drawings, the equipment, devices, and functions shall be defined as follows:

a. Interface Device: An addressable device that interconnects hard wired systems or devices to an analog/addressable system.

b. Remote Fire Alarm and Mass Notification Control Unit: A control panel, electronically remote from the fire alarm and mass notification control panel, that receives inputs from automatic and manual fire alarm devices; may supply power to detection devices and interface devices; may provide transfer of power to the notification appliances; may provide transfer of condition to relays or devices connected to the control unit; and reports to and receives signals from the fire alarm control panel.

c. Fire Alarm and Mass Notification Control Panel (FACP/FMCP): A master control panel having the features of a fire alarm and mass notification control unit and fire alarm and mass notification control units are interconnected. The panel has central processing, memory, input and output terminals, video display units (VDUs), and printers.

d. Local Operating Console (LOC): A unit designed to allow emergency responders and/or building occupants to operate the MNS including delivery or recorded and/or live messages, initiate strobe and textural visible appliance operation and other relayed functions.

e. Terminal Cabinet: A steel cabinet with locking, hinge-mounted door that terminal strips are securely mounted.

1.5 SYSTEM DESCRIPTION

1.5.1 Scope

a. This work includes completion of design and providing a new, complete, or modifying the existing analog/addressable fire alarm and mass notification system as described herein and on the contract drawings

for the building number. Include in the system wiring, raceways, pull boxes, terminal cabinets, outlet and mounting boxes, control equipment, alarm, and supervisory signal initiating devices, alarm notification appliances, supervising station fire alarm system transmitter, and other accessories and miscellaneous items required for a complete operating system even though each item is not specifically mentioned or described. Provide system complete and ready for operation.

b. Provide equipment, materials, installation, workmanship, inspection, and testing in strict accordance with the required and advisory provisions of NFPA 72, ISO 7240-16, IEC 60268-16, except as modified herein. The system layouts on the drawings show the intent of coverage and are shown in suggested locations. Submit plan view drawing showing device locations, terminal cabinet locations, junction boxes, other related equipment, conduit routing, wire counts, circuit identification in each conduit, and circuit layouts for all floors. Drawings shall comply with the requirements of NFPA 170. Final quantity, system layout, and coordination are the responsibility of the Contractor. A single fire alarm control panel is indicated with terminal cabinets at each floor, at each riser location.

c. Where remote fire alarm control units are needed, they shall be provided at a terminal cabinet location. Each remote fire alarm control unit shall be powered from a wiring riser specifically for that use or from a local emergency power panel located on the same floor as the remote fire alarm control unit. Where remote fire control units are provided, equipment for notification appliances may be located in the remote fire alarm control units.

1.5.2 Technical Data and Computer Software

Identify data delivered by reference to the particular specification paragraph against which it is furnished. Data to be submitted shall include complete system, equipment, and software descriptions. Descriptions shall show how the equipment will operate as a system to meet the performance requirements of this contract. The data package shall also include the following:

a. Identification of programmable portions of system equipment and capabilities.

b. Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.

c. Provision of operational software data on all modes of programmable portions of the fire alarm and detection system.

d. Description of Fire Alarm Control Panel equipment operation.

e. Description of auxiliary and remote equipment operations.

f. Library of application software.

g. Operation and maintenance manuals.

1.5.3 Keys

Keys and locks for equipment shall be identical. Provide not less than six keys of each type required.

Local Operating Console (LOC) is not permitted to be locked or lockable.

1.6 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01, Data

Catalog cuts and/or manufacturer's literature marked to show model and catalog number for all equipment and all materials used in the system. Where the submittal sheet describes items in addition to that item being submitted, the item shall be clearly marked on the sheet and the superfluous information shall be crossed out. The submittal package shall include, but shall not be limited to, the following:

a. Control Panel, including all modules, operating software, programming, and maintenance manuals

b. Addressable Interface Devices

c. Batteries and battery chargers

d. Cabinets

e. Fire Alarm Pull Stations

f. Smoke Detectors

g. Thermal Detectors

h. Audible and Visual Alarm Devices

i. Conduit and Connectors

j. Back-boxes for devices

k. Wire and Cable

l. Addressable Interface Devices

m. Graphic Annunciator

n. Amplifiers

o. Electromagnetic Door Holders

p. Antenna and lightening arrestor grounding

q. Current OSFM Device Listing Sheets

SD-02 Shop Drawings

a. Fire alarm system and shop drawings shall be reviewed, approved and stamped by a fire protection engineer licensed in California. Drawings shall be prepared and signed by a manufacturer's representative or design engineer as meeting contract specifications before submission to the COR. Submittals shall be

approved by NASA Permit Review Board, Fire Marshal as well as by the COR. No installation shall begin prior to obtaining said approvals.

b. Electrical drawings shall not be on less than 24 by 36 inch sheets, 1/8 inch scale (minimum) and shall identify all symbols used. The complete control panel schematic, including all modules if so constructed, shall be on a single sheet drawing with all circuit terminals and interconnections identified. Address numbers for addressable devices shall be shown on the drawings.

c. Seven copies of the shop drawings shall be submitted. The submitted drawings shall include complete schematic circuit diagrams for all equipment, wiring diagrams showing connections between all system components, description of system operation, annunciator schedule showing titles for each fire alarm and supervisory and trouble zone. Complete riser diagrams indicating wiring sequence of all devices and control equipment shall be included with submittal data.

d. As-built drawings and testing and maintenance instructions shall be submitted prior to final testing of the system. The as-built drawings shall be the shop or working drawings corrected to the actual installed conditions. Six complete sets of as-built drawings shall be delivered to the COR. Four copies of the data CDR shall be submitted to the COR for distribution to the NASA "on-site" Maintenance contractor (2 copies) and NASA Engineering Documentation Center (2 copies).

e. All submittal and as-built drawings shall be drafted in a Computer Aided Engineering (CAE) application. The final delivery as-built disks shall be in AutoCAD Release 2010 or later.The data CDR's shall be submitted with the as-built drawings. CDR's shall be labeled as "fire alarm as-builts" and contain the following:

    1. Building number and floor or area.

    2. Date and name of person or company who made the drawing.

    3. Operating system used to develop the drawing.

    4. Software used to create the drawing and version.

f. File name.

g. Font(s) that were used to create the drawing, if non-standard.

h. Drawing shall have a minimum text size of 3/32 inch.

i. File name shall also be on lower right-hand corner of the drawing.

SD-03 Product Data

Catalog cuts and manufacturer's literature marked to show model and catalog number for all equipment on all materials used in the system shall be submitted. Where the submittal sheet described items in addition to that item being submitted, the item shall be clearly marked on the sheet and the superfluous information shall be crossed out. The submittal package shall include, but not be limited to the following:

a. Fire Alarm Control Unit and Mass Notification Control Unit (FMCP), including all modules

b. Addressable Interface Devices

c. Batteries and battery chargers

d. Cabinets

e. Fire Alarm Pull Stations

f. Smoke Detectors

g. Thermal Detectors

h. Audible and Visual Alarm Devices / Notification appliances

i. Conduit and Connectors

j. Back-boxes for devices

k. Wire and Cable

l. Addressable Interface Devices Remote Fire Alarm/Mass Notification Control Units

m. Graphic Annunciator

n. Amplifiers

o. Electromagnetic Door Holders

p. Antenna and lightening arrestor grounding

q. Technical Data And Computer Software

r. LCD, LED Display Unit (VDU)

s. Terminal cabinets

t. Transceivers (including housing)

u. Tone generators

v. Digitalized voice generators

w. Radio transceivers and interface panels for mass notification

x. Local Operating Console (LOC)

y. Current OSFM Device Listing Sheets

SD-05 Design Data

Battery power
Battery chargers

SD-06 Test Reports

Field Quality Control
Testing Procedures
Smoke sensor testing procedures

SD-07 Certificates

Installer
Formal Inspection and Tests
Final Testing

All equipment and devices shall be of a make and type listed in UL 1 or UL 2 or FM APP GUIDE for the specific purpose for which it is used. Satisfactory proof as to the quality of the equipment and materials shall be furnished by the Contractor at the time the drawings are submitted.

SD-09 Manufacturer's Field Reports

System Operation
Fire Alarm/Mass Notification System

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions
Instruction of Government Employees

Prior to acceptance of the entire system and for use during instruction periods, the COR shall be furnished 6 bound copies of operation and maintenance manuals including an index, copies of all submittal materials (except diagrams and drawings shall be as-built), and a complete parts list. A spare partial list shall also be provided which indicates manufacturer's name, serial number, order number, size, and operation characteristics. Manuals shall also contain a schedule of all device locations, serial or identification numbers, and sensitivity settings. Scheduling of Final acceptance tests will be made only after receipt of the manuals.

SD-11 Closeout Submittals

As-Built Drawings

SD-18, Records

a. The Contractor shall possess a valid State of California contractor's License.

b. The system supplier shall furnish evidence that there is an experienced and efficient service organization which carries a stock of repair parts for the system to be furnished and that the organization is capable of providing repair service within 24 hours of a trouble call.

1.7 QUALITY ASSURANCE

Equipment and devices shall be compatible and operable with existing station fire alarm system and shall not impair reliability or operational functions of existing supervising station fire alarm system.

a. In NFPA publications referred to herein, consider advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears; interpret reference to "authority having jurisdiction" to mean the JP/NASA Ames Fire Marshal or Fire Marshal approved representative.

b. The recommended practices stated in the manufacturer's literature or documentation shall be considered as mandatory requirements.

c. Devices and equipment for fire alarm service shall be listed by UL Fire Prot Dir or approved by FM APP GUIDE.

1.7.1 Qualifications

1.7.1.1 Design Services

Installations requiring completion of installation drawings and specification or modifications of fire detection, fire alarm, mass notification system, fire suppression systems or mass notification systems shall require the services and review of a qualified engineer. For the purposes of meeting this requirement, a qualified engineer is defined as an individual meeting one of the following conditions:

a. A California registered Professional Engineer with verification of experience and at least four years of current experience in the design of the fire protection and detection systems.

b. A NICET Level 4 Fire Alarm Technician.

1.7.1.2 Supervisor

The installing Contractor shall provide the following: NICET Fire Alarm Technicians to perform the installation of the system. A NICET Level 3 Fire Alarm Technician shall supervise the installation of the fire alarm system/mass notification system. A Fire Alarm Technician with a minimum of 8 years of experience shall perform/supervise the installation of the fire alarm system/mass notification system. The Fire Alarm technicians supervising the installation of equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.7.1.3 Technician

The installing Contractor shall provide the following: Fire Alarm Technicians with a minimum of four years of experience utilized to assist in the installation and terminate fire alarm/mass notification devices, cabinets and panels. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.7.1.4 Installer

The installing Contractor shall provide the following: Fire Alarm installer with a minimum of two years of experience utilized to assist in the installation of fire alarm/mass notification devices, cabinets and panels. An electrician shall be allowed to install wire or cable and to install conduit for the fire alarm system/mass notification system. The Fire Alarm installer shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on

the drawings.

1.7.1.5 Test Personnel

Fire Alarm Technicians with a minimum of eight years of experience (NICET Level III) utilized to test and certify the installation of the fire alarm/mass notification devices, cabinets and panels. The Fire Alarm technicians testing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.7.1.6 Manufacturer's Representative

The fire alarm and mass notification equipment manufacturer's representative shall be present for the connection of wiring to the control panel. The Manufacturer's Representative shall be an employee of the manufacturer with necessary technical training NICET Level III on the system being installed.

1.7.1.7 Manufacturer

Components shall be of current design and shall be in regular and recurrent production at the time of installation. Provide design, materials, and devices for a protected premises fire alarm system, complete, conforming to NFPA 72, except as otherwise or additionally specified herein.

1.7.2 Regulatory Requirements

1.7.2.1 Requirements for Fire Protection Service

Equipment and material shall have been tested by UL and listed in UL Fire Prot Dir or approved by FM and listed in FM APP GUIDE. Where the terms "listed" or "approved" appear in this specification, they shall mean listed in UL Fire Prot Dir or FM APP GUIDE. The omission of these terms under the description of any item of equipment described shall not be construed as waiving this requirement. All listings or approval by testing laboratories shall be from an existing ANSI or UL published standard.

1.7.2.2 Fire Alarm/Mass Notification System

Furnish equipment that is compatible and is UL listed, FM approved, or listed by a nationally recognized testing laboratory for the intended use. All listings by testing laboratories shall be from an existing ANSI or UL published standard. Submit a unique identifier for each device, including the control panel and initiating and indicating devices, with an indication of test results, and signature of the factory-trained technician of the control panel manufacturer and equipment installer. With reports on preliminary tests, include printer information. Include the NFPA 72 Record of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.

1.7.2.3 Fire Alarm Testing Services or Laboratories

Construct fire alarm and fire detection equipment in accordance with UL Fire Prot Dir, UL Electrical Construction, or FM APP GUIDE.

1.8 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather,

humidity, and temperature variation, dirt and dust, and other contaminants.

1.9 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

Submit 6 copies of the Operation and Maintenance Instructions, indexed and in booklet form. The Operation and Maintenance Instructions shall be a single volume or in separate volumes, and may be submitted as a Technical Data Package. Manuals shall be approved prior to training. The Interior Fire Alarm And Mass Notification System Operation and Maintenance Instructions shall include:

a. "Manufacturer Data Package 5" as specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA.

b. Operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features.

c. Maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed.

d. The manuals shall include complete procedures for system revision and expansion, detailing both equipment and software requirements.

e. Software delivered shall be provided, on each type of CD/DVD media utilized.

f. Printouts of configuration settings for all devices.

g. Routine maintenance checklist. The routine maintenance checklist shall be arranged in a columnar format. The first column shall list all installed devices, the second column shall state the maintenance activity or state no maintenance required, the third column shall state the frequency of the maintenance activity, and the fourth column for additional comments or reference. All data (devices, testing frequencies, etc.) shall comply with UFC 3-601-02.

1.10 EXTRA MATERIALS

1.10.1 Repair Service/Replacement Parts

Repair services and replacement parts for the system shall be available for a period of 10 years after the date of final acceptance of this work by the COR. During guarantee period, the service technician shall be on-site within 24 hours after notification. All repairs shall be completed within 24 hours of arrival on-site.

1.10.2 Interchangeable Parts

Spare parts furnished shall be directly interchangeable with the corresponding components of the installed system. Spare parts are for the Government's future use, not the Contractor. Spare parts shall be suitably packaged and identified by nameplate, tagging, or stamping. Spare parts shall be delivered to the COR at the time of the final acceptance testing.

1.10.3 Spare Parts

Furnish the following spare parts and accessories:

a. 10% - minimum 1 fuse for each fused circuit in the system

b. 10% - minimum 3 of each type of notification appliance in the system (e.g. speaker, FA strobe, MNS strobe, etc.)

c. 10% of each type of initiating device included in the system (e.g. smoke detector, thermal detector, manual station, etc.)

   1. Minimum four spare automatic smoke detectors

   2. Minimum one spare automatic thermal detectors

   3. Minimum two spare alarm input modules, mounted in cabinet

   4. Two spare sets of auxiliary relays, NO & NC contacts, mounted in cabinet

d. One spare audible alarm output zone module, mounted in cabinet

e. The Contractor shall furnish a list, in duplicate, of all other spare parts and accessories that the manufacturer recommends to be stocked for maintenance of the system.

1.10.4 Special Tools

Software, connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to the COR. See training section for the training for programming and licensing of Government technicians.

PART 2 PRODUCTS

2.1 MANUFACTURER

a. All fire alarm equipment shall be the product of a single manufacturer, Siemens, Simplex, or Edwards Systems Technology (EST). The control panel's operating software and operating, programming, and maintenance manuals shall be provided as part of the control panel equipment package.

b. All fire alarm equipment systems shall be provided by factory approved system suppliers and/or subcontractors who maintain a local staff of competent technicians qualified to assume proper installation of the system specified, and be capable of providing maintenance and repair of these systems on a contract or job order basis.

c. Existing central station alarm transmitters are manufactured by Monaco Enterprises and include ground plane antenna and coaxial cable.

d. Equipment manufacturer supplier shall meet the following requirements:

   1. Have been in the business of installing and maintaining the specific type of system equipment under the present firm name for at least the last three years.

2. Have been distributing and/or installing the specific brand of system equipment for at least three years prior to the date on the contract documents.

3. Have the capability of dispatching a maintenance or repair truck with a qualified repairmen to the job site within twenty four (24) hours (one day) or less of a request for service on the equipment. Warranty period inclusive.

2.2 MATERIALS AND EQUIPMENT

Submit annotated catalog data as required in the paragraph SUBMITTAL, in table format on the drawings, showing manufacturer's name, model, voltage, and catalog numbers for equipment and components. Submitted shop drawings shall not be smaller than ISO A1. Also provide UL or FM listing cards for equipment provided.

2.2.1 Standard Products

Provide materials, equipment, and devices that have been tested by a nationally recognized testing laboratory, such as UL or FM, and listed or approved for fire protection service when so required by NFPA 72 or this specification. Select material from one manufacturer, where possible, and not a combination of manufacturers, for any particular classification of materials. Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 5 years prior to bid opening.

2.2.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, date of installation, installing Contractor's name and address, and the contract number provided on a new plate permanently affixed to the item or equipment. Major components include, but are not limited to, the following:

a. FACPs

b. Automatic transmitter/transceiver

c. Terminal cabinet

d. Graphic Annunciator

Furnish nameplates to obtain approval by the COR before installation. Obtain approval by the COR for installation locations. Nameplates shall be etched metal or plastic, permanently attached by screws to panels or adjacent walls.

2.3 GENERAL PRODUCT REQUIREMENT

All fire alarm and mass notification equipment shall be listed for use under the applicable reference standards. Interfacing of Listed UL 864 or similar approved industry listing with Mass Notification Panels listed to UL 2017 or equal shall be done in a laboratory listed configuration, if the software programming features can not provide a listed interface control. If a field modification is needed, such as adding equipment like relays, the manufacturer of the panels being same or different brand from manufacturer shall provide the installing contractor for review and

confirmation by the installing contractor. The installing contractor shall, as part of the submittal documents, provide this information.

2.4 SYSTEM OPERATION

The Addressable Interior Fire Alarm and Mass Notification System shall be a complete, supervised, noncoded, analog/addressable fire alarm and mass notification system conforming to NFPA 72, UL 864, and UL 2017. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. The system may be placed in the alert mode by local microphones or remotely from authorized locations/users.

Submit data on each circuit to indicate that there is at least 25 percent spare capacity for notification appliances, 25 percent spare capacity for initiating devices. Annotate data for each circuit on the drawings. Submit a complete description of the system operation in matrix format on the drawings. Submit a complete list of device addresses and corresponding messages.

2.4.1 Alarm Initiating Devices and Notification Appliances (Visual, Voice, Textural)

a. Connect alarm initiating devices to initiating device circuits (IDC) Class "A" to signal line circuits (SLC) Class "A" and installed in accordance with NFPA 72.

b. Connect alarm notification appliances and speakers to notification appliance circuits (NAC) Class "A".

c. The system shall operate in the alarm mode upon actuation of any alarm initiating device or a mass notification signal. The system shall remain in the alarm mode until initiating device(s) or mass notification signal is/are reset and the control panel is manually reset and restored to normal. Audible, and visual appliances and systems shall comply with NFPA 72 and as specified herein. Fire alarm system/mass notification system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc.

2.4.2 Functions and Operating Features

The system shall provide the following functions and operating features:

a. The FMCP shall provide power, annunciation, supervision, and control for the system. Addressable systems shall be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits with sufficient memory to perform as specified.

b. For Class "A" or "X" circuits with conductor lengths of 10 feet or less, the conductors shall be permitted to be installed in the same raceway in accordance with NFPA 72.

c. Provide signaling line circuits for each floor.

d. Provide signaling line circuits for the network.

e. Provide notification appliance circuits. The visual alarm notification appliances shall have the flash rates synchronized as required by

NFPA 72.

f. Provide electrical supervision of the primary power (AC) supply, presence of the battery, battery voltage, and placement of system modules within the control panel.

g. Provide an audible and visual trouble signal to activate upon a single break or open condition, or ground fault (or short circuit for Class "X"). The trouble signal shall also operate upon loss of primary power (AC) supply, absence of a battery supply, low battery voltage, or removal of alarm or supervisory panel modules. Provide a trouble alarm silence feature that shall silence the audible trouble signal, without affecting the visual indicator. After the system returns to normal operating conditions, the trouble signal shall again sound until the trouble is acknowledged. A smoke sensor in the process of being verified for the actual presence of smoke shall not initiate a trouble condition.

h. Provide program capability via switches in a locked portion of the FACP to bypass the automatic notification appliance circuits, fire reporting system, air handler shutdown, smoke control operation, elevator recall, door release, door unlocking features. Operation of this programming shall indicate this action on the FACP display and printer output.

i. Alarm, supervisory, and/or trouble signals shall be automatically transmitted to the NASA Dispatch.

j. Alarm functions shall override trouble or supervisory functions. Supervisory functions shall override trouble functions.

k. The system shall be capable of being programmed from the panel keyboard. Programmed information shall be stored in non-volatile memory.

l. The system shall be capable of operating, supervising, and/or monitoring both addressable and non-addressable alarm and supervisory devices.

m. There shall be no limit, other than maximum system capacity, as to the number of addressable devices, that may be in alarm simultaneously.

n. Where the fire alarm/mass notification system is responsible for initiating an action in another emergency control device or system, such as an HVAC system, an atrium exhaust system, a smoke control system, an elevator system, releasing panel, the addressable fire alarm relay shall be within 3 feet of the emergency control device.

o. An alarm signal shall automatically initiate the following functions:

1. Transmission of an alarm signal to the NASA Dispatch.

2. Visual indication of the device operated on the control panel (FACP/MNCP), LCD, LED Display unit (VDU), and on the graphic annunciator. Indication on the graphic annunciator shall be by floor, zone or circuit, and type of device.

3. Continuous actuation of all alarm notification appliances.

4. Recording of the event via electronically in the history log of the fire control system unit.

5. Release of doors held open by electromagnetic devices.

6. Operation of the smoke control system, atrium exhaust system.

7. Release of power to electric locks (delayed egress locks) on doors that are part of the means of egress.

8. Operation of a smoke sensor in an elevator lobby or other location associated with the automatic recall of elevators, shall recall the elevators in addition to other requirements of this paragraph.

9. Operation of a duct smoke sensor shall shut down the appropriate air handler in accordance with NFPA 90A in addition to other requirements of this paragraph and as allowed by NFPA 72.

10. Operation of duct smoke detector/sensor shall release the fire extinguishing system after a 45 second time delay.

11. Operation of a sprinkler waterflow switch serving an elevator machinery room or elevator shaft shall operate shunt trip circuit breaker(s) to shut down power to the elevators in accordance with ASME A17.1/CSA B44.

12. Operation of an interface, that operates vibrating pagers worn by hearing-impaired occupants.

p. A supervisory signal shall automatically initiate the following functions:

1. Visual indication of the device operated on the FACP, VDU, and on the graphic annunciator, and sound the audible alarm at the respective panel.

2. Transmission of a supervisory signal to the NASA Dispatch.

3. Recording of the event electronically in the history log of the control unit.

q. A trouble condition shall automatically initiate the following functions:

1. Visual indication of the system trouble on the FACP, and on the graphic annunciator, and sound the audible alarm at the respective panel.

2. Transmission of a trouble signal to the NASA Dispatch.

3. Recording of the event in the history log of the control unit.

r. The maximum permissible elapsed time between the actuation of an initiating device and its indication at the FACP is 10 seconds.

s. The maximum elapsed time between the occurrence of the trouble condition and its indication at the FACP is 200 seconds.

t. Activation of a LOC pushbutton shall activate the audible and visual alarms in the facility. The audible message shall be the one associated with the pushbutton activated.

2.5 SYSTEM MONITORING

2.5.1 Valves

Each valve affecting the proper operation of a fire protection system, including automatic sprinkler control valves, standpipe control valves, sprinkler service entrance valve, valves at fire pumps, isolating valves for pressure type waterflow or supervision switches, and valves at backflow preventers, whether supplied under this contract or existing, shall be electrically monitored to ensure its proper position. Provide each tamper switch with a separate address.

2.5.2 Independent Fire Detection System

Each existing independent smoke detection subsystem, kitchen fire extinguishing system, and releasing system (e.g., AFFF) shall be monitored both for the presence of an alarm condition and for a trouble condition. Provide each monitored condition with a separate address.

2.6 MASS NOTIFICATION SYSTEM FUNCTIONS

2.6.1 Notification Appliance Network

The audible notification appliance network consists of speakers located to provide intelligible instructions at all locations in the building areas as indicated. The Mass Notification System announcements shall take priority over all other audible announcements of the system including the output of the fire alarm system in a normal or alarm state. When a mass notification announcement is activated during a fire alarm, all fire alarm system functions shall continue in an alarm state except for the output signals of the fire alarm audible and visual notification appliances.

2.6.2 Strobes

Provide strobes to alert hearing-impaired occupants.

2.6.3 Text Displays

LED text displays (textural visible appliances) for hearing impaired occupants. The textual displays shall be programmable and shall display the same content of the voice message being played. The signs shall be able to provide a minimum of 4 inch high letters and be located in high traffic areas easily seen by building occupants. The system shall interface with the Programmable sign controller to activate the proper message.

2.6.4 Wide Area MNS

The Wide Area MNS system (if available) in the area of the building shall not be activated by the in-building MNS.

2.6.5 Voice Notification

An autonomous voice notification control unit is used to monitor and control the notification appliance network and provide consoles for local operation. Using a console, authorized personnel in the building can initiate delivery of pre-recorded voice messages, provide live voice messages and instructions, and initiate visual strobe and optional textual message notification appliances. The autonomous voice notification control

unit will temporarily override audible fire alarm notification while delivering Mass Notification messages to ensure they are intelligible.

2.6.6 Installation-Wide Control

If an installation-wide control system for mass notification exists on the base, the autonomous control unit shall communicate with the central control unit of the installation-wide system. The autonomous control unit shall receive commands/messages from the central control unit and provide status information.

2.7 OVERVOLTAGE AND SURGE PROTECTION

2.7.1 Signaling Line Circuit Surge Protection

For systems having circuits located outdoors, communications equipment shall be protected against surges induced on any signaling line circuit and shall comply with the applicable requirements of IEEE C62.41.1 and IEEE C62.41.2. Cables and conductors, that serve as communications links, shall have surge protection circuits installed at each end that meet the following waveforms:

a. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Protection shall be provided at the equipment. Additional triple electrode gas surge protectors, rated for the application, shall be installed on each wireline circuit within 3 feet of the building cable entrance. Fuses shall not be used for surge protection.

2.7.2 Sensor Wiring Surge Protection

Digital and analog inputs and outputs shall be protected against surges induced by sensor wiring installed outdoors and as shown. The inputs and outputs shall be tested with the following waveforms:

a. A 10 by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.

b. An 8 by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes. Fuses shall not be used for surge protection.

2.8 ADDRESSABLE INTERFACE DEVICES

The initiating device being monitored shall be configured as a Class "A" initiating device circuits. The system shall be capable of defining any module as an alarm module and report alarm trouble, loss of polling, or as a supervisory module, and reporting supervisory short, supervisory open or loss of polling such as waterflow switches, valve supervisory switches, fire pump monitoring, independent smoke detection systems, relays for output function actuation, etc. The module shall be UL or FM listed as compatible with the control panel. The monitor module shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. Monitor module shall contain an integral LED that flashes each time the monitor module is polled. Pull stations with a monitor module in a common backbox are not required to have

an LED. Existing fire alarm system initiating device circuits shall be connected to a single module to power and supervise the circuit.

a. Pressure Switches - Addressable interface devices shall be provided for interconnection to the fire alarm system.

2.9 ADDRESSABLE CONTROL MODULE

The control module shall be capable of operating as a relay (dry contact form C) for interfacing the control panel with other systems, and to control door holders or initiate elevator fire service. The module shall be UL or FM listed as compatible with the control panel. The indicating device or the external load being controlled shall be configured as a Class "B" notification appliance circuits. The system shall be capable of supervising, audible, visual and dry contact circuits. The control module shall have both an input and output address. The supervision shall detect a short on the supervised circuit and shall prevent power from being applied to the circuit. The control model shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. The control module shall contain an integral LED that flashes each time the control module is polled and is visible through the device coverplate. Control Modules shall be located in environmental areas that reflect the conditions to which they were listed.

2.10 ISOLATION MODULES

Provide isolation modules to subdivide each signaling line circuit into groups of not more than 20 addressable devices between adjacent isolation modules.

2.11 SMOKE SENSORS

2.11.1 Photoelectric Smoke Sensors

Provide addressable photoelectric smoke sensors as follows:

a. Provide analog/addressable two-wire photoelectric smoke sensors utilizing the photoelectric light scattering principle for operation in accordance with UL 268. Smoke sensors shall be listed for use with the fire alarm control panel.

b. Provide non-adjustable, factory set, self-restoring type sensors that do not require any readjustment after actuation at the FACP to restore them to normal operation. Sensors shall be UL listed as smoke-automatic fire sensors.

c. Components shall be rust and corrosion resistant. Vibration shall have no effect on the sensor's operation and sensor shall not activate alarm due to rapid changes in humidity or a fan maintenance shutdown. Protect the detection chamber with a fine mesh metallic screen that prevents the entrance of insects or airborne materials. The screen shall not inhibit the movement of smoke particles into the chamber.

d. Provide twist lock bases. The sensors shall maintain contact with their bases without the use of springs. Terminate field wiring on the screw terminals. The sensor shall have an LED visual indicator to show actuation.

e. The sensor address shall identify the particular unit, its location

within the system, and its sensitivity setting. Sensors shall be of the low voltage type rated for use on a 24 VDC system not requiring separate power circuits for operation.

f. An operator at the control panel, having a proper access level, shall have the capability to manually access the following information for each initiating device.

1. Primary status

2. Device type

3. Present average value

4. Present sensitivity selected

5. Sensor range (normal, dirty, etc.)

2.11.2 Projected Beam Smoke Detectors

Detectors shall be designed for detection of abnormal smoke densities. Detectors shall consist of separate transmitter and receiver units. The transmitter unit shall emit an infrared beam to the receiver unit. The use of a supplied reflector is required for the combined unit. When the signal at the receiver falls below a preset sensitivity, the detector shall initiate an alarm. The receiver shall contain an LED that is powered upon an alarm condition. Long-term changes to the received signal caused by environmental variations shall be automatically compensated. Detectors shall incorporate features to assure that they are operational; a trouble signal shall be initiated if the beam is obstructed, the limits of the compensation circuit are reached, or the housing cover is removed. Detectors shall have multiple sensitivity settings in order to meet UL listings for the different distances covered by the beam. In the event of beam interference for more than three seconds a trouble alarm shall be transmitted.

2.11.3 Duct Smoke Sensors

Addressable duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Detectors, mounted in a special housing fitted with duct sampling tubes. The detector shall be complete with terminating equipment, fully supervised and shall not activate alarms due to the rapid change in humidity. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have a manual reset. Detectors shall be rated for air velocities that include air flows between 500 and 4000 fpm. Unless shown otherwise on the drawings, the power for the duct smoke detector assembly shall be low voltage, and fed from the fire alarm control panel. While the fans are operating, a continuous cross-sectional sampling of air shall flow through the smoke detector, after which the sampled air shall be returned to the duct. The air duct housing shall incorporate a relay to perform fan shutdown, and terminals for a remote annunciator lamp.

a. The assembly shall consist of a housing to accommodate sampling tubes that extend into and across the duct of the ventilation system, and a plug-in detector head located in the air sampling chamber. The detector shall be the photoelectric type, and there shall be provisions to check the detector sensitivity in place under actual airflow conditions.

The duct detector package shall conform to the requirements of NFPA 90A, UL 268A, and shall be UL listed for use in air-handling systems. The control functions, operation, reset, and bypass shall be controlled from the fire alarm control panel.

b. Lights to indicate the operation and alarm condition; and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Detectors mounted above 6 feet and those mounted below 6 feet that cannot be easily accessed while standing on the floor, shall be provided with a remote detector indicator panel containing test and reset switches.

c. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall provide for control of auxiliary contacts that provide control, interlock, and shutdown functions. Auxiliary contacts provide for this function shall be located within 3 feet of the controlled circuit or appliance. The detectors shall be supplied by the fire alarm system manufacturer to ensure complete system compatibility.

d. Exterior located detectors shall be mounted on a weather proof duct housing base with suitable interface modules/devices for connection to the system wiring and to the corresponding fan shutdown.

e. Provide a remote reset momentary contact switch at the control panel for resetting the duct detectors.

f. Complete installation instructions shall be supplied with the unit.

g. An inspection door shall be installed on the duct work for visual confirmation of sampling tube orientation and for future maintenance.

2.11.4 Air Sampling Smoke Detectors

Air sampling detectors are early warning devices use to detect what may be the beginning of a fire. The detector uses a series of perforated pipes in the protected area to continuously draw smoke into the sampling chamber. Once in the sampling chamber the air is sampled by mass scattering of light, laser particle counting, cloud density measuring to determine if there is possibly a fire in the protected area. These units shall be programmable in multiple levels to indicate detection of particles that are not normally present, to indicate the presence of particle that could be produced by a fire and to indicate the presence of particles of the proper size and quantity to indicate that a fire conditions exists.

2.11.5 Smoke Sensor Testing

Smoke sensors shall be tested in accordance with NFPA 72 and manufacturer's recommended calibrated test method. Submit smoke sensor testing procedures for approval. In addition to the NFPA 72 requirements, smoke detector sensitivity shall be tested during the preliminary tests.

2.12 HEAT DETECTORS

Detectors shall be on the "ordinary" temperature range as per NFPA 72.

Exterior located detector shall be weatherproof mounted in a weatherproof back box and addressable type.

2.12.1 Heat Detectors

Addressable Thermal detectors shall be designed for detection of fire by fixed temperature, combination fixed temperature and rate-of-rise principle, rate-compensating principle. The alarm condition shall be determined by comparing sensor valve with the stored values. Heat detector spacing shall be rated in accordance with UL 521. Detectors located in areas subject to moisture, exterior atmospheric conditions, or hazardous locations as defined by CEC and NFPA 70 and as indicated, shall be types approved for such locations.

2.12.1.1 Combination Fixed-Temperature and Rate-of-Rise Detectors

Detectors shall be designed for surface or semi-flush outlet box mounting and supported independently of wiring connections. Contacts shall be self-resetting after response to rate-of-rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication that is readily visible. Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes shall operate on fixed temperature principle only. The UL 521 test rating for the fixed temperature portion shall be 135 degrees F. The UL 521 test rating for the Rate-of-Rise detectors shall be rated for 50 by 50 feet.

2.12.1.2 Rate Compensating Detectors

Detectors shall be surface or flush mounted vertical or horizontal type, with outlet box supported independently of wiring connections. Detectors shall be hermetically sealed and automatically resetting. Rate Compensated detectors shall be rated for 50 by 50 feet.

2.12.1.3 Fixed Temperature Detectors

Detectors shall be designed for surface or semi-flush outlet box mounting and supported independently of wiring connections. Detectors shall be designed to detect high heat. The detectors shall have a specific temperature setting of 135 degrees F. The UL 521 test rating for the fixed temperature detectors shall be rated for 50 by 50 feet. The fixed temperature detection sensor may be either self restoring or fusible non-restorable type. When non-restorable, a clearly visual indication on the detector shall indicate operation.

2.12.2 Self-Test Routines

Automatic self-test routines shall be performed on each sensor that will functionally check sensor sensitivity electronics and ensure the accuracy of the value being transmitted. Any sensor that fails this test shall indicate a trouble condition with the sensor location at the control panel.

2.12.3 Operator Access

An operator at the control panel, having the proper access level, shall have the capability to manually access the following information for each heat sensor:

a. Primary status

b. Device type

c. Present average value

d. Sensor range (select for room size)

2.12.4 Operator Control

An operator at the control panel, having the proper access level, shall have the capability to manually control the following information for each heat sensor:

a. Alarm detection sensitivity values

b. Enable or disable the point/device

c. Control sensors relay driver output

2.13 MULTI SENSOR DETECTORS

Multi-sensor detectors shall contain fixed temperature 135 degrees F heat sensor, rate-of-rise heat sensor, photoelectric smoke sensor elements in a single housing. Each detection sensor shall be listed to initiate a fire alarm condition.

2.14 MULTI CRITERIA DETECTORS

Multi-criteria detectors shall contain fixed temperature 135 degrees F heat sensor, rate-of-rise heat sensor, photoelectric smoke sensor, elements in a single housing.

2.15 ELECTRIC POWER

2.15.1 Primary Power

Power to the fire alarm control panel shall be 120 VAC service from an independent, dedicated 20 amps minimum circuit breaker connected to the building AC power supply ahead of any other disconnect switch service to the building in accordance with NFPA 72.

2.16 SECONDARY POWER SUPPLY

Provide for system operation in the event of primary power source failure. Transfer from normal to auxiliary (secondary) power or restoration from auxiliary to normal power shall be automatic and shall not cause transmission of a false alarm.

2.16.1 Batteries

Provide sealed, maintenance-free, gel cell rechargeable type batteries as the source for emergency power to the FMCP. Batteries shall contain suspended electrolyte. The battery system shall be maintained in a fully charged condition by means of a solid state battery charger. Provide an automatic transfer switch to transfer the load to the batteries in the event of the failure of primary power.

2.16.1.1 Capacity

Battery size shall be the greater of the following two capacities.

a. Sufficient capacity to operate the fire alarm system under supervisory and trouble conditions, including audible trouble signal devices for 48

hours and shall have capacity to enable an alarm to be transmitted and operate all audible and visual signal devices under alarm conditions for an additional 15 minutes.

b. Sufficient capacity to operate the mass notification for 60 minutes after loss of AC power.

2.16.1.2 Battery Power Calculations

a. Verify that battery capacity exceeds supervisory and alarm power requirements.

1. Substantiate the battery calculations for alarm, alert, and supervisory power requirements. Ampere-hour requirements for each system component and each panel component, and the battery-recharging period shall be included in compliance with UL 864.

2. Provide complete battery calculations for both the alarm, alert, and supervisory power requirements. Ampere-hour requirements for each system component shall be submitted with the calculations.

3. A voltage drop calculation to indicate that sufficient voltage is available for proper operation of the system and all components, at the minimum rated voltage of the system operating on batteries.

b. For battery calculations use the following assumptions: Assume a starting voltage of 24 VDC for starting the calculations to size the batteries. Calculate the required Amp-Hours for the specified standby time, and then calculate the required Amp-Hours for the specified alarm time. Calculate the nominal battery voltage after operation on batteries for the specified time period. Using this voltage perform a voltage drop calculation for circuit containing device and/or appliances remote from the power sources.

2.16.2 Battery Chargers

Provide a solid state, fully automatic, variable charging rate battery charger with means for fully varying the charging rate from a suitable high rate to a trickle rate depending on the battery voltage, and shall maintain the battery in a fully charged condition automatically. The charger shall be capable of providing 120 percent of the connected system load and shall maintain the batteries at full charge. In the event the batteries are fully discharged (20.4 Volts dc), the charger shall recharge the batteries back to 95 percent of full charge within 48 hours after a single discharge cycle as described in paragraph CAPACITY above. Provide pilot light to indicate when batteries are manually placed on a high rate of charge as part of the unit assembly if a high rate switch is provided.

The loss of primary computer power, or the sequence of applying primary of secondary power, shall not affect the transmission of fire alarm, supervisory, or trouble signals.

2.17 FIRE ALARM AND MASS NOTIFICATION CONTROL PANEL (FACP/FMCP)

Provide a complete control panel fully enclosed in a lockable steel enclosure as specified herein. Operations required for testing or for normal care and maintenance of the systems shall be performed from the front of the enclosure. If more than a single unit is required at a location to form a complete control panel, the unit enclosures shall match

exactly. If more than a single unit is required, and is located in the lobby/entrance, notify the COR prior to installing the equipment.

a. The Contractor shall furnish and install a complete, supervised manual and addressable, class "A", four-wire automatic fire alarm system. All fire alarm equipment shall be a product of a single manufacturer, Siemens, Simplex or Edwards System Technology (EST). For center wide continuity, no other equipment shall be acceptable. All equipment shall be UL listed, Fire Marshal approved or other nationally recognized testing laboratory approved for the application specified herein. Furthermore, all components of the fire alarm system shall carry a full one-year warranty for any manufacturing defect. All initiating and signaling devices shall be approved for use with the fire alarm control panel unless specifically instructed otherwise by this specification, or unless the type of device required is not made by the fire alarm control panel manufacturer. All control and annunciation lights shall be identified with permanent type identification signs and shall also be visible with the control panel door closed. Tape-type signs will not be permitted. The control panel shall have an engraved laminated plastic sign stating the function of that panel (e.g. fire alarm control panel). The control panel's operating system program software and installed data software shall be provided as part of the control panel equipment package. The control panel shall be factory assembled and shall incorporate the following functions and features:

b. Each control unit shall provide power, supervision, control, and logic for the entire system, utilizing solid state, modular components, internally mounted and arranged for easy access. Each control unit shall be suitable for operation on a 120 volt, 60 hertz, normal building power supply. Provide each panel with supervisory functions for power failure, internal component placement, and operation.

c. Visual indication of alarm, supervisory, or trouble initiation on the fire alarm control panel shall be by liquid crystal display or similar means with a minimum of 80 characters. The mass notification control unit shall have the capability of temporarily deactivate the fire alarm audible notification appliances while delivering voice messages.

d. Provide secure operator console for initiating recorded messages, strobes and displays; and for delivering live voice messages. Provide capacity for at least eight pre-recorded messages. Provide the ability to automatically repeat pre-recorded messages. Provide a secure microphone for delivering live messages. Provide adequate discrete outputs to temporarily deactivate fire alarm audible notification, and initiate/synchronize strobes. Provide a complete set of self-diagnostics for controller and appliance network. Provide local diagnostic information display and local diagnostic information and system event log file.

e. The panel shall provide electrical supervision of the microprocessor operation, software configuration, all initiating, signaling, AC power input, and tripping circuits. For either a ground fault or an open circuit condition, there shall be a distinctive audible and visual trouble indication. In addition, all initiating, signaling, and deluge actuation circuits shall be operational under a signal fault condition. Loss of AC power shall activate an audible and visual alarm. In addition, for any ground fault a separate, labeled ground fault indicator lamp shall be illuminated. The audible trouble device and visual trouble indicator(s) shall remain on until the system has been

restored to normal, except that a silence switch will be provided to silence the trouble signal.

f. Automatic, locked-in fire alarm signals.

g. Manual, self-restoring type fire alarm system reset switch.

h. A supervised silencing toggle switch for the alarm signaling circuits. When the switch is in the "silenced" position, there shall be a visual and audible indication.

i. Trouble signal ring back.

j. Audible and visual annunciation indicating the disabling of elevator power shunt trip capability.

k. Sufficient auxiliary alarm (N.O. and N.C.) and trouble contacts to perform all specified functions. Plus two spare sets of N.O. and N.C. common alarm and trouble contacts for future connection. The panel shall include normally open and normally closed common alarm and common trouble contacts.

l. Any alarm signal shall override trouble condition. All trouble-free functions shall remain fully operational.

m. Individual red zone alarm annunciation LED lamps and individual amber zone trouble annunciation LED for each fire alarm zone.

n. Supervised isolation switches to permit testing or servicing of the alarm system without tripping the auxiliary alarm contacts, the building alarm panel, or the alarm transmitter.

o. All alarm signals shall override trouble conditions.

2.17.1 Cabinet

Install control panel components in cabinets large enough to accommodate all components and also to allow ample gutter space for interconnection of panels as well as field wiring. The enclosure shall be identified by an engraved laminated phenolic resin nameplate. Lettering on the nameplate shall say "Fire Alarm and Mass Notification Control Panel" and shall not be less than one inch high. Provide prominent rigid plastic or metal identification plates for lamps, circuits, meters, fuses, and switches. The cabinet shall be provided in a sturdy steel housing, complete with back box, hinged steel door with cylinder lock, and surface mounting provisions.

2.17.2 Control Modules

Provide power and control modules to perform all functions of the FACP. Provide audible signals to indicate any alarm, supervisory, or trouble condition. The alarm signals shall be different from the trouble signal. Connect circuit conductors entering or leaving the panel to screw-type terminals with each terminal marked for identification. Locate diodes and resistors, if any, on screw terminals in the FACP. Circuits operating at 24 VDC shall not operate at less than the UL listed voltage at the sensor or appliance connected. Circuits operating at any other voltage shall not have a voltage drop exceeding 10 percent of nominal voltage.

2.17.3 Silencing Switches

2.17.3.1 Alarm Silencing Switch

Provide an alarm silencing switch at the FMCP that shall silence the audible and visual. This switch shall be overridden upon activation of a subsequent alarm.

2.17.3.2 Supervisory/Trouble Silencing Switch

Provide supervisory and trouble silencing switch that shall silence the audible trouble and supervisory signal, but not extinguish the visual indicator. This switch shall be overridden upon activation of a subsequent alarm, supervision, or trouble condition. Audible trouble indication must resound automatically every 24 hours after the silencing feature has been operated.

2.17.4 Non-Interfering

Power and supervise each circuit such that a signal from one device does not prevent the receipt of signals from any other device. Circuits shall be manually reset by switch from the FACP after the initiating device or devices have been restored to normal.

2.17.5 Audible Notification System

The Audible Notification System shall comply with the requirements of NFPA 72 for Emergency Voice/Alarm Communications System requirements ISO 7240-16, IEC 60268-16, except as specified herein. The system shall be a one-way multi-channel voice notification system incorporating user selectability of a minimum eight distinct sounds for tone signaling, and the incorporation of a voice module for delivery of prerecorded messages. Audible appliances shall produce a temporal code 3 tone for three cycles followed by a voice message that is repeated until the control panel is reset or silenced. Automatic messages shall be broadcast through speakers throughout the building/facility but not in stairs or elevator cabs. A live voice message shall override the automatic audible output through use of a microphone input at the control panel or the LOC.

a. When using the microphone, live messages shall be broadcast throughout a selected floor or floors or all call. The system shall be capable of operating all speakers at the same time. The Audible Notification System shall support Public Address (PA) paging for the facility. The microprocessor shall actively interrogate circuitry, field wiring, and digital coding necessary for the immediate and accurate rebroadcasting of the stored voice data into the appropriate amplifier input. Loss of operating power, supervisory power, or any other malfunction that could render the digitalized voice module inoperative shall automatically cause the code 3 temporal tone to take over all functions assigned to the failed unit in the event an alarm is activated.

b. The Mass Notification functions shall override the manual or automatic fire alarm notification or Public Address (PA) functions. Other fire alarm functions including transmission of a signal(s) to the fire department shall remain operational. The system shall have the capability of utilizing LOC with redundant controls of the notification system control panel. Notification Appliance Circuits (NAC) shall be provided for the activation of strobe appliances. The activation of the NAC Circuits shall follow the operation of the speaker NAC

circuits. Audio output shall be selectable for line level. Amplifier outputs shall be not greater than 100 watts RMS output. The strobe NAC Circuits shall provide at least 2 amps of 24 VDC power to operate strobes and have the ability to synchronize all strobes. A hand held microphone shall be provided and, upon activation, shall take priority over any tone signal, recorded message or PA microphone operation in progress, while maintaining the strobe NAC Circuits activation.

2.17.5.1 Outputs and Operational Modules

All outputs and operational modules shall be fully supervised with on-board diagnostics and trouble reporting circuits. Provide form "C" contacts for system alarm and trouble conditions. Provide circuits for operation of auxiliary appliance during trouble conditions. During a Mass Notification event the panel shall not generate nor cause any trouble alarms to be generated with the Fire Alarm system.

2.17.5.2 Mass Notification

a. Mass Notification functions shall take precedence over all other function performed by the Audible Notification System. Messages shall utilize a male or female (select per site) voice and shall be similar to the following:

   1. 1000 Hz tones (as required in 18.4.2.1 of NFPA 72).

   2. "May I have your attention please. May I have your attention please. A fire emergency has been reported in the building. Please leave the building by the nearest exit or exit stairway. Do not use the elevators." (Provide a 2 second pause.) "May I have your attention please, (repeat the message)."

   3. "May I have your attention please. May I have your attention please. (insert installation specific message here)" (Provide a 2 second pause.) (repeat the message).

b. Include ALL installation specific message in this section.

c. The LOC shall incorporate a Push-To-Talk (PTT) microphone, redundant controls and system status indicators of/for the system. The unit shall incorporate microphone override of any tone generation or prerecorded messages. The unit shall be fully supervised from the control panel. The housing shall contain a latch (not lock).

d. Auxiliary Input Module shall be designed to be an outboard expansion module to either expand the number of optional LOC's, or allow a telephone interface.

e. LOC shall incorporate a Push-To-Talk (PTT) microphone, and controls to allow Public Address paging in the facility. The Public Address paging function shall not override any alarm or notification functions and shall be disabled by such signals. The microphone shall be handheld style. All wiring to the LOC shall be supervised in accordance with UFC 4-021-01. Systems that require field modification or are not supervised for multiple LOC's shall not be approved.

f. When an installation has more than one LOC, the LOC's shall be programmed to allow only one LOC to be available for page or messaging at a time. Once one LOC becomes active, all other LOC's will have an

indication that the system is busy (Amber Busy Light)and cannot be used at that time. This is to avoid two messages being given at the same time. Also, it must be possible to override or lockout the LOC's from the Master Command Panel (in accordance with NFPA 72.)

2.17.6 Memory

Provide each control unit with non-volatile memory and logic for all functions. The use of long life batteries, capacitors, or other age-dependent devices shall not be considered as equal to non-volatile processors, PROMS, or EPROMS.

2.17.7 Field Programmability

Provide control units and control panels that are fully field programmable for control, initiation, notification, supervisory, and trouble functions of both input and output. The system program configuration shall be menu driven. System changes shall be password protected and shall be accomplished using personal computer based equipment.

2.17.8 Input/Output Modifications

The FACP shall contain features that allow the bypassing of input devices from the system or the modification of system outputs. These control features shall consist of a panel mounted keypad and a keyboard. Any bypass or modification to the system shall indicate a trouble condition on the FMCP.

2.17.9 Resetting

Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm, supervisory or trouble condition on the system still exists.

2.17.10 Instructions

Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the instructions on the interior of the FACP. Install the frame in a conspicuous location observable from the FACP. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory, and trouble. The instructions shall be approved by the COR before being posted.

2.17.11 Walk Test

The FACP shall have a walk test feature. When using this feature, operation of initiating devices shall result in limited system outputs, so that the notification appliances operate for only a few seconds and the event is indicated on the system printer, but no other outputs occur.

2.17.12 History Logging

In addition to the required printer output, the control panel shall have the ability to store a minimum of 400 events in a log. These events shall be stored in a battery-protected memory and shall remain in the memory until the memory is downloaded or cleared manually. Resetting of the control panel shall not clear the memory.

2.17.13 Remote LCD Text Display

An LCD text display shall be provided at locations as shown on the drawings. The size shall not exceed 16 inches length by 3 inches deep with a height necessary to meet the requirements of Chapter 24 of NFPA 72). The text display shall as a minimum meet the following requirements:

a. Two lines of information for high priority messaging.

b. Minimum of 20 characters per line (40 total) displayed.

c. Text shall be no less than height requirements in Table 24.4.2.20.14.5 of NFPA 72 and color/contrast requirements of 24.4.2.20 of NFPA 72.

d. 32K character memory.

e. Display shall be wall or ceiling mounted.

f. Mounting brackets for a convenient wall/cubicle mount.

g. During non-emergency periods, date and time shall be displayed.

h. All programming shall be accomplished from the Mass Notification network. No user programming shall be required.

An LCD text display shall be provided at locations as shown on the drawings. The LCD text display shall spell out the words "EVACUATE" and "ANNOUNCEMENT" and the remainder of the emergency instructions. The design of LCD text display shall be such that it cannot be read when not illuminated.

2.18 REMOTE FIRE ALARM CONTROL UNITS

Provide complete remote control units fully enclosed in a lockable steel enclosure as specified herein. Operations required for testing or for normal care and maintenance of the control units shall be performed from the front of the enclosure. If more than a single unit is required at a location to form a complete control panel, the unit enclosures shall match exactly. Each control unit shall provide power, supervision, control, and logic for its portion of the entire system, utilizing solid state, modular components, internally mounted and arranged for easy access. Each control unit shall be suitable for operation on a 120 volt, 60 hertz, normal building power supply. Provide each unit with supervisory functions for power failure, internal component placement, and operation.

2.18.1 Cabinet

Install remote control unit components in cabinets large enough to accommodate components and also to allow ample gutter space for interconnection of units as well as field wiring. The enclosure shall be identified by an engraved laminated phenolic resin nameplate. Lettering on the nameplate shall be labeled "Remote Fire Alarm/Mass Notification Control Unit" and shall not be less than one inch high. Provide prominent rigid plastic or metal identification plates for lamps, circuits, meters, fuses, and switches. The cabinet shall be provided in a sturdy steel housing, complete with back box, hinged steel door with cylinder lock (keyed the same as the FMCP), and surface mounting provisions.

2.18.2 Control Modules

Provide power and control modules to perform all functions of the remote control unit. Provide audible signals to indicate any alarm or trouble condition. The alarm signals shall be different from the trouble signal. Connect circuit conductors entering or leaving the panel to screw-type terminals with each terminal marked for identification. Locate diodes and relays, if any, on screw terminals in the remote control unit. Circuits shall not have a voltage drop exceeding 10 percent of nominal voltage. Circuits shall be arranged so that there is 25 percent spare capacity for any circuit.

2.18.3 Silencing Switches

Provide an alarm silencing switch at the remote control unit that shall silence the audible signal and extinguish the visual alarms. This switch shall be overridden upon activation of a subsequent alarm. Provide trouble and supervisory silencing switch that shall silence the audible trouble and supervisory signal, but not extinguish the visual indicator. This switch shall be overridden upon activation of a subsequent trouble or supervisory signal. Audible trouble indication must resound automatically every 24 hours after the silencing feature has been operated.

2.18.4 Non-Interfering

Power and supervise each circuit such that a signal from one device does not prevent the receipt of signals from any other device. Circuits shall be manually resettable by switch from the remote control unit after the initiating device or devices have been restored to normal.

2.18.5 Memory

Provide each control unit with non-volatile memory and logic for all functions. The use of long life batteries, capacitors, or other age-dependent devices shall not be considered as equal to non-volatile processors, PROMS, or EPROMS.

2.18.6 Field Programmability

Provide control units that are fully field programmable for control, initiating, supervisory, and trouble functions of both input and output. The system program configuration shall be menu driven. System changes shall be password protected and shall be accomplished using personal computer based equipment. Any proprietary equipment and proprietary software needed by qualified technicians to implement future changes to the fire alarm system shall be provided as part of this contract.

2.18.7 Input/Output Modifications

Each remote control unit shall contain features that allow the elimination of input devices from the system or the modification of system outputs. Any such modifications shall indicate a trouble condition on the remote control unit, the FACP, and a printed output of the trouble condition.

2.18.8 Resetting

Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm, supervisory, or trouble condition on the system still exists.

2.18.9 Instructions

Provide a typeset printed or typewritten instruction card mounted behind a Lexan plastic or glass cover in a stainless steel or aluminum frame. Install the frame in a conspicuous location observable from the remote fire alarm control unit. Install the frame in a conspicuous location observable from the remote fire alarm control unit. The card shall show those steps to be taken by an operator when a signal is received as well as the functional operation of the system under all conditions, normal, alarm, supervisory, and trouble. The instructions shall be approved by the COR before being posted.

2.18.10 Walk Test

Each remote control unit shall have a walk test feature. When using this feature, operation of initiating devices shall result in limited system outputs, so that the notification appliances operate for only a few seconds and the event is indicated on the system printer, but no other outputs occur.

2.18.11 History Logging

In addition to the required printer output, the control panel shall have the ability to store a minimum of 1000 events in a log. These events shall be stored in a battery-protected memory and shall remain in the memory until the memory is downloaded or cleared manually. Resetting of the control panel shall not clear the memory.

2.19 AMPLIFIERS, PREAMPLIFIERS, TONE GENERATORS

Any amplifiers, preamplifiers, tone generators, digitalized voice generators, and other hardware necessary for a complete, operational, textual audible circuit conforming to NFPA 72 shall be housed in a remote FMCP, terminal cabinet, or in the FMCP. Submit data to indicate that the amplifiers have sufficient capacity to simultaneously drive all notification speakers at the maximum rating plus 50 percent spare capacity. Annotate data for each circuit on the drawings.

Primary and backup audio amplifiers shall be rated 100 watts minimum with built-in power supply and battery back-up capability. The output shall be either 25 VRMS or 70.7 VMS with frequency response of 120 to 12,000 Hz. Primary amplifier shall automatically switch to back-up amplifier upon failure of primary amplifier. Provide one backup audio amplifier per amplifier panel.

2.19.1 Construction

Amplifiers shall utilize computer grade solid state components and shall be provided with output protection devices sufficient to protect the amplifier against any transient up to 10 times the highest rated voltage in the system.

2.19.2 Operation

The system shall automatically operate and control all building speakers except those installed in the stairs and within elevator cabs. The speakers in the stairs and elevator cabs shall operate only when the microphone is used to deliver live messages.

2.19.3 Inputs

Equip each system with separate inputs for the tone generator, digitalized voice driver and panel mounted microphone Public Address Paging Function, where allowed. Microphone inputs shall be of the low impedance, balanced line type. Both microphone and tone generator input shall be operational on any amplifier.

2.19.4 Tone Generator

The tone generator shall be of the modular, plug-in type with securely attached labels to identify the component as a tone generator and to identify the specific tone it produces. The tone generator shall produce a code 3 temporal tone and shall be constantly repeated until interrupted by either the digitalized voice message, the microphone input, or the alarm silence mode as specified. The tone generator shall be single channel with an automatic backup generator per channel such that failure of the primary tone generator causes the backup generator to automatically take over the functions of the failed unit and also causes transfer of the common trouble relay.

2.19.5 Protection Circuits

Each amplifier shall be constantly supervised for any condition that could render the amplifier inoperable at its maximum output. Failure of any component shall cause automatic transfer to a designated backup amplifier, illumination of a visual "amplifier trouble" indicator on the control panel, appropriate logging of the condition on the system printer, and other actions for trouble conditions as specified.

2.20 LCD, LED DISPLAY UNIT (VDU)

a. The VDU shall be the secondary operator-to-system interface for data retrieval, alarm annunciation, commands, and programming functions. The desk mounted VDU shall consist of a LCD monitor and a keyboard. The VDU shall have a 17 inch minimum touch screen, capable of displaying 25 lines of 80 characters each. Communications with the FACP shall be supervised. Faults shall be recorded on the printer. Power required shall be 120 VAC, 60 Hz from the same source as the fire alarm control panel.

b. To eliminate confusion during an alarm situation, the screen shall have dedicated areas for the following functions:

   1. Alarm and returns to normal

   2. Commands, reports, and programming

   3. Time, day, and date

c. Use Full English language throughout to describe system activity and instructions. Full English language descriptors defining system points shall be 100 percent field programmable by factory trained personnel, alterable and user definable to accurately describe building areas.

d. Alarms and other changes of status shall be displayed in the screen area reserved for this information. Upon receipt of alarm, an audible alarm shall sound and the condition and point type shall flash until

acknowledged by the operator. Returns to normal shall also be annunciated and shall require operator acknowledgment. The following information shall be provided in English:

1. Condition of device (alarm, trouble, or supervisory).

2. Type of device (manual pull, waterflow, etc.)

3. Location of device plus numerical system address.

e. The system shall have multiple levels of priority for displaying alarms to conform with UL 864. Priority levels shall be as follows:

1. Level 1 - Mass Notification

2. Level 2 - Fire Alarms

3. Level 3 - Supervisory Alarms

4. Level 4 - Trouble Signals

f. Provide the system with memory so that no alarm is lost. A highlighted message shall advise the operator when unacknowledged alarms are in the system.

g. Multiple levels of access shall be provided for operators and supervisors via user-defined passwords. The following functions shall be provided for each level:

1. Operator level access functions:

(a) Display system directory, definable by device.

(b) Display status of an individual device.

(c) Manual command (alarm device with an associated command shall use the same system address for both functions).

(d) Report generation, definable by device, output on either the VDU or printer, as desited by the operator.

(e) Activate building notification appliances.

2. Supervisory level access functions:

(a) Reset time and date.

(b) Enable or disable event initiated programs, printouts, and initiators.

(c) Enable or disable individual devices and system components.

h. The above supervisory level functions shall not require computer programming skills. Changes to system programs shall be recorded on the printer and maintained in the control panel as a trouble condition.

2.21 GRAPHIC ANNUNCIATOR

2.21.1 Annunciator Panel

a. Floor Plan - Provide a graphic annunciator that indicates the building floor plans, including the locations of stairs and elevators. Stairs and elevators shall be identified by letter and number. Annunciator shall include a symbol legend, north arrow, location of the fire alarm control panel, and a "you are here" indicator. The graphic annunciator shall be as indicated on the contract drawings and shall incorporate all system revisions and floor plan modifications up to the project completion.

b. Indicating LEDs - Provide the graphic annunciator with individual light emitting diode (LED) indicating lights for each type of alarm and supervisory device. Provide an amber LED for indicating a system trouble condition and a separate amber LED for indicating a supervisory condition. Provide a green LED to indicate presence of power and a red LED to indicate an alarm condition. The actuation of any alarm signal shall cause the illumination of a device LED. System supervisory or trouble shall cause the illumination of a trouble LED. Provide a push button LED test switch. The test switch shall not require key operation. Annunciator LEDs shall only be extinguished by operation of the system reset switch on the FACP.

c. Material - Construct the graphic annunciator panel with plastic cover and frame as shown on the drawings. Control equipment and wiring shall be housed in a semi-recessed or surface mounted back box. The exposed portions of the back box shall be chrome plated with knockouts.

2.21.2 Programming

Where programming for the operation of the annunciator LEDs is accomplished by a separate software program than the software for the FMCP, the software program shall not require reprogramming after loss of power. The software shall be reprogrammable in the field.

2.22 MANUAL STATIONS

Addressable Manual Fire Alarm Station - Provide metal or plastic, semi-flush mounted, double action, addressable manual stations, that are not subject to operation by jarring or vibration. Gravity or mercury switches are not acceptable. Stations shall be equipped with screw terminals for each conductor. Stations shall have a separate screw terminal for each conductor. Switches and contacts shall be rated for the voltage and current upon which they shall operate.

Stations that require the replacement of any portion of the device after activation are not permitted. Stations shall be finished in fire-engine red with molded raised lettering operating instructions of contrasting color. Surface mounted boxes shall be painted the same color as the alarm station.

Boxes requiring breaking of glass panels for operation are not acceptable; however, boxes employing glass rods are acceptable. The use of a key or wrench shall be required to reset the station. (Specified in 3.2.2.)

Exterior stations shall be weather-proof with weatherproof back boxes.

2.23 NOTIFICATION APPLIANCES

2.23.1 Fire Alarm/Mass Notification Speakers

Audible appliances shall conform to the applicable requirements of UL 464. Appliances shall be connected into notification appliance circuits. Audible appliances shall generate a unique audible sound from other devices provided in the building and surrounding area. Surface mounted audible appliances shall be painted white. Recessed audible appliances shall be installed with a grill that is painted white with a factory finish to match the surface to which it is mounted.

a. Speakers shall conform to the applicable requirements of UL 1480. Speakers shall have six different sound output levels and operate with audio line input levels of 70.7 VRMs and 25 VRMs, by means of selectable tap settings. Tap settings shall include taps of 1/8, 1/4, 1/2, 1, and 2 watt. Speakers shall incorporate a high efficiency speaker for maximum output at minimum power across a frequency range of 150 Hz to 10,000 Hz, and shall have a sealed back construction. Speakers shall be capable of installation on standard 4 inch square electrical boxes. Where speakers and strobes are provided in the same location, they may be combined into a single unit. All inputs shall be polarized for compatibility with standard reverse polarity supervision of circuit wiring via the FMCP.

b. Provide speaker mounting plates constructed of cold rolled steel having a minimum thickness of 16 gauge and equipped with mounting holes and other openings as needed for a complete installation. Fabrication marks and holes shall be ground and finished to provide a smooth and neat appearance for each plate. Each plate shall be primed and painted.

c. Speakers shall utilize screw terminals for termination of all field wiring.

2.23.2 Visual Notification Appliances

Visual notification appliances are provided to alert hearing-impaired occupants. Visual notification appliances shall conform to the applicable requirements of UL 1971 and conform to the Architectural Barriers Act (ABA). Colored lens, such as amber, shall comply with UL 1638. The manufacturer shall have the color lens tested to the full UL 1971 polar plotting criteria, voltage drop, and temperature rise as stated in 1971. Fire Alarm Notification Appliances shall have clear high intensity optic lens, xenon flash tubes, and be marked "Fire", "Alert" in red letters. Fire Alarm/Mass Notification Appliances shall have amber high intensity optic lens, xenon flash tubes, and output white light and be marked "ALERT" in red letters. The light pattern shall be disbursed so that it is visible above and below the strobe and from a 90 degree angle on both sides of the strobe. Strobe flash rate shall be 1 flash per second and a minimum of 15 candela (actual output after derating for tinted lens) based on the UL 1971 test. Strobe shall be surface or semi-flush mounted. Where more than two appliances are located in the same room or corridor or field of view, provide synchronized operation. Devices shall use screw terminals for all field wiring.

2.23.3 Fire Alarm Bells (Exterior Only)

Bells shall be UL listed or FM approved, weather proof, motor driven, and aluminum shell size as shown on the drawings. They shall be 24 volt D.C.

and shall have a minimum rating of 90 db at 10 ft. Bell finish shall be textured red enamel. Bell to be surface mounted with weatherproof back boxes.

2.23.4 Fire Alarm Horns

Text

2.24 ENVIRONMENTAL ENCLOSURES OR GUARDS

Environmental enclosures shall be provided to permit Fire Alarm or Mass Notification components to be used in areas that exceed the environmental limits of the listing. The enclosure shall be listed for the device or appliance as either a manufactured part number or as a listed compatible accessory for the UL category that the component is currently listed. Guards required to deter mechanical damage shall be either a listed manufactured part or a listed accessory for the category of the initiating device or notification appliance.

2.25 INTERFACE TO THE BASE WIDE MASS NOTIFICATION NETWORK

2.25.1 Fiber Optic

The fiber optic transceiver shall be fully compatible with EIA standards for RS-232, RS-422 and RS-485 at data rates from 0 (DC) to 2.1 mbps (200 kbps for RS-232) in the low speed mode or from 10 kbps to 10 mbps in the high-speed mode. The fiber optic transceiver shall be capable of full duplex asynchronous transmissions in both point-to-point systems and drop-and-repeat data networks. The fiber optic transceiver shall be user configurable for the protocol, speed and mode of operation required. The fiber optic transceiver shall be installed as a stand-alone, card-cage unit. The fiber optic transceiver shall operate on multi-mode fiber optic cable. The fiber optic transceiver shall be supplied with ST type optical connectors. Cabling: as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEM.

2.25.2 Radio

The radio transceiver shall be bi-direction and meet all the requirements of paragraph, RADIO TRANSMITTER AND INTERFACE PANELS as specified in this Specification Section. The transceiver utilized in the Mass Notification System shall be capable of the following:

a. Communication with the Monaro D-21 Central Control/Monitoring System to provide supervision of communication link and status changes are reported by automatic and manual poll/reply/acknowledge routines.

b. All monitored points/status changes are transmitted immediately and at programmed intervals until acknowledged by the Central Control/Monitoring System.

c. Each transceiver shall transmits a unique identity code as part of all messages; the code is set by the user at the transceiver.

2.25.2.1 Radio Frequency Communications

Use of radio frequency-type communications systems shall comply with National Telecommunications and Information Administration (NTIA) requirements.

2.25.2.2 Licensed Radio Frequency Systems

An approved DD Form 1494 for the system is required prior to operation.

2.25.3 Secure Radio System

2.25.3.1 Communications Network

The communications network provides two-way signals between central control units and autonomous control units (in individual building systems), and should include redundant (primary and backup) communication links. The system shall incorporate technology to prevent easy interruption of the radio traffic for MNS Alerting.

2.25.3.2 Radio Frequency Communications

Use of radio frequency-type communications systems shall comply with National Telecommunications and Information Administration (NTIA) requirements. The systems shall be designed to minimize the potential for interference, jamming, eavesdropping, and spoofing.

2.25.3.3 Licensed Radio Frequency Systems

An approved DD Form 1494 for the system is required prior to operation.

2.26 AUTOMATIC FIRE TRANSCEIVER

The transceiver panel is manufactured by Monaco. The transceiver is Government furnished equipment (GFE). The Contractor shall provide labor and material for complete installation.

2.26.1 Radio Transceiver and Interface Panels

Transceivers shall be compatible with proprietary supervising station receiving equipment. Each radio alarm transceiver shall be the manufacturer's recognized commercial product, completely assembled, wired, factory tested, and delivered ready for installation and operation. Transceivers shall be provided in accordance with applicable portions of NFPA 72, Federal Communications Commission (FCC) 47 CFR 90 and Federal Communications Commission (FCC) 47 CFR 15. Transceivers electronics module shall be contained within the physical housing as an integral, removable assembly. The proprietary supervising station receiving equipment is D-21 Monaco and the transceivers shall be of the same manufacturer with this equipment. At the Contractors option, and if UL or FM listed, the transmitter may be housed in the same panel as the fire alarm control panel. The transmitter shall be Narrowband radio, with FCC certification for narrowband operation and meets the requirements of the NTIA (National Telecommunications and Information Administration) Manual of Regulations and Procedures for Federal Frequency Management.

a. Operation: Each transceiver shall operate from 120-volt ac power. In the event of 120-volt ac power loss, the transceivers shall automatically switch to battery operation. Switchover shall be accomplished with no interruption of protective service, and shall automatically transmit a trouble message. Upon restoration of ac power, transfer back to normal ac power supply shall also be automatic.

b. Battery Power: Transceiver standby battery capacity shall provide

sufficient power to operate the transceiver in a normal standby status for a minimum of 48 hours and be capable of transmitting alarms during that period.

c. Transceiver housing shall be NEMA Type 1. The housing shall contain a lock that is keyed identical to the fire alarm system for the building, identical to radio alarm transmitter housings on the base. Radio alarm transmitter housing shall be factory painted with a suitable priming coat and not less than two coats of a hard, durable weatherproof enamel.

d. The antenna shall be BSA-1 VHF omni directional, 136-174 MHz manufactured by Monaco. The antenna must be cut to system frequency by the installer. Provide all necessary materials such as mini RG-8/X coaxial cable with connectors, mounting hardware and unistrut support as shown on the drawings

e. Contractor responsible for all installation of Monaco, programming will be done by government in house contractor

2.26.2 Signals to Be Transmitted to the Base Receiving Station

The following signals shall be sent to the base receiving station:

a. Sprinkler water flow

b. Manual pull stations

c. Smoke detectors

d. Duct smoke detectors

e. Sleeping room smoke detectors

f. Heat detectors

g. Fire Extinguishing System

h. Sprinkler valve supervision

i. Fire pump running

j. Fire pump supervision

k. Water supply level and temperature

l. Combustion Engine Drive Fire Pump Running

1. Selector Switch in position than automatic

2. Engine Over-speed

3. Low Fuel

4. Low Battery

5. Engine Trouble (Low Oil, Over temp, etc)

2.27 WIRING

a. Provide wiring materials under this section as specified in Section 26 20 00.

b. Interior distribution system with the additions and modifications specified herein. CEC and NFPA 70 accepted fire alarm cables that do not require the use of raceways except as modified herein are not permitted.

2.27.1 Alarm Wiring

a. All wiring shall be in EMT or rigid conduit per Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS.

b. Field wiring shall be Belden No. 9572 #16, 9580 #14 or 9582 #12 gauge, solid conductor or as specified on the drawings and must be a California approved fire rated alarm wires and cables. Where addressable initiation and control circuits are used, wiring shall be Belden no. 9575, 16 gauge shielded twisted pair, Belden No. 9581, 14 gauge shielded twisted pair or No. 9579, 16 gauge, shielded two pair with shielded connected to ground at the Fire Alarm Control Panel System. Wiring connecting the 120 volt AC power supply shall be 12 AWG minimum THHN. Conductors shall be given an insulation rating of at least 75 degrees Celsius. Wiring between Fire Alarm Panel portions of the system shall be in accordance with the above or the equipment manufacturer's minimum recommendations for sizing, twisting, and shielding. Antenna cable shall be in conduit to weather-head and be of 50 ohm coaxial type with PL 259 connectors. All individual wires shall be tagged for identification. Antenna shield shall be grounded at the control panel.

c. All system splices shall be through terminal cabinets or junction boxes located as shown on the drawings. Terminal blocks shall be used for all shielded wiring connections including the continuous ground shield connections. Any additional splices or connections shall be in accordance with the above. Terminal cabinets located above the ceiling shall be marked with red dots on the ceiling.

d. Junction boxes shall be provided as shown plus any additional need for installation. Where splices are made, terminal strips shall be provided in the junction box.

e. The use of wire nuts and crimp on compression connectors are not acceptable.

2.28 ELECTROMAGNETIC DOOR HOLDERS

Where indicated on the drawings, provide magnetic fire door hold open devices. The electromagnetic holding devices shall be designed to operate on 120 VAC, and require not more than 3 watts of power to develop 25 psi of holding force. Under normal conditions, the magnets shall attract and hold the doors open. The initiation of any fire alarm shall cause the release of the electromagnetic door holding device permitting the door to be closed by the door closer. Operation shall be fail safe with no moving parts. Electromagnetic door hold-open devices shall not be required to be held open during building power failure. The device shall be UL listed based on UL 228 tests.

2.29 GAS AND REFRIGERANT DETECTION SYSTEMS INTERFACE

a. Provide addressable monitor modules to monitor the following:

1. Gas detection panel output relay for OEL signal.

2. Gas detection panel output relay for 25% LEL signal.

3. Gas detection panel output relay for 50% IDLH signal.

4. Gas detection panel common trouble output relay.

5. Refrigerant gas system emergency manual break glass shutdown stations.

6. Machinery room ventilation system emergency manual break glass activation stations.

7. UPS trouble output relay.

b. Provide addressable control modules to operate the following:

1. Refrigerant gas system shutdown.

2. Machinery room ventilation system startup.

c. Provide a dedicated notification appliance circuit to activate the gas leak horn/strobes and strobes.

d. Provide gas leak horn/strobes in the machinery room and strobes outside the room adjacent to each entrance door. Strobe lens color to be green per NASA Standard for Gas Alarms. Provide sign that reads "REFRIGERANT LEAK DETECTION SYSTEM ALARM" "Gas Detection System Alarm" adjacent to each appliance.

e. Provide separate break glass station for the refrigerant gas manual shutdown and machinery room ventilation activation. Provide instruction sign adjacent to each station.

2.30 ELEVATOR INTERFACE

a. Provide addressable monitor modules to monitor the following:

1. Elevator power shunt trip breaker control power supervisory relay.

2. Elevator controller Phase I recall completion output signal.

3. Elevator controller Phase II activation output signal.

4. Fire sprinkler activation in the elevator hoistway or elevator machine room.

b. Provide addressable control modules for the following:

1. Phase I primary floor smoke detector activation signal (primary recall).

2. Phase I alternate floor smoke detector activation signal (alternate recall).

3. Elevator machine room or elevator hoistway heat detector, smoke detector or fire sprinkler activation signal.

4. Elevator power shunt trip breaker control.

c. Provide power supervisory relay for elevator power shunt trip breaker control power.

d. Program panel logic such that the elevator power shunt trip breaker control relay cannot activate until the elevator phase I recall completion output signal has been received.

e. Program panel logic such that the elevator power shunt trip breaker control relay cannot activate if the elevator phase II activation output signal has been received. Once received, the elevator phase II activation output signal input monitor module must be manually reset before the elevator power shunt trip breaker control relay can be activated.

PART 3 EXECUTION

3.1 GENERAL

a. All work shall comply with Section 26 00 00 INTERIOR DISTRIBUTION SYSTEM and conform to NFPA 72, CEC and NFPA 70, except as stated below. The drawings show the minimum wiring requirements, number of conductors, and runs. Equipment requiring additional equipment, wire, or cabinets shall be provided and installed by the Contractor without extra cost to the Government. The wiring within component enclosures and terminal cabinets shall be installed in a neat and workmanlike manner and shall be run parallel with, or at right angles to, the sides and back of any enclosure or cabinet. All circuit conductors entering or leaving any enclosure or cabinet shall be connected to terminal blocks with each terminal marked in accordance with the manufacturer's wiring diagram for identification. Connections shall be made with either crimp on terminal spade lugs or with approved pressure type terminal blocks. Coaxial connectors shall be weather-proofed with a coax-seal wrap where exposed to weather. A terminal cabinet or junction box with terminal strips shall be installed where circuit risers originate or where any circuit tap is made. All wiring within the panel shall be readily accessible without removing any component parts.

b. All conduits associated with the fire alarm system shall have conduit couplings and connectors painted red. Also, all junction boxes shall be painted red.

c. Each alarm initiating device or interface device in the system shall have its own individual address. Printed address numbers shall be affixed to the devices. Device address number shall be set by the equipment manufacturer or supplied.

3.2 INSTALLATION

3.2.1 FMCP

Locate the FACP/FMCP where indicated on the drawings, variable per job site. Recess, semi-recess, or surface mount the enclosure with the top of

the cabinet 6 feet above the finished floor or center the cabinet at 5 feet, whichever is lower. Conductor terminations shall be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection shall be permanently mounted in the FMCP.

3.2.2 Manual Stations

Locate manual stations as required by NFPA 72 and as shown on the drawings. Mount stations so that their operating handles are not less than 42" and not more than 48" above the finished floor. Mount stations so they are located no farther than 5 feet from the exit door they serve, measured horizontally.

3.2.3 Notification Appliance Devices

Locate notification appliance devices as required by NFPA 72. Mount assemblies on walls as required by NFPA 72 and to meet the intelligibility requirements. Ceiling mounted speakers shall conform to NFPA 72. Visual alarms shall have light output ratings appropriate for the installed locations and per NFPA 72 requirements. Visual alarms shall be synchronized per NFPA 72.

3.2.4 Smoke and Heat Sensors

Locate sensors as required by NFPA 72 and their listings on a 4 inch mounting box. Locate smoke and heat sensors on the ceiling. Install heat sensors not less than 4 inches from a side wall to the near edge. Heat sensors located on the wall shall have the top of the sensor at least 4 inches below the ceiling, but not more than 12 inches below the ceiling. Smoke sensors are permitted to be on the wall no lower than 12 inches from the ceiling with no minimum distance from the ceiling. In raised floor spaces, install the smoke sensors to protect 225 square feet per sensor. Install smoke sensors no closer than 5 feet from air handling supply outlets. All devices shall be labeled with labels that are visible from the floor. Handlettering is not acceptable.

3.2.5 Graphic Annunciator

Locate the annunciator as shown on the drawings. Surface mount the panel, with the top of the panel 6 feet above the finished floor or center the panel at 5 feet, whichever is lower.

3.2.6 Water Flow Detectors and Tamper Switches

Connect to water flow detectors and tamper switches.

3.2.7 Local Operating Console (LOC)

Locate the LOC as required by NFPA 72 and as indicated. Mount the console so that the top message button is no higher than 44 inches above the floor.

3.2.8 Antenna

Antenna shall be installed on the exterior wall of the building in accordance with manufacturer's installation instructions an as shown on the drawings.

3.3 SYSTEM FIELD WIRING

3.3.1 Wiring within Cabinets, Enclosures, and Boxes

Provide wiring installed in a neat and workmanlike manner and installed parallel with or at right angles to the sides and back of any box, enclosure, or cabinet. Conductors that are terminated, spliced, or otherwise interrupted in any enclosure, cabinet, mounting, or junction box shall be connected to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make connections with approved pressure type terminal blocks, that are securely mounted. The use of wire nuts or similar devices shall be prohibited. Wiring shall conform to CEC and NFPA 70.

Indicate the following in the wiring diagrams.

a. Point-to-point wiring diagrams showing the points of connection and terminals used for electrical field connections in the system, including interconnections between the equipment or systems that are supervised or controlled by the system. Diagrams shall show connections from field devices to the FACP and remote fire alarm control units, initiating circuits, switches, relays and terminals.

b. Complete riser diagrams indicating the wiring sequence of devices and their connections to the control equipment. Include a color code schedule for the wiring. Include floor plans showing the locations of devices and equipment.

3.3.2 Terminal Cabinets

Provide a terminal cabinet at the base of any circuit riser, on each floor at each riser, and where indicated on the drawings. Terminal size shall be appropriate for the size of the wiring to be connected. Conductor terminations shall be labeled and a drawing containing conductors, their labels, their circuits, and their interconnection shall be permanently mounted in the terminal cabinet. Minimum size is 8 inches by 8 inches. Only screw-type terminals are permitted.

3.3.3 Alarm Wiring

Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Provide all wiring in electrical metallic. Conceal conduit in finished areas of new construction and wherever practicable in existing construction. The use of flexible conduit not exceeding a 6 foot length shall be permitted in initiating device or notification appliance circuits. Run conduit or tubing (rigid, IMC, EMT, FMC, etc. as permitted by NFPA 72 and CEC and NFPA 70) concealed unless specifically indicated otherwise.

All conductors shall be concealed, installed above ceiling in metal conduit or electrical metallic tubing, and run concealed unless otherwise noted. Wiring in unfinished areas shall be exposed. Any exposed mounting back boxes shall be seamless metal boxes without knockouts. No other wiring, other than fire alarm wiring, shall be installed in the fire alarm conduit.

Grounding conductor or shielded cable shall be grounded only at the control panel grounding terminal unless the manufacturer requires other methods. No other grounding connections of the shield shall be allowed. Pigtail or T-tap connections to signal line circuits, initiating device circuits,

supervisory alarm circuits, and notification appliance circuits are prohibited. T-tapping using screw terminal blocks is allowed for Class "B" signaling line circuits. Color coding is required for circuits and shall be maintained throughout the circuit. Conductors used for the same functions shall be similarly color coded. Conform wiring to CEC and NFPA 70.

Each conductor used for the same specific function shall be distinctively color coded. Two different color codes shall be used for initiating device circuits. Power supply and wiring connection the secondary source of power shall be as indicated. Wiring for the fire alarm and voice communication system shall be shielded, as specified.

3.3.4 Conductor Terminations

Labeling of conductors at terminal blocks in terminal cabinets, FACP, and remote fire alarm control units shall be provided at each conductor connection. Each conductor or cable shall have a shrink-wrap label to provide a unique and specific designation. Each terminal cabinet, FACP, and fire alarm control unit shall contain a laminated drawing that indicates each conductor, its label, circuit, and terminal. The laminated drawing shall be neat, using 12 point lettering minimum size, and mounted within each cabinet, panel, or unit so that it does not interfere with the wiring or terminals. Maintain existing color code scheme where connecting to existing equipment.

3.4 DISCONNECTION AND REMOVAL OF EXISTING SYSTEM

Maintain existing fire alarm equipment fully operational until the new equipment has been tested and accepted by the COR. As new equipment is installed, label it "NOT IN SERVICE" until the new equipment is accepted. Once the new system is completed, tested, and accepted by the Government, it shall be placed in service and connected to the station fire alarm system. Remove tags from new equipment and tag the existing equipment "NOT IN SERVICE" until removed from the building.

a. The shut off of any existing system shall require advance notification an written approval from the COR. Any required disruption to the existing system shall be coordinated with the Construction Manager an shall be performed by the "on-site" NASA Maintenance contractor. Downtime required to switch over from the existing fire alarm system to the new fire alarm/mass notification system shall be kept to a minimum. The Contractor shall provide fire watch whenever the existing fire alarm system is down due to construction work.

b. After acceptance of the new system by the COR, existing equipment not connected to the new system shall be removed, unused exposed conduit shall be removed, and damaged surfaces shall be restored. The material shall be removed from the site and disposed of by the Contractor.

c. Disconnect and remove the existing fire alarm and smoke detection systems where indicated and elsewhere in the specification.

d. Fire alarm control panels and fire alarm devices disconnected and removed shall be turned over to the COR.

e. Properly dispose of fire alarm outlet and junction boxes, wiring, conduit, supports, and other such items.

3.5 CONNECTION OF NEW SYSTEM

The following new system connections shall be made during the last phase of construction, at the beginning of the preliminary tests. New system connections shall include:

a. Connection of new control modules to existing magnetically held smoke door (hold-open) devices.

b. Connection of new elevator recall smoke sensors to existing wiring and conduit.

c. Connection of new system transceiver to existing base fire reporting system.

Once these connections are made, system shall be left energized and new audio/visual devices deactivated. Report immediately to the COR, coordination and field problems resulting from the connection of the above components.

3.6 FIRESTOPPING

Provide firestopping for holes at conduit penetrations through floor slabs, fire rated walls, partitions with fire rated doors, corridor walls, and vertical service shafts in accordance with Section 07 84 00 FIRESTOPPING.

3.7 PAINTING

Paint exposed electrical, fire alarm conduit, and surface metal raceway to match adjacent finishes in exposed areas. Paint junction boxes, conduit, and surface metal raceways red in unfinished areas. Painting shall comply with Section 09 90 00 PAINTS AND COATINGS.

3.8 CONTRACTOR QUALITY CONTROL

3.8.1 Testing Procedures

Submit detailed test procedures, prepared and signed by a Registered Professional Engineer or a NICET Level 4 Fire Alarm Technician, and signed by representative of the installing company, for the fire detection and alarm system 60 days prior to performing system tests. Detailed test procedures shall list all components of the installed system such as initiating devices and circuits, notification appliances and circuits, signaling line devices and circuits, control devices/equipment, batteries, transmitting and receiving equipment, power sources/supply, annunciators, special hazard equipment, emergency communication equipment, interface equipment, Guard's Tour equipment, and transient (surge) suppressors. Test procedures shall include sequence of testing, time estimate for each test, and sample test data forms per NFPA 72. The test data forms shall be in a check-off format (pass/fail with space to add applicable test data) and shall be used for the preliminary testing and the acceptance testing. The test data forms shall record the test results and shall:

a. Identify the NFPA Class and Style of all Initiating Device Circuits (IDC), Notification Appliance Circuits (NAC), Voice Notification System, and Signaling Line Circuits (SLC).

b. Identify each test required by NFPA 72 Test Methods and required test herein to be performed on each component, and describe how this test

shall be performed.

c. Identify each component and circuit as to type, location within the facility, and unique identity within the installed system. Provide necessary floor plan sheets showing each component location, test location, and alphanumeric identity.

d. Identify all test equipment and personnel required to perform each test (including equipment necessary for testing smoke detectors using manufacturer approved aerosol spray).

e. Provide space to identify the date and time of each test. Provide space to identify the names and signatures of the individuals conducting and witnessing each test.

The final test shall be coordinated with the test of the fire suppression system, smoke control, system, elevator recall, gas detection and any other interfaced system to verify a totally integrated, complete and operational system. Fragmented test of different system shall not be accepted.

3.8.2 Tests Stages

The required tests are as follows:

3.8.2.1 Installation Tests

a. Megger Tests: After wiring has been installed, and prior to making any connections to panels or devices, wiring shall be megger tested for insulation resistance, grounds, and/or shorts. Conductors with 300 volt rated insulation shall be tested at a minimum of 250 VDC. Conductors with 600 volt rated insulation shall be tested at a minimum of 500 VDC. The tests shall be witnessed by the COR and test results recorded for use at the final acceptance test.

b. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the COR and test results recorded for use at the final acceptance test.

3.8.2.2 System Preliminary Testing

After the system installation is complete, the Contractor shall conduct preliminary tests to ensure that devices and circuits are functioning properly. Tests shall meet the requirements of paragraph entitled "Minimum System Tests." After preliminary testing is complete, provide a letter certifying that the installation is complete and fully operable. The letter shall state that each initiating and indicating device was tested in place and functioned properly. The letter shall also state that panel functions were tested and operated properly. The letter shall include the names and titles of the witnesses to the preliminary tests. The Contractor and an authorized representative from each supplier of equipment shall be in attendance at the preliminary testing to make necessary adjustments.

3.8.2.3 Request for Formal Inspection and Tests

When all installation and preliminary tests have been completed and corrections made, submit a signed, dated letter with a request for formal inspection and tests to the COR. Accompanying the letter shall be a

printout from either the internal FACP memory or an attached printer listing the date, time, device address, and device descriptor for each device and circuit tested.

3.8.2.4 Final Testing

Notify the COR in writing when the system is ready for final acceptance testing. Submit request for test at least 10 working days prior to the test date. The tests shall be performed in accordance with the approved test procedures in the presence of the COR and the NASA Ames Fire Marshall. Furnish instruments and personnel required for the tests. A final acceptance test will not be scheduled until the operation and maintenance (O&M) manuals are furnished to the COR and the following are provided at the job site:

a. The systems manufacturer's technical representative

b. Marked-up red line drawings of the system as actually installed

c. Megger test results

d. Loop resistance test results

e. Complete program printout including input/output addresses

The final tests shall be witnessed by the NASA Ames Fire Marshal. At this time, any and all required tests shall be repeated at their discretion.

3.8.2.5 System Acceptance

Following acceptance of the system, as-built drawings and O&M manuals shall be delivered to the COR for review and acceptance. Submit six sets of detailed as-built drawings. The drawings shall show the system as installed, including deviations from both the project drawings and the approved shop drawings. These drawings shall be submitted within two weeks after the final acceptance test of the system. At least one set of as-built (marked-up) drawings shall be provided at the time of, or prior to the final acceptance test.

a. Furnish five sets of full size paper as-built drawings and schematics. The drawings shall be prepared on uniform sized mylar sheets not less than 30 by 42 inches with 8 by 4 inch title block similar to contract drawings. Furnish one set of CD or DVD discs containing software back-up and CAD based drawings in latest version of AutoCAD and DXF format of as-built drawings and schematics.

b. Include complete wiring diagrams showing connections between devices and equipment, both factory and field wired.

c. Include a riser diagram and drawings showing the as-built location of devices and equipment.

In existing buildings, the transfer of devices from the existing system to the new system and the permission to begin demolition of the old fire alarm system will not be permitted until the as-built drawings and O&M manuals are received.

3.8.3 Minimum System Tests

Test the system in accordance with the procedures outlined in NFPA 72, ISO 7240-16, IEC 60268-16. The required tests are as follows:

a. Megger Tests: After wiring has been installed, and prior to making any connections to panels or devices, wiring shall be megger tested for insulation resistance, grounds, and/or shorts. Conductors with 300 volt rated insulation shall be tested at a minimum of 250 VDC. Conductors with 600 volt rated insulation shall be tested at a minimum of 500 VDC. The tests shall be witnessed by the COR and test results recorded for use at the final acceptance test.

b. Loop Resistance Tests: Measure and record the resistance of each circuit with each pair of conductors in the circuit short-circuited at the farthest point from the circuit origin. The tests shall be witnessed by the COR and test results recorded for use at the final acceptance test.

c. Verify the absence of unwanted voltages between circuit conductors and ground. The tests shall be accomplished at the preliminary test with results available at the final system test.

d. Verify that the control unit is in the normal condition as detailed in the manufacturer's O&M manual.

e. Test each initiating and indicating device and circuit for proper operation and response at the control unit. Smoke sensors shall be tested in accordance with manufacturer's recommended calibrated test method. Use of magnets is prohibited. Testing of duct smoke detectors shall comply with the requirements of NFPA 72 except that, for item 12(e) (Supervision) in Table 14.4.2.2, disconnect at least 20 percent of devices. If there is a failure at these devices, then supervision shall be tested at each device.

f. Test the system for specified functions in accordance with the contract drawings and specifications and the manufacturer's O&M manual.

g. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the time period and in the manner specified.

h. Determine that the system is operable under trouble conditions as specified.

i. Visually inspect wiring.

j. Test the battery charger and batteries. Indicate battery manufacture date using minimum .25 inch format 00/00/0000.

k. Verify that software control and data files have been entered or programmed into the FACP. Hard copy records of the software shall be provided to the COR.

l. Verify that red-line drawings are accurate.

m. Measure the current in circuits to ensure there is the calculated spare capacity for the circuits.

n. Measure voltage readings for circuits to ensure that voltage drop is not excessive.

o. Disconnect the verification feature for smoke sensors during tests to minimize the amount of smoke needed to activate the sensor. Testing of smoke sensors shall be conducted using real smoke or the use of canned smoke which is permitted.

p. Measure the voltage drop at the most remote appliance (based on wire length) on each notification appliance circuit.

q. Gas detection audible and visual annunciation provided inside and outside mechanical room have activated. Equipment shutdown and exhaust fan startup relays have activated.

r. Visual annunciation provided inside elevator car indicates that the automatic sprinklers, smoke or heat detectors in the elevator hoistway or elevator machine room have activated. Shunt trip shutdown and elevator recall relays have activated. Shunt trip power supervision is monitored.

3.8.3.1 Intelligibility Tests

Intelligibility testing of the System shall be accomplished in accordance with NFPA 72 for Voice Evacuation Systems, IEC 60268-16, and ASA S3.2. Following are the specific requirements for intelligibility tests:

a. Intelligibility Requirements: Verify intelligibility by measurement after installation.

b. Ensure that a CIS value greater than the required minimum value is provided in each area where building occupants typically could be found. The minimum required value for CIS is 0.7 (or an STI of 0.5). All readings for Sound Pressure Level (SPL) and Intelligibility score shall be recorded on the installation drawings next to the speaker symbol.

c. Areas of the building provided with hard wall and ceiling surfaces (such as metal or concrete) that are found to cause excessive sound reflections may be permitted to have a CIS score less than the minimum required value if approved by the COR, and if building occupants in these areas can determine that a voice signal is being broadcast and they must walk no more than 33 feet to find a location with at least the minimum required CIS value within the same area.

d. Areas of the building where occupants are not expected to be normally present are permitted to have a CIS score less than the minimum required value if personnel can determine that a voice signal is being broadcast and they must walk no more than 50 feet to a location with at least the minimum required CIS value within the same area.

e. Test each initiating and indicating device and circuit for proper operation and response at the control unit. Smoke sensors shall be tested in accordance with manufacturer's recommended calibrated test method. Use of magnets is prohibited. Testing of duct smoke detectors shall comply with the requirements of NFPA 72 except that, for item 12(e) (Supervision) in Table 14.4.2.2, disconnect at least 20 percent of devices. If there is a failure at these devices, then supervision shall be tested at each device.

f. The distance the occupant must walk to the location meeting the minimum required CIS value shall be measured on the floor or other walking surface as follows:

1. Along the centerline of the natural path of travel, starting from any point subject to occupancy with less than the minimum required CIS value.

2. Curving around any corners or obstructions, with a 12 inches clearance there from.

3. Terminating directly below the location where the minimum required CIS value has been obtained.

Use commercially available test instrumentation to measure intelligibility as specified by ISO 7240-19 and ISO 7240-16 as applicable. Use the mean value of at least three readings to compute the intelligibility score at each test location.

3.9 INSTRUCTION OF GOVERNMENT EMPLOYEES

3.9.1 Instructor

Include in the project the services of an instructor, who has received specific training from the manufacturer for the training of other persons regarding the inspection, testing, and maintenance of the system provided. The instructor shall train the Government employees designated by the COR who are to have charge of the equipment, in the care, adjustment, maintenance, and operation of the fire alarm and fire detection system. Each instructor shall be thoroughly familiar with all parts of this installation on which they are to give instruction. The instructor shall be trained in operating theory as well as in practical O&M work. Submit the instructor's information and qualifications including the training history.

3.9.2 Required Instruction Time

Notify the COR 15 working days prior to instruction sessions. Provide a minimum of 4 hours of instruction after final acceptance of the system. The instruction shall be given during regular working hours on such dates and times as are selected by the COR. The instruction may be divided into two or more periods at the discretion of the COR. The training shall allow for rescheduling for unforeseen maintenance and/or fire department responses.

3.9.3 Technical Training

Equipment manufacturer or a factory representative shall provide technical training to the Government at the manufacturing training facility. Training shall allow for classroom and online instruction, as well as individual hands on programming, trouble shooting and diagnostics exercises. Factory train shall occur within 2 month prior to start of system installation.

3.10 TECHNICAL DATA AND COMPUTER SOFTWARE

Provide, in manual format, lesson plans, operating instructions, maintenance procedures, and training data for the training courses. The

operations training shall familiarize designated government personnel with proper operation of the installed system. The maintenance training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, and expand functions inherent to the system, at no additional cost to the Government.

Furnish all necessary training for the software programming including maintenance and operating manuals. Software shall be provided to the Government and licensed to them for their use prior to the installation of the control panels. Training shall be a minimum of 8 hours.

Any proprietary equipment and proprietary software needed by qualified technicians to implement future changes to the system shall be provided as part of this contract. Training and program licensing for two (2) in-house technicians is included as part of this contract at no further cost to the Government.

-- End of Section --

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DIVISION 31 - EARTHWORK

SECTION 31 00 00

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SECTION 31 00 00

EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for earthwork activities for buildings, utilities, roadways, railroads, and airfields.

1.2 PAYMENT PROCEDURES

Payment will constitute full compensation for all labor, equipment, tools, supplies, and incidentals necessary to complete the work.

1.2.1 Classified Excavation

Classified excavation will be paid for at the contract unit prices per cubic yard for common or rock excavation.

1.2.2 Piping Trench Excavation

Payment for trench excavation will constitute full payment for excavation and backfilling, including specified overdepth except in unstable trench bottoms.

1.2.3 Unclassified Excavation

Unclassified excavation will be paid for at the contract unit price per cubic yard for unclassified excavation.

1.3 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.

1.4 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1/D1.1M	Structural Welding Code - Steel

AMERICAN WOOD PROTECTION ASSOCIATION (AWPA)

AWPA C2	Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA P5	Standard for Waterborne Preservatives

ASTM INTERNATIONAL (ASTM)

ASTM A139/A139M	Standard Specification for Electric-Fusion (ARC)-Welded Steel Pipe (NPS 4 and over)
ASTM A252	Standard Specification for Welded and Seamless Steel Pipe Piles
ASTM C136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C33/C33M	Standard Specification for Concrete Aggregates
ASTM D 1140	Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D 2487	Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 422	Particle-Size Analysis of Soils
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D 4718	Standard Practice for Correction of Unit and Water Content for Soils Containing Oversize Weight Particles

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 600/4-79/020	Methods for Chemical Analysis of Water and Wastes
EPA SW-846.3-3	Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-203	Paper, Kraft, Untreated

1.5 DEFINITIONS

1.5.1 Satisfactory Materials

Satisfactory materials comprise any materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, SC, CL, ML, CH, MH. Satisfactory materials for grading comprise stones less than 8 inches, except for fill material for pavements and railroads which comprise stones less than 3 inches in any dimension.

1.5.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. Notify the COR when encountering any contaminated materials.

1.5.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Perform testing, required for classifying materials, in accordance with ASTM D 4318, ASTM C136, ASTM D 422, and ASTM D 1140.

1.5.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, express the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve as a percentage of the maximum density in accordance with ASTM D 4718corrected with ASTM D 4718.

1.5.5 Topsoil

Material suitable for topsoils obtained from areas indicated on the drawings is defined as: Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material detrimental to plant growth. Amend topsoil pH range to obtain a pH of 5.5

to 7.

1.5.6 Unstable Material

Unstable materials are too wet to properly support the utility pipe, conduit, or appurtenant structure.

1.5.7 Select Granular Material

1.5.7.1 General Requirements

Select granular material consist of materials classified as GW, GP by ASTM D 2487 where indicated. The liquid limit of such material must not exceed 35 percent when tested in accordance with ASTM D 4318. The plasticity index must not be greater than 12 percent when tested in accordance with ASTM D 4318, and not more than 35 percent by weight may be finer than No. 200 sieve when tested in accordance with ASTM D 1140.

1.5.7.2 California Bearing Ratio Values

1.5.8 Initial Backfill Material

Initial backfill consists of select granular material or satisfactory materials free from rocks of such size as recommended by the pipe manufacturer.

1.5.9 Expansive Soils

Expansive soils are defined as soils that have a plasticity index equal to or greater than 25 when tested in accordance with ASTM D 4318.

1.5.10 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.6 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Shoring
Dewatering Work Plan

SD-03 Product Data

Utilization of Excavated Materials

Opening of any Excavation or Borrow Pit
Shoulder Construction

SD-06 Test Reports

Testing
Borrow Site Testing

SD-07 Certificates

Testing

PART 2 PRODUCTS

2.1 REQUIREMENTS FOR OFFSITE SOILS

Test offsite soils brought in for use as backfill for the chemicals listed in the following table.

Compounds	EPA Test Methods
Total Petroleum Hydrocarbons (including Benzene, Toluene, Ethylbenzene, Xylenes)	8015M
Volatile Organic Compounds	8260B/624
Metals	6010/6020/7000
Pesticides	8081A
PCBs (including Aroclor	1268) 8082A

Provide Borrow Site Testing for listed compounds from a composite sample of material from the borrow site, with at least one test from each borrow site. Within 24 hours of conclusion of physical tests, submit 3 copies of test results including lab QC reports to the COR. Do not bring material onsite until tests have been approved by the COR.

2.2 BURIED WARNING AND IDENTIFICATION TAPE

Provide polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inches minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Provide permanent color and printing, unaffected by moisture or soil.

Warning Tape Color Codes

Red:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air

2.2.1 Warning Tape for Metallic Piping

Provide acid and alkali-resistant polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.003 inch and a minimum strength of 1500 psi lengthwise, and 1250 psi crosswise, with a maximum 350 percent elongation.

2.2.2 Detectable Warning Tape for Non-Metallic Piping

Provide polyethylene plastic tape conforming to the width, color, and printing requirements specified above, with a minimum thickness of 0.004

inch, and a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Manufacture tape with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.3 DETECTION WIRE FOR NON-METALLIC PIPING

Insulate a single strand, solid copper detection wire with a minimum of 12 AWG.

2.4 CAPILLARY WATER BARRIER

Provide capillary water barrier of clean, poorly graded crushed rock, crushed gravel, or uncrushed gravel placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below. Conform to ASTM C33/C33M for fine aggregate grading with a maximum of 3 percent by weight passing ASTM D 1140, No. 200 sieve.

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Where indicated or directed, strip topsoil to a depth of 4 inches. Spread topsoil on areas already graded and prepared for topsoil, or transported and deposited in stockpiles convenient to areas that are to receive application of the topsoil later, or at locations indicated or specified. Keep topsoil separate from other excavated materials, brush, litter, objectionable weeds, roots, stones larger than 2 inches in diameter, and other materials that would interfere with planting and maintenance operations. Remove from the site any surplus of topsoil from excavations and gradings.

3.2 GENERAL EXCAVATION

Perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Perform the grading in accordance with the typical sections shown and the tolerances specified in paragraph FINISHING. Transport satisfactory excavated materials and place in fill or embankment within the limits of the work. Excavate unsatisfactory materials encountered within the limits of the work below grade and replace with satisfactory materials as directed. Include such excavated material and the satisfactory material ordered as replacement in excavation. Dispose surplus satisfactory excavated material not required for fill or embankment in areas approved for surplus material storage or designated waste areas. Dispose unsatisfactory excavated material in designated waste or spoil areas. During construction, perform excavation and fill in a manner and sequence that will provide proper drainage at all times. Excavate material required for fill or embankment in excess of that produced by excavation within the grading limits from the borrow areas indicated or from other approved areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Finish excavation of ditches, gutters, and channel changes by cutting accurately to the cross sections, grades, and elevations shown on drawings. Do not excavate ditches and gutters below grades shown. Backfill the

excessive open ditch or gutter excavation with satisfactory, thoroughly compacted, material or with suitable stone or cobble to grades shown. Dispose excavated material as shown or as directed, except in no case allow material be deposited a maximum 4 feet from edge of a ditch. Maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Make excavations to the lines, grades, and elevations shown, or as directed. Provide trenches and foundation pits of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or other hard foundation material of loose debris and cut to a firm, level, stepped, or serrated surface. Remove loose disintegrated rock and thin strata. Do not disturb the bottom of the excavation when concrete or masonry is to be placed in an excavated area. Do not excavate to the final grade level until just before the concrete or masonry is to be placed. Where pile foundations are to be used, stop the excavation of each pit at an elevation 1 foot above the base of the footing, as specified, before piles are driven. After the pile driving has been completed, remove loose and displaced material and complete excavation, leaving a smooth, solid, undisturbed surface to receive the concrete or masonry.

3.2.3 Drainage

Provide for the collection and disposal of surface and subsurface water encountered during construction. Completely drain construction site during periods of construction to keep soil materials sufficiently dry. Construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity as required to maintain dry soils. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed.

3.2.4 Dewatering

Control groundwater flowing toward or into excavations to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. Do not permit French drains, sumps, ditches or trenches within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Take control measures by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, maintain the water level continuously, at least 3 feet below the working level. Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly.

3.2.5 Trench Excavation Requirements

Excavate the trench as recommended by the manufacturer of the pipe to be installed. Slope trench walls below the top of the pipe, or make vertical,

and of such width as recommended in the manufacturer's printed installation manual. Provide vertical trench walls where no manufacturer's printed installation manual is available. Shore trench walls more than 5 feet high, cut back to a stable slope, or provide with equivalent means of protection for employees who may be exposed to moving ground or cave in. Shore vertical trench walls soilin accordance with OSHA regulations. Give special attention to slopes which may be adversely affected by weather or moisture content.

3.2.5.1 Bottom Preparation

Grade the bottoms of trenches accurately to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Excavate bell holes to the necessary size at each joint or coupling to eliminate point bearing. Remove stones as recommended by the pipe manufacturer to avoid point bearing.

3.2.5.2 Removal of Unyielding Material

Where overdepth is not indicated and unyielding material such as concrete, is encountered in the bottom of the trench, remove such material 12 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.2.5.3 Removal of Unstable Material

Where unstable material is encountered such as concrete, in the bottom of the trench, remove such material to the depth directed and replace it to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the Contractor is responsible for excavating the resulting material and replacing it without additional cost to the Government.

3.2.5.4 Excavation for Appurtenances

Provide excavation for manholes, catch-basins, inlets, or similar structures of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Clean rock or loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Remove loose disintegrated rock and thin strata. Specify removal of unstable material. When concrete or masonry is to be placed in an excavated area, take special care not to disturb the bottom of the excavation. Do not excavate to the final grade level until just before the concrete or masonry is to be placed.

3.2.5.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, provide excavation by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the COR, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.2.6 Underground Utilities

The Contractor is responsible for movement of construction machinery and equipment over pipes and utilities during construction. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power-driven

equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the COR. Report damage to utility lines or subsurface construction immediately to the COR.

3.2.7 Structural Excavation

Ensure that footing subgrades have been inspected and approved by the COR prior to concrete placement. Excavate to bottom of pile cap prior to placing or driving piles, unless authorized otherwise by the COR. Backfill and compact over excavations and changes in grade due to pile driving operations to 95 percent of ASTM D 6938 maximum density.

3.3 SELECTION OF BORROW MATERIAL

Select borrow material to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Obtain borrow material from the borrow areas shown on Drawings. Unless otherwise provided in the contract, the Contractor is responsible for obtaining the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling from the owners. Borrow material from approved sources on Government-controlled land may be obtained without payment of royalties. Unless specifically provided, do not obtain borrow within the limits of the project site without prior written approval. Consider necessary clearing, grubbing, and satisfactory drainage of borrow pits and the disposal of debris thereon related operations to the borrow excavation.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS AND BORROW PITS

Except as otherwise permitted, excavate borrow pits and other excavation areas providing adequate drainage. Transport overburden and other spoil material to designated spoil areas or otherwise dispose of as directed. Provide neatly trimmed and drained borrow pits after the excavation is completed. Ensure that excavation of any area, operation of borrow pits, or dumping of spoil material results in minimum detrimental effects on natural environmental conditions.

3.5 SHORING

3.5.1 General Requirements

Submit a Shoring and Sheeting plan for approval 15 days prior to starting work. Submit drawings and calculations, certified by a registered professional engineer, describing the methods for shoring and sheeting of excavations. Finish shoring, including sheet piling, and install as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Remove shoring, bracing, and sheeting as excavations are backfilled, in a manner to prevent caving.

3.5.2 Geotechnical Engineer

Hire a Professional Geotechnical Engineer to provide inspection of excavations and soil/groundwater conditions throughout construction. The

Geotechnical Engineer is responsible for performing pre-construction and periodic site visits throughout construction to assess site conditions. The Geotechnical Engineer is responsible for updating the excavation, sheeting and dewatering plans as construction progresses to reflect changing conditions and submit an updated plan if necessary. Submit a monthly written report, informing the Contractor and COR of the status of the plan and an accounting of the Contractor's adherence to the plan addressing any present or potential problems. The COR is responsible for arranging meetings with the Geotechnical Engineer at any time throughout the contract duration.

3.6 GRADING AREAS

Where indicated, divide work into grading areas within which satisfactory excavated material will be placed in embankments, fills, and required backfills. Do not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing. Place and grade stockpiles of satisfactory and unsatisfactory as specified. Keep stockpiles in a neat and well drained condition, giving due consideration to drainage at all times. Clear, grub, and seal by rubber-tired equipment, the ground surface at stockpile locations; separately stockpile excavated satisfactory and unsatisfactory materials. Protect stockpiles of satisfactory materials from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, remove and replace such material with satisfactory material from approved sources.

3.7 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Do not excavate to final grade until just before concrete is to be placed. For pile foundations, stop the excavation at an elevation of from 6 to 12 inches above the bottom of the footing before driving piles. After pile driving has been completed, complete the remainder of the excavation to the elevations shown.

3.8 GROUND SURFACE PREPARATION

3.8.1 General Requirements

Remove and replace unsatisfactory material with satisfactory materials, as directed by the COR, in surfaces to receive fill or in excavated areas. Scarify the surface to a depth of 6 inches before the fill is started. Plow, step, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so that the fill material will bond with the existing material. When subgrades are less than the specified density, break up the ground surface to a minimum depth of 6 inches, pulverizing, and compacting to the specified density. When the subgrade is part fill and part excavation or natural ground, scarify the excavated or natural ground portion.

3.9 UTILIZATION OF EXCAVATED MATERIALS

Dispose unsatisfactory materials removing from excavations into designated waste disposal or spoil areas. Use satisfactory material removed from excavations, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. Submit procedure and location for disposal of unused satisfactory material. Submit proposed source of borrow material. Do not waste any satisfactory excavated material without specific written authorization. Dispose of satisfactory material, authorized to be wasted,

in designated areas approved for surplus material storage or designated waste areas as directed. Clear and grub newly designated waste areas on Government-controlled land before disposal of waste material thereon. Stockpile and use coarse rock from excavations for constructing slopes or embankments adjacent to streams, or sides and bottoms of channels and for protecting against erosion. Do not dispose excavated material to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

3.10 BURIED TAPE AND DETECTION WIRE

3.10.1 Buried Warning and Identification Tape

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6 inches below top of subgrade.

3.10.2 Buried Detection Wire

Bury detection wire directly taped to the top of non-metallic piping the full length of the top of pipe. Extend the wire continuously and unbroken, from manhole to manhole. Terminate the ends of the wire inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. Furnish insulated wire over it's entire length. Install wires at manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, terminate the wire in the valve pit at the pump station end of the pipe.

3.11 BACKFILLING AND COMPACTION

Place backfill adjacent to any and all types of structures, and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials, to prevent wedging action or eccentric loading upon or against the structure. Prepare ground surface on which backfill is to be placed and provide compaction requirements for backfill materials in conformance with the applicable portions of paragraphs GROUND SURFACE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.11.1 Trench Backfill

Backfill trenches to the grade shown. Do not backfill the trench until all specified tests are performed.

3.11.1.1 Replacement of Unstable Material

Replace unstable material removed from the bottom of the trench or excavation with select granular material placed in layers not exceeding 6 inches loose thickness.

3.11.1.2 Bedding and Initial Backfill

Provide bedding of the type and thickness shown. Place initial backfill material and compact it with approved tampers to a height of at least one foot above the utility pipe or conduit. Bring up the backfill evenly on both sides of the pipe for the full length of the pipe. Take care to

ensure thorough compaction of the fill under the haunches of the pipe. Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Compact backfill to top of pipe to 90 percent of ASTM D 1557 maximum density. Provide plastic piping with bedding to spring line of pipe. Provide materials as follows:

a. Class I: Angular, 0.25 to 1.5 inch, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

b. Class II: Coarse sands and gravels with maximum particle size of 1.5 inch, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D 2487.

c. Clean, coarse-grained sand classified as SW or SP by ASTM D 2487 for bedding and backfill as indicated.

d. Clean, coarsely graded natural gravel, crushed stone or a combination thereof identified as having a classification of GW in accordance with ASTM D 2487 for bedding and backfill as indicated. Do not exceed maximum particle size of 3 inches.

3.11.1.3 Final Backfill

Fill the remainder of the trench, except for special materials for roadways, railroads and airfields, with satisfactory material. Place backfill material and compact as follows:

a. Roadways, Railroads, and Airfields: Place backfill up to the required elevation as specified. Do not permit water flooding or jetting methods of compaction.

b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Deposit backfill in layers of a maximum of 12 inches loose thickness, and compact it to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Do not permit compaction by water flooding or jetting. Apply this requirement to all other areas not specifically designated above.

3.11.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed , place backfill in such a manner that the structure is not be damaged by the shock of falling earth. Deposit the backfill material, compact it as specified for final backfill, and bring up the backfill evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.12 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.12.1 Gas Distribution

Excavate trenches to a depth that will provide a a minimum 24 inch of

cover in other excavation.

3.12.2 Water Lines

Excavate trenches to a depth that provides a minimum cover of 3 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.12.3 Heat Distribution System

Free initial backfill material of stones larger than 1/4 inch in any dimension.

3.12.4 Electrical Distribution System

Provide a minimum cover of 24 inches from the finished grade to direct burial cable and conduit or duct line, unless otherwise indicated.

3.12.5 Sewage Absorption Trenches or Pits

3.12.5.1 Porous Fill

Provide backfill material consisting of clean crushed rock or gravel having a gradation such that 100 percent passes the 2 inch sieve and zero percent passes the 1/2 inch sieve. conforming to the requirements of gradation No. 4 for coarse aggregate in ASTM C33/C33M.

3.12.5.2 Cover

Filter fabric as indicated.

3.12.6 Pipeline Casing

Provide new smooth wall steel pipeline casing under existing structures. Provide each new pipeline casing, where indicated and to the lengths and dimensions shown, complete and suitable for use with the new piped utility as indicated. Install pipeline casing by dry boring and jacking method as follows:

3.12.6.1 Bore Holes

Mechanically bore holes and case through the soil with a cutting head on a continuous auger mounted inside the casing pipe. Weld lengths of pipe together in accordance with AWS D1.1/D1.1M. Do not use water or other fluids in connection with the boring operation.

3.12.6.2 Cleaning

Clean inside of the pipeline casing of dirt, weld splatters, and other foreign matter which would interfere with insertion of the piped utilities by attaching a pipe cleaning plug to the boring rig and passing it through the pipe.

3.12.6.3 End Seals

After installation of piped utilities in pipeline casing, provide watertight end seals at each end of pipeline casing between pipeline casing and piping utilities. Provide watertight segmented elastomeric end seals.

3.13 EMBANKMENTS

3.13.1 Earth Embankments

Construct earth embankments from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 3 inches. Place the material in successive horizontal layers of loose material not more than 12 inches in depth. Spread each layer uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, plow, disk, or otherwise brake up each layer; moisten or aerate as necessary; thoroughly mix; and compact to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements are identical with those requirements specified in paragraph SUBGRADE PREPARATION. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.14 SUBGRADE PREPARATION

3.14.1 Proof Rolling

Finish proof rolling on an exposed subgrade free of surface water (wet conditions resulting from rainfall) which would promote degradation of an otherwise acceptable subgrade. After compacting, proof roll the existing subgrade with several passes of a or a fully loaded water truck or a 15 ton, pneumatic-tired roller. Operate the roller and truck in a systematic manner to ensure the number of passes over all areas, and at speeds between 2-1/2 to 3-1/2 mph. When proof rolling, provide one-half of the passes made with the roller in a direction perpendicular to the other passes. Notify the COR a minimum of 3 days prior to proof rolling. Perform proof rolling in the presence of the COR. Undercut rutting or pumping of material as directed by the COR and replace with fill and backfill select material.

3.14.2 Construction

Shape subgrade to line, grade, and cross section, and compact as specified. Include plowing, disking, and any moistening or aerating required to obtain specified compaction for this operation. Remove soft or otherwise unsatisfactory material and replace with satisfactory excavated material or other approved material as directed. Bring up low areas resulting from removal of unsatisfactory material or excavation of rock to required grade with satisfactory materials, and shape the entire subgrade to line, grade, and cross section and compact as specified. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 1/2 inch when tested with a 12-foot straightedge applied both parallel and at right angles to the centerline of the area. Do not vary the elevation of the finish subgrade more than 0.05 foot from the established grade and cross section.

3.14.3 Compaction

Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas and railroads, compact each layer of the embankment to at least 90 percent of laboratory maximum density (ASTM D 1557).

3.14.3.1 Subgrade for Pavements

Compact subgrade for pavements to at least 95 percentage laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, thoroughly blend, reshape, and compact the top 6 inch of subgrade.

3.14.3.2 Subgrade for Shoulders

Compact subgrade for shoulders to at least 95 percentage laboratory maximum density for the depth below the surface of shoulder shown.

3.15 SHOULDER CONSTRUCTION

Construct shoulders of satisfactory excavated or borrow material or as otherwise shown or specified.. Submit advanced notice on shoulder construction for rigid pavements. Construct shoulders immediately after adjacent paving is complete. In the case of rigid pavements, do not construct shoulders until permission of the COR has been obtained. Compact the entire shoulder area to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Finish compaction by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Finish shoulder construction in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. Align the completed shoulders true to grade and shaped to drain in conformity with the cross section shown.

3.16 FINISHING

Finish the surface of excavations, embankments, and subgrades to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. Provide the degree of finish for graded areas within 0.1 foot of the grades and elevations indicated except that the degree of finish for subgrades specified in paragraph SUBGRADE PREPARATION. Finish gutters and ditches in a manner that will result in effective drainage. Finish the surface of areas to be turfed from settlement or washing to a smoothness suitable for the application of turfing materials. Repair graded, topsoiled, or backfilled areas prior to acceptance of the work, and re-established grades to the required elevations and slopes.

3.16.1 Subgrade and Embankments

During construction, keep embankments and excavations shaped and drained. Maintain ditches and drains along subgrade to drain effectively at all times. Do not disturb the finished subgrade by traffic or other operation. Protect and maintain the finished subgrade in a satisfactory condition until ballast, subbase, base, or pavement is placed. Do not permit the storage or stockpiling of materials on the finished subgrade. Do not lay subbase, base course, ballast, or pavement until the subgrade has been checked and approved, and in no case place subbase, base, surfacing, pavement, or ballast on a muddy, spongy, or frozen subgrade.

3.16.2 Capillary Water Barrier

Place a capillary water barrier under concrete floor and area-way slabs

grade directly on the subgrade and compact with a minimum of two passes of a hand-operated plate-type vibratory compactor.

3.16.3 Grading Around Structures

Construct areas within 5 feet outside of each building and structure line true-to-grade, shape to drain, and maintain free of trash and debris until final inspection has been completed and the work has been accepted.

3.17 PLACING TOPSOIL

On areas to receive topsoil, prepare the compacted subgrade soil to a 2 inches depth for bonding of topsoil with subsoil. Spread topsoil evenly and grade to the elevations and slopes shown. Do not spread topsoil when frozen or excessively wet or dry. Obtain material required for topsoil in excess of that produced by excavation within the grading limits from areas indicated.

3.18 TESTING

Perform testing by a Corps validated commercial testing laboratory or the Contractor's validated testing facility. Submit qualifications of the Corps validated commercial testing laboratory or the Contractor's validated testing facilities. If the Contractor elects to establish testing facilities, do not permit work requiring testing until the Contractor's facilities have been inspected, Corps validated and approved by the COR.

a. Determine field in-place density in accordance with ASTM D 6938.

b. Perform tests on recompacted areas to determine conformance with specification requirements. Appoint a registered professional civil engineer to certify inspections and test results. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. The following number of tests, if performed at the appropriate time, will be the minimum acceptable for each type operation.

3.18.1 Fill and Backfill Material Gradation

One test per 1000 cubic yards stockpiled or in-place source material. Determine gradation of fill and backfill material in accordance with ASTM D 422 .

3.18.2 In-Place Densities

a. One test per 2,500 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by other than hand-operated machines.

b. One test per 10,000 square feet, or fraction thereof, of each lift of fill or backfill areas compacted by hand-operated machines.

c. One test per 200 linear feet, or fraction thereof, of each lift of embankment or backfill for roads.

d. One test per 200 linear feet, or fraction thereof, of each lift of embankment or backfill for railroads.

3.18.3 Moisture Contents

In the stockpile, excavation, or borrow areas, perform a minimum of two tests per day per type of material or source of material being placed during stable weather conditions. During unstable weather, perform tests as dictated by local conditions and approved by the COR.

3.18.4 Optimum Moisture and Laboratory Maximum Density

Perform tests for each type material or source of material including borrow material to determine the optimum moisture and laboratory maximum density values. One representative test per 500 cubic yards of fill and backfill, or when any change in material occurs which may affect the optimum moisture content or laboratory maximum density.

3.18.5 Tolerance Tests for Subgrades

Perform continuous checks on the degree of finish specified in paragraph SUBGRADE PREPARATION during construction of the subgrades.

3.18.6 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, inspect the pipe to determine whether significant displacement has occurred. Conduct this inspection in the presence of the COR. Inspect pipe sizes larger than 36 inches, while inspecting smaller diameter pipe by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgment of the COR, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, replace or repair the defects as directed at no additional cost to the Government.

3.19 DISPOSITION OF SURPLUS MATERIAL

Provide surplus material or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber as removed from Government property as directed by the COR.

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HOT MIX BITUMINOUS PAVEMENT

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for marking roads, streets and parking areas; this section also includes removal of paint or tape markings from pavement surfaces.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO MP 1a	Performance Graded Asphalt Binder

ASPHALT INSTITUTE (AI)

AI MS-02	Mix Design Methods

ASTM INTERNATIONAL (ASTM)

ASTM C 117	Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 128	Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C 131	Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 188	Standard Test Method for Density of

	Hydraulic Cement
ASTM C 29/C 29M	Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C 88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D 1073	Fine Aggregate for Bituminous Paving Mixtures
ASTM D 1188	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
ASTM D 140/D 140M	Standard Practice for Sampling Bituminous Materials
ASTM D 1559	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 242/D 242M	Mineral Filler for Bituminous Paving Mixtures
ASTM D 2726	Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D 4867/D 4867M	Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 546	Sieve Analysis of Mineral Filler for Bituminous Paving Mixtures
ASTM D 692/D 692M	Coarse Aggregate for Bituminous Paving Mixtures
ASTM D 70	Specific Gravity and Density of Semi-Solid Bituminous Materials (Pycnometer Method)
ASTM D 75/D 75M	Standard Practice for Sampling Aggregates
ASTM D 854	Specific Gravity of Soil Solids by Water Pycnometer
ASTM D 979	Sampling Bituminous Paving Mixtures
ASTM D 995	Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D2041/D2041M	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D2172/D2172M	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D3381/D3381M	Viscosity-Graded Asphalt Cement for Use in Pavement Construction

ASTM D946/D946M Penetration-Graded Asphalt Cement for Use in Pavement Construction

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-04 Samples

Bituminous pavement

SD-05 Design Data

Job-mix formula

Submit a job-mix formula, prepared specifically for this project within one year of submittal for roads, for approval by the COR prior to preparing and placing the bituminous mixture. Design mix using procedures contained in Chapter V, Marshall Method of Mix Design, of AI MS-02. Formulas shall indicate physical properties of the mixes as shown by tests made by a commercial laboratory approved by the COR, using materials identical to those to be provided on this project. Submit formulas with material samples. Job-mix formula for each mixture shall be in effect until modified in writing by the Contractor and approved by the COR. Provide a new job-mix formula for each source change. Submittal shall include all tests indicated in MIX DESIGN section of this specification.

ASPHALT CEMENT BINDER

MIX DESIGN

SD-06 Test Reports

Specific gravity test of asphalt

Coarse aggregate tests

Weight of slag test

Percent of crushed pieces in gravel

Fine aggregate tests

Specific gravity of mineral filler

Bituminous mixture tests

Aggregates tests

Bituminous mix tests

Pavement courses

Submit in accordance with paragraph entitled "Mock-Up Test Section."

1.4 QUALITY ASSURANCE

1.4.1 Safety Requirements

Provide adequate and safe stairways with handrails to the mixer platform, and safe and protected ladders or other means for accessibility to plant operations. Guard equipment and exposed steam or other high temperature lines or cover with a suitable type of insulation.

1.4.2 Required Data

Job-mix formula shall show the following:

a. Source and proportions, percent by weight, of each ingredient of the mixture;

b. Correct gradation, the percentages passing each size sieve listed in the specifications for the mixture to be used, for the aggregate and mineral filler from each separate source and from each different size to be used in the mixture and for the composite mixture;

c. Amount of material passing the No. 200 sieve determined by dry sieving;

d. Number of blows of hammer compaction per side of molded specimen;

e. Temperature viscosity relationship of the asphalt cement;

f. Stability, flow, percent voids in mineral aggregate, percent air voids, unit weight;

g. Asphalt absorption by the aggregate;

h. Effective asphalt content as percent by weight of total mix;

i. Temperature of the mixture immediately upon completion of mixing;

j. Asphalt performance grade penetration range; and

k. Curves for the leveling binder and wearing courses.

1.4.3 Charts

Plot and submit, on a grain size chart, the specified aggregate gradation band, the job-mix gradation and the job-mix tolerance band.

1.4.4 Selection of Optimum Asphalt Content

Base selection on percent of total mix and the average of values at the following points on the curves for each mix:

a. Stability: Peak

b. Unit Weight: Peak

c. Percent Air Voids: Median

1.5 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage and store with a minimum of handling. Store aggregates in such a manner as to prevent segregation, contamination, or intermixing of the different aggregate sizes.

1.6 ENVIRONMENTAL CONDITIONS

Place bituminous mixture only during dry weather and on dry surfaces. Place courses only when the surface temperature of the underlying course is greater than 45 degrees F for course thicknesses greater than one inch and 55 degrees F for course thicknesses one inch or less.

1.7 CONSTRUCTION EQUIPMENT

Calibrated equipment, such as scales, batching equipment, spreaders and similar equipment, shall have been recalibrated by a calibration laboratory approved by the COR within 12 months of commencing work.

1.7.1 Mixing Plant

Design, coordinate, and operate the mixing plant to produce a mixture within the job-mix formula tolerances and to meet the requirements of ASTM D 995, including additional plant requirements specified herein. The plant shall be a batch type, continuous mix type or drum-dryer mixer type, and shall have sufficient capacity to handle the new bituminous construction. Minimum plant capacity shall be 100 tons per hour. The mixing plant and equipment shall remain accessible at all times for inspecting operation, verifying weights, proportions and character of materials, and checking mixture temperatures. The plant and plant site shall meet the requirements of Section 01 57 19.00 20 TEMPORARY ENVIRONMENTAL CONTROLS.

1.7.1.1 Cold Aggregate Feeder

Provide plant with a feeder or feeders capable of delivering the maximum number of aggregate sizes required in their proper proportion. Provide adjustment for total and proportional feed and feeders capable of being locked in any position. When more than one cold elevator is used, feed each elevator as a separate unit and install individual controls integrated with a master control.

1.7.1.2 Dryer

Provide rotary drum-dryer which continuously agitates the mineral aggregate during the heating and drying process. When one dryer does not dry the aggregate to specified moisture requirements, provide additional dryers.

1.7.1.3 Plant Screens and Bins for Batch and Continuous Mix Plants

Use screen to obtain accurate gradation and allow no bin to contain more than 10 percent oversize or undersize. Inspect screens each day prior to commencing work for plugged, worn, or broken screens. Clean plugged screens and replace worn or broken screens with new screens prior to beginning operations. Divide hot aggregate bins into at least three compartments arranged to ensure separate and adequate storage of appropriate fractions of the aggregate.

1.7.1.4 Testing Laboratory

Provide a testing laboratory for control and acceptance testing functions during periods of mix production, sampling and testing, and whenever materials subject to the provisions of these specifications are being supplied or tested. The laboratory shall provide adequate equipment, space, and utilities as required for the performance of the specified tests.

1.7.1.5 Surge and Storage Bins

Use for temporary storage of hot bituminous mixtures will be permitted under the following conditions:

a. When stored in surge bins for a period of time not to exceed 3 hours.

b. When stored in insulated and heated storage bins for a period of time not to exceed 12 hours. If it is determined by the COR that there is an excessive amount of heat loss, segregation and oxidation of the mixture due to temporary storage, discontinue use of surge bins or storage bins.

1.7.1.6 Drum-Dryer Mixer

Do not use drum-dryer mixer if specified requirements of the bituminous mixture or of the completed bituminous pavement course cannot be met. If drum-dryer mixer is prohibited, use either batch or continuous mix plants meeting the specifications and producing a satisfactory mix.

1.7.2 Paving Equipment

1.7.2.1 Spreading Equipment

Self-propelled electronically controlled type, unless other equipment is authorized by the COR. Equip spreading equipment of the self-propelled electronically controlled type with hoppers, tamping or vibrating devices, distributing screws, electronically adjustable screeds, and equalizing devices. Capable of spreading hot bituminous mixtures without tearing, shoving, or gouging and to produce a finished surface of specified grade and smoothness. Operate spreaders, when laying mixture, at variable speeds between 5 and 45 feet per minute. Design spreader with a quick and efficient steering device; a forward and reverse traveling speed; and automatic devices to adjust to grade and confine the edges of the mixture to true lines. The use of a spreader that leaves indented areas or other objectionable irregularities in the fresh laid mix during operations is prohibited.

1.7.2.2 Rolling Equipment

Self-propelled pneumatic-tired rollers supplemented by three-wheel and tandem type steel wheel rollers. The number, type and weight of rollers shall be sufficient to compact the mixture to the required density without detrimentally affecting the compacted material. Rollers shall be suitable for rolling hot-mix bituminous pavements and capable of reversing without backlash. Pneumatic-tired rollers shall be capable of being operated both forward and backward without turning on the mat, and without loosening the surface being rolled. Equip rollers with suitable devices and apparatus to keep the rolling surfaces wet and prevent adherence of bituminous mixture. Vibratory rollers especially designed for bituminous concrete compaction may be used provided rollers do not impair stability of pavement structure

and underlying layers. Repair depressions in pavement surfaces resulting from use of vibratory rollers. Rollers shall be self-propelled, single or dual vibrating drums, and steel drive wheels, as applicable; equipped with variable amplitude and separate controls for energy and propulsion.

1.7.2.3 Hand Tampers

Minimum weight of 25 pounds with a tamping face of not more than 50 square inches.

1.7.2.4 Mechanical Hand Tampers

Commercial type, operated by pneumatic pressure or by internal combustion.

PART 2 PRODUCTS

2.1 AGGREGATES

Grade and proportion aggregates and filler so that combined mineral aggregate conforms to specified grading.

2.1.1 Coarse Aggregates

ASTM D 692/D 692M, except as modified herein. At least 75 percent by weight of aggregate retained on the No. 4 sieve shall have two or more fractured faces. Percentage of wear, Los Angeles test, except for slag, shall not exceed 40 in accordance with ASTM C 131. Weight of slag shall not be less than 70 pounds per cubic foot. Soundness test is required in accordance with ASTM C 88; after 5 cycles, loss shall not be more than 12 percent when tested with sodium sulfate or 18 percent when tested with magnesium sulfate.

2.1.2 Fine Aggregate

ASTM D 1073, except as modified herein. Fine aggregate shall be produced by crushing stone, slag or gravel that meets requirements for wear and soundness specified for coarse aggregate. Where necessary to obtain the gradation of aggregate blend or workability, natural sand may be used. Quantity of natural sand to be added shall be approved by the COR and shall not exceed 15 percent of weight of coarse and fine aggregate and material passing the No. 200sieve.

2.1.3 Mineral Filler

Nonplastic material meeting the requirements of ASTM D 242/D 242M.

2.1.4 Aggregate Gradation

The combined aggregate gradation shall conform to gradations specified in Table I, when tested in accordance with ASTM C 136 and ASTM C 117, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

Table I. Aggregate Gradations

	Gradation 1	Gradation 2	Gradation 3
Sieve Size, inch	Percent Passing by Mass	Percent Passing by Mass	Percent Passing by Mass

1	100	---	---
3/4	76-96	100	---
1/2	68-88	76-96	100
3/8	60-82	69-89	76-96
No. 4	45-67	53-73	58-78
No. 8	32-54	38-60	40-60
No. 16	22-44	26-48	28-48
No. 30	15-35	18-38	18-38
No. 50	9-25	11-27	11-27
No. 100	6-18	6-18	6-18
No. 200	3-6	3-6	3-6

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to ASTM D946/D946M Penetration Grade 1A. Test data indicating grade certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the COR. The supplier is defined as the last source of any modification to the binder. The CORmay sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained by the Contractor in accordance with ASTM D 140/D 140M and in the presence of the COR. These samples shall be furnished to the Engineer for the verification testing, which shall be at no cost to the Contractor. Samples of the asphalt cement specified shall be submitted for approval not less than 14 days before start of the test section.

2.3 MIX DESIGN

The Contractor shall develop the mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF). No hot-mix asphalt for payment shall be produced until a JMF has been approved. The hot-mix asphalt shall be designed using procedures contained in AI MS-02 and the criteria shown in Table II. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867/D 4867M is less than 75, the aggregates shall be rejected or the asphalt mixture treated with an approved anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 75. If an antistrip agent is required, it shall be provided by the Contractor at no additional cost.

2.3.1 JMF Requirements

The job mix formula shall be submitted in writing by the Contractor for approval at least 14 days prior to the start of the test section and shall include as a minimum:

a. Percent passing each sieve size.

b. Percent of asphalt cement.

c. Percent of each aggregate and mineral filler to be used.

d. Asphalt viscosity grade, penetration grade, or performance grade.

e. Number of blows of hammer per side of molded specimen.

f. Laboratory mixing temperature.

g. Lab compaction temperature.

h. Temperature-viscosity relationship of the asphalt cement.

i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.

j. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-02.

k. Specific gravity and absorption of each aggregate.

l. Percent natural sand.

m. Percent particles with two or more fractured faces (in coarse aggregate).

n. Fine aggregate angularity.

o. Percent flat or elongated particles (in coarse aggregate).

p. Tensile Strength Ratio.

q. Antistrip agent (if required) and amount.

r. List of all modifiers and amount.

s. Percentage and properties (asphalt content, binder properties, and aggregate properties) of RAP in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table II. Marshall Design Criteria

Test Property	75 Blow Mix	50 Blow Mix
Stability, pounds minimum	*2150	*1350
Flow, 0.01 inch	8-16	8-18
Air voids, percent	3-5	3-5
Percent Voids in mineral aggregate (minimum)	See Table III	See Table III
TSR, minimum percent	75	75

* This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.

Table III. Minimum Percent Voids in Mineral Aggregate (VMA)**

Aggregate (See Table 2)	Minimum VMA, percent
Gradation 1	13.0
Gradation 2	14.0
Gradation 3	15.0

** Calculate VMA in accordance with AI MS-02, based on ASTM D 2726 bulk specific gravity for the aggregate.

2.3.2 Adjustments to JMF

The JMF for each mixture shall be in effect until a new formula is approved in writing by the COR. Should a change in sources of any materials be made, a new mix design shall be performed and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the JMF within the limits specified below to optimize mix volumetric properties. Adjustments to the JMF shall be limited to plus or minus 3 percent on the 1/2 inch, No. 4, and No. 8 sieves; plus or minus 1.0 percent on the No. 200 sieve; and plus or minus 0.40 percent binder content. If adjustments are needed that exceed these limits, a new mix design shall be developed. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table I; this is acceptable.

2.4 RECYCLED HOT MIX ASPHALT

Recycled HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. The RAP shall be of a consistent gradation and asphalt content and properties. When RAP is fed into the plant, the maximum RAP chunk size shall not exceed 2 inches. The recycled HMA mix shall be designed using procedures contained in AI MS-02. The job mix shall meet the requirements of paragraph MIX DESIGN. RAP should only be used for shoulder surface course mixes and for any intermediate courses. The amount of RAP shall be limited to 30 percent.

2.4.1 RAP Aggregates and Asphalt Cement

The blend of aggregates used in the recycled mix shall meet the requirements of paragraph AGGREGATES. The percentage of asphalt in the RAP shall be established for the mixture design according to ASTM D2172/D2172M using the appropriate dust correction procedure.

2.4.2 RAP Mix

The blend of new asphalt cement and the RAP asphalt binder shall meet the penetration requirements in paragraph ASPHALT CEMENT BINDER. The virgin asphalt cement shall not be more than two standard asphalt material grades different than that specified in paragraph ASPHALT CEMENT BINDER.

2.5 SOURCE QUALITY CONTROL

Employ a commercial laboratory approved by the COR to perform testing. The laboratory used to develop the JMF and the laboratory used to perform all sampling and testing shall meet the requirements of ASTM D 3666. A certification signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted

to the COR prior to the start of construction. The certification shall contain as a minimum:

a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.

b. A listing of equipment to be used in developing the job mix.

c. A copy of the laboratory's quality control system.

d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

2.5.1 Tests

Perform testing in accordance with the following:

a. Specific Gravity Test of Asphalt: ASTM D 70

b. Coarse Aggregate Tests:

1. Bulk Specific Gravity: ASTM C 127

2. Abrasion Loss: ASTM C 131

3. Soundness Loss: ASTM C 88

c. Weight of Slag Test: ASTM C 29/C 29M

d. Percent of Crushed Pieces in Gravel: Count by observation and weight

e. Fine Aggregate Tests:

1. Bulk Specific Gravity: ASTM C 128

2. Soundness Loss: ASTM C 88

f. Specific Gravity of Mineral Filler: ASTM C 188 or ASTM D 854

g. Bituminous Mixture Tests:

1. Bulk Specific Gravity: ASTM D 1188 or ASTM D 2726

2. Theoretical Maximum Specific Gravity: ASTM D2041/D2041M

3. Tensile Strength Ratio: ASTM D 4867/D 4867M

2.5.2 Specimens

ASTM D 1559 for the making and testing of bituminous specimens with the following exceptions:

a. Compaction: Apply 75 blows of the hammer to each flat face of the specimens gathered from the asphalt plant providing the project with the asphalt concrete mix a minimum of two (2) times for every 8 hour day.

b. Curves: Plot curves for the leveling, binder, and wearing courses to show the effect on the test properties of at least four different

percentages of asphalt on the unit weight, stability, flow, air voids, and voids in mineral aggregate; each point on the curves shall represent the average of at least four specimens.

c. Cooling of Specimen: After compaction is completed, allow the specimen to cool in air to the same temperature approximately as that of the water, 77 degrees F, to be used in the specific gravity determination.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Preparation of Asphalt Binder Material

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 160 degrees C 325 degrees F when added to the aggregates. Modified asphalts shall be no more than 174 degrees C 350 degrees F when added to the aggregate.

3.1.2 Preparation of Mineral Aggregates

Store different size aggregate in separate stockpiles so that different sizes will not mix. Stockpile different-sized aggregates in uniform layers by use of a clam shell or other approved method so as to prevent segregation. The use of bulldozers in stockpiling of aggregate or in feeding aggregate to the dryer is prohibited. Feed aggregates into the cold elevator by means of separate mechanical feeders so that aggregates are graded within requirements of the job-mix formulas and tolerances specified. Regulate rates of feed of the aggregates so that moisture content and temperature of aggregates are within tolerances specified herein. Dry and heat aggregates to the temperature necessary to achieve the mixture determined by the job mix formula within the job tolerance specified. Provide adequate dry storage for mineral filler.

3.1.3 Preparation of Bituminous Mixture

Accurately weigh aggregates and dry mineral filler and convey into the mixer in the proportionate amounts of each aggregate size required to meet the job-mix formula. In batch mixing, after aggregates and mineral filler have been introduced into the mixer and mixed for not less than 15 seconds, add asphalt by spraying or other approved methods and continue mixing for a period of not less than 20 seconds, or as long as required to obtain a homogeneous mixture. The time required to add or spray asphalt into the mixer will not be added to the total wet-mixing time provided the operation does not exceed 10 seconds and a homogeneous mixture is obtained. When a continuous mixer is employed, mixing time shall be more than 35 seconds to obtain a homogeneous mixture. Additional mixing time, when required, will be as directed by the COR. When mixture is prepared in a twin-pugmill mixer, volume of the aggregates, mineral filler, and asphalt shall not extend above tips of mixer blades when blades are in a vertical position. Overheated and carbonized mixtures, or mixtures that foam or show indication of free moisture, will be rejected. When free moisture is detected in batch or continuous mix plant produced mixtures, waste the mix and withdraw the aggregates in the hot bins immediately and return to the respective stockpiles; for drum-dryer mixer plants, waste the mix, including that in surge or storage bins that is affected by free moisture.

3.1.4 Transportation of Bituminous Mixtures

Transport bituminous material from the mixing plant to the paving site in trucks having tight, clean, smooth beds that have been coated with a minimum amount of concentrated solution of hydrated lime and water or other approved coating to prevent adhesion of the mixture to the truck. Petroleum products will not be permitted for coating truck. If air temperature is less than 60 degrees F or if haul time is greater than 30 minutes, cover each load with canvas or other approved material of ample size to protect the mixture from the loss of heat. Make deliveries so that the spreading and rolling of all the mixture prepared for one day's run can be completed during daylight, unless adequate approved artificial lighting is provided. Deliver mixture to area to be paved so that the temperature at the time of dumping into the spreader is within the range specified herein. Reject loads that are below minimum temperature, that have crusts of cold unworkable material, or that have been wet excessively by rain. Hauling over freshly laid material is prohibited.

3.1.5 Surface Preparation of Underlying Course

Prior to the laying of the asphalt concrete, clean underlying course of foreign or objectionable matter with power blowers or power brooms, supplemented by hand brooms and other cleaning methods where necessary. During the placement of multiple lifts of bituminous concrete, each succeeding lift of bituminous concrete shall have its underlying lift cleaned and provided with a bituminous tack coat if the time period between the placement of each lift of bituminous concrete exceeds 14 days, or the underlying bituminous concrete has become dirty.

3.1.6 Spraying of Contact Surfaces

Spray contact surfaces of previously constructed pavement with a thin coat of bituminous materials to act as an anti-stripping agent. Paint contact surfaces of structures with a thin coat of emulsion or other approved bituminous material prior to placing the bituminous mixture. Tack coat the previously placed primed coats on base courses when surface has become excessively dirty and cannot be cleaned or when primed surface has cured to the extent that it has lost all bonding effect.

3.2 PLACEMENT

3.2.1 Machine Spreading

The range of temperatures of the mixtures at the time of spreading shall be between 250 degrees F and 300 degrees F. Bituminous concrete having temperatures less than minimum spreading temperature when dumped into the spreader will be rejected. Adjust spreader and regulate speed so that the surface of the course is smooth and continuous without tears and pulling, and of such depth that, when compacted, the surface conforms with the cross section, grade, and contour indicated. Unless otherwise directed, begin the placing along the centerline of areas to be paved on a crowned section or on the high side of areas with a one-way slope. Place mixture in consecutive adjacent strips having a minimum width of 10 feet, except where the edge lanes require strips less than 10 feet to complete the area. Construct longitudinal joints and edges to true line markings. Establish lines parallel to the centerline of the area to be paved, and place string lines coinciding with the established lines for the spreading machine to follow. Provide the number and location of the lines needed to accomplish

proper grade control. When specified grade and smoothness requirements can be met for initial lane construction by use of an approved long ski-type device of not less than 30 feet in length and for subsequent lane construction by use of a short ski or shoe, in-place string lines for grade control may be omitted. Place mixture as nearly continuous as possible and adjust the speed of placing as needed to permit proper rolling.

3.2.2 Shoveling, Raking, and Tamping After Machine-Spreading

Shovelers and rakers shall follow the spreading machine. Add or remove hot mixture and rake the mixture as required to obtain a course that when completed will conform to requirements specified herein. Broadcasting or fanning of mixture over areas being compacted is prohibited. When segregation occurs in the mixture during placing, suspend spreading operation until the cause is determined and corrected. Correct irregularities in alignment left by the spreader by trimming directly behind the machine. Immediately after trimming, compact edges of the course by tamping laterally with a metal lute or by other approved methods. Distortion of the course during tamping is prohibited.

3.2.3 Hand-Spreading in Lieu of Machine-Spreading

In areas where the use of machine spreading is impractical, spread mixture by hand. The range of temperatures of the mixtures when dumped onto the area to be paved shall be between 250 and 300 degrees F. Mixtures having temperatures less than minimum spreading temperature when dumped onto the area to be paved will be rejected. Spread hot mixture with rakes in a uniformly loose layer of a thickness that, when compacted, will conform to the required grade, thickness, and smoothness. During hand spreading, place each shovelful of mixture by turning the shovel over in a manner that will prevent segregation. Do not place mixture by throwing or broadcasting from a shovel. Do not dump loads any faster than can be properly handled by the shovelers and rakers.

3.3 COMPACTION OF MIXTURE

Compact mixture by rolling. Begin rolling as soon as placement of mixture will bear rollers. Delays in rolling freshly spread mixture shall not be permitted. Start rolling longitudinally at the extreme sides of the lanes and proceed toward center of pavement, or toward high side of pavement with a one-way slope. Operate rollers so that each trip overlaps the previous adjacent strip by at least one foot. Alternate trips of the roller shall be of slightly different lengths. Conduct tests for conformity with the specified crown, grade and smoothness immediately after initial rolling. Before continuing rolling, correct variations by removing or adding materials as necessary. If required, subject course to diagonal rolling with the steel wheeled roller crossing the lines of the previous rolling while mixture is hot and in a compactible condition. Speed of the rollers shall be slow enough to avoid displacement of hot mixture. Correct displacement of mixture immediately by use of rakes and fresh mixture, or remove and replace mixture as directed. Continue rolling until roller marks are eliminated and course has a density of at least 95 percent but not more than 100 percent of that attained in a laboratory specimen of the same mixture prepared in accordance with ASTM D 1559. During rolling, moisten wheels of the rollers enough to prevent adhesion of mixture to wheels, but excessive water is prohibited. Operation of rollers shall be by competent and experienced operators. Provide sufficient rollers for each spreading machine in operation on the job and to handle plant output.

In places not accessible to the rollers, compact mixture thoroughly with hot hand tampers. Skin patching of an area after compaction is prohibited. Remove mixture that becomes mixed with foreign materials or is defective and replace with fresh mixture compacted to the density specified herein. Roller shall pass over unprotected edge of the course only when laying of course is to be discontinued for such length of time as to permit mixture to become cold.

3.4 JOINTS

Joints shall present the same texture and smoothness as other portions of the course, except permissible density at the joint may be up to 2 percent less than the specified course density. Carefully make joints between old and new pavement or within new pavements in a manner to ensure a thorough and continuous bond between old and new sections of the course. Vertical contact surfaces of previously constructed sections that are coated with dust, sand, or other objectionable material shall be painted with a thin uniform coat of emulsion or other approved bituminous material just before placing fresh mixture.

3.4.1 Transverse

Roller shall pass over unprotected end of freshly laid mixture only when laying of course is to be discontinued. Except when an approved bulkhead is used, cut back the edge of previously laid course to expose an even, vertical surface for the full thickness of the course. When required, rake fresh mixture against joints, thoroughly tamp with hot tampers, smooth with hot smoothers, and roll. Transverse joints in adjacent lanes shall be offset a minimum of 2 feet.

3.4.2 Longitudinal Joints

Space 6 inches apart. Do not allow joints to coincide with joints of existing pavement or previously placed courses. Spreader screed shall overlap previously placed lanes 2 to 3 inches and be of such height to permit compaction to produce a smooth dense joint. With a lute, push back mixture placed on the surface of previous lanes to the joint edge. Do not scatter mix. Remove and waste excess material. When edges of longitudinal joints are irregular, honeycombed, or poorly compacted, cut back unsatisfactory sections of joint and expose an even vertical surface for the full thickness of the course. When required, rake fresh mixture against joint, thoroughly tamp with hot tampers, smooth with hot smoothers, and roll while hot.

3.5 FIELD QUALITY CONTROL

3.5.1 Sampling

3.5.1.1 Aggregates At Source

Prior to production and delivery of aggregates, take at least one initial sample in accordance with ASTM D 75/D 75M from each stockpile. Collect each sample by taking three incremental samples at random from the source material to make a composite sample of not less than 50 pounds. Repeat the sampling when the material source changes or when testing reveals unacceptable deficiencies or variations from the specified grading of materials.

3.5.1.2 Cold Feed Aggregate Sampling

Take two samples daily from the belt conveying materials from the cold feed. Collect materials in three increments at random to make a representative composite sample of not less than 50 pounds. Take samples in accordance with ASTM D 75/D 75M.

3.5.1.3 Coarse and Fine Aggregates

Take a 50 pound sample from the cold feed at least once daily for sieve analyses and specific gravity tests. Additional samples may be required to perform more frequent tests when analyses show deficiencies, or unacceptable variances or deviations. The method of sampling is as specified herein for aggregates.

3.5.1.4 Mineral Filler

ASTM D 546. Take samples large enough to provide ample material for testing.

3.5.1.5 Pavement and Mixture

Take plant samples for the determination of mix properties and field samples for thickness and density of the completed pavements. Furnish tools, labor and material for samples, and satisfactory replacement of pavement. Take samples and tests at not less than frequency specified hereinafter and at the beginning of plant operations; for each day's work as a minimum; each change in the mix or equipment; and as often as directed. Accomplish sampling in accordance with ASTM D 979.

3.5.2 Testing

3.5.2.1 Aggregates Tests

a. Gradation: ASTM C 136.

b. Mineral Filler Content: ASTM D 546.

c. Abrasion: ASTM C 131 for wear (Los Angeles test). Perform one test initially prior to incorporation into the work and each time the source is changed.

3.5.2.2 Bituminous Mix Tests

Test one sample for each 500 tons, or fraction thereof, of the uncompacted mix for extraction in accordance with ASTM D2172/D2172M; perform a sieve analysis on each extraction sample in accordance with ASTM C 136 and ASTM C 117. Test one sample for each 500 tons or fraction thereof for stability and flow in accordance with ASTM D 1559. Test one sample for each material blend for Tensile Strength Ratio in accordance with ASTM D 4867/D 4867M.

3.5.2.3 Pavement Courses

Perform the following tests:

a. Density: For each 1000 tons of bituminous mixture placed, determine the representative laboratory density by averaging the density of four laboratory specimens prepared in accordance with ASTM D 1559. Samples

for laboratory specimens shall be taken from trucks delivering mixture to the site; record in a manner approved by the COR the project areas represented by the laboratory densities. From each representative area recorded, determine field density of pavement by averaging densities of 4 inch diameter cores obtained from leveling, binder, and wearing course s; take one core for each 2000 square yards or fraction thereof of course placed. Determine density of laboratory prepared specimens and cored samples in accordance with ASTM D 1188 or ASTM D 2726, as applicable. Separate pavement layers by sawing or other approved means. Maximum allowable deficiency at any point, excluding joints, shall not be more than 2 percent less than the specified density for any course. The average density of each course, excluding joints, shall be not less than the specified density. Joint densities shall not be more than 2 percent less than specified course densities and are not included when calculating average course densities. When the deficiency exceeds the specified tolerances, correct each such representative area or areas by removing the deficient pavement and replacing with new pavement.

b. Thickness: Determine thickness of binder and wearing courses from samples taken for the field density test. The maximum allowable deficiency at any point shall not be more than 1/4 inch less than the thickness for the indicated course. Average thickness of course or of combined courses shall be not less than the indicated thickness. Where a deficiency exceeds the specified tolerances, correct each such representative area or areas by removing the deficient pavement and replacing with new pavement.

c. Smoothness: Straightedge test the compacted surface of leveling, binder, and wearing courses as work progresses. Apply straightedge parallel with and at right angles to the centerline after final rolling. Unevenness of leveling and binder courses shall not vary more than 1/4 inch in 10 feet; variations in the wearing course shall not vary more than 1/8 inch in 10 feet. Correct each portion of the pavement showing irregularities greater than that specified.

d. Finished Grades: Finish grades of each course placed shall not vary from the finish elevations, profiles, and cross sections indicated by more than 1/2 inch. Finished surface of the final wearing course will be tested by the COR by running lines of levels at intervals of 25 feet longitudinally and transversely to determine elevations of completed pavement. Within 45 days after completion of final placement, Correct deficient paved areas by removing existing work and replacing with new materials that meet the specifications. Skin patching for correcting low areas is prohibited.

e. Finish Surface Texture of Wearing Course: Visually check final surface texture for uniformity and reasonable compactness and tightness.Final wearing course with a surface texture having undesirable irregularities such as segregation, cavities, pulls or tears, checking, excessive exposure of coarse aggregates, sand streaks, indentations, ripples, or lack of uniformity shall be removed and replaced with new materials.

3.6 PROTECTION

Do not permit vehicular traffic, including heavy equipment, on pavement until surface temperature has cooled to at least 120 degrees F. Measure surface temperature by approved surface thermometers or other satisfactory methods.

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SECTION 32 17 24.00 10

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for marking roads, streets and parking areas; this section also includes removal of paint or tape markings from pavement surfaces.

1.2 UNIT PRICES

1.2.1 Measurement

1.2.1.1 Surface Preparation

The unit of measurement for surface preparation will be the number of square feet of pavement surface prepared for marking and accepted by the COR.

1.2.1.2 Pavement Striping and Markings

The unit of measurement for pavement striping and markings will be the number of square feet of reflective and nonreflective striping or marking actually completed and accepted by the COR.

1.2.1.3 Raised Pavement Markers

The unit of measurement for raised pavement markers will be the number of square feet of each specific color required. Payment will be for the total number actually placed and approved by the COR.

1.2.1.4 Removal of Pavement Markings

The unit of measurement for removal of pavement markings shall be the number of square feet of pavement markings actually removed and accepted by the COR.

1.2.2 Payment

The quantities of surface preparation, pavement striping or markings, raised pavement markers, and removal of pavement markings determined as specified in paragraph Measurement, will be paid for at the contract unit price. The payment will constitute full compensation for furnishing all labor, materials, tools, equipment, appliances, and doing all work involved in marking pavements. Any striping or markings which are placed without reflective media, when reflective media is required, shall be removed and replaced at no cost to the Government. Striping or markings which do not conform to the alignment and/or location required shall be removed and replaced at no cost to the Government.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the

basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 247	Standard Specification for Glass Beads Used in Pavement Markings

ASTM INTERNATIONAL (ASTM)

ASTM D4280	Extended Life Type, Nonplowable, Raised, Retroreflective Pavement Markers
ASTM D4505	Preformed Retroflective Pavement Marking Tape for Extended Service Life
ASTM D792	Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM E28	Softening Point of Resins Derived from Naval Stores by Ring and Ball Apparatus

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS TT-B-1325	Beads (Glass Spheres) Retro-Reflective (Metric)
FS TT-P-1952	Paint, Traffic and Airfield Markings, Waterborne

1.4 SYSTEM DESCRIPTION

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Submit lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation. Equipment operating on roads and runways shall display low speed traffic markings and traffic warning lights.

1.4.1 Paint Application Equipment

1.4.1.1 Self-Propelled or Mobile-Drawn Pneumatic Spraying Machines

The equipment to apply paint to pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. The machine shall have a speed during application not less than 5 mph, and shall be capable of applying the stripe widths indicated, at the paint coverage rate specified in paragraph APPLICATION, and of even uniform thickness with clear-cut edges. Equipment used for marking streets and

highways shall be capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines or a combination of solid and intermittent lines using a maximum of two different colors of paint as specified. The paint applicator shall have paint reservoirs or tanks of sufficient capacity and suitable gauges to apply paint in accordance with requirements specified. Tanks shall be equipped with suitable air-driven mechanical agitators. The spray mechanism shall be equipped with quick-action valves conveniently located, and shall include necessary pressure regulators and gauges in full view and reach of the operator. Paint strainers shall be installed in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Pneumatic spray guns shall be provided for hand application of paint in areas where the mobile paint applicator cannot be used.

1.4.1.2 Hand-Operated, Push-Type Machines

All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces will be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

1.4.2 Thermoplastic Application Equipment

1.4.2.1 Thermoplastic Material

Thermoplastic material shall be applied to the primed pavement surface by spray techniques or by the extrusion method, wherein one side of the shaping die is the pavement and the other three sides are contained by, or are part of, suitable equipment for heating and controlling the flow of material. By either method, the markings shall be applied with equipment that is capable of providing continuous uniformity in the dimensions of the stripe.

1.4.2.2 Application Equipment

a. Application equipment shall provide continuous mixing and agitation of the material. Conveying parts of the equipment between the main material reservoir and the extrusion shoe or spray gun shall prevent accumulation and clogging. All parts of the equipment which come into contact with the material shall be easily accessible and exposable for cleaning and maintenance. All mixing and conveying parts up to and including the extrusion shoes and spray guns shall maintain the material at the required temperature with heat-transfer oil or electrical-element-controlled heat.

b. The application equipment shall be constructed to ensure continuous uniformity in the dimensions of the stripe. The applicator shall provide a means for cleanly cutting off stripe ends squarely and shall provide a method of applying "skiplines". The equipment shall be capable of applying varying widths of traffic markings.

c. The applicator shall be equipped with a drop-on type bead dispenser

capable of uniformly dispensing reflective glass spheres at controlled rates of flow. The bead dispenser shall be automatically operated and shall begin flow prior to the flow of composition to assure that the strip is fully reflectorized.

1.4.2.3 Mobile and Maneuverable

Application equipment shall be mobile and maneuverable to the extent that straight lines can be followed and normal curves can be made in a true arc. The equipment used for the placement of thermoplastic pavement markings shall be of two general types: mobile applicator and portable applicator.

a. Mobile Application Equipment: The mobile applicator shall be defined as a truck-mounted, self-contained pavement marking machine that is capable of hot applying thermoplastic by either the extrusion or spray method. The unit shall be equipped to apply the thermoplastic marking material at temperatures exceeding 375 degrees F, at widths varying from 3 to 12 inches and in thicknesses varying from 0.020 to 0.190 inch and shall have an automatic drop-on bead system. The mobile unit shall be capable of operating continuously and of installing a minimum of 20,000 lineal feet of longitudinal markings in an 8-hour day.

    1. The mobile unit shall be equipped with a melting kettle which holds a minimum of 6000 pounds of molten thermoplastic material. The kettle shall be capable of heating the thermoplastic composition to temperatures of 375 to 425 degrees F. A thermostatically controlled heat transfer liquid shall be used. Heating of the composition by direct flame will not be allowed. Oil and material temperature gauges shall be visible at both ends of the kettle. The mobile unit shall be equipped with a minimum of two extrusion shoes located one on each side of the truck, and shall be capable of marking simultaneous edgeline and centerline stripes. Each extrusion shoe shall be a closed, oil-jacketed unit; shall hold the molten thermoplastic at a temperature of 375 to 425 degrees F; and shall be capable of extruding a line of 3 to 8 inches in width; and at a thickness of not less than 0.125 inch nor more than 0.190 inch, and of generally uniform cross section.

    2. The mobile unit shall be equipped with an electronic programmable line pattern control system. The control system shall be capable of applying skip or solid lines in any sequence, through any and all of the extrusion shoes, or the spray guns, and in programmable cycle lengths. In addition, the mobile unit shall be equipped with an automatic counting mechanism capable of recording the number of lineal feet of thermoplastic markings applied to the pavement surface with an accuracy of 0.5 percent.

b. Portable Application Equipment: The portable applicator shall be defined as hand-operated equipment, specifically designed for placing special markings such as crosswalks, stopbars, legends, arrows, and short lengths of lane, edge and centerlines. The portable applicator shall be capable of applying thermoplastic pavement markings by the extrusion method. The portable applicator shall be loaded with hot thermoplastic composition from the melting kettles on the mobile applicator. The portable applicator shall be equipped with all the necessary components, including a materials storage reservoir, bead dispenser, extrusion shoe, and heating accessories, so as to be capable of holding the molten thermoplastic at a temperature of 375 to 425

degrees F, of extruding a line of 3 to 12 inches in width, and in thicknesses of not less than 0.125 inch nor more than 0.190 inch and of generally uniform cross section.

1.4.3 Reflective Media Dispenser

The dispenser for applying the reflective media shall be attached to the paint dispenser and shall operate automatically and simultaneously with the applicator through the same control mechanism. The dispenser shall be capable of adjustment and designed to provide uniform flow of reflective media over the full length and width of the stripe at the rate of coverage specified in paragraph APPLICATION, at all operating speeds of the applicator to which it is attached.

1.4.4 Preformed Tape Application Equipment

Mechanical application equipment shall be used for the placement of preformed marking tape. Mechanical application equipment shall be defined as a mobile pavement marking machine specifically designed for use in applying precoated, pressure-sensitive pavement marking tape of varying widths, up to 12 inches. The applicator shall be equipped with rollers, or other suitable compactive device, to provide initial adhesion of the preformed, pressure-sensitive marking tape with the pavement surface. Additional hand-operated rollers shall be used as required to properly seat the thermoplastic tape.

1.4.5 Surface Preparation Equipment

1.4.5.1 Sandblasting Equipment

Sandblasting equipment shall include an air compressor, hoses, and nozzles of proper size and capacity as required for cleaning surfaces to be painted. The compressor shall be capable of furnishing not less than 150 cfm of air at a pressure of not less than 90 psi at each nozzle used, and shall be equipped with traps that will maintain the compressed air free of oil and water.

1.4.5.2 Waterblast Equipment

The water pressure shall be specified at 2600 psi at 140 degrees F in order to adequately clean the surfaces to be marked.

1.4.6 Marking Removal Equipment

Equipment shall be mounted on rubber tires and shall be capable of removing markings from the pavement without damaging the pavement surface or joint sealant. Waterblasting equipment shall be capable of producing an adjustable, pressurized stream of water. Sandblasting equipment shall include an air compressor, hoses, and nozzles. The compressor shall be equipped with traps to maintain the air free of oil and water.

1.4.6.1 Shotblasting Equipment

Shotblasting equipment shall be capable of producing an adjustable depth of removal of marking and pavement. Each unit shall be self-cleaning and self-contained, shall be able to confine dust and debris from the operation, and shall be capable of recycling the abrasive for reuse.

1.4.6.2 Chemical Equipment

Chemical equipment shall be capable of application and removal of chemicals from the pavement surface, and shall leave only non-toxic biodegradable residue.

1.5 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment
Composition Requirements
Qualifications

SD-06 Test Reports

Sampling and Testing

SD-07 Certificates

Volatile Organic Compound (VOC)

1.6 QUALITY ASSURANCE

1.6.1 Qualifications

Submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of chemicals.

1.6.2 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.6.3 Maintenance of Traffic

1.6.3.1 Airfield

The performance of work in the controlled zones of airfields shall be coordinated with the COR and with the Flight Operations Officer. Verbal communications shall be maintained with the control tower before and during work in the controlled zones of the airfield. The control tower shall be advised when the work is completed. A radio for this purpose will be provided by the Government .

1.6.3.2 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

1.7 DELIVERY, STORAGE, AND HANDLING

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

1.8 ENVIRONMENTAL REQUIREMENTS

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 40 degrees F and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the effectiveness of material removal.

PART 2 PRODUCTS

2.1 PAINT

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paints for airfields, roads, parking areas, and streets shall conform to FS TT-P-1952, color as indicated . Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.

2.2 THERMOPLASTIC COMPOUNDS

The thermoplastic reflectorized pavement marking compound shall be extruded or sprayed in a molten state onto a primed pavement surface. Following a surface application of glass beads and upon cooling to normal pavement temperatures, the marking shall be an adherent reflectorized strip of the specified thickness and width that is capable of resisting deformation by traffic.

2.2.1 Composition Requirements

Submit Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use. The binder component shall be formulated as a hydrocarbon resin. The pigment, beads and filler shall be uniformly dispersed in the binder resin. The thermoplastic composition shall be free from all skins, dirt, and foreign objects and shall comply with the following requirements:

Component	Percent by Weight	
	White	Yellow
Binder	17 min.	17 min.
Titanium dioxide	10 min.	-
Glass beads	20 min.	20 min.
Calcium carbonate and inert fillers	49 max.	*
Yellow pigments	-	*
*Amount and type of yellow pigment, calcium carbonate and inert fillers shall be at the option of the manufacturer, providing the other composition requirements of this specification are met.		

2.2.2 Physical Properties

2.2.2.1 Color

The color shall be as indicated.

2.2.2.2 Drying Time

When installed at 70 degrees F and in thicknesses between 1/8 and 3/16 inch, after curing 15 minutes.

2.2.2.3 Softening Point

The composition shall have a softening point of not less than 194 degrees F when tested in accordance with ASTM E28.

2.2.2.4 Specific Gravity

The specific gravity of the composition shall be between 1.9 and 2.2 as determined in accordance with ASTM D792.

2.2.3 Asphalt Concrete Primer

The primer for asphalt concrete pavements shall be a thermosetting adhesive with a solids content of pigment reinforced synthetic rubber and synthetic plastic resin dissolved and/or dispersed in a volatile organic compound (VOC). Submit certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located. Solids content shall not be less than 10 percent by weight at 70 degrees F and 60 percent relative humidity. A wet film thickness of 0.005 inch plus or minus 0.001 inch, shall dry to a tack-free condition in less than 5 minutes.

2.2.4 Portland Cement Concrete Primer

The primer for Portland cement concrete pavements shall be an epoxy resin primer. The primer shall be of the type recommended by the manufacturer of the thermoplastic composition. Epoxy primers recommended by the manufacturer shall be approved by the COR prior to use. Requests for approval shall be accompanied with technical data, instructions for use, and a 1 quart sample of the primer material.

2.3 PREFORMED TAPE

The preformed tape shall be an adherent reflectorized strip in accordance with ASTM D4505 Type I or IV, Class optional.

2.4 RAISED REFLECTIVE MARKERS

Either metallic or nonmetallic markers of the button or prismatic reflector type may be used. Markers shall be of permanent colors, as specified for pavement marking, and shall retain the color and brightness under the action of traffic. Button markers shall have a diameter of not less than 4 inches, and shall be spaced not more than 40 feet apart on solid longitudinal lines. Broken centerline marker spacings shall be in segments indicated with gaps indicated between segments. Markers shall have rounded surfaces presenting a smooth contour to traffic and shall not project more than 3/4 inch above level of pavement. Pavement markers and adhesive epoxy shall conform to ASTM D4280.

2.5 REFLECTIVE MEDIA

Reflective media for airfields shall conform to FS TT-B-1325, Type I, Gradation A. Reflective media for roads and streets shall conform to FS TT-B-1325, Type I, Gradation A or AASHTO M 247, Type I.

2.6 SAMPLING AND TESTING

Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at source of supply, sufficiently in advance of needs to allow 60 days for testing. Submit certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory. Upon notification by the Contractor that the material is at the site or source of supply, a sample shall be taken by random selection from sealed containers in the presence of the COR. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number, intended use, and quantity involved. Testing shall be performed in an approved independent laboratory. If materials are approved based on reports furnished by the Contractor, samples will be retained by the Government for possible future testing should the material appear defective during or after application.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Thoroughly clean surfaces to be marked before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, sandblasting, approved chemicals, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

3.1.1 Pretreatment for Early Painting

Where early painting is required on rigid pavements, apply a pretreatment with an aqueous solution, containing 3 percent phosphoric acid and 2 percent zinc chloride, to prepared pavement areas prior to painting.

3.1.2 Cleaning Existing Pavement Markings

In general, markings shall not be placed over existing pavement marking patterns. Remove existing pavement markings, which are in good condition but interfere or conflict with the newly applied marking patterns. Deteriorated or obscured markings that are not misleading or confusing or interfere with the adhesion of the new marking material do not require removal. New preformed and thermoplastic pavement markings shall not be applied over existing preformed or thermoplastic markings. Whenever grinding, scraping, sandblasting or other operations are performed the work must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

3.1.3 Cleaning Concrete Curing Compounds

On new portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, thermoplastic and preformed markings shall be applied no sooner than 24 hours after the blasting has been completed. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.

b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.

c. All remaining curing compound is intact; all loose and flaking material is removed.

d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.

e. The surface to be marked is dry.

3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

3.2.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 40 degrees F and less than 95 degrees F. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces and new Portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint. Paint shall be applied pneumatically with approved equipment at rate of coverage specified . Provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

3.2.1.1 Rate of Application

a. Reflective Markings: Pigmented binder shall be applied evenly to the pavement area to be coated at a rate of 105 plus or minus 5 square feet/gallon. Glass spheres shall be applied uniformly to the wet paint on airfield pavement at a rate of 8, on road and street pavement at a rate of 6 plus or minus 0.5 pounds of glass spheres per gallon of paint.

b. Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 105 plus or minus 5 square feet/gallon.

3.2.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

3.2.2 Thermoplastic Compounds

Thermoplastic pavement markings shall be placed upon dry pavement; surface dry only will not be considered an acceptable condition. At the time of installation, the pavement surface temperature shall be a minimum of 40 degrees F and rising. Thermoplastics, as placed, shall be free from dirt or tint.

3.2.2.1 Longitudinal Markings

All centerline, skipline, edgeline, and other longitudinal type markings shall be applied with a mobile applicator. All special markings, crosswalks, stop bars, legends, arrows, and similar patterns shall be placed with a portable applicator, using the extrusion method.

3.2.2.2 Primer

After surface preparation has been completed the asphalt and/or concrete pavement surface shall be primed. The primer shall be applied with spray equipment. Primer materials shall be allowed to "set-up" prior to applying the thermoplastic composition. The asphalt concrete primer shall be allowed to dry to a tack-free condition, usually occurring in less than 10 minutes. The Portland cement concrete primer shall be allowed to dry in accordance with the thermoplastic manufacturer's recommendations. To shorten the curing time of the epoxy resins an infrared heating device may be used on the concrete primer.

a. Asphalt Concrete Primer: Primer shall be applied to all asphalt concrete pavements at a wet film thickness of 0.005 inch, plus or minus 0.001 inch (265-400 square feet/gallon).

b. Portland Cement Concrete Primer: Primer shall be applied to all concrete pavements (including concrete bridge decks) at a wet film thickness of between 0.04 to 0.05 inch (320-400 square feet/gallon).

3.2.2.3 Markings

After the primer has "set-up", the thermoplastic shall be applied at temperatures no lower than 375 degrees F nor higher than 425 degrees F at the point of deposition. Immediately after installation of the marking, drop-on glass spheres shall be mechanically applied so that the spheres are held by and imbedded in the surface of the molten material.

a. Extruded Markings: All extruded thermoplastic markings shall be applied at the specified width and at a thickness of not less than 0.125 inch nor more than 0.190 inch.

b. Sprayed Markings: All sprayed thermoplastic markings shall be applied at the specified width and the thicknesses designated in the contract plans. If the plans do not specify a thickness, centerline markings shall be applied at a wet thickness of 0.090 inch, plus or minus 0.005 inch, and edgeline markings at a wet thickness of 0.060 inch plus or minus 0.005 inch.

c. Reflective Glass Spheres: Immediately following application, reflective glass spheres shall be dropped onto the molten thermoplastic marking at the rate of 1 pound/20 square feet of compound.

3.2.3 Preformed Tape

The pavement surface temperature shall be a minimum of 60 degrees F and the ambient temperature shall be a minimum of 60 degrees F and rising. The preformed markings shall be placed in accordance with the manufacturer's written instructions.

3.2.4 Raised Reflective Markers

Prefabricated markers shall be aligned carefully at the required spacing and permanently fixed in place by means of epoxy resin adhesives. To insure good bond, pavement in areas where markers will be set shall be thoroughly cleaned by sandblasting and use of compressed air prior to applying adhesive.

3.2.5 Reflective Media

Application of reflective media shall immediately follow application of pigmented binder. Drop-on application of glass spheres shall be accomplished to insure that reflective media is evenly distributed at the specified rate of coverage. Should there be malfunction of either paint applicator or reflective media dispenser, operations shall be discontinued immediately until deficiency is corrected.

3.3 MARKING REMOVAL

Pavement marking, including plastic tape, shall be removed in the areas shown on the drawings. Removal of marking shall be as complete as possible without damage to the surface. Aggregate shall not be exposed by the removal process. After the markings are removed, the cleaned pavement surfaces shall exhibit adequate texture for remarking as specified in paragraph SURFACE PREPARATION. Demonstrate removal of pavement marking in an area designated by the COR. The demonstration area will become the standard for the remainder of the work.

3.3.1 Equipment Operation

Equipment shall be controlled and operated to remove markings from the pavement surface, prevent dilution or removal of binder from underlying pavement, and prevent emission of blue smoke from asphalt or tar surfaces.

3.3.2 Cleanup and Waste Disposal

The worksite shall be kept clean of debris and waste from the removal operations. Cleanup shall immediately follow removal operations in areas subject to air traffic. Debris shall be disposed of at approved sites.

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SECTION 32 31 13

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for steel fencing, including posts, fabric, gates, and miscellaneous accessories.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM A116	Standard Specification for Metallic-Coated, Steel Woven Wire Fence Fabric
ASTM A153/A153M	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A702	Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought
ASTM A780/A780M	Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A90/A90M	Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings
ASTM B117	Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM C94/C94M	Standard Specification for Ready-Mixed Concrete
ASTM F 1043	Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	Standard Specification for Pipe, Steel, Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures

ASTM F 567	Standard Practice for Installation of Chain Link Fence
ASTM F 626	Standard Specification for Fence Fittings
ASTM F 883	Padlocks
ASTM G 152	Operating Open Flame Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G 153	Operating Enclosed Carbon Arc Light Apparatus for Exposure of Nonmetallic Materials
ASTM G 154	Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials
ASTM G 155	Standard Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS RR-F-191	Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories)
FS RR-F-191/1	Fencing, Wire and Post, Metal (Chain-Link Fence Fabric)
FS RR-F-191/2	Fencing, Wire and Post, Metal (Chain-Link Fence Gates)
FS RR-F-191/3	Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces)
FS RR-F-191/4	Fencing, Wire and Post, Metal (Chain-Link Fence Accessories)

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fence Assembly

Location of Gate, Corner, End, and Pull Posts

Gate Assembly

Gate Hardware and Accessories

Erection/Installation Drawings

SD-03 Product Data

Fence Assembly

Gate Assembly

Gate Hardware and Accessories

Recycled Material Content

Zinc Coating

PVC Coating

Aluminum Alloy Coating

Fabric

Stretcher Bars

Concrete

SD-04 Samples

Fabric

SD-07 Certificates

Certificates of Compliance

SD-08 Manufacturer's Instructions

Fence Assembly

Gate Assembly

Hardware Assembly

Accessories

1.4 ASSEMBLY AND INSTALLATION INSTRUCTIONS

Submit manufacturer's erection/installation drawings and instructions that detail proper assembly and materials in the design for fence, gate, hardware and accessories.

Submit erection/installation drawings along with manufacturer's catalog data for complete fence assembly, gate assembly, hardware assembly and accessories.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

1.6 QUALITY ASSURANCE

1.6.1 Required Report Data

Submit reports of listing of chain-link fencing and accessories regarding weight in ounces for zinc coating.

1.6.2 Certificates of Compliance

Submit certificates of compliance in accordance with the applicable reference standards and descriptions of this section for the following:

a. Zinc coating

b. Fabric. Stretcher bars

d. Gate hardware and accessories

e. Concrete

PART 2 PRODUCTS

2.1 GENERAL

Provide fencing materials conforming to the requirements of ASTM A116, ASTM A702, ASTM F 626, and as specified.

Submit manufacturer's data indicating percentage of recycled material content in protective fence materials, including chain link fence, fabric, and gates to verify affirmative procurement compliance.

2.2 ZINC COATING

Provide hot-dip galvanized (after fabrication) ferrous-metal components and accessories, except as otherwise specified.

Provide zinc coating of weight not less than 1.94 ounces per square foot, as determined from the average result of two specimens, when tested in accordance with ASTM A90/A90M.

Provide zinc coating conforming to the requirements of the following:

a. Pipe: FS RR-F-191/3 Class 1 Grade A in accordance with ASTM F 1083.

b. Hardware and accessories: ASTM A153/A153M, Table 1

c. Surface: ASTM F 1043

d. External: Type B-B surface zinc with organic coating, 0.97 ounce per square foot minimum thickness of acrylated polymer.

e. Internal: Surface zinc coating of 0.97 ounce per square foot minimum.

Provide galvanizing repair material that is cold-applied zinc-rich coating conforming to ASTM A780/A780M.

2.3 FABRIC

FS RR-F-191 and detailed specifications as referenced and other requirements as specified.

FS RR-F-191/1; Type I, zinc-coated steel, 9 gage Mesh size, 2 inches. Provide selvage knuckled at one selvage and twisted and barbed at the other. Height of fabric, as indicated.

Provide fabric consisting of No. 9-gage wires woven into a 2-inch diamond mesh, with dimensions of fabric and wire conforming to ASTM A116, ASTM A702 and ASTM F 626, with 2.0 ounces per square foot zinc galvanizing.

Provide one-piece fabric widths for fence heights up to 12 feet.

2.4 TOP AND BOTTOM SELVAGES

Provide knuckled selvages at top and bottom for fabric with 2 inch mesh and up to 60 inches high, and if over 60 inches high, provide twisted and barbed top selvage and knuckled bottom selvage.

2.5 POSTS, TOP RAILS, BOTTOM RAILS AND BRACES

FS RR-F-191/3 line posts; Class 1, steel pipe, Grade A. End, corner, and pull posts; Class 1, steel pipe, Grade A. Braces and rails; Class 1, steel pipe, Grade A, in minimum sizes listed in FS RR-F-191/3 for each class and grade unless specified on the drawings.

2.6 LINE POSTS

Minimum acceptable line posts are as follows:

Up to 6-feet high:

Grade A: 1.900 inch O.D. pipe weighing 2.72 pounds per linear foot.

Over 6-feet high:

2.0 inch O.D. pipe weighing 3.65 pounds per linear foot.

2.7 END, CORNER, AND PULL POSTS

Provide minimally acceptable end, corner, and pull posts as follows:

Up to 6 feet high:

Grade A: 2.375 inch O.D. pipe weighing 3.65 pounds per linear foot.

Over 6 feet high:

Grade A: 2.875 inch O.D. pipe weighing 5.79 pounds per linear foot.

2.8 SLEEVES

Provide sleeves for setting into concrete construction of the same material as post sections, sized 1-inch greater than the diameter or dimension of the post. Weld flat plates to each sleeve base to provide anchorage and prevent intrusion of concrete.

2.9 TOP RAIL

Provide a minimum of 1.660 inches O.D. pipe rails. Grade A weighing 2.27 pounds per linear foot. Provide expansion couplings 6-inches long at each joint in top rails.

2.10 CENTER RAILS BETWEEN LINE POSTS

For fencing over 6-feet high, provide 1.660 inches O.D. pipe center rails,

Grade A weighing 2.27 pounds per linear foot.

2.11 BOTTOM RAIL

Provide bottom rail conforming to minimum sizes specified in FS RR-F-191/3 for each class and grade unless members are to be oversized.

2.12 POST-BRACE ASSEMBLY

Provide bracing consisting of 1.660 inches O.D. pipe Grade A weighing 2.27 pounds per linear foot and 3/8 inch adjustable truss rods and turnbuckles.

2.13 TENSION WIRE

Provide galvanized wire, No. 7-gage, coiled spring wire, provided at the bottom of the fabric only. Provide zinc coating that weighs not less than 2.0 ounces per square foot.

2.14 STRETCHER BARS

Provide bars that have one-piece lengths equal to the full height of the fabric with a minimum cross section of 3/16 by 3/4 inch, in accordance with ASTM A116, ASTM A702 and ASTM F 626.

2.15 POST TOPS

Provide tops that are steel, wrought iron, or malleable iron designed as a weathertight closure cap. Provide one cap for each post, unless equal protection is provided by a combination post-cap and barbed-wire supporting arm. Provide caps with an opening to permit through passage of the top rail.

2.16 STRETCHER BAR BANDS

Provide bar bands for securing stretcher bars to posts that are steel, wrought iron, or malleable iron spaced not over 15 inches on center. Bands may also be used in conjunction with special fittings for securing rails to posts. Provide bands with projecting edges chamfered or eased.

2.17 GATE POSTS

Provide a gate post for supporting each gate leaf as follows:

Up to 6-feet wide:

2.875 inch O.D. pipe Grade A weighing 5.79 pounds per linear foot.

Over 6 feet wide and up to 13 feet wide:

2.875 inch O.D. pipe Grade A weighing 5.79 pounds per linear foot.

Over 13-feet and up to 18-feet wide:

Provide 6.625 inch O.D. pipe weighing 18.97 pounds per linear foot.

Over 18-feet wide:

Provide 8.625 inch O.D. pipe weighing 24.70 pounds per linear foot.

2.18 GATES

FS RR-F-191/2; Type I, single swing, II, double swing, III, single cantilever sliding, wheel sliding gate IV, double cantilever sliding. Shape and size of gate frame, as indicated. Framing and bracing members, round of steel alloy. Steel member finish, zinc-coated. Provide gate frames and braces of minimum sizes listed in FS RR-F-191/3 for each Class and Grade, except that steel pipe frames are a minimum of 1.90 inches o.d., 0.120 inches minimum wall thickness and aluminum pipe frames and intermediate braces are 1.869 inches o.d. minimum, 0.940 lb/ft of length. Gate fabric, is as specified for fencing fabric. Coating for steel latches, stops, hinges, keepers, and accessories, galvanized. Provide plunger bar type gate latches or special gate frames, as indicated on the drawings. Provide truss rods or intermediate braces for gate leaves less than 8 feet wide. Attach gate fabric to gate frame in accordance with manufacturer's standards, except that welding is not permitted. Arrange padlocking latches to be accessible from both sides of gate, regardless of latching arrangement.

For gate leaves up to 6-feet high or 6-feet wide, provide perimeter gate frames of 1.66 inch O.D. pipe Grade A weighing 2.27 pounds per linear foot.

For gate leaves over 6 feet high or 6 feet wide, provide perimeter gate frames of 1.90 inch O.D. pipe Grade A weighing 2.72 pounds per linear foot.

Provide gate frame assembly that is welded or assembled with special malleable or pressed-steel fittings and rivets to provide rigid connections. Install fabric with stretcher bars at vertical edges; stretcher bars may also be used at top and bottom edges. Attach stretcher bars and fabric to gate frames on all sides at intervals not exceeding 15 inches. Attach hardware with rivets or by other means which provides equal security against breakage or removal.

Provide diagonal cross-bracing, consisting of 3/8-inch diameter adjustable-length truss rods on welded gate frames, where necessary to obtain frame rigidity without sag or twist. Provide nonwelded gate frames with diagonal bracing.

2.19 GATE HARDWARE AND ACCESSORIES

Provide gate hardware and accessories that conforms to ASTM A116, ASTM A702, ASTM F 626, and be as specified:

Provide malleable iron hinges to suit gate size, non-lift-off type, offset to permit 180-degree opening.

Provide latch that permits operation from either side of the gate, with a padlock eye provided as an integral part of the latch.

Provide stops and holders of malleable iron for vehicular gates. Provide stops that automatically engage the gate and hold it in the open position until manually released.

Provide double gates with a cane bolt and ground-set keeper, with latch or locking device and padlock eye designed as an integral part.

Provide manufacturer's standard heavy-duty track ball bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, and accessories as required for easy operation of manual sliding gates.

2.20 MISCELLANEOUS HARDWARE

Provide miscellaneous hot-dip galvanized hardware as required.

2.21 WIRE TIES

Provide 16-gage galvanized steel wire for tying fabric to line posts,spaced 12 inches on center. For tying fabric to rails and braces, space wire ties 24 inches on center. For tying fabric to tension wire, space 0.105-inch hog rings 24 inches on center.

Manufacturer's standard procedure will be accepted if of equal strength and durability.

FS RR-F-191/4. Provide wire ties constructed of the same material as the fencing fabric.

2.22 CONCRETE

Provide concrete conforming to ASTM C94/C94M, and obtaining a minimum 28-day compressive strength of 3,000 psi.

2.23 GROUT

Provide grout of proportions one part portland cement to three parts clean, well-graded sand and a minimum amount of water to produce a workable mix.

2.24 PADLOCKS

Padlocks provided by Government conforming to ASTM F 883, with chain.

PART 3 EXECUTION

Provide complete installation conforming to ASTM F 567.

3.1 GENERAL

Ensure final grading and established elevations are complete prior to commencing fence installation.

3.2 EXCAVATION

Provide excavations for post footings which are drilled holes in virgin or compacted soil, of minimum sizes as indicated.

Space footings for line posts 10 feet on center maximum and at closer intervals when indicated, with bottoms of the holes approximately 3-inches below the bottoms of the posts. Set bottom of each post not less than 36-inches below finished grade when in firm, undisturbed soil. Set posts deeper, as required, in soft and problem soils and for heavy, lateral loads.

Uniformly spread soil from excavations adjacent to the fence line or on areas of Government property, as directed.

If solid rock is below the soil overburden, drill to the full depth required except that penetration into rock need not exceed the minimum depths specified above.

3.3 SETTING POSTS

Remove loose and foreign materials from holes and the soil moistened prior to placing concrete.

Provide tops of footings that are trowel finished and sloped or domed to shed water away from posts. Set hold-open devices, sleeves, and other accessories in concrete.

Keep exposed concrete moist for at least 5 working days after placement or cured with a membrane curing material, as approved.

Maintain vertical alignment of posts set in concrete construction until concrete has set.

3.3.1 Earth and Bedrock

Provide concrete bases of dimensions indicated. Compact concrete to eliminate voids, and finish to a dome shape.

3.3.2 Concrete Slabs and Walls

Set posts into zinc-coated sleeves, set in concrete slab or wall, to a minimum depth of 12 inches. Fill sleeve joint with lead, nonshrink grout, or other approved material. Set posts for support of removable fence sections into sleeves that provide a tight sliding joint and hold posts aligned and plumb without use of lead or setting material.

3.3.3 Bracing

Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 12 inches below top of fence, and two diagonal tension rods.

3.4 CONCRETE STRENGTH

Provide concrete that has attained at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than 5 working days after placement, before rails, tension wire, or fabric are installed. Do not stretch fabric and wires or hang gates until the concrete has attained its full design strength.

Take samples and test concrete to determine strength as specified according to Section 03 30 00 CAST-IN-PLACE CONCRETE.

3.5 TOP RAILS

Provide top rails that run continuously through post caps or extension arms, bending to radius for curved runs. Provide expansion couplings as recommended by the fencing manufacturer.

3.6 CENTER RAILS

Provide single piece center rails between posts set flush with posts on the fabric side, using special offset fittings where necessary.

3.7 BRACE ASSEMBLY

Provide bracing assemblies at end and gate posts and at both sides of

corner and pull posts, with the horizontal brace located at midheight of the fabric.

Install brace assemblies so posts are plumb when the diagonal rod is under proper tension.

Provide two complete brace assemblies at corner and pull posts where required for stiffness and as indicated.

3.8 TENSION WIRE INSTALLATION

Install tension wire by weaving them through the fabric and tying them to each post with not less than 7-gage galvanized wire or by securing the wire to the fabric with 10-gage ties or clips spaced 24 inches on center.

3.9 FABRIC INSTALLATION

Provide fabric in single lengths between stretch bars with bottom barbs placed approximately 1-1/2-inches above the ground line. Pull fabric taut and tied to posts, rails, and tension wire with wire ties and bands.

Install fabric on the security side of fence, unless otherwise directed.

Ensure fabric remains under tension after the pulling force is released.

3.10 STRETCHER BAR INSTALLATION

Thread stretcher bars through or clamped to fabric 4 inches on center and secured to posts with metal bands spaced 15 inches on center.

3.11 GATE INSTALLATION

Install gates plumb, level, and secure, with full opening without interference. Install ground set items in concrete for anchorage as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricated where necessary.

3.12 TIE WIRES

Provide tie wires that are U-shaped to the pipe diameters to which attached. Twist ends of tie wires not less than two full turns and bent so as not to present a hazard.

3.13 FASTENERS

Install nuts for tension bands and hardware on the side of the fence opposite the fabric side. Peen ends of bolts to prevent removal of nuts.

3.14 ZINC-COATING REPAIR

Clean and repair galvanized surfaces damaged by welding or abrasion, and cut ends of fabric, or other cut sections with specified galvanizing repair material applied in strict conformance with the manufacturer's printed instructions.

3.15 TOLERANCES

Provide posts that are straight and plumb within a vertical tolerance of 1/4 inch after the fabric has been stretched. Provide fencing and gates

that are true to line with no more than 1/2 inch deviation from the established centerline between line posts. Repair defects as directed.

3.16 SITE PREPARATION

3.16.1 Clearing and Grading

Clear fence line of trees, brush, and other obstacles to install fencing. Establish a graded, compacted fence line prior to fencing installation.

3.17 FENCE INSTALLATION

Install fence on prepared surfaces to line and grade indicated. Secure fastening and hinge hardware in place to fence framework by peening or welding. Allow for proper operation of components. Coat peened or welded areas with a repair coating matching original coating. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.

3.17.1 Post Spacing

Provide line posts spaced equidistantly apart, not exceeding 10 feeton center. Provide gate posts spaced as necessary for size of gate openings. Do not exceed 500 feet on straight runs between braced posts. Provide corner or pull posts, with bracing in both directions, for changes in direction of 15 degrees or more, or for abrupt changes in grade. Provide drawings showing location of gate, corner, end, and pull posts.

3.17.2 Top and Bottom Tension Wire

Install top and bottom tension wires before installing chain-link fabric, and pull wires taut. Place top and bottom tension wires within 8 inches of respective fabric line.

3.18 ACCESSORIES INSTALLATION

3.18.1 Post Caps

Design post caps to accommodate top rail. Install post caps as recommended by the manufacturer.

3.18.2 Padlocks

Padlocks will be provided by the Governmentfor gate openings. Provide chains that are securely attached to gate or gate posts.

3.19 GROUNDING

Ground fencing as indicated on drawings and specified.

Ground all fences crossed by overhead powerlines in excess of 600 volts, and all electrical equipment attached to the fence. Ground fences on each side of all gates, at each corner, at the closest approach to each building located within 50 feet of the fence, and where the fence alignment changes more than 15 degrees. Grounding locations can not exceed 650 feet. Bond each gate panel with a flexible bond strap to its gate post. Ground fences crossed by powerlines of 600 volts or more at or near the point of crossing and at distances not exceeding 150 feet on each side of crossing. Provide ground conductor consisting of No. 8 AWG solid copper wire. Provide

copper-clad steel rod grounding electrodes 3/4 inch by 10 foot long. Drive electrodes into the earth so that the top of the electrode is at least 6 inches below the grade. Where driving is impracticable, bury electrodes a minimum of 12 inches deep and radially from the fence, with top of the electrode not less than 2 feet or more than 8 feet from the fence. Clamp ground conductor to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. Total resistance of the fence to ground cannot exceed 25 ohms

3.20 SECURITY

Install new security fencing, remove existing security fencing, and perform related work to provide continuous security for facility. Schedule and fully coordinate work with COR and cognizant Security Officer.

3.21 SECURITY SLATS INSTALLATION

Privacy slats: install slots in direction indicated, securely locked in place, vertically for privacy factor of 70 to 75.

3.22 CLEANUP

Remove waste fencing materials and other debris from the work site.

-- End of Section --

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DIVISION 33 - UTILITIES

SECTION 33 05 23.13

UTILITY HORIZONTAL DIRECTIONAL DRILLING

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PART 2 PRODUCTS

2.1 DRILL ROD Select the appropriate drill rod to be used.Submit certified statement that the drill rod has been inspected and is in satisfactory condition for its intended use.
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SECTION 33 05 23.13

UTILITY HORIZONTAL DIRECTIONAL DRILLING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for directional drilling systems, equipment, piping and procedures.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM D1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

29 CFR 1926.652	Safety and Health Regulations for Construction; Subpart P, Excavations; Requirements for Protective Systems

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Statement of Qualifications and Records or previous similar jobs.

Submit Soil Test Data prior to commencement of drilling/excavation work.

SD-02 Shop Drawings

Record Drawings

SD-03 Product Data

Submit Manufacturer's Catalog Data for the polyethylene pipe.

SD-07 Certificates

Drill Rod

SD-08 Manufacturer's Instructions

Material Safety Data Sheets

SD-11 Closeout Submittals

Work Complete Logs of Guided Directional Drill Operations

1.4 COMMENCEMENT, DELIVERY, STORAGE, AND HANDLING OF MATERIALS

Prior to commencement of the work, submit the following to the Engineer of Record for review and approval:

Manufacturer's Catalog Data

Material Safety Data Sheets

Statement of Qualifications and Records

Soil Test Data

Provide written documentation of conformance with ASTM D1557. Submit a complete list of all drilling fluids, additives, and mixtures to be used along with Material Safety Data Sheets.

Inspect materials delivered to the site for damage. All materials found during inspection or during the progress of work to have cracks, flaws, surface abrasions, or other defects will be rejected. Remove defective materials from the job site.

Disposal of fluids is the responsibility of the Contractor. Dispose of fluids in a manner that is in compliance with all permits and applicable federal, state, and local regulations. The Contractor may dispose of the drilling fluids on approved land owned by the Government subject to written approval from the COR. Spread the drilling slurry over the Government-approved disposal area and plow into the soil.

1.5 QUALIFICATIONS

Ensure that Contractor and his field supervisor assigned to this project are experienced in work of this nature and have successfully completed similar projects of similar length, pipe type, pipe size, and soil type using directional drilling in the last three (3) years. As part of the bid submission, submit a description of such project(s) which include, at a minimum, a listing of the location(s), date of project(s), owner, pipe type, size installed, length of installation, type, and manufacturer of equipment used, and other information relevant to the successful completion of the project.

1.6 SAFETY

Include in directional drilling equipment machine safety requirements a common grounding system to prevent electrical shock in the event of underground electrical cable strike. Ensure the grounding system connects

all pieces of interconnecting machinery; the drill, mud mixing system, drill power unit, drill rod trailer, operators booth, worker grounding mats, and any other interconnected equipment to a common ground. Equip the drill with an "electrical strike" audible and visual warning system that notifies the system operators of an electrical strike.

PART 2 PRODUCTS

2.1 DRILL ROD

Select the appropriate drill rod to be used.Submit certified statement that the drill rod has been inspected and is in satisfactory condition for its intended use.

2.2 PRODUCT

Install piping as indicated on the Drawings or as approved by the COR.

2.3 DRILLING FLUIDS

Use a high quality bentonite drilling fluid to ensure hole stability, cuttings transport, bit and electronics cooling, and hole lubrication to reduce drag on the drill pipe and the product pipe. Use only fluid with a composition which complies with all federal, state, and local environmental regulations.

Mix the bentonite drilling fluid with potable water (of proper pH) to ensure no contamination is introduced into the soil during the drilling, reaming, or pipe installation process. The Contractor is responsible for any required pH adjustments.

Disposal of the drilling fluids is the responsibility of the Contractor. Conduct disposal in compliance with all relative environmental regulations, right-of-way and work space agreements, and permit requirements.

Collect drilling fluid returns in the entrance pit, exit pit, or spoils recovery pit. Immediately clean up any drilling fluid spills or overflows from these pits.

PART 3 EXECUTION

3.1 DRILL SET-UP AREA

The Contractor is responsible for design and construction of the drill entrance and exit pits.

3.2 DRILL ENTRANCE AND EXIT PITS

Drill entrance and exit pits are required. Maintain at minimum size to allow only the minimum amount of drilling fluid storage prior to transfer to mud recycling or processing system or removal from the site.

Do not allow drilling mud to flow freely on the site or around the entrance or exit pits. Remove spilled mud and restore ground to original condition. Provide shore pits in compliance with OSHA Standards, 29 CFR 1926.652.

When drilling near wetlands or water courses, provide secondary containment to prevent drilling fluids from entering the wetlands, and secure written approval of secondary containment plan from the COR.

3.3 DRILL ENTRANCE AND EXIT ANGLE

Ensure entrance and exit angles and elevation profile maintains adequate cover to reduce risk of drilling fluid breakouts and ground exit occurs as specified herein. Ensure that entrance and exit angles ensure pullback forces do not exceed 5 percent strain on the polyethylene pipe.

3.4 PILOT HOLE

The type and size of the pilot string cutting head and the diameter of the drill pipe is at the Contractor's discretion.

Drill the pilot hole along the path shown on the plan and profile drawings. Pilot hole tolerances are as follows:

a. Vertical Tolerance: Provide minimum cover below channel bottom as specified on the plans. The Contractor may go deeper if necessary to prevent breakout.

b. Horizontal Tolerance: plus/minus - 60 inches from the centerline of the product pipe.

c. Curve Radius: No curve is acceptable with a radius less than 1,000 feet.

d. Entry Point Location: Make pilot hole entry point within plus/minus - 60 inches of the location shown on the drawings or as directed by the COR in the field.

e. Exit Point Location: Make the exit point location within plus/minus - 60 inches of the location shown on the drawings or as directed by the COR in the field.

f. The installed pipeline cover requirements as shown on the drawings or as specified is mandatory.

3.5 REAMING

Conduct reaming operations at the Contractor's discretion. Determine the type of back reamer to be utilized by the type of subsurface soil conditions that are encountered during the pilot hole drilling operation. The reamer type is at the Contractor's discretion.

3.6 PULL BACK

Fully assemble the entire pipeline to be installed via direction drill prior to commencement of pull back operations.

Support the pipeline during pullback operations in a manner to enable it to move freely and prevent damage. Install the pipeline in one continuous pull.

Minimize torsion stress by using a swivel to connect the pull section to the reaming assembly.

Maximum allowable tensile force imposed on the pull section is not to exceed 90 percent of the pipe manufacturer's safe pull (or tensile) strength. If the pull section is made up of multiple pipe size or materials, the lowest safe pull strength value governs and the maximum

allowable tensile force is not to exceed 90 percent of this value.

Minimize external pressure during installation of the pullback section in the reamed hole. Replace damaged pipe resulting from external pressure at no cost to the Government. Buoyancy modification is at the discretion of the Contractor.

3.7 CONNECTION OF PRODUCT PIPE TO WATER LINE

After the product pipe has been successfully installed, allow the product pipe to recover for 24 hours prior to connection of the water line. The Contractor is responsible for ensuring that a sufficient length of the product pipe has been pulled through the hole so that the pull-nose is not pulled back into bore hole due to stretch recovery of the product pipe.

3.8 GUIDANCE SYSTEMS

Walkover guidance systems are not acceptable for this project; use a magnetic survey tool locator installed behind the pilot string cutting head and an electric grid (tru-tracker) system for this project.

3.9 DOCUMENTATION

Maintain drilling logs that accurately provide drill bit location (both horizontally and vertically) at least every 2 inches along the drill path. In addition, keep logs that record, as a minimum the following, every 15 minutes throughout each drill pass, back ream pass, or pipe installation pass:

a. Drilling Fluid Pressure

b. Drilling Fluid Flow Rate

c. Drill Thrust Pressure

d. Drill Pullback Pressure

e. Drill Head Torque

Make all instrumentation, readings, and logs available to the COR at all times during operation.

3.10 UTILITY LOCATING AND MARKING

Locate and clearly mark all utilities prior to start of excavation or drilling. The Contractor is responsible for damage to utilities, and repairs for such damages, at no cost to the Government.

3.11 CLEANUP AND FINAL CLOSEOUT

Immediately upon completion of work of this section, remove all rubbish and debris from the job site. Remove all construction equipment and implements of service leaving the entire area involved in a neat condition acceptable of the COR.

Immediately clean "blow holes" or "breakouts" of drilling fluid to the surface and return the surface area to its original condition. Dispose of all drilling fluids, soils, and separated materials in compliance with federal, state, and local environmental regulations.

Submit an electronic copy and three hard copies of the record drawings to the COR within five days after completing the pull back. Include in the record drawings a plan, profile, and all information recorded during the progress of the work. Clearly tie the record drawings to the project's survey control. Maintain and submit upon completion signed final work complete logs of guided directional drill operations.

-- End of Section --

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SECTION 33 11 00

WATER DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for potable and nonpotable (raw water and sea or salt water) systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	Standard Specifications for Highway Bridges

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Eng Man	Manual for Railway Engineering

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	Hypochlorites
AWWA B301	Liquid Chlorine
AWWA C104/A21.4	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105/A21.5	Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110/A21.10	Ductile-Iron and Gray-Iron Fittings for Water
AWWA C111/A21.11	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C151/A21.51	Ductile-Iron Pipe, Centrifugally Cast, for Water

AWWA C153/A21.53	Ductile-Iron Compact Fittings for Water Service
AWWA C200	Steel Water Pipe - 6 In. and Larger
AWWA C203	Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C205	Cement-Mortar Protective Lining and Coating for Steel Water Pipe - 4 In. and Larger - Shop Applied
AWWA C206	Field Welding of Steel Water Pipe
AWWA C207	Standard for Steel Pipe Flanges for Waterworks Service-Sizes through 4 in. through 144 in.
AWWA C208	Standard for Dimensions for Fabricated Steel Water Pipe Fittings
AWWA C209	Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections and Fitting for Steel Water Pipelines
AWWA C210	Standard for Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
AWWA C300	Reinforced Concrete Pressure Pipe, Steel-Cylinder Type
AWWA C301	Prestressed Concrete Pressure Pipe, Steel-Cylinder Type
AWWA C303	Concrete Pressure Pipe, Bar-Wrapped, Steel-Cylinder Type
AWWA C500	Metal-Seated Gate Valves for Water Supply Service
AWWA C502	Dry-Barrel Fire Hydrants
AWWA C503	Wet-Barrel Fire Hydrants
AWWA C504	Standard for Rubber-Seated Butterfly Valves
AWWA C508	Swing-Check Valves for Waterworks Service, 2 In. Through 24 In. NPS
AWWA C509	Resilient-Seated Gate Valves for Water Supply Service
AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
AWWA C605	Underground Installation of Polyvinyl

	Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C606	Grooved and Shouldered Joints
AWWA C651	Standard for Disinfecting Water Mains
AWWA C700	Standard for Cold Water Meters - Displacement Type, Bronze Main Case
AWWA C701	Standard for Cold-Water Meters - Turbine Type for Customer Service
AWWA C702	Cold-Water Meters - Compound Type
AWWA C703	Cold-Water Meters - Fire Service Type
AWWA C704	Propeller-Type Meters for Waterworks Applications
AWWA C706	Direct-Reading, Remote-Registration Systems for Cold-Water Meters
AWWA C707	Encoder-Type Remote-Registration Systems for Cold-Water Meters
AWWA C800	Underground Service Line Valves and Fittings
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm through 300 mm), for Water Distribution
AWWA C901	Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In. , for Water Service
AWWA C905	Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings 14 In. Through 48 In. for Water Transmission and Distribution
AWWA C906	Polyethylene (PE) Pressure Pipe and Fittings, 4 In. through 63 In., for Water Distribution and Transmission
AWWA C909	Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 IN through 24 IN , for Water, Wastewater, and Reclaimed Water Service
AWWA C950	Fiberglass Pressure Pipe
AWWA M11	Manual: Steel Water Pipe: A Guide for Design and Installation
AWWA M23	Manual: PVC Pipe - Design and Installation
AWWA M9	Manual: Concrete Pressure Pipe

ASME INTERNATIONAL (ASME)

ASME B16.1	Gray Iron Threaded Fittings; Classes 25, 125 and 250
ASME B16.15	Cast Bronze Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B18.2.2	Standard for Square and Hex Nuts
ASME B18.5.2.1M	Metric Round Head Short Square Neck Bolts
ASME B18.5.2.2M	Metric Round Head Square Neck Bolts

ASTM INTERNATIONAL (ASTM)

ASTM A307	Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A47/A47M	Standard Specification for Ferritic Malleable Iron Castings
ASTM A48/A48M	Standard Specification for Gray Iron Castings
ASTM A53/A53M	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A563	Standard Specification for Carbon and Alloy Steel Nuts
ASTM A563M	Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A746	Standard Specification for Ductile Iron Gravity Sewer Pipe
ASTM B32	Standard Specification for Solder Metal

ASTM B42	Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B61	Standard Specification for Steam or Valve Bronze Castings
ASTM B62	Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B88	Standard Specification for Seamless Copper Water Tube
ASTM B88M	Standard Specification for Seamless Copper Water Tube (Metric)
ASTM C 150/C 150M	Standard Specification for Portland Cement
ASTM C 94/C 94M	Standard Specification for Ready-Mixed Concrete
ASTM D 1599	Resistance to Short-Time Hydraulic Failure Pressure of Plastic Pipe, Tubing, and Fittings
ASTM D 1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2464	Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2564	Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D 2774	Underground Installation of Thermoplastic Pressure Piping

ASTM D 2855	Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 2997	Centrifugally Cast "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3139	Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3839	Underground Installation of "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 4161	"Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe Joints Using Flexible Elastomeric Seals
ASTM F 1483	Oriented Poly(Vinyl Chloride), PVCO, Pressure Pipe
ASTM F 402	Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 1961	Standard on Fire Hose
NFPA 24	Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 704	Standard System for the Identification of the Hazards of Materials for Emergency Response

UNDERWRITERS LABORATORIES (UL)

UL 246	Hydrants for Fire-Protection Service
UL 262	Gate Valves for Fire-Protection Service
UL 312	Check Valves for Fire-Protection Service
UL 789	Standard for Indicator Posts for

Fire-Protection Service

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-3	Recommended Practice for the Installation of Polyvinyl Chloride (PVC) Pressure Pipe (Nominal Diameters 4-36 Inch)
UBPPA UNI-B-8	Recommended Practice for the Direct Tapping of Polyvinyl Chloride (PVC) Pressure Water Pipe (Nominal Diameters 6-12 Inch)

1.3 DESIGN REQUIREMENTS

1.3.1 Water Distribution Mains

Provide water distribution mains indicated as 8 inch lines of polyvinyl chloride (PVC) plastic or pipe. Provide water main accessories, gate valves as specified and where indicated. Submit design calculations of water piping.

1.3.2 Water Service Lines

Provide water service lines indicated as 8 inch lines from water distribution main to building service at a point approximately 5 feet from building. Water service lines shall be polyvinyl chloride (PVC) plastic pipe. polyvinyl chloride (PVC) plastic pipe appurtenances, and valves as specified for water mains may also be used for service lines. Provide water service line appurtenances as specified. Submit design calculations of water piping.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Piping Materials

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Hydrants

Indicator posts

Corporation stops

Valve boxes

Submit manufacturer's standard drawings or catalog cuts, except submit both drawings and cuts for push-on and rubber-gasketed bell-and-spigot joints. Include information concerning gaskets with submittal for joints and couplings.

SD-05 Design Data

Design calculations of water piping

SD-06 Test Reports

Bacteriological Disinfection

Test results from commercial laboratory verifying disinfection

SD-07 Certificates

Water distribution main piping, fittings, joints, valves, and coupling

Water service line piping, fittings, joints, valves, and coupling

Shop-applied lining

Lining

Fire hydrants

Displacement Type Meters

Compound Type Meters

Certificates shall attest that tests set forth in each applicable referenced publication have been performed, whether specified in that publication to be mandatory or otherwise and that production control tests have been performed at the intervals or frequency specified in the publication. Other tests shall have been performed within 3 years of the date of submittal of certificates on the same type, class, grade, and size of material as is being provided for the project.

SD-08 Manufacturer's Instructions

Delivery, storage, and handling

Installation procedures for water piping

SD-11 Record Drawings

Record Drawings

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials on site in enclosures or under protective covering. Store plastic piping, jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes, fittings, valves free of dirt and debris.

1.5.2 Handling

Handle pipe, fittings, valves, hydrants, and other accessories in a manner to ensure delivery to the trench in sound undamaged condition. Take special care to avoid injury to coatings and linings on pipe and fittings; make repairs if coatings or linings are damaged. Do not place any other material or pipe inside a pipe or fitting after the coating has been applied. Carry, do not drag pipe to the trench. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Store rubber gaskets that are not to be installed immediately, under cover out of direct sunlight.

1.5.2.1 Coated and Wrapped Steel Pipe

1.5.2.2 Polyethylene (PE) Pipe, Fittings, and Accessories

Handle PE pipe, fittings, and accessories in accordance with AWWA C901.

1.5.2.3 Miscellaneous Plastic Pipe and Fittings

Handle Polyvinyl Chloride (PVC), pipe and fittings in accordance with the manufacturer's recommendations. Store plastic piping and jointing materials that are not to be installed immediately under cover out of direct sunlight.

Storage facilities shall be classified and marked in accordance with NFPA 704.

PART 2 PRODUCTS

2.1 WATER DISTRIBUTION MAIN MATERIALS

2.1.1 Piping Materials

2.1.1.1 Ductile-Iron Piping

a. Pipe and Fittings: Pipe, except flanged pipe, AWWA C151/A21.51, Pressure Class 350. Flanged pipe, AWWA C115/A21.15. Fittings, AWWA C110/A21.10 or AWWA C153/A21.53 ; fittings with push-on joint ends conforming to the same requirements as fittings with mechanical-joint ends, except that the bell design shall be modified, as approved, for push-on joint. Fittings shall have pressure rating at least equivalent to that of the pipe. Ends of pipe and fittings shall be suitable for the specified joints. Pipe and fittings shall have cement-mortar lining, AWWA C104/A21.4, standard thickness.

b. Joints and Jointing Material:

1. Joints: Joints for pipe and fittings shall be push-on joints or mechanical joints.

2. Push-On Joints: Shape of pipe ends and fitting ends, gaskets, and lubricant for joint assembly, AWWA C111/A21.11.

3. Mechanical Joints: Dimensional and material requirements for pipe ends, glands, bolts and nuts, and gaskets, AWWA C111/A21.11.

4. Flanged Joints: Bolts, nuts, and gaskets for flanged connections as recommended in the Appendix to AWWA C115/A21.15. Flange for setscrewed flanges shall be of ductile iron, ASTM A536, Grade 65-45-12, and conform to the applicable requirements of ASME B16.1, Class 250. Setscrews for setscrewed flanges shall be 190,000 psi tensile strength, heat treated and zinc-coated steel. Gasket and lubricants for setscrewed flanges, in accordance with applicable requirements for mechanical-joint gaskets specified in AWWA C111/A21.11. Design of setscrewed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.

5. Insulating Joints: Designed to effectively prevent metal-to-metal contact at the joint between adjacent sections of piping. Joint shall be of the flanged type with insulating gasket, insulating bolt sleeves, and insulating washers. Gasket shall be of the dielectric type, full face, and in other respects as recommended in the Appendix to AWWA C115/A21.15. Bolts and nuts, as recommended in the Appendix to AWWA C115/A21.15.

6. Sleeve-Type Mechanical Coupled Joints: As specified in paragraph entitled "Sleeve-Type Mechanical Couplings."

7. Type Joints: pipe ends and couplings, AWWA C606. Joint dimension shall be as specified in AWWA C606 for rigid joints .

2.1.1.2 Polyvinyl Chloride (PVC) Plastic Piping

a. Pipe and Fittings: Pipe, AWWA C900, shall be plain end or gasket bell end, Pressure Class 150 (DR 18) with cast-iron-pipe-equivalent OD.

b. Fittings for PVC pipe: Fittings shall be gray iron or ductile iron, AWWA C110/A21.10 or AWWA C153/A21.53, and have cement-mortar lining, AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with PVC plastic pipe specified in this paragraph. Iron fittings and specials shall be cement-mortar lined in accordance with AWWA C104/A21.4. Fittings and specials may be of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C605 and AWWA C900.

c. Joints and Jointing Material: Joints for pipe shall be push-on joints, ASTM D 3139. Joints between pipe and metal fittings, valves, and other accessories shall be push-on joints ASTM D 3139, or compression-type joints/mechanical joints, ASTM D 3139 and AWWA C111/A21.11. Provide each joint connection with an elastomeric gasket suitable for the bell or coupling with which it is to be used. Gaskets for push-on joints for pipe, ASTM F 477. Gaskets for push-on joints and compression-type joints/mechanical joints for joint connections between pipe and metal fittings, valves, and other accessories, AWWA C111/A21.11, respectively, for push-on joints and mechanical joints. Mechanically coupled joints using a sleeve-type mechanical coupling, as specified in paragraph entitled "Sleeve-Type Mechanical Couplings," may be used as an optional jointing method in lieu of push-on joints on plain-end PVC

plastic pipe, subject to the limitations specified for mechanically coupled joints using a sleeve-type mechanical coupling and to the use of internal stiffeners as specified for compression-type joints in ASTM D 3139.

2.1.2 Valves, Hydrants, and Other Water Main Accessories

2.1.2.1 Gate Valves

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be nonrising stem type with double-disc gates and mechanical-joint ends or push-on joint ends as appropriate for the adjoining pipe, (2) AWWA C509 shall be nonrising stem type with mechanical-joint ends or resilient-seated gate valves 3 to 12 inches in size, and (3) UL 262 shall be inside-screw type with operating nut, double-disc or split-wedge type gate, and shall have mechanical-joint ends or push-on joint ends as appropriate for the pipe to which it is joined. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have 0-ring stem seals . Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. In lieu of mechanical-joint ends and push-on joint ends, valves may have special ends for connection to sleeve-type mechanical coupling. Valve ends and gaskets for connection to sleeve-type mechanical coupling shall conform to the applicable requirements specified for the joint or coupling. Valves shall be of one manufacturer.

2.1.2.2 Gate Valves

AWWA C500, AWWA C509, or UL 262. Unless otherwise specified, valves conforming to: (1) AWWA C500 shall be outside-screw-and-yoke rising-stem type with double-disc gates and flanged ends, (2) AWWA C509 shall be outside-screw-and-yoke rising-stem type with flanged ends, and (3) UL 262 shall be outside-screw-and-yoke type, shall have solid or one-piece type gate and flanged ends, and shall be designed for a hydraulic working pressure of psi. Materials for UL 262 valves shall conform to the reference standards specified in AWWA C500. Provide valves with handwheels that open by counterclockwise rotation of the valve stem. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. In lieu of flanged ends, valves may have shouldered ends suitable for shouldered type joints, as specified in paragraph entitled "Ductile-Iron Piping." Valves shall be of one manufacturer.

2.1.2.3 Check Valves

Swing-check type, AWWA C508 or UL 312. Valves conforming to: (1) AWWA C508 shall have iron or steel body and cover and flanged ends, and (2) UL 312 shall have cast iron or steel body and cover, flanged ends, and designed for a working pressure of psi. Materials for UL 312 valves shall conform to the reference standards specified in AWWA C508. Valves shall have clear port opening. In lieu of flanged ends, valves may have shouldered ends suitable for shouldered type joints, as specified in paragraph entitled "Ductile-Iron Piping." Valves shall be of one manufacturer.

2.1.2.4 Rubber-Seated Butterfly Valves

Rubber-seated butterfly valves shall conform to the performance requirements of AWWA C504. Wafer type valves conforming to the performance requirements of AWWA C504 in all respects, but not meeting laying length

requirements will be acceptable if supplied and installed with a spacer providing the specified laying length. All tests required by AWWA C504 shall be met. Flanged-end valves shall be installed in an approved pit and provided with a union or sleeve-type coupling in the pit to permit removal. Mechanical-end valves3 through 10 inches in diameter may be direct burial if provided with a suitable valve box, means for manual operation, and an adjacent pipe joint to facilitate valve removal. Valve operators shall restrict closing to a rate requiring approximately 60 seconds, from fully open to fully closed.

2.1.2.5 Pressure Reducing Valves

Pressure reducing valves shall maintain a constant downstream pressure regardless of fluctuations in demand. Valves shall be suitable for psi operating pressure on the inlet side, with outlet pressure set for psi. The valves shall be of the hydraulically-operated, pilot controlled, globe or angle type, and may be actuated either by diaphragm or piston. The pilot control shall be the diaphragm-operated, adjustable, spring-loaded type, designed to permit flow when controlling pressure exceeds the spring setting. Ends shall be flanged. Valve bodies shall be bronze, cast iron or cast steel with bronze trim. Valve stem shall be stainless steel. Valve discs and diaphragms shall be synthetic rubber. Valve seats shall be bronze. Pilot controls shall be bronze with stainless steel working parts.

2.1.2.6 Vacuum and Air Relief Valves

Vacuum and air relief valves shall be of the size shown and shall be of a type that will release air and prevent the formation of a vacuum. The valves shall automatically release air when the lines are being filled with water and shall admit air into the line when water is being withdrawn in excess of the inflow. Valves shall be iron body with bronze trim and stainless steel float.

2.1.2.7 Fire Hydrants

Wet-barrel type , except that flush-type hydrants shall be provided where indicated. Paint hydrants with at least one coat of primer and two coats of yellow enamel paint, except use red enamel paint for tops of hydrants in non-potable water systems. Stencil hydrant number and main size on the hydrant barrel using black stencil paint.

a. Wet-Barrel Type Fire Hydrants: Wet-barrel type hydrants, AWWA C503 or UL 246, "Wet Barrel" design, shall have 6 inch inlet, one 4 1/2 inch pumper connection, and two2 1/2 inch hose connections. Pumper connection and hose connections shall be individually valved with independent nozzle gate valves. Inlet shall have mechanical-joint end only , except where flanged end is indicated; end shall conform to the applicable requirements as specified for the joint. Size and shape of operating nut, cap nuts, and threads on hose and pumper connections shall be as indicated. Hydrants indicated as "traffic type," shall have frangible sections as mentioned in AWWA C502 breakable features as mentioned in AWWA C503. The traffic type hydrant shall have special couplings joining upper and lower sections of hydrant barrel and upper and lower sections of hydrant stem and shall be designed to have the special couplings break from a force not less than that which would be imposed by a moving vehicle; hydrant shall operate properly under normal conditions.

b. Flush-Type Fire Hydrants: Hydrants shall conform to the applicable

requirements of AWWA C502, except that they shall be of a design that will permit placement of hydrant below surface of pavement. Hydrants shall have6 inch inlet,4 1/4 inch minimum valve opening, one 4 1/2 inch pumper connection, and one 2 1/2 inch hose connection. Hose and pumper connections and operating nuts shall be readily accessible, and enclosed in a cast iron box with top flush with pavement and having cast-iron cover with flush lifting handle. Inlet shall have mechanical-joint or push-on joint end , except where flanged end is indicated. Size and shape of operating nut and cap nuts and threads on hose and pumper connections shall be as indicated.

2.1.2.8 Tracer Wire for Nonmetallic Piping

Provide bare copper or aluminum wire not less than 0.10 inch in diameter in sufficient length to be continuous over each separate run of nonmetallic pipe.

2.2 WATER SERVICE LINE MATERIALS

2.2.1 Piping Materials

2.2.1.1 Plastic Piping

Plastic pipe and fittings shall bear the seal of the National Sanitation Foundation (NSF) for potable water service. Plastic pipe and fittings shall be supplied from the same manufacturer.

a. Polyvinyl Chloride (PVC) Plastic Piping with Elastomeric-Gasket Joints:

Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 40, with joints meeting the requirements of 150 psi working pressure, 200 psi hydrostatic test pressure, unless otherwise shown or specified.

b. Polyvinyl Chloride (PVC) Plastic Piping with Solvent Cement Joints:

Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 150 psi working pressure and 200 psi hydrostatic test pressure.

c. Polyethylene (PE) Plastic Pipe: Pipe tubing, and heat fusion fitting shall conform to AWWA C901.

d. Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe: AWWA C909, plain end or gasket bell end, Pressure Class 150 with cast iron pipe equivalent outside diameter.

2.2.1.2 Insulating Joints

Joints between pipe of dissimilar metals shall have a rubber-gasketed or other suitable approved type of insulating joint or dielectric coupling which will effectively prevent metal-to-metal contact between adjacent sections of piping.

2.2.2 Water Service Line Appurtenances

2.2.2.1 Corporation Stops

Ground key type; bronze, ASTM B61 or ASTM B62; and suitable for the working

pressure of the system. Ends shall be suitable for solder-joint, or flared tube compression type joint. Threaded ends for inlet and outlet of corporation stops, AWWA C800; coupling nut for connection to flared copper tubing, ASME B16.26.

2.2.2.2 Curb or Service Stops

Ground key, round way, inverted key type; made of bronze, ASTM B61 or ASTM B62; and suitable for the working pressure of the system. Ends shall be as appropriate for connection to the service piping. Arrow shall be cast into body of the curb or service stop indicating direction of flow.

2.2.2.3 Service Clamps

Service clamps used for repairing damaged cast-iron, steel, PVC or asbestos-cement pipe shall have a pressure rating not less than that of the pipe to be connected and shall be either the single or double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.2.2.4 Goosenecks

Type K copper tubing. Joint ends for goosenecks shall be appropriate for connecting to corporation stop and service line. Length of goosenecks shall be in accordance with standard practice.

2.2.2.5 Dielectric Fittings

Dielectric fittings shall be installed between threaded ferrous and nonferrous metallic pipe, fittings and valves, except where corporation stops join mains. Dielectric fittings shall prevent metal-to-metal contact of dissimilar metallic piping elements and shall be suitable for the required working pressure.

2.2.2.6 Check Valves

Check valves shall be designed for a minimum working pressure of 150 psi or as indicated. Valves shall have a clear waterway equal to the full nominal diameter of the valve. Valves shall open to permit flow when inlet pressure is greater than the discharge pressure, and shall close tightly to prevent return flow when discharge pressure exceeds inlet pressure. The size of the valve, working pressure, manufacturer's name, initials, or trademark shall be cast on the body of each valve. Valves 2 inches and larger shall be outside lever and spring type.

Valves 2 inches and smaller shall be all bronze designed for screwed fittings, and shall conform to MSS SP-80, Class 150, Types 3 and 4 as suitable for the application.

2.2.2.7 Gate Valves 3 Inch Size and Larger

Gate valves 3 inch size and larger on buried piping AWWA C500 or UL 262 and of one manufacturer. Valves, AWWA C500, nonrising stem type with double-disc gates. Valves, UL 262, inside-screw type with operating nut, split wedge or double disc type gate, and designed for a hydraulic working pressure of 175 psi. Materials for UL 262 valves conforming to the reference standards specified in AWWA C500. Valves shall open by counterclockwise rotation of the valve stem. Stuffing boxes shall have

0-ring stem seals and shall be bolted and constructed so as to permit easy removal of parts for repair.

2.2.2.8 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 150 psi.

2.2.2.9 Displacement Type Meters

Displacement type meters shall conform to AWWA C700. Registers shall be straight-reading and shall read in cubic meters U.S. gallon . Meters in sizes 13 through 1/2 through 1 shall not be frost-protection design. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706 or an encoder type remote register designed in accordance with AWWA C707. Meters shall comply with the accuracy and capacity requirements of AWWA C700.

2.2.2.10 Compound Type Meters

Compound type meters shall conform to AWWA C702 and shall be furnished with strainers. The main casing shall be bronze cast iron protected by corrosion resistant coating with stainless steel external fasteners. The main casing shall be tapped for field testing purposes. Registers shall be straight-reading type, shall be permanently sealed and shall read in U.S. gallons . The meter shall be equipped with a coordinating register. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA C706. Meters shall comply with the accuracy and capacity requirements of AWWA C702.

2.2.2.11 Meter Boxes

Meter boxes shall be of cast iron or, concrete. The boxes shall be of sufficient size to completely enclose the meter and shutoff valve or service stop. Meter boxes set in paved areas subject to vehicular traffic shall be cast iron, or concrete with cast iron lid and cast iron meter reader lid.

2.2.2.12 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES

3.1.1 General Requirements for Installation of Pipelines

These requirements shall apply to all pipeline installation except where specific exception is made in the "Special Requirements..." paragraphs.

3.1.1.1 Location of Water Lines

Terminate the work covered by this section at a point approximately 5 feet from the building , unless otherwise indicated. Where the location of the water line is not clearly defined by dimensions on the drawings, do not lay water line closer horizontally than 10 feet from any sewer line.

Where water piping is required to be installed within 3 feet of existing structures, the water pipe shall be sleeved as required in Paragraph "Casting Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

a. Water Piping Installation Parallel With Sewer Piping

1. Normal Conditions: Lay water piping at least 10 feet horizontally from a sewer or sewer manhole whenever possible. Measure the distance edge-to-edge.

2. Unusual Conditions: When local conditions prevent a horizontal separation of 10 feet, the water piping may be laid closer to a sewer or sewer manhole provided that:

(a) The bottom (invert) of the water piping shall be at least 18 inches above the top (crown) of the sewer piping.

(b) Where this vertical separation cannot be obtained, the sewer piping shall be constructed of AWWA-approved water pipe and pressure tested in place without leakage prior to backfilling. Approved waste water disposal method shall be utilized.

(c) The sewer manhole shall be of watertight construction and tested in place.

b. Installation of Water Piping Crossing Sewer Piping

1. Normal Conditions: Water piping crossing above sewer piping shall be laid to provide a separation of at least 18 inches between the bottom of the water piping and the top of the sewer piping.

2. Unusual Conditions: When local conditions prevent a vertical separation described above, use the following construction:

(a) Sewer piping passing over or under water piping shall be constructed of AWWA-approved ductile iron water piping, pressure tested in place without leakage prior to backfilling.

(b) Water piping passing under sewer piping shall, in addition, be protected by providing a vertical separation of at least 18 inches between the bottom of the sewer piping and the top of the water piping; adequate structural support for the sewer piping to prevent excessive deflection of the joints and the settling on and breaking of the water piping; and that the length, minimum 20 feet, of the water piping be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer piping.

c. Sewer Piping or Sewer Manholes: No water piping shall pass through or

come in contact with any part of a sewer manhole.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 11.

3.1.1.3 Pipe Laying and Jointing

Remove fins and burrs from pipe and fittings. Before placing in position, clean pipe, fittings, valves, and accessories, and maintain in a clean condition. Provide proper facilities for lowering sections of pipe into trenches. Do not under any circumstances drop or dump pipe, fittings, valves, or any other water line material into trenches. Cut pipe in a neat workmanlike manner accurately to length established at the site and work into place without springing or forcing. Replace by one of the proper length any pipe or fitting that does not allow sufficient space for proper installation of jointing material. Blocking or wedging between bells and spigots will not be permitted. Lay bell-and-spigot pipe with the bell end pointing in the direction of laying. Grade the pipeline in straight lines; avoid the formation of dips and low points. Support pipe at proper elevation and grade. Secure firm, uniform support. Wood support blocking will not be permitted. Lay pipe so that the full length of each section of pipe and each fitting will rest solidly on the pipe bedding; excavate recesses to accommodate bells, joints, and couplings. Provide anchors and supports where necessary for fastening work into place. Make proper provision for expansion and contraction of pipelines. Keep trenches free of water until joints have been properly made. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Do not lay pipe when conditions of trench or weather prevent installation. Depth of cover over top of pipe shall not be less than 2 1/2 feet.

3.1.1.4 Installation of Tracer Wire

Install a continuous length of tracer wire for the full length of each run of nonmetallic pipe. Attach wire to top of pipe in such manner that it will not be displaced during construction operations.

3.1.1.5 Connections to Existing Water Lines

Make connections to existing water lines after approval is obtained and with a minimum interruption of service on the existing line. Make connections to existing lines under pressure in accordance with the recommended procedures of the manufacturer of the pipe being tapped .

3.1.1.6 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.1.7 Flanged Pipe

Flanged pipe shall only be installed above ground or with the flanges in valve pits.

3.1.2 Special Requirements for Installation of Water Mains

3.1.2.1 Installation of Ductile-Iron Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the requirements of AWWA C600 for pipe installation, joint assembly, valve-and-fitting installation, and thrust restraint.

a. Jointing: Make push-on joints with the gaskets and lubricant specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly.

b. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage . Thrust blocks shall be in accordance with the requirements of AWWA C600 for thrust restraint, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94/C 94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

c. Exterior Protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet, using Class C polyethylene film, in accordance with AWWA C105/A21.5.

3.1.2.2 Installation of PVC Plastic Water Main Pipe

Installation of PVC Plastic Water Main Pipe and Associated Fittings: Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines"; with the requirements of UBPPA UNI-B-3 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Jointing: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to metal fittings, valves, and other accessories, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of UBPPA UNI-B-3 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings, valves, and other accessories in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical joints with the gaskets, glands, bolts, nuts, and internal stiffeners previously specified for this type joint; assemble in accordance with the requirements of UBPPA UNI-B-3 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel. Assemble joints made with sleeve-type

mechanical couplings in accordance with the recommendations of the coupling manufacturer using internal stiffeners as previously specified for compression-type joints.

b. Offset: Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the COR, but shall not exceed 5 degrees.

c. Pipe Anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Thrust blocks shall be in accordance with the requirements of UBPPA UNI-B-3 for reaction or thrust blocking and plugging of dead ends, except that size and positioning of thrust blocks shall be as indicated. Use concrete, ASTM C 94/C 94M, having a minimum compressive strength of 2,500 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

d. Fittings: Install in accordance with AWWA C605.

3.1.2.3 Installation of Polyethylene (PE) Plastic Piping

a. General Installation:

PE pipes shall be installed in accordance with ASTM D 2774.

b. Jointing:

Jointing shall comply with ASTM D 2657, Technique I-Socket Fusion or Technique II-Butt Fusion.

c. Offsets:

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the COR, but shall not exceed 5 degrees.

3.1.2.4 Installation of Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Piping

a. General Installation:

Install PVCO Pressure piping in accordance with AWWA C605.

b. Jointing:

As required for PVC piping.

c. Anchorage:

As required for PVC piping.

d. Offsets:

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the COR, but shall not exceed 5 degrees.

e. Installation of Valves: Install gate valves, AWWA C500 and UL 262, in accordance with the requirements of AWWA C600 for valve-and-fitting

installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves, AWWA C509, in accordance with the requirements of AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. Install gate valves on PVC water mains in accordance with the recommendations for appurtenance installation in AWWA M23, Chapter 7, "Installation." Make and assemble joints to gate valves and check valves as specified for making and assembling the same type joints between pipe and fittings.

3.1.3 Installation of Water Service Piping

3.1.3.1 Location

Connect water service piping to the building service where the building service has been installed. Where building service has not been installed, terminate water service lines approximately 5 feet from the building line at a point directed by the COR ; such water service lines shall be closed with plugs or caps.

3.1.3.2 Service Line Connections to Water Mains

Connect service lines to the main by a corporation stop and gooseneck and install a service stop as indicated on the Government approved drawings. Service line connection to PVC plastic water mains in accordance with UBPPA UNI-B-8 and the recommendations of AWWA M23, Chapter 9, "Service Connections."

3.1.4 Special Requirements for Installation of Water Service Piping

3.1.4.1 Installation of Metallic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of AWWA C600 for pipe installation, unless otherwise specified.

a. Jointing:

1. Screwed Joints: Make screwed joints up tight with a stiff mixture of graphite and oil, inert filler and oil, or graphite compound; apply to male threads only. Threads shall be full cut; do not leave more than three threads on the pipe exposed after assembling the joint.

2. Joints for Copper Tubing: Cut copper tubing with square ends; remove fins and burrs. Handle tubing carefully; replace dented, gouged, or otherwise damaged tubing with undamaged tubing. Make solder joints using ASTM B32, 95-5 tin-antimony or Grade Sn96 solder. Solder and flux shall contain not more than 0.2 percent lead. Before making joint, clean ends of tubing and inside of fitting or coupling with wire brush or abrasive. Apply a rosin flux to the tubing end and on recess inside of fitting or coupling. Insert tubing end into fitting or coupling for the full depth of the recess and solder. For compression joints on flared tubing, insert tubing through the coupling nut and flare tubing.

3. Flanged Joints: Make flanged joints up tight, taking care to avoid undue strain on flanges, valves, fittings, and accessories.

b. Protection of Buried Steel Service Line Piping: Unless otherwise specified, prepare, prime, and coat exterior surface of zinc-coated steel pipe and associated fittings to be buried with hot-applied coal-tar enamel with a bonded single layer of felt wrap in accordance with AWWA C203 . For the felt wrap material, use fibrous-glass mat as specified in AWWA C203; use of asbestos felt will not be permitted. Use solvent wash only to remove oil, grease, and other extraneous matter from zinc-coated pipe and fittings.

3.1.4.2 Installation of Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" and with the applicable requirements of ASTM D 2774 and ASTM D 2855, unless otherwise specified. Handle solvent cements used to join plastic piping in accordance with ASTM F 402.

a. Jointing: Make solvent-cemented joints for PVC plastic piping using the solvent cement previously specified for this material; assemble joints in accordance with ASTM D 2855. Make plastic pipe joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

b. Plastic Pipe Connections to Appurtenances: Connect plastic pipe service lines to corporation stops and gate valves in accordance with the recommendations of the plastic pipe manufacturer.

3.1.4.3 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

3.1.4.4 Location of Meters

Meters and meter boxes and vaults shall be installed at the locations shown on the drawings. The meters shall be centered in the boxes and vaults to allow for reading and ease of removal or maintenance.

3.1.5 Disinfection

Prior to disinfection, obtain COR approval of the proposed method for disposal of waste water from disinfection procedures. Disinfect new water piping and existing water piping affected by Contractor's operations in accordance with AWWA C651. Fill piping systems with solution containing minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Flush solution from the systems with domestic water until maximum residual chlorine content is within the range of 0.2 and 0.5 parts per million, or the residual chlorine content of domestic water supply. Obtain at least two consecutive satisfactory bacteriological samples from new water piping, analyze by a certified laboratory, and submit the results prior to the new water piping being placed into service. Disinfection of systems supplying nonpotable water is not required.

3.1.6 Optional Disinfection Method

Disinfect new potable water lines and affected portions of existing potable

water lines with geothermal water. Geothermal water shall be not less than 90 degrees Celsius and contact time shall be not less than 30 minutes. After disinfection, thoroughly flush new potable water lines and affected portions of existing potable water lines with the chlorinated base water supply for a minimum of two hours.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

Prior to hydrostatic testing, obtain COR approval of the proposed method for disposal of waste water from hydrostatic testing. The COR will conduct field inspections and witness field tests specified in this section. The Contractor shall perform field tests, and provide labor, equipment, and incidentals required for testing . The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with the drawings and specifications. Do not begin testing on any section of a pipeline where concrete thrust blocks have been provided until at least 5 days after placing of the concrete.

3.2.2 Testing Procedure

Test water mains and water service lines in accordance with the applicable specified standard, except for the special testing requirements given in paragraph entitled "Special Testing Requirements." Test PVC plastic water mains and water service lines made with PVC plastic water main pipe in accordance with the requirements of UBPPA UNI-B-3 for pressure and leakage tests. The amount of leakage on pipelines made of PVC plastic water main pipe shall not exceed the amounts given in UBPPA UNI-B-3, except that at joints made with sleeve-type mechanical couplings, no leakage will be allowed. Test water service lines in accordance with applicable requirements of AWWA C600 for hydrostatic testing. No leakage will be allowed at plastic pipe joints .

3.2.3 Special Testing Requirements

For pressure test, use a hydrostatic pressure 50 psi greater than the maximum working pressure of the system, except that for those portions of the system having pipe size larger than 2 inches in diameter, hydrostatic test pressure shall be not less than 200 psi. Hold this pressure for not less than 2 hours. Prior to the pressure test, fill that portion of the pipeline being tested with water for a soaking period of not less than 24 hours. For leakage test, use a hydrostatic pressure not less than the maximum working pressure of the system. Leakage test may be performed at the same time and at the same test pressure as the pressure test.

3.3 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

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SECTION 33 11 23

NATURAL GAS PIPING

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for exterior and interior fuel gas piping.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN GAS ASSOCIATION (AGA)

AGA ANSI B109.1	Diaphragm-Type Gas Displacement Meters (Under 500 cubic ft./hour Capacity)
AGA ANSI B109.2	Diaphragm-Type Gas Displacement Meters (500 cubic ft./hour Capacity and Over)
AGA ANSI B109.3	Rotary-Type Gas Displacement Meters

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.41/CSA 6.9	Quick-Disconnect Devices for Use with Gas Fuel Appliances
ANSI Z21.45	Flexible Connectors of Other Than All-Metal Construction for Gas Appliances
ANSI Z21.69/CSA 6.16	Connectors for Movable Gas Appliances

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 25-06	Earthquake-Activated Automatic Gas Shutoff Devices
ASCE 7	Minimum Design Loads for Buildings and Other Structures

ASME INTERNATIONAL (ASME)

ASME B1.1	Unified Inch Screw Threads (UN and UNR Thread Form)

ASME B1.20.1	Pipe Threads, General Purpose (Inch)
ASME B16.11	Forged Fittings, Socket-Welding and Threaded
ASME B16.3	Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.33	Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psi, Sizes NPS 1/2 - NPS 2
ASME B16.38	Large Metallic Valves for Gas Distribution (Manually Operated, NPS 2 1/2 to 12, 125 psig Maximum)
ASME B16.39	Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.40	Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems
ASME B16.5	Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B18.2.1	Square and Hex Bolts and Screws (Inch Series)
ASME B18.2.2	Standard for Square and Hex Nuts
ASME B31.8	Gas Transmission and Distribution Piping Systems
ASME BPVC SEC VIII D1	BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A193/A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194/A194M	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM D 2513	Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

ASTM D 2683	Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-69	Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	National Fuel Gas Code
NFPA 58	Liquefied Petroleum Gas Code
MIL-STD-101	Color Code for Pipelines & for Compressed Gas Cylinders

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

49 CFR 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
49 CFR 195	Transportation of Hazardous Liquids by Pipeline

1.3 RELATED REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS applies to this section, with additions and modifications specified herein.

1.4 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Valve box

Pressure regulator

Gas equipment connectors

Valves

Warning and identification tape

Risers

Transition fittings

Gas meter

SD-07 Certificates

Welder's qualifications

PE welder's qualifications

Welder's identification symbols

SD-08 Manufacturer's Instructions

PE pipe and fittings

Submit manufacturer's installation instructions and manufacturer's visual joint appearance chart.

1.5 QUALITY ASSURANCE

1.5.1 Welder's Qualifications

Comply with ASME B31.8. The steel welder shall have a copy of a certified ASME B31.8 qualification test report. The PE welder shall have a certificate from a PE pipe manufacturer's sponsored training course. Contractor shall also conduct a qualification test. Submit each welder's identification symbols, assigned number, or letter, used to identify work of the welder. Affix symbols immediately upon completion of welds. Welders making defective welds after passing a qualification test shall be given a requalification test and, upon failing to pass this test, shall not be permitted to work this contract.

1.5.2 PE Welder's Qualifications

Prior to installation, Contractor shall have supervising and installing personnel trained by a PE pipe manufacturer's sponsored course of not less than one week duration, or present proof satisfactory to the COR that personnel are currently working in the installation of PE gas distribution lines.

1.5.3 Safety Standards

49 CFR 192.

1.6 DELIVERY, STORAGE, AND HANDLING

Handle, transport, and store plastic pipe and fittings carefully. Plug or cap pipe ends during transportation or storage to minimize dirt and moisture entry. Do not subject to abrasion or concentrated external loads. Discard PE pipe sections and fittings that have been damaged.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Conform to NFPA 54 and with requirements specified herein. Supply piping to appliances or equipment shall be at least as large as the inlets thereof.

2.2 PIPE AND FITTINGS

2.2.1 Aboveground and Within Buildings and Vaults

a. Pipe: Black steel in accordance with ASTM A53, Schedule 40, threaded ends for sizes 2 inches and smaller; otherwise, plain end beveled for butt welding.

b. Threaded Fittings: ASME B16.3, black malleable iron.

c. Socket-Welding Fittings: ASME B16.11, forged steel.

d. Butt-Welding Fittings: ASME B16.9, with backing rings of compatible material.

e. Unions: ASME B16.39, black malleable iron.

f. Flanges and Flanged Fittings: ASME B16.5 steel flanges or convoluted steel flanges conforming to ASME BPVC SEC VIII D1. Flange faces shall have integral grooves of rectangular cross sections which afford containment for self-energizing gasket material.

2.2.2 Underground Polyethylene (PE)

PE pipe and fittings are as follows:

a. Pipe: ASTM D 2513, 100 psig working pressure, Standard Dimension Ratio (SDR), the ratio of pipe diameter to wall thickness, 11.5 maximum.

b. Socket Fittings: ASTM D 2683.

c. Butt-Fusion Fittings: ASTM D 2513, molded.

2.2.3 Risers

Manufacturer's standard riser, transition from plastic to steel pipe with 7 to 12 mil thick epoxy coating. Use swaged gas-tight construction with O-ring seals, metal insert, and protective sleeve. Provide remote bolt-on or bracket riser supports as indicated.

2.2.4 Transition Fittings

a. Steel to Plastic (PE): As specified for "riser" except designed for steel-to-plastic with tapping tee or sleeve. Coat or wrap exposed steel pipe with heavy plastic coating.

2.3 SHUTOFF VALVES, BELOW GROUND

2.3.1 Metallic Ball Valves

ASME B16.33 or ASME B16.38 corrosion-resisting steel, with threaded or flanged ends. Provide polytetrafluoroethylene (PTFE) seats.

2.3.2 PE Ball or Plug Valves

ASME B16.40 and ASTM D 2513, Class C materials (PE 2306 or PE 3406), strength rating of Class 4 location with class factor of 0.20, and SDR matching PE pipe dimensions and working pressure.

2.4 VALVES, ABOVEGROUND

Provide lockable valves where indicated.

2.4.1 Shutoff Valves, Sizes Larger Than 2 Inches

Steel body ball valve with flanged ends in accordance with ASME B16.38. Provide PTFE seats.

2.4.2 Shutoff Valves, Sizes 2 Inches and Smaller

Steel body ball valve in accordance with ASME B16.33, full port pattern, reinforced PTFE seals, threaded ends, and PTFE seat.

2.4.3 Pressure Regulator

Self-contained with spring-loaded diaphragm pressure regulator, psig to inches water reduction, pressure operating range as required for the pressure reduction indicated, volume capacity not less than indicated, and threaded ends for sizes 2 inches and smaller, otherwise flanged.

2.4.4 Earthquake Automatic Gas Shutoff Valve

ASCE 25-06 and UL listed or AGA listed or International Association of Plumbing and Mechanical Officials (IAPMO) listed. The valve may be either pendulum or ball construction.

2.5 GAS METER

AGA ANSI B109.1, AGA ANSI B109.2 or AGA ANSI B109.3 pipe mounted, diaphragm or bellow style, enamel coated steel case. Provide combined register totalizer, water escape hole in housing, and means for sealing against tampering. Gas meter shall be a smart meter capable of two-way communications between the meter and the central system.

2.6 GAS EQUIPMENT CONNECTORS

a. Flexible Connectors: ANSI Z21.45.

b. Quick Disconnect Couplings: ANSI Z21.41/CSA 6.9.

c. Semi-Rigid Tubing and Fittings: ANSI Z21.69/CSA 6.16.

2.7 VALVE BOX

Provide street valve box with cast-iron cover and two-piece 5 1/4 inch shaft-slip valve box extension or rectangular concrete valve box, sized large enough for removal of valve without removing box. Cast the word "Gas" into the box cover. Use valve box for areas as follows:

a. Roads and Traffic Areas: Heavy duty, cast iron cover.

b. Other Areas: Standard duty, concrete cover.

2.8 CASING

Where indicated at railroad or other crossing, provide ASTM A53, galvanized pipe, Schedule 40.

2.9 BURIED UTILITY WARNING AND IDENTIFICATION TAPE

Provide detectable aluminum-foil plastic-backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried piping. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 3 inch minimum width, color-coded yellow for natural gas, with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be "CAUTION BURIED GAS PIPING BELOW" or similar wording. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material.

2.10 HANGERS AND SUPPORTS

MSS SP-58.

2.11 WELDING FILLER METAL

ASME B31.8.

2.12 PIPE-THREAD TAPE

Antiseize and sealant tape of polytetrafluoroethylene (PTFE).

2.13 BOLTING (BOLTS AND NUTS)

Stainless steel bolting; ASTM A193/A193M, Grade B8M or B8MA, Type 316, for bolts; and ASTM A194/A194M, Grade 8M, Type 316, for nuts. Dimensions of bolts, studs, and nuts shall conform with ASME B18.2.1and ASME B18.2.2 with coarse threads conforming to ASME B1.1, with Class 2A fit for bolts and studs and Class 2B fit for nuts. Bolts or bolt-studs shall extend through the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Bolts shall have American Standard regular square or heavy hexagon heads; nuts shall be American Standard heavy semifinished hexagonal.

2.14 GASKETS

Fluorinated elastomer, compatible with flange faces.

2.15 IDENTIFICATION FOR ABOVEGROUND PIPING

MIL-STD-101 for legends and type and size of characters. For pipes 3/4 inch od and larger, provide printed legends to identify contents of pipes and arrows to show direction of flow. Color code label backgrounds to signify levels of hazard. Make labels of plastic sheet with pressure-sensitive adhesive suitable for the intended application. For pipes smaller than 3/4 inch od, provide brass identification tags 1 1/2 inches in diameter with legends in depressed black-filled characters.

PART 3 EXECUTION

3.1 INSTALLATION

Install gas piping, appliances, and equipment in accordance with NFPA 54. Install distribution piping in accordance with ASME B31.8.

3.1.1 Excavating and Backfilling

Perform excavating and backfilling of pipe trenches as specified in Section 31 00 00 EARTHWORK. Place pipe directly in trench bottom and cover with minimum 3 inches of sand to top of pipe. If trench bottom is rocky, place pipe on a 3 inch bed of sand and cover as above. Provide remaining backfilling. Coordinate provision of utility warning and identification tape with backfill operation. Bury utility warning and identification tape with printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

3.1.2 Piping

Cut pipe to actual dimensions and assemble to prevent residual stress. Provide supply connections entering the buildings as indicated. Within buildings, run piping parallel to structure lines and conceal in finished spaces. Terminate each vertical supply pipe to burner or appliance with tee, nipple and cap to form a sediment trap. To supply multiple items of gas-burning equipment, provide manifold with inlet connections at both ends.

3.1.2.1 Cleanliness

Clean inside of pipe and fittings before installation. Blow lines clear using 80 to 100 psig clean dry compressed air. Rap steel lines sharply along entire pipe length before blowing clear. Cap or plug pipe ends to maintain cleanliness throughout installation.

3.1.2.2 Aboveground Steel Piping

Determine and establish measurements for piping at the job site and accurately cut pipe lengths accordingly. For 2 inch diameter and smaller, use threaded or socket-welded joints. For 2 1/2 inch diameter and larger, use flanged or butt-welded joints.

a. Threaded Joints: Where possible use pipe with factory-cut threads, otherwise cut pipe ends square, remove fins and burrs, and cut taper pipe threads in accordance with ASME B1.20.1. Provide threads smooth, clean, and full-cut. Apply anti-seize paste or tape to male threads portion. Work piping into place without springing or forcing. Backing off to permit alignment of threaded joints will not be permitted. Engage threads so that not more than three threads remain exposed. Use unions for connections to valves and meters for which a means of disconnection is not otherwise provided.

b. Welded Joints: Weld by the shielded metal-arc process, using covered electrodes and in accordance with procedures established and qualified in accordance with ASME B31.8.

c. Flanged Joints: Use flanged joints for connecting welded joint pipe and fittings to valves to provide for disconnection. Install joints so that flange faces bear uniformly on gaskets. Engage bolts so that there is complete threading through the nuts and tighten so that bolts are uniformly stressed and equally torqued.

d. Pipe Size Changes: Use reducing fittings for changes in pipe size. Size changes made with bushings will not be accepted.

e. Painting: Paint new ferrous metal piping, including supports, in accordance with Section 09 90 00 PAINTS AND COATINGS. Do not apply

paint until piping tests have been completed.

f. Identification of Piping: Identify piping aboveground in accordance with MIL-STD-101, using adhesive-backed or snap-on plastic labels and arrows. In lieu of labels, identification tags may be used. Apply labels or tags to finished paint at intervals of not more than 50 feet. Provide two copies of the piping identification code framed under glass and install where directed.

3.1.2.3 Buried Plastic Lines

Provide totally PE piping. Prior to installation, obtain printed instructions and technical assistance in proper installation techniques from pipe manufacturer. When joining new PE pipe to existing pipe line, ascertain what procedural changes in the fusion process is necessary to attain optimum bonding.

a. PE Piping: Prior to installation, Contractor shall have supervising and installing personnel, certified in accordance with paragraph entitled "Welder's Qualifications." Provide fusion-welded joints except where transitions have been specified. Use electrically heated tools, thermostatically controlled and equipped with temperature indication. (Where connection must be made to existing plastic pipe, contractor shall be responsible for determination of compatibility of materials and procedural changes in fusion process necessary to attain maximum integrity of bond.)

b. Laying PE Pipe: Bury pipe 24 inches below finish grade or deeper when indicated. Lay in accordance with manufacturer's printed instructions.

3.1.2.4 Connections to Existing Pipeline

When making connections to live gas mains, use pressure tight installation equipment operated by workmen trained and experienced in making hot taps. For connections to existing underground pipeline or service branch, use transition fittings for dissimilar materials.

3.1.2.5 Wrapping

Where connection to existing steel line is made underground, tape wrap new steel transition fittings and exposed existing pipe having damaged coating. Clean pipe to bare metal. Initially stretch first layer of tape to conform to the surface while spirally half-lapping. Apply a second layer, half-lapped and spiraled as the first layer, but with spirals perpendicular to first wrapping. Use 10 mil minimum thick polyethylene tape. In lieu of tape wrap, heat shrinkable 10 mil minimum thick polyethylene sleeve may be used.

3.1.3 Valves

Install valves approximately at locations indicated. Orient stems vertically, with operators on top, or horizontally. Provide support for valves to resist operating torque applied to PE pipes.

3.1.3.1 Pressure Regulator

Provide ball valve ahead of regulator. Install regulator outside of building and 18 inches aboveground on riser.Install gas meter in conjunction with pressure regulator. On outlet side of regulator, provide

a union and a 3/8 inch gage tap with plug.

3.1.3.2 Stop Valve and Shutoff Valve

Provide stop valve on service branch at connection to main and shut-off valve on riser outside of building.

3.1.4 Pipe Sleeves

Where piping penetrates concrete or masonry wall, floor or firewall, provide pipe sleeve poured or grouted in place. Make sleeve of steel or cast-iron pipe of such size to provide 1/4 inch or more annular clearance around pipe. Extend sleeve through wall or slab and terminate flush with both surfaces. Pack annular space with oakum, and caulk at ends with silicone construction sealant.

3.1.5 Piping Hangers and Supports

Provide seismic restraints in accordance with NFPA 54 and ASCE 7.

3.1.6 Final Connections

Make final connections to equipment and appliances using rigid pipe and fittings, except for the following:

3.1.6.1 Domestic Water Heaters

Connect with AGA-Approved semi-rigid tubing and fittings.

3.2 FIELD QUALITY CONTROL

3.2.1 Metal Welding Inspection

Inspect for compliance with NFPA 54 and ASME B31.8. Replace, repair, and then re-inspect defective welds.

3.2.2 PE Fusion Welding Inspection

Visually inspect butt joints by comparing with, manufacturer's visual joint appearance chart. Inspect fusion joints for proper fused connection. Replace defective joints by cutting out defective joints or replacing fittings. Inspect 100 percent of all joints and reinspect all corrections. Arrange with the pipe manufacturer's representative in the presence of the COR to make first time inspection.

3.2.3 Pressure Tests

Use test pressure of 1 1/2 times maximum working pressure, but in no case less than 50 psig. Do not test until every joint has set and cooled at least 8 hours at temperatures above 50 degrees F. Conduct testing before backfilling; however, place sufficient backfill material between fittings to hold pipe in place during tests. Test system gas tight in accordance with NFPA 54. Use clean dry air or inert gas, such as nitrogen or carbon dioxide, for testing. Systems which may be contaminated by gas shall first be purged as specified. Make tests on entire system or on sections that can be isolated by valves. After pressurization, isolate entire piping system from sources of air during test period. Maintain test pressure for at least 8 hours between times of first and last reading of pressure and temperature. Take first reading at least one hour after test pressure has

been applied. Do not take test readings during rapid weather changes. Provide temperature same as actual trench conditions. There shall be no reduction in the applied test pressure other than that due to a change in ambient temperature. Allow for ambient temperature change in accordance with the relationship PF + 14.7 = (P1 + 14.7) (T2 + 460) / T1 + 460), in which "T" and "PF" represent Fahrenheit temperature and gage pressure, respectively, subscripts "1" and "2" denote initial and final readings, and "PF" is the calculated final pressure. If "PF" exceeds the measured final pressure (final gage reading) by 1/2 psi or more, isolate sections of the piping system, retest each section individually, and apply a solution of warm soapy water to joints of each section for which a reduction in pressure occurs after allowing for ambient temperature change. Repair leaking joints and repeat test until no reduction in pressure occurs. In performing tests, use a test gage calibrated in one psi increments and readable to 1/2 psi.

3.2.4 System Purging

After completing pressure tests, and before testing a gas contaminated line, purge line with nitrogen at junction with main line to remove all air and gas. Clear completed line by attaching a test pilot fixture at capped stub-in line at building location and let gas flow until test pilot ignites. Procedures shall conform to NFPA 54 and ASME B31.8.

-CAUTION-

Failure to purge may result in explosion within line when air-to-gas is at correct mixture.

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SECTION 33 30 00

SANITARY SEWERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA 01-102	Concrete Pipe Handbook
ACPA 01-103	Concrete Pipe Installation Manual

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	Grooved and Shouldered Joints
AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 4 In. Through 12 In. (100 mm through 300 mm), for Water Distribution
AWWA M23	Manual: PVC Pipe - Design and Installation

ASME INTERNATIONAL (ASME)

ASME B1.20.1	Pipe Threads, General Purpose (Inch)

ASTM INTERNATIONAL (ASTM)

ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A74	Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM C 150/C 150M	Standard Specification for Portland Cement
ASTM C 33/C 33M	Standard Specification for Concrete Aggregates
ASTM C361	Standard Specification for Reinforced Concrete Low-Head Pressure Pipe

ASTM C425	Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C564	Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C700	Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C969	Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C972	Compression-Recovery of Tape Sealant
ASTM C990	Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C 94/C 94M	Standard Specification for Ready-Mixed Concrete
ASTM D 1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2235	Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2412	Determination of External Loading Characteristics of Plastic Pipe by

	Parallel-Plate Loading
ASTM D 2464	Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2680	Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D2996	Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D3753	Glass-Fiber-Reinforced Polyester Manholes and Wetwells
ASTM D4101	Standard Specification for Polypropylene Injection and Extrusion Materials
ASTM D 3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3262	"Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Sewer Pipe
ASTM D 3350	Polyethylene Plastics Pipe and Fittings Materials
ASTM D 412	Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers - Tension
ASTM D 624	Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM F 402	Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 405	Corrugated Polyethylene (PE) Tubing and

	Fittings
ASTM F 477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 714	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 758	Smooth-Wall Poly(Vinyl Chloride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage
ASTM F 794	Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
ASTM F 949	Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	Recommended Practice for Low-Pressure Air Testing of Installed Sewer Pipe

1.2 SYSTEM DESCRIPTION

1.2.1 Sanitary Sewer Gravity Pipeline

Provide mains and laterals of clay pipe, acrylonitrile-butadiene-styrene (ABS) composite plastic pipe or polyvinyl chloride (PVC) plastic pipe. Provide building connections of acrylonitrile-butadiene-styrene (ABS) solid-wall plastic pipe or polyvinyl chloride (PVC) plastic pipeas indicated on the Drawings and directed by utility authorities.

1.2.2 Sanitary Sewer Pressure Lines

Provide pressure lines as indicated on the Deawings and directed by the utility authorities.

1.2.3 USACENASA Project

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 5 feet outside the building to which the sewer system is to be connected. Replace damaged material and redo unacceptable work at no additional cost to the Government. Backfilling shall be accomplished after inspection by the COR. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the COR. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded

if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Existing Conditions

SD-02 Shop Drawings

Drawings
Precast concrete manhole
Metal items
Frames, covers, and gratings

SD-03 Product Data

Pipeline materials

SD-06 Test Reports

Reports

SD-07 Certificates

Portland Cement
Gaskets

1.4 QUALITY ASSURANCE

1.4.1 Installer Qualifications

Install specified materials by a licensed underground utility Contractor licensed for such work in California where the work is to be performed. Installing Contractor's License shall be current and be state certified or state registered.

1.4.2 Drawings

a. Submit Installation Drawings showing complete detail, both plan and side view details with proper layout and elevations.

b. Submit As-Built Drawings for the complete sanitary sewer system showing complete detail with all dimensions, both above and below grade, including invert elevation.

c. Sign and seal As-Built Drawings by a Professional Surveyor and Mapper. Include the following statement: "All potable water lines crossed by sanitary hazard mains are in accordance with the permitted utility separation requirements."

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery and Storage

1.5.1.1 Piping

Inspect materials delivered to site for damage; store with minimum of handling. Store materials on site in enclosures or under protective coverings. Store plastic piping and jointing materials and rubber gaskets under cover out of direct sunlight. Do not store materials directly on the ground. Keep inside of pipes and fittings free of dirt and debris.

1.5.1.2 Metal Items

Check upon arrival; identify and segregate as to types, functions, and sizes. Store off the ground in a manner affording easy accessibility and not causing excessive rusting or coating with grease or other objectionable materials.

1.5.1.3 Cement, Aggregate, and Reinforcement

As specified in Section 03 30 00 CAST-IN-PLACE CONCRETE.

1.6 PROJECT/SITE CONDITIONS

Submit drawings of existing conditions, after a thorough inspection of the area in the presence of the COR. Details shall include the environmental conditions of the site and adjacent areas. Submit copies of the records for verification before starting work.

PART 2 PRODUCTS

2.1 PIPELINE MATERIALS

Pipe shall conform to the respective specifications and other requirements specified below. Submit manufacturer's standard drawings or catalog cuts. When a conflict occurs conform to local sanitary district pipe material specifications and requirements.

2.1.1 Cast-Iron Soil Piping

2.1.1.1 Cast-Iron Hub and Spigot Soil Pipe and Fittings

ASTM A74, extra heavy, with ASTM C564 compression-type rubber gaskets.

2.1.1.2 Cast-Iron Hubless Soil Pipe and Fittings

CISPI 301 with CISPI 310 coupling joints.

2.1.2 Clay Piping

2.1.2.1 Clay Pipe and Fittings

ASTM C700, extra strength bell-and-spigot piping only.

2.1.2.2 Clay Piping Jointing Materials

ASTM C425.

2.1.3 Concrete Gravity Sewer Piping

2.1.3.1 Concrete Gravity Pipe and Fittings

Pipe shall be reinforced concrete pipe conforming to ASTM C76. Circular pipe with elliptical reinforcement shall have a readily visible line at least 12 inches long painted or otherwise applied on the inside and outside of the pipe at each end so that when the pipe is laid in the proper position, the line will be at the center of the top of the pipe. Fittings and specials shall conform to the applicable requirements specified for the pipe and shall be of the same strength as the pipe. Cement used in manufacturing pipe and fittings shall be Type V conforming to ASTM C 150/C 150M.

2.1.3.2 Jointing Materials for Concrete Gravity Piping

Gaskets and pipe ends for rubber gasket joint shall conform to ASTM C443. Gaskets shall be suitable for use with sewage.
Submit certificates of compliance stating that the fittings or gaskets used for waste drains or lines designated on the plans.

2.1.4 Concrete Pressure Piping

2.1.4.1 Concrete Pressure Pipe and Fittings

Pipe shall conform to ASTM C361. Pipe shall be designed for hydrostatic head of 100 feet and external loading of 20 feet of earth cover. Circular pipe with elliptical reinforcement shall have a readily visible line at least 12 inches long painted or otherwise applied on the inside and outside of the pipe at each end so that SECTION 33 when the pipe is laid in the proper position, the line will be at the center of the top of the pipe. Cement used in manufacturing pipe and fittings shall be Type V. Bolt holes in follower rings shall be of a shape to hold fast the necks of the bolts used. Sleeve-type mechanical couplings shall not be used as an optional method of jointing except where pipeline is adequately anchored to resist tension pull across the joint.

2.1.4.2 Grooved and Shouldered Type Joints

Grooved pipe ends shouldered pipe ends and couplings shall conform to AWWA C606. Joint dimensions shall be as specified in AWWA C606 for rigid joints.

2.1.5 ABS Composite Plastic Piping

2.1.5.1 ABS Composite Plastic Pipe and Fittings

ASTM D 2680.

2.1.5.2 Jointing Materials for ABS Composite Plastic Piping

Solvent cement and primer shall conform to ASTM D 2680.

2.1.6 ABS Solid-Wall Plastic Piping

2.1.6.1 ABS Solid-Wall Plastic Pipe and Fittings

ASTM D 2751, SDR 35, with ends suitable for either solvent cement joints or elastomer joints.

2.1.6.2 ABS Solid-Wall Plastic Joints and Jointing Materials

Solvent cement for solvent cement joints shall conform to ASTM D 2235. Elastomeric joints shall conform to ASTM D 3212. Gaskets for elastomeric joints shall conform to ASTM F 477.

2.1.7 PVC Plastic Gravity Sewer Piping

ASTM D 3034, SDR 35, or ASTM F 949 with ends suitable for elastomeric gasket joints.

2.1.7.1 PVC Plastic Gravity Pipe and Fittings

ASTM D 3034, SDR 35, or ASTM F 949 with ends suitable for elastomeric gasket joints.

a. Pipe and Fittings 4 inch Diameter to 12 inch: Pipe shall conform to AWWA C900 and shall be plain end or gasket bell end, Pressure Class 150 (DR 18), with cast-iron-pipe-equivalent OD. Fittings shall be gray-iron or ductile-iron conforming to AWWA C110/A21.10 or AWWA C153/A21.53 and shall have cement-mortar lining conforming to AWWA C104/A21.4, standard thickness. Fittings with push-on joint ends shall conform to the same requirements as fittings with mechanical-joint ends, except that bell design shall be modified, as approved, for push-on joint suitable for use with the PVC plastic pressure pipe specified in this paragraph.

2.1.7.2 PVC Plastic Gravity Joints and Jointing Material

Joints shall conform to ASTM D 3212. Gaskets shall conform to ASTM F 477.

2.1.8 High Density Polyethylene Pipe

ASTM F 894, Class 63, size 18 inches through 120 inches. ASTM F 714, size 4 inches through 48 inches. The polyethylene shall be certified by the resin producer as meeting the requirements of ASTM D 3350, cell Class 334433C. The pipe stiffness shall be greater than or equal to 1170/D for cohesionless material pipe trench backfills. Fittings for High Density Polyethylene Pipe: ASTM F 894. Joints for high density polyethylene pipe: Rubber gasket joints shall conform to ASTM C443.

2.1.9 Reinforced Plastic Mortar Pipe (RPMP)

Reinforced plastic mortar pipe shall be produced be in accordance with ASTM D 3262 and shall have an outside diameter equal to ductile iron pipe dimensions from 18 inches to 48 inches. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner. The minimum pipe stiffness shall be 36 psi. RPMP shall be in accordance with ASTM D 3262. Fittings for RPMP: ASTM D 3840. Joints for RPMP: Bell and spigot gasket coupling utilizing an elastomeric gasket in accordance with ASTM D 4161 and ASTM F 477.

2.1.10 Reinforced Thermosetting Resin Pipe ((RTRP)

RTRP pipe: ASTM D 3262. Fittings for RTRP: ASTM D 3262. Joints for RTRP: Bell and spigot type utilizing an elastomeric gasket in accordance with ASTM F 477.

2.1.10.1 Filament Wound RTRP-I

RTRP-I shall conform to ASTM D 2996, except pipe shall have an outside diameter equal to cast iron outside diameter or standard weight steel pipe. The pipe shall be suitable for a normal working pressure of 150 psi at 73 degrees F. The inner surface of the pipe shall have a smooth uniform continuous resin-rich surface liner conforming to ASTM D 2996.

2.1.10.2 Centrifugally Cast RTRP-II

RTRP-II shall conform to ASTM D 2997. Pipe shall have an outside diameter equal to standard weight steel pipe.

2.2 CONCRETE MATERIALS

2.2.1 2.2.1 Portland Cement

Submit certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes. Portland cement shall conform to ASTM C 150, Type II for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking.

2.2.2 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94, compressive strength of 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 2500 psi minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Precast Concrete Manholes & Glass-Fiber-Reinforced Polyester Manholes

Precast concrete manhole risers, base sections, and tops shall conform to ASTM C478 and base and first riser shall be monolithic. Glass-Fiber-Reinforced Polyester Manholes shall conform to ASTM D 3753.

2.3.2 Gaskets and Connectors

Gaskets for joints between manhole sections shall conform to ASTM C443. Resilient connectors for making joints between manhole and pipes entering manhole shall conform to ASTM C923 or ASTM C990.

2.3.3 External Preformed Rubber Joint Seals

An external preformed rubber joint seal shall be an accepted method of sealing cast iron covers to precast concrete sections to prevent ground water infiltration into sewer systems. All finished and sealed manholes constructed in accordance with paragraph entitled "Manhole Construction" shall be tested for leakage in the same manner as pipelines as described in paragraph entitled "Leakage Tests." The seal shall be multi-section with a neoprene rubber top section and all lower sections made of Ethylene Propylene Diene Monomer (EPDM) rubber with a minimum thickness of 60 mils. Each unit shall consist of a top and bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be a non-hardening butyl rubber sealant and

shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. Extension sections shall cover up to two more adjusting rings. Properties and values are listed in the following tables:

Properties, Test Methods and Minimum Values for Rubber used in Preformed Joint Seals

Physical Properties Test Methods EPDM Neoprene Butyl mastic

Tensile, psi ASTM D 412 1840 2195

Elongation percent ASTM D 412 553 295 350

Tear Resistance, ppi ASTM D 624 280 160 - (Die B)

Rebound, percent, ASTM C972 - - 11 5 minutes (mod.)

Rebound, percent, ASTM C972 - - 12 2 hours

2.3.4 Metal Items

2.3.4.1 Frames,Covers, and Gratings for Manholes

CID A-A-60005, cast iron; figure numbers shall be as follows:

a. Traffic manhole: Provide in paved areas.

Frame: Figure 1, Size 22A
Cover: Figure 8, Size 22A
Steps: Figure 19

b. Non-traffic manhole:

Frame: Figure 4, Size 22
Cover: Figure 12, Size 22
Steps: Figure 19

Frames and covers shall be cast iron, ductile iron or reinforced concrete. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 400 pounds. Reinforced concrete frames and covers shall be as indicated or shall conform to ASTM C478. The word "Sanitary Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.4.2 Manhole Steps

Zinc-coated steel conforming to 29 CFR 1910.27. As an option, plastic or rubber coating pressure-molded to the steel may be used. Plastic coating shall conform to ASTM D 4101, copolymer polypropylene. Rubber shall conform to ASTM C443, except shore A durometer hardness shall be 70 plus or minus 5. Aluminum steps or rungs will not be permitted. Steps are not required in manholes less than 4 feet deep.

2.3.4.3 Manhole Ladders

A steel ladder shall be provided where the depth of a manhole exceeds 12 feet. The ladder shall not be less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a

minimum 3/8 inch thick and 2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A123.

2.4 REPORTS

Submit Test Reports. Compaction and density test shall be in accordance with Section 31 00 00 EARTHWORK. Submit Inspection Reports for daily activities during the installation of the sanitary system. Information in the report shall be detailed enough to describe location of work and amount of pipe laid in place, measured in linear feet.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPELINES AND APPURTENANT CONSTRUCTION

3.1.1 General Requirements for Installation of Pipelines

These general requirements apply except where specific exception is made in the following paragraphs entitled "Special Requirements."or when they conflict with local sanitary district installation requirements.

3.1.1.1 Location

The work covered by this section shall terminate at a point approximately 5 feet from the building , unless otherwise indicated.

3.1.1.2 Earthwork

Perform earthwork operations in accordance with Section 31 00 00 EARTHWORK.

3.1.1.3 Pipe Laying and Jointing

Inspect each pipe and fitting before and after installation; replace those found defective and remove from site. Provide proper facilities for lowering sections of pipe into trenches. Lay nonpressure pipe with the bell or groove ends in the upgrade direction. Adjust spigots in bells and tongues in grooves to give a uniform space all around. Blocking or wedging between bells and spigots or tongues and grooves will not be permitted. Replace by one of the proper dimensions, pipe or fittings that do not allow sufficient space for installation of joint material. At the end of each work day, close open ends of pipe temporarily with wood blocks or bulkheads. Provide batterboards not more than 25 feet apart in trenches for checking and ensuring that pipe invert elevations are as indicated. Laser beam method may be used in lieu of batterboards for the same purpose. Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D 2680; saddles for ABS pipe shall comply with Table 3 of ASTM D 2751; and saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

3.1.1.4 Connections to Existing Lines

Obtain approval from the COR before making connection to existing line. Conduct work so that there is minimum interruption of service on existing line.

3.1.2 Special Requirements

3.1.2.1 Installation of Cast Iron Soil Piping

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the pipe manufacturer. Make joints with the rubber gaskets specified for cast iron soil pipe joints and assemble in accordance with the recommendations of the pipe manufacturer.

3.1.2.2 Installation of ABS Composite Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the plastic pipe manufacturer. Make joints with the primer and solvent cement specified for this joint and assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.

3.1.2.2.1 Installation of Clay Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM C12 for pipe laying. Make joints with a compression joint material specified for clay pipe joints and assemble in accordance with the recommendations of the manufacturer of the pipe.

3.1.2.2.2 Installation of Concrete Gravity Sewer Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the provisions for rubber gasket jointing and jointing procedures of ACPA 01-103 or of ACPA 01-102, Chapter 9, "Installation, Inspection and Construction Testing." Make joints with the gaskets specified for concrete gravity sewer pipe joints. Clean and dry surfaces receiving lubricants, cements, or adhesives. Affix gaskets to pipe not more than 24 hours prior to the installation of the pipe. Protect gaskets from sun, blowing dust, and other deleterious agents at all times. Before installation of the pipe, inspect gaskets and remove and replace loose or improperly affixed gaskets. Align each pipe section with the previously installed pipe section, and pull the joint together. If, while pulling the joint, the gasket becomes loose and can be seen through the exterior joint recess when the pipe is pulled up to within 1 inch of closure, remove the pipe and remake the joint.

3.1.2.2.3 Installation of Concrete Pressure Lines

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the laying and joining requirements specified in the guide specifications for installation of pipe given in AWWA M9, Chapter 14, "Guide Specifications for Installation of Pipe."

a. Joints: Make joints with the gaskets specified for concrete pressure pipe joints, using an approved lubricant recommended by the pipe manufacturer. Assemble these joints in accordance with the joining requirements specified in the guide specifications for installation of pipe given in AWWA M9, Chapter 14, "Guide Specifications for Installation of Pipe," and with the recommendations given for laying

the pipe in AWWA M9, Chapter 6, "Installation by Trenching or Tunneling -- Methods and Equipment."

b. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated on the Drawings. Use concrete conforming to ASTM C94/C94M having a minimum compressive strength of 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.3 Installation of Ductile-Iron Pressure Lines

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of AWWA C600 for pipe installation, joint assembly, and valve-and-fitting installation.

a. Make push-on joints with the gaskets and lubricant specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical-joints with the gaskets, glands, bolts, and nuts specified for this type joint; assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11. Make flanged joints with gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight, taking care to avoid undue strain on flanges, fittings, and other accessories. Align bolt holes for each flanged joint. Use full size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange. When flanged pipe or fittings have dimensions that do not allow the making of a proper flanged joint as specified, replace it by one of proper dimensions. Assemble joints made with sleeve-type mechanical couplings in accordance with the recommendations of the coupling manufacturer, as approved. Make grooved and shouldered type joints with the couplings previously specified for this type joint connecting pipe with the grooved or shouldered ends specified for this type joint and assemble in accordance with the recommendations of the coupling manufacturer, as approved. Groove pipe in the field only with approved groove cutting equipment designed especially for the purpose and produced by a manufacturer of grooved joint couplings; secure approval for field-cut grooves before assembling the joint.

b. Exterior protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet in accordance with AWWA C105/A21.5, using Class A polyethylene film.

c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated. Use concrete conforming to ASTM C94/C94M having a minimum compressive strength of 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.4 Installation of ABS Composite Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General

SECTION 33.

3.1.2.5 Installation of Ductile Iron Gravity Sewer Pipe

Unless otherwise specified, install pipe and associated fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of AWWA C600 for pipe installation and joint assembly.

a. Make push-on joints with the gaskets and lubricant specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly. Make mechanical-joints with the gaskets, glands, bolts, and nuts specified for this type joint and assemble in accordance with the applicable requirements of AWWA C600 for joint assembly and the recommendations of Appendix A to AWWA C111/A21.11.

b. Exterior protection: Completely encase buried ductile iron pipelines with polyethylene tube or sheet in accordance with AWWA C105/A21.5, using Class A polyethylene film.

3.1.2.6 Installation of ABS Solid-Wall Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations of the plastic pipe manufacturer. Make solvent cement joints with the solvent cement previously specified for this type joint. Make elastomeric joints with the gaskets specified for this type joint and assemble in accordance with the recommendations of the pipe manufacturer. Handle solvent cement in accordance with ASTM F 402.

3.1.2.7 Installation of PVC Plastic Piping

Install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the requirements of ASTM D 2321 for laying and joining pipe and fittings. Make joints with the gaskets specified for joints with this piping and assemble in accordance with the requirements of ASTM D 2321 for assembly of joints. Make joints to other pipe materials in accordance with the recommendations of the plastic pipe manufacturer.

3.1.2.8 Installation of PVC Plastic Pressure Pipe and Fittings

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section; with the requirements of AWWA C605 for laying of pipe, joining PVC pipe to fittings and accessories, and setting of hydrants, valves, and fittings; and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Pipe Less Than 4 Inch Diameter:

1. Threaded joints shall be made by wrapping the male threads with joint tape or by applying an approved thread lubricant, then threading the joining members together. The joints shall be tightened with strap wrenches which will not damage the pipe and fittings. The joint shall be tightened no more than 2 threads past hand-tight.

2. Push-On Joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. Care shall be exercised to ensure that the gasket remains in proper position in the bell or coupling while making the joint.

3. Solvent-weld joints shall comply with the manufacturer's instructions.

b. Pipe 4 Inch Diameter Joints: Make push-on joints with the elastomeric gaskets specified for this type joint, using either elastomeric-gasket bell-end pipe or elastomeric-gasket couplings. For pipe-to-pipe push-on joint connections, use only pipe with push-on joint ends having factory-made bevel; for push-on joint connections to fittings, cut spigot end of pipe off square and re-bevel pipe end to a bevel approximately the same as that on ductile-iron pipe used for the same type of joint. Use an approved lubricant recommended by the pipe manufacturer for push-on joints. Assemble push-on joints for pipe-to-pipe joint connections in accordance with the requirements of AWWA C605 for laying the pipe and the recommendations in AWWA M23, Chapter 7, "Installation," for pipe joint assembly. Assemble push-on joints for connection to fittings in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories and with the applicable requirements of AWWA C600 for joint assembly. Make compression-type joints/mechanical-joints with the gaskets, glands, bolts, nuts, and internal stiffeners specified for this type joint and assemble in accordance with the requirements of AWWA C605 for joining PVC pipe to fittings and accessories, with the applicable requirements of AWWA C600 for joint assembly, and with the recommendations of Appendix A to AWWA C111/A21.11. Cut off spigot end of pipe for compression-type joint/mechanical-joint connections and do not re-bevel.

c. Pipe anchorage: Provide concrete thrust blocks (reaction backing) for pipe anchorage. Size and position thrust blocks as indicated on the Drawings. Use concrete conforming to ASTM C 94/C 94M having a minimum compressive strength of 2,000 psi at 28 days; or use concrete of a mix not leaner than one part cement, 2 1/2 parts sand, and 5 parts gravel, having the same minimum compressive strength.

3.1.2.9 Pipeline

Installation Beneath Railroad Right-of-Way. Where pipeline passes under the right-of-way of a commercial railroad, install piping in accordance with the specifications for pipelines conveying nonflammable substances in AREMA Eng Man.

3.1.3 Concrete Work

Cast-in-place concrete is included in Section 03 30 00 CAST-IN-PLACE CONCRETE. The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.1.4 Manhole Construction

Construct base slab of cast-in-place concrete or use precast concrete base sections. Make inverts in cast-in-place concrete and precast concrete bases with a smooth-surfaced semi-circular bottom conforming to the inside contour of the adjacent sewer sections. For changes in direction of the

sewer and entering branches into the manhole, make a circular curve in the manhole invert of as large a radius as manhole size will permit. For cast-in-place concrete construction, either pour bottom slabs and walls integrally or key and bond walls to bottom slab. No parging will be permitted on interior manhole walls. For precast concrete construction, make joints between manhole sections with the gaskets specified for this purpose; install in the manner specified for installing joints in concrete piping. Parging will not be required for precast concrete manholes.

Cast-in-place concrete work shall be in accordance with the requirements specified under paragraph entitled "Concrete Work" of this section. Make joints between concrete manholes and pipes entering manholes with the resilient connectors specified for this purpose; install in accordance with the recommendations of the connector manufacturer. Where a new manhole is constructed on an existing line, remove existing pipe as necessary to construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use construct the manhole. Cut existing pipe so that pipe ends are approximately flush with the interior face of manhole wall, but not protruding into the manhole. Use resilient connectors as previously specified for pipe connectors to concrete manholes.

3.1.5 Miscellaneous Construction and Installation

3.1.5.1 Connecting to Existing Manholes

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.1.5.2 Metal Work

a. Workmanship and finish: Perform metal work so that workmanship and finish will be equal to the best practice in modern structural shops and foundries. Form iron to shape and size with sharp lines and angles. Do shearing and punching so that clean true lines and surfaces are produced. Make castings sound and free from warp, cold shuts, and blow holes that may impair their strength or appearance. Give exposed surfaces a smooth finish with sharp well-defined lines and arises. Provide necessary rabbets, lugs, and brackets wherever necessary for fitting and support.

b. Field painting: After installation, clean cast-iron frames, covers, gratings, and steps not buried in concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. Do not paint surfaces subject to abrasion.

3.1.6 Sewage Absorption Trench Construction

Grade pipe lines uniformly downward to the outlet. Lay perforated pipe with the perforations downward. Lay drain tile with 1/4 inch open joints. Cover open joints of drain tile with the cover material specified so that it extends not less than 100 degrees on each side of the vertical center line of the tile. Wire covering in place.

3.1.7 Installations of Wye Branches

Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.2 FIELD QUALITY CONTROL

3.2.1 Field Tests and Inspections

The COR will conduct field inspections and witness field tests specified in this section. Perform field tests and provide labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished as set forth in Section 01 45 00 Quality Control. Be able to produce evidence, when required, that each item of work has been constructed in accordance with the drawings and specifications.

3.2.2 Tests for Nonpressure Lines

Check each straight run of pipeline for gross deficiencies by holding a light in a manhole; it shall show a practically full circle of light through the pipeline when viewed from the adjoining end of line. When pressure piping is used in a nonpressure line for nonpressure use, test this piping as specified for nonpressure pipe.

3.2.2.1 Leakage Tests

Test lines for leakage by either infiltration tests or exfiltration tests, or by low-pressure air tests. Prior to testing for leakage, backfill trench up to at least lower half of pipe. When necessary to prevent pipeline movement during testing, place additional backfill around pipe sufficient to prevent movement, but leaving joints uncovered to permit inspection. When leakage or pressure drop exceeds the allowable amount specified, make satisfactory correction and retest pipeline section in the same manner. Correct visible leaks regardless of leakage test results.

a. Infiltration tests and exfiltration tests: Perform these tests for sewer lines made of the specified materials, not only concrete, in accordance with ASTM C 969. Make calculations in accordance with the Appendix to ASTM C 969.

b. Low-pressure air tests: Perform tests as follows:

   1. ABS composite plastic pipelines: Test in accordance with the applicable requirements of UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

2. PVC plastic pipelines: Test in accordance with UBPPA UNI-B-6. Allowable pressure drop shall be as given in UBPPA UNI-B-6. Make calculations in accordance with the Appendix to UBPPA UNI-B-6.

3.2.2.2 Deflection Testing

Perform a deflection test on entire length of installed plastic pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads determined in accordance with ASTM D 2412. Deflection of pipe in the installed pipeline under external loads shall not exceed 4.5 percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a pull-through device or a deflection measuring device.

a. Pull-through device: This device shall be a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. Circular sections shall be so spaced on the shaft that distance from external faces of front and back sections will equal or exceed diameter of the circular section. Pull-through device may also be of a design promulgated by the Uni-Bell Plastic Pipe Association, provided the device meets the applicable requirements specified in this paragraph, including those for diameter of the device, and that the mandrel has a minimum of 9 arms. Ball, cylinder, or circular sections shall conform to the following:

   1. A diameter, or minor diameter as applicable, of 95 percent of the average inside diameter of the pipe; tolerance of plus 0.5 percent will be permitted.

   2. Homogeneous material throughout, shall have a density greater than 1.0 as related to water at 39.2 degrees F, and shall have a surface Brinell hardness of not less than 150.

   3. Center bored and through-bolted with a 1/4 inch minimum diameter steel shaft having a yield strength of not less than 70,000 psi, with eyes or loops at each end for attaching pulling cables.

   4. Each eye or loop shall be suitably backed with a flange or heavy washer such that a pull exerted on opposite end of shaft will produce compression throughout remote end.

b. Deflection measuring device: Sensitive to 1.0 percent of the diameter of the pipe being tested and shall be accurate to 1.0 percent of the indicated dimension. Deflection measuring device shall be approved prior to use.

c. Pull-through device procedure: Pass the pull-through device through each run of pipe, either by pulling it through or flushing it through with water. If the device fails to pass freely through a pipe run, replace pipe which has the excessive deflection and completely retest in same manner and under same conditions.

d. Deflection measuring device procedure: Measure deflections through each run of installed pipe. If deflection readings in excess of 4.5 percent of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show a deflection in excess of 4.5 percent of average inside diameter of pipe,

replace pipe which has excessive deflection and completely retest in same manner and under same conditions.

3.2.3 Field Tests for Concrete

Field testing requirements are covered in Section 03 30 00 CAST-IN-PLACE CONCRETE.

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SECTION 33 40 00

STORM DRAINAGE UTILITIES

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for storm drainage piping systems using concrete, clay, steel, ductile iron, aluminum, polyvinyl chloride (PVC), and polyethylene (PE) pipe.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	Standard Specifications for Highway Bridges
AASHTO M 167M/M 167	Standard Specification for Corrugated Steel Structural Plate, Zinc-Coated, for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M 190	Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches
AASHTO M 198	Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
AASHTO M 219	Standard Specification for Corrugated Aluminum Alloy Structural Plate for Field-Bolted Pipe, Pipe-Arches, and Arches
AASHTO M 243	Standard Specification for Field-Applied Coating of Corrugated Metal Structural Plate for Pipe, Pipe-Arches, and Arches
AASHTO M 294	Standard Specification for Corrugated Polyethylene Pipe, 6 to 30 Inches Diameter

AMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 346	Specification for Cast-in-Place Concrete

Pipe

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY ASSOCIATION (AREMA)

AREMA Eng Man	Manual for Railway Engineering

ASTM INTERNATIONAL (ASTM)

ASTM A123/A123M	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A48/A48M	Standard Specification for Gray Iron Castings
ASTM A536	Standard Specification for Ductile Iron Castings
ASTM A716	Standard Specification for Ductile Iron Culvert Pipe
ASTM A74	Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A742/A742M	Standard Specification for Steel Sheet, Metallic Coated and Polymer Precoated for Corrugated Steel Pipe
ASTM A760/A760M	Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ASTM A762/A762M	Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A798/A798M	Standard Practice for Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications
ASTM A807/A807M	Standard Practice for Installing Corrugated Steel Structural Plate Pipe for Sewers and Other Applications
ASTM A849	Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe
ASTM A929/A929M	Standard Specification for Steel Sheet, Metallic-Coated by the Hot-Dip Process for Corrugated Steel Pipe
ASTM B26/B26M	Standard Specification for Aluminum-Alloy Sand Castings
ASTM B745/B745M	Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains

ASTM C1103	Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C1103M	Standard Practice for Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
ASTM C139	Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C14	Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C1433	Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
ASTM C1433M	Standard Specification for Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers (Metric)
ASTM C14M	Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe (Metric)
ASTM C231/C231M	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C270	Standard Specification for Mortar for Unit Masonry
ASTM C443	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C443M	Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric)
ASTM C444	Perforated Concrete Pipe
ASTM C444M	Perforated Concrete Pipe (Metric)
ASTM C478	Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C478M	Standard Specification for Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C506	Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C506M	Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe (Metric)

ASTM C507	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C507M	Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C55	Concrete Brick
ASTM C564	Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C655	Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C76	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C76M	Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe (Metric)
ASTM C877	External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections
ASTM C877M	External Sealing Bands for Concrete Pipe, Manholes, and Precast Box Sections (Metric)
ASTM C923	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C923M	Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals (Metric)
ASTM C924	Testing Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C924M	Testing Concrete Pipe Sewer Liner by Low-Pressure Air Test Method (Metric)
ASTM D 1056	Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1171	Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D 1557	Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)

ASTM D 1751	Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D 1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2167	Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2321	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D 2729	Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3034	Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3350	Polyethylene Plastics Pipe and Fittings Materials
ASTM D 6938	Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM F 1417	Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air
ASTM F 477	Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 679	Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F 714	Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 894	Polyethylene (PE) Large Diameter Profile

	Wall Sewer and Drain Pipe
ASTM F 949	Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

1.3 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Placing Pipe

SD-04 Samples

Pipe for Culverts and Storm Drains

SD-07 Certificates

Resin Certification
Pipeline Testing
Hydrostatic Test on Watertight Joints
Determination of Density
Frame and Cover for Gratings

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the COR. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.4.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

Manufactured in accordance with and conforming to ASTM C76, Class I, II, III, IV, V, or ASTM C655, D-Load as indicated on the Drawings.

2.1.1.1 Reinforced Arch Culvert and Storm Drainpipe

Manufactured in accordance with and conforming to ASTM C506, Class A-II, A-III, A-IV as indicated on the Drawings.

2.1.1.2 Reinforced Elliptical Culvert and Storm Drainpipe

Manufactured in accordance with and conforming to ASTM C507. Horizontal elliptical pipe shall be Class HE-A, HE-I, HE-II, HE-III or HE-IV. Vertical elliptical pipe shall be Class VE-II, VE-III, VE-IV, VE-V,or VE-VI as indicated on the Drawings.

2.1.2 Perforated Piping

2.1.2.1 Concrete Pipe

Manufactured in accordance with and conforming to ASTM C444, and applicable requirements of ASTM C14, Class as indicated on the Drawings.

2.1.3 PVC Pipe

Submit the pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, prior to installation of the pipe.

2.1.3.1 Type PSM PVC Pipe

ASTM D 3034, Type PSM, maximum SDR 35, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.3.2 Profile PVC Pipe

ASTM F 794, Series 46, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.3.3 Smooth Wall PVC Pipe

ASTM F 679 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.3.4 Corrugated PVC Pipe

ASTM F 949 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.4 PE Pipe

Submit the pipe manufacturer's resin certification, indicating the cell classification of PE used to manufacture the pipe, prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D 3350.

2.1.4.1 Smooth Wall PE Pipe

ASTM F 714, maximum DR of 21 for pipes 3 to 24 inches in diameter and maximum DR of 26 for pipes 26 to 48 inches in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335434C.

2.1.4.2 Corrugated PE Pipe

AASHTO M 294, Type S or C. For slow crack growth resistance, acceptance of resins shall be determined by using the notched constant ligament-stress (NCLS) test meeting the requirements of AASHTO M 294. Pipe walls shall have the following properties:

Nominal Size (in.)	Minimum Wall Area (square in/ft)	Minimum Moment of Inertia of Wall Section (in to the 4th/in)
12	1.50	0.024
15	1.91	0.053
18	2.34	0.062
24	3.14	0.116
30	3.92	0.163
36	4.50	0.222
42	4.69	0.543
48	5.15	0.543
54	5.67	0.800
60	6.45	0.800

2.1.4.3 Profile Wall PE Pipe

ASTM F 894, RSC 160, produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 334433C. Pipe walls shall have the following properties:

		Minimum Moment Of Inertia of Wall Section (in to the 4th/in)	
Nominal Size (in.)	Minimum Wall Area (square in/ft)	Cell Class 334433C	Cell Class 335434C
18	2.96	0.052	0.038
21	4.15	0.070	0.051
24	4.66	0.081	0.059
27	5.91	0.125	0.091
30	5.91	0.125	0.091
33	6.99	0.161	0.132
36	8.08	0.202	0.165
42	7.81	0.277	0.227
48	8.82	0.338	0.277

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A929/A929M.

2.2.2 Precast Reinforced Concrete Box

Manufactured in accordance with and conforming to ASTM C1433.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 3,000 psi concrete under Section 03 30 00 CAST-IN-PLACE CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 1-1/2 inches. Air content shall be determined in accordance with ASTM C231/C231M. The concrete covering over steel reinforcing shall not be less than 1 inch thick for covers and not less than 1-1/2 inches thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 3 inches between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed 2 gallons of water per sack of cement. Water shall be clean and free of harmful acids, alkalies, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Precast Concrete Segmental Blocks

Precast concrete segmental block shall conform to ASTM C139, not more than 8 inches thick, not less than 8 inches long, and of such shape that joints can be sealed effectively and bonded with cement mortar.

2.3.4 Precast Reinforced Concrete Manholes

Conform to ASTM C478. Joints between precast concrete risers and tops shall be full-bedded in cement mortar and shall be smoothed to a uniform surface on both interior and exterior of the structure or made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.5 Prefabricated Corrugated Metal Manholes

Manholes shall be of the type and design recommended by the manufacturer.

Manholes shall be complete with frames and cover, or frames and gratings.

2.3.6 Frame and Cover for Gratings

Submit certification on the ability of frame and cover or gratings to carry the imposed live load. Frame and cover for gratings shall be cast gray iron, ASTM A48/A48M, Class 35B; cast ductile iron, ASTM A536, Grade 65-45-12; or cast aluminum, ASTM B26/B26M, Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans. The word "Storm Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.3.7 Joints

2.3.7.1 Flexible Watertight Joints

a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C443. Factory-fabricated resilient joint materials shall conform to ASTM C425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 54 inches.

b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C443. Certified copies of test results shall be delivered to the COR before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.7.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C877.

2.3.7.3 Flexible Watertight, Gasketed Joints

a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets as indicated on the Drawings. The closed-cell expanded rubber gaskets shall be a continuous band approximately 7 inches wide and approximately 3/8 inch thick, meeting the requirements of ASTM D 1056, Type 2 A1, and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D 1171. Rubber O-ring gaskets shall be 13/16 inch in diameter for pipe diameters of 36 inches or smaller and 7/8 inch in diameter for larger pipe having 1/2 inch deep end corrugation. Rubber O-ring gaskets shall be 1-3/8 inches in diameter for pipe having 1 inch deep end corrugations. O-rings shall meet the requirements of AASHTO M 198 or ASTM C443. Flexible plastic gaskets shall conform to requirements of AASHTO M 198, Type B.

b. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Watertight joints shall

be tested and shall meet the test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.

2.3.8 Flap Gates

Flap Gates shall be medium with circular opening and double-hinged. Top pivot points shall be adjustablee. The seat shall be one-piece cast iron with a raised section around the perimeter of the waterway opening to provide the seating face. The seating face of the seat shall be cast iron, bronze, stainless steel or neoprene. The cover shall be one-piece cast iron with necessary reinforcing rib, lifting eye for manual operation, and bosses to provide a pivot point connection with the links. The seating face of the cover shall be cast iron, bronze, stainless steel, neoprene. Links or hinge arms shall be cast or ductile iron. Holes of pivot points shall be bronze bushed. All fasteners shall be either galvanized steel, bronze or stainless steel to match.

2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the storm drainage structure exceeds 12 feet. These ladders shall be not less than 16 inches in width, with 3/4 inch diameter rungs spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A123/A123M.

2.5 DOWNSPOUT BOOTS

Boots used to connect exterior downspouts to the storm-drainage system shall be of gray cast iron conforming to ASTM A48, Class 30B or 35B. Shape and size shall be as indicated.

2.6 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C923.

2.7 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.7.1 Concrete, PVC and PE Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced concrete pipe shall conform to AASHTO M 198 or ASTM C443.

2.8 EROSION CONTROL RIPRAP

Provide nonerodible rock not exceeding 15 inches in its greatest dimension and choked with sufficient small rocks to provide a dense mass with a minimum thickness of as indicated.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 31 00 00 EARTHWORK and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 24 inches to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheeting and bracing, where required, shall be placed within the trench width as specified, without any overexcavation. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the COR, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in granular material minimum 4 inch in depth in trenches with soil foundation. Depth of granular bedding in trenches with rock foundation shall be 1/2 inch in depth per foot of depth of fill, minimum depth of bedding shall be 8 inch up to maximum depth of 24 inches. The middle third of the granular bedding shall be loosely placed. Bell holes and depressions for joints shall be removed and formed so entire barrel of pipe is uniformly supported. The bell hole and depressions for the joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.2 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

3.3 PLACING PIPE

Submit printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (%)
Plastic (PVC & HDPE)	5

Note post installation requirements of paragraph 'Deflection Testing' in PART 3 of this specification for all pipe products including deflection testing requirements for flexible pipe.

3.3.1 Concrete, PVC, Ribbed PVC, Ductile Iron and Cast-Iron Pipe

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 Elliptical and Elliptical Reinforced Concrete Pipe

The manufacturer's reference lines, designating the top of the pipe, shall be within 5 degrees of a vertical plane through the longitudinal axis of the pipe, during placement. Damage to or misalignment of the pipe shall be prevented in all backfilling operations.

3.4 JOINTING

3.4.1 Concrete Pipe

3.4.1.1 Cement-Mortar Bell-and-Spigot Joint

The first pipe shall be bedded to the established grade line, with the bell end placed upstream. The interior surface of the bell shall be thoroughly cleaned with a wet brush and the lower portion of the bell filled with mortar as required to bring inner surfaces of abutting pipes flush and even. The spigot end of each subsequent pipe shall be cleaned with a wet brush and uniformly matched into a bell so that sections are closely fitted. After each section is laid, the remainder of the joint shall be filled with mortar, and a bead shall be formed around the outside of the joint with sufficient additional mortar. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint shall be wrapped or bandaged with cheesecloth to hold mortar in place.

3.4.1.2 Cement-Mortar Oakum Joint for Bell-and-Spigot Pipe

A closely twisted gasket shall be made of jute or oakum of the diameter required to support the spigot end of the pipe at the proper grade and to make the joint concentric. Joint packing shall be in one piece of sufficient length to pass around the pipe and lap at top. This gasket shall be thoroughly saturated with neat cement grout. The bell of the pipe shall be thoroughly cleaned with a wet brush, and the gasket shall be laid

in the bell for the lower third of the circumference and covered with mortar. The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted in the bell, and carefully driven home. A small amount of mortar shall be inserted in the annular space for the upper two-thirds of the circumference. The gasket shall be lapped at the top of the pipe and driven home in the annular space with a caulking tool. The remainder of the annular space shall be filled completely with mortar and beveled at an angle of approximately 45 degrees with the outside of the bell. If mortar is not sufficiently stiff to prevent appreciable slump before setting, the outside of the joint thus made shall be wrapped with cheesecloth. Placing of this type of joint shall be kept at least five joints behind laying operations.

3.4.1.3 Cement-Mortar Tongue-and-Groove Joint

The first pipe shall be bedded carefully to the established grade line with the groove upstream. A shallow excavation shall be made underneath the pipe at the joint and filled with mortar to provide a bed for the pipe. The grooved end of the first pipe shall be thoroughly cleaned with a wet brush, and a layer of soft mortar applied to the lower half of the groove. The tongue of the second pipe shall be cleaned with a wet brush; while in horizontal position, a layer of soft mortar shall be applied to the upper half of the tongue. The tongue end of the second pipe shall be inserted in the grooved end of the first pipe until mortar is squeezed out on interior and exterior surfaces. Sufficient mortar shall be used to fill the joint completely and to form a bead on the outside.

3.4.1.4 Plastic Sealing Compound Joints for Tongue-and-Grooved Pipe

Sealing compounds shall follow the recommendation of the particular manufacturer in regard to special installation requirements. Surfaces to receive lubricants, primers, or adhesives shall be dry and clean. Sealing compounds shall be affixed to the pipe not more than 3 hours prior to installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times.

3.4.1.5 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.6 External Sealing Band Joint for Noncircular Pipe

Surfaces to receive sealing bands shall be dry and clean. Bands shall be installed in accordance with manufacturer's recommendations.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of reinforced concrete, plain concrete, brick, precast reinforced concrete, precast concrete segmental blocks, prefabricated corrugated metal, or bituminous coated corrugated metal; complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe studs and junction chambers of prefabricated corrugated metal manholes shall be fully bituminous-coated and paved when the connecting branch lines are so treated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet vertically, and shall be installed to provide at least 6 inches of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 6 inches in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation equal to the midpoint (spring line) of RCP or has reached an elevation of at least 12 inches above the top of the pipe for flexible pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 12 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the COR, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Backfilling Pipe in Fill Sections

For pipe placed in fill sections, backfill material and the placement and compaction procedures shall be as specified below. The fill material shall be uniformly spread in layers longitudinally on both sides of the pipe, not exceeding 6 inches in compacted depth, and shall be compacted by rolling parallel with pipe or by mechanical tamping or ramming. Prior to commencing normal filling operations, the crown width of the fill at a height of 12 inches above the top of the pipe shall extend a distance of not less than twice the outside pipe diameter on each side of the pipe or 12 feet, whichever is less. After the backfill has reached at least 12 inches above the top of the pipe, the remainder of the fill shall be placed

and thoroughly compacted in layers not exceeding 12 inches. Use select granular material for this entire region of backfill for flexible pipe installations.

3.7.3 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.4 Compaction

3.7.4.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.4.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

a. Under airfield and heliport pavements, paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.

b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.

c. Under nontraffic areas, density shall be not less than that of the surrounding material or 85 percent (whichever is greater).

3.7.5 Determination of Density

Testing is the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or by the Contractor subject to approval. Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557

3.8 PIPELINE TESTING

3.8.1 Leakage Tests

Lines shall be tested for leakage by low pressure air or water testing or

exfiltration tests, as appropriate. Low pressure air testing for concrete pipes shall conform to ASTM C924. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C1103. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 2 feet or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the COR. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 2 feet is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 0.2 gallons per inch in diameter per 100 feet of pipeline per hour. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished.

3.8.2 Deflection Testing

No sooner than 30 days after completion of installation and final backfill, an initial post installation inspection shall be accomplished. Clean or flush all lines prior to inspection. Perform a deflection test on entire length of installed flexible pipeline on completion of work adjacent to and over the pipeline, including leakage tests, backfilling, placement of fill, grading, paving, concreting, and any other superimposed loads. Deflection of pipe in the installed pipeline under external loads shall not exceed limits in paragraph PLACING PIPE above as percent of the average inside diameter of pipe. Determine whether the allowable deflection has been exceeded by use of a laser profiler or mandrel.

a. Laser Profiler Inspection: If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, remove pipe which has excessive deflection, and replace with new pipe. Initial post installation inspections of the pipe interior with laser profiling equipment shall utilize low barrel distortion video equipment for pipe sizes 48 inches or less. Use a camera with lighting suitable to allow a clear picture of the entire periphery of the pipe interior. Center the camera in the pipe both vertically and horizontally and be able to pan and tilt to a 90 degree angle with the axis of the pipe rotating 360 degrees. Use equipment to move the camera through the pipe that will not obstruct the camera's view or interfere with proper documentation of the pipe's condition. The video image shall be clear, focused, and relatively free from roll static or other image distortion qualities that would prevent the reviewer from evaluating the condition of the pipe. For initial post installation inspections for pipe sizes larger than 48 inches, visual inspection shall be completed of the pipe interior.

b. Pull-Through Device Inspection: Pass the pull-through device through each run of pipe by pulling it by hand. If deflection readings in excess of the allowable deflection of average inside diameter of pipe are obtained, retest pipe by a run from the opposite direction. If retest continues to show excess allowable deflections of the average inside diameter of pipe, remove pipe which has excessive deflection,

replace with new pipe, and completely retest in same manner and under same conditions. Pull-through device: The mandrel shall be rigid, nonadjustable having a minimum of 9 fins, including pulling rings at each end, engraved with the nominal pipe size and mandrel outside diameter. The mandrel shall be 5 percent less than the certified-actual pipe diameter for Corrugated Steel, 3 percent less than the certified-actual pipe diameter for Concrete-Lined Corrugated Steel and Ductile Iron Culvert provided by manufacturer. When mandrels are utilized to verify deflection of flexible pipe products, the Government will verify the mandrel OD through the use of proving rings that are manufactured with an opening that is certified to be as shown above.

c. Deflection measuring device: Shall be approved by the COR prior to use.

d. Warranty period test: Pipe found to have a deflection of greater than allowable deflection in paragraph PLACING PIPE above, just prior to end of one-year warranty period shall be replaced with new pipe and tested as specified for leakage and deflection. Inspect 100 percent of all pipe systems under the travel lanes, including curb and gutter. Random inspections of the remaining pipe system outside of the travel lanes shall represent at least 10 percent of the total pipe footage of each pipe size. Inspections shall be made, depending on the pipe size, with video camera or visual observations. In addition, for flexible pipe installations, perform deflection testing on 100 percent of all pipes under the travel lanes, including curb and gutter, with either a laser profiler or 9-fin mandrel. For flexible pipe, random deflection inspections of the pipe system outside of the travel lanes shall represent at least 10 percent of the total pipe footage of each pipe size. When mandrels are utilized to verify deflection of flexible pipe products during the final post installation inspection, the Government will verify the mandrel OD through the use of proving rings.

3.8.3 Post-Installation Inspection

One hundred percent of all reinforced concrete pipe installations shall be checked for joint separations, soil migration through the joint, cracks greater than 0.01 inches, settlement and alignment. One hundred percent of all flexible pipes shall be checked for rips, tears, joint separations, soil migration through the joint, cracks, localized bucking, bulges, settlement and alignment.

a. Replace pipes having cracks greater than 0.1 inches in width or deflection greater than 5 percent deflection. An engineer shall evaluate all pipes with cracks greater than 0.01 inches but less than 0.10 inches to determine if any remediation or repair is required. RCP with crack width less than 0.10 inches and located in a non-corrosive environment (pH 5.5) are generally acceptable. Repair or replace any pipe with crack exhibiting displacement across the crack, exhibiting bulges, creases, tears, spalls, or delamination.

b. Reports: The deflection results and finial post installation inspection report shall include: a copy of all video taken, pipe location identification, equipment used for inspection, inspector name, deviation from design, grade, deviation from line, deflection and deformation of flexible pipe systems, inspector notes, condition of joints, condition of pipe wall (e.g. distress, cracking, wall damage dents, bulges, creases, tears, holes, etc.).

3.9 FIELD PAINTING

After installation, clean cast-iron frames, covers, gratings, and steps not buried in masonry or concrete to bare metal of mortar, rust, grease, dirt, and other deleterious materials and apply a coat of bituminous paint. After installation, clean steel covers and steel or concrete frames not buried in masonry or concrete to bare metal of mortar, dirt, grease, and other deleterious materials. Apply a coat of primer, to a minimum dry film thickness of 1.5 mil ; and apply a top coat to a minimum dry film thickness of 1.5 milsper coat min 2 coats, color optional. Painting shall conform to Section 09 90 00 PAINTS AND COATINGS. Do not paint surfaces subject to abrasion.

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PROCESS AND PRESSURE SYSTEM

PART 1 GENERAL

1.1 SUMMARY

This section covers the requirements for welding of piping and piping system components which will contain fluids under pressure including hydraulic systems.

1.2 DESCRIPTION

This section applies to work on all pressure systems not explicitly covered elsewhere in this specification, including vessels, piping, and associated equipment and establishes the general requirements for welding and joining process used for the fabrication, manufacture, and installation of metal components, assemblies and systems. Welding to be included: pressure piping, structural welding on supports, and temporary attachment welding to the pressure piping and components.

Work included: Welding and joining process and procedure development described herein shall be utilized for both the shop and field construction of metal items unless indicated otherwise.

Welding Operations: Welding, brazing, soldering and other metal joining processes and operations shall be developed, qualified and documented to verify compliance with specified requirements.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

All material, equipment, and workmanship, specified by the number, symbol or title of a referenced standard shall comply with the latest edition thereof and all amendments and supplements thereto in effect on the date of the Invitation to Bid, except where a particular edition or revision thereof is indicated in the reference.

ASTM INTERNATIONAL (ASTM)

ASTM A36	Standard Specification for Carbon Structural Steel
ASTM A193	Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A194	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both

ASTM A269	Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

ASME INTERNATIONAL (ASME)

ASME B31.3	Process Piping
ASME BPVC	Boiler and Pressure Vessels Code
ASME BPVC SEC VIII D1	BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1
ASME BPVC SEC II-A	BPVC Section II-Materials-Part A-Ferrous Materials Specifications
ASME BPVC SEC II-C	BPVC Section II-Materials Part C-Specifications for Welding Rods Electrodes and Filler Metals
ASME BPVC SEC IX	BPVC Section IX-Welding and Brazing Qualifications
ASME BPVC SEC V	BPVC Section V-Nondestructive Examination

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT SNT-TC-1A	Recommended Practice No. SNT-TC-1A: Personnel Qualification and Certification in Nondestructive Testing and ANSI/ASNT CP-105: Training Outlines for Qualification of Nondestructive Testing Personnel
ANSI/ASNT CP-189	ASNT Standard for Qualification and Certification of Nondestructive Testing Personnel (ANSI/ASNT CP-105-2006)

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-127	Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application

NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS (NBBPVI)

NBBPVI NB-23	National Board Inspection Code

NACE INTERNATIONAL (NACE)

NACE RP0274	High Voltage Electrical Inspection of Pipeline Coatings

AMERICAN WELDING SOCIETY (AWS)

AWS B2.1	Specification for Welding Procedure and Performance Qualification
AWS C1.1	Recommended Practices for Resistance Welding
AWS D1.1	Structural Welding Code - Steel
AWS D10.9	Qualifications of Welding Procedures and Welding for Piping and Tubing

1.4 QUALIFICATIONS OF CONTRACTORS

At the time of contract award, and during the full period of contract execution, the Contractors performing fabrication, installation, cutting or welding on the pressure piping must hold as a minimum an ASME Code PP or "U" stamp. Contractors performing fabrication, installation, cutting or welding on pressure vessels shall hold an ASME Code "U" stamp in accordance with ASME Section VIII and National Board NB-23 or "R" stamp per NF_23 for repair or alteration work on pressure vessels. All work shall be performed in strict accordance with the applicable code and quality assurance manual of the performing fabricator, except that the Code stamp need not be applied to piping unless explicitly required by ASME, such as for boiler external piping.

Welding on pressure vessels and piping, including permanent or temporary attachments, shall be in accordance with ASME Section IX and ASME B31.3 or ASME Pressure Vessel Code Section VIII Division 1 as applicable.

Contractors performing structural welds on the pressure piping supports not in contact with the pressure boundary shall comply with AWS D1.1. All welds to the pressure boundary shall be as specified in 1.3.

1.5 PERSONNEL AND PROCEDURE QUALIFICATIONS

1.5.1 Personnel Certification

Prior to inspection, NDE personnel shall be certified in accordance with the requirements of the applicable codes of construction.

1.5.2 Welding Procedures and Welders Qualifications

The welding and weld examination, as a minimum, shall be in accordance with ANSI/ASME B31.3, Process Piping, and the ASME Boiler and Pressure Vessel Code, Section IX, where they apply. Welding procedures, welders, welding operators, and tackers shall be qualified for the applicable material, position and thickness in accordance with ASME Boiler and Pressure Vessel Code, Section IX. All nondestructive examination shall be performed by personnel certified in accordance with ASNT recommended practice ASNT SNT-TC-1A to Level II. Welding, weld examination and weld heat treatment for structural attachments not welded directly to the pressure boundary shall be in accordance with AWS D1.1.

Butt welded joints shall be performed using a TIG root pass. All butt welded joints shall be full penetration welds.

No cutting or welding is to be performed on any pressure components until

after submission and approval of welding procedures for those components.

Welders shall stamp their identification number by each weld that they perform, using a low stress stamp.

NASA shall have the option to require the requalification of any welder or welding operator at any time. If the welder or welding operator does not pass the requalification test, the Government can restrict that welder or welding operator from welding. That welder must successfully requalify each procedure prior to performing welding on this contract.

1.6 SUBMITTALS

Government approval is required for submittals. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

1.6.1 Welding Procedures and Qualification Records

Procedures and their qualification records including their specific applications shall be submitted for review and approval prior to use. This shall include any special techniques, equipment, tooling and sequences. Where prequalified procedures are established by specific codes, they may be submitted for approval.

Welder/operator qualifications records shall be prepared, submitted, and maintained current and available at the welding site for the Government upon request. Qualification records shall include production assignments or "maintenance of qualification/process use".

The Contractor shall submit his written practice for the qualification and certification of NDE personnel for approval. Written practice shall be in accordance with ASNT-SNT-TC-1A or ASNT-CP-189.

Welding equipment manufacturers' data, for specialty automated or mechanized welding and weldment fixturing equipment, shall be included as part of the applicable welding procedure qualification records.

Weld assembly sequences for unique applications shall be prepared and submitted for approval prior to start of affected welding activities.

1.6.2 Inspection and Test Schedules

Detailed functional performance and test plans, procedures and schedules shall be submitted for approval prior to implementation.

Contractor shall submit a work plan for Government review and designation of hold points for Government witness or inspection.

1.6.3 Product Literature and Shop Drawings

The Contractor shall submit, to the COR for approval, product literature, samples and shop drawings as specified or required to describe major items proposed for incorporation in the work. Only submittals approved by the COR shall be used to pursue the work.

In submitting proposed substitutes for items named, the Contractor shall understand that he is providing an implied warranty that the items proposed are equal in quality, utility, function, appearance, and fit in the

allocated space to the item named in these specifications and are suitable for the purpose intended. If a substitution requires additional materials or work, such added materials or work shall be the responsibility of the Contractor. All proposed substitutes must be approved by the COR.

1.6.4 Product Literature

The Contractor shall submit detailed technical literature describing the major products or items proposed for use. Manufacturer's detailed specifications, drawings, photographs, performance criteria, installation instructions, test data, samples of colors, finished, and other information required to describe the item shall be provided.

Submittals shall indicate specific items, options, and finishes proposed, and shall reference drawing numbers and/or specification sections and paragraph numbers covering the work in question. Items in standard printed literature that are not being submitted shall be deleted or voided.

1.6.5 Shop Drawings

Shop drawings shall be submitted for fabricated items or assemblies proposed for use in the course of the work. Shop drawings shall include material lists, wiring diagrams, individual piece drawings, plans, power requirements, elevations and sections. Certified prints of purchased items shall be used in the preparation of shop drawings.

Shop drawings are to be drawn at large scale, fully detailed with all stock materials and stock or purchased components fully identified.

Drawings are to be identified showing the Project Name, the Contract Number, the Contractor's Name, and the Specification Section Number and Contract Drawing detail reference relating to the work shown.

1.6.6 Calculations

Where engineering drawings and calculations are required to be prepared by the Contractor, the drawings and calculations shall be prepared by, or under the direct supervision of, registered California Professional Engineers in the specific discipline required to perform such work. The responsible individual shall stamp his official license seal, date, and sign all copies of drawings and calculations submitted for approval. All calculations involving seismic loadings shall be prepared by, or under the direct supervision of, and signed and sealed by individuals currently licensed in the Structure Engineering and who can demonstrate competency in seismic design.

1.6.7 Test Procedures and Results

Where testing of materials, components, subsystems or equipment is required by the Contractor in the technical sections of these specifications, complete procedures and results for each test shall be submitted. Test procedures which are prepared specifically for the work of this Contract shall be submitted for approval prior to use. Procedures shall include required test prerequisites and description or data on the following:

a. Required equipment with applicable operating specs.

b. List or description of special equipment/jigs/fixtures required for the test.

c. Sketch the test set-up with description.

d. Step by step test procedures.

e. Safety precautions.

f. Calculations (as required) including predicted and allowable values.

At the completion of each test, results shall be prepared and include the following:

a. Description and conclusion of actual test.

b. Data from actual test.

d. Recommendations (if applicable).

1.6.8 Pressure Test Certification Records

The Contractor shall document the leaktightness of each piping system on ARC Form 342 "Hydrostatic Pneumatic or Vacuum Test Certification" or equivalent, and these records shall be submitted to the COR within 10 days after completion of pressure testing. These forms will be furnished by the COR. A separate form shall be used to describe the record test data for each section of the piping system, where tested in sections. The form shall describe the piping that is being tested in enough detail to be readily identifiable with the specification and drawings. Completed forms shall be submitted for approval and signature.

1.6.9 Operations and Maintenance Manuals

Two copies of each manual shall be submitted 30 days prior to completion of onsite construction and shall present the following basic categories of information in a practical, complete and comprehensive manner, prepared for use by operating and maintenance personnel.

a. Initial installation.

b. Instructions for operating and maintaining the equipment.

c. Recommended inspection and maintenance points as well as time period for inspection and maintenance.

d. Ordering instructions for all replacement parts, gaskets, etc.

1.6.9.1 Organization of Manuals

The information shall be organized in a logical and orderly sequence. A general description of the equipment, including significant technical characteristics, shall be included to familiarize operating and maintenance personnel with the equipment.

1.6.9.2 General Manual Content

Necessary drawings and other illustrations shall be included or copies of appropriate drawings shall be bound into the manual. Test, adjustment and calibration information shall be specified. Safety and other warning notices, and installation, maintenance, and operating precautions shall be

emphasized.

1.6.9.3 Parts Lists

A parts list shall be included showing part nomenclature, manufacturer's part number, and other information necessary for accurate identification and ordering of replacement parts. Copies of parts lists from product catalogs, if available, shall be included. Common hardware items, or other parts to be locally procured, shall be adequately identified by technical descriptions.

1.6.9.4 Binding Requirements

The manuals shall be clearly legible, prepared on good quality paper, and multiple-page manuals shall be securely bound.

1.6.9.5 Standard Manuals

If a standard manual is furnished, covering more than the specific piece of equipment, the applicable model (or other identification), parts, and other information for the specific equipment shall be clearly identified.

1.6.10 Statements

A document, required of the Contractor, or through the Contractor by way of a supplier, installer, manufacturer, or other lower tier Contractor, the purpose of which is to further the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other verification of quality.

1.6.11 Project Quality Control and Inspection Program

a. The Contractor shall submit for review, within 30 days of receipt of the Notice to Proceed, a preliminary Quality Control and Inspection Program Plan(s) that describe how the Contractor will apply and implement his and is subtier contractor's integrated Quality Control and Inspection Program to the work of this contract. A final plan shall be submitted within 60 days after Notice to Proceed.

b. The Contractor shall submit the manual elements and procedures referenced in his Quality Control and Inspection Program for the work for review. Also, submit copies of subtier contractor and/or supplier Quality Control and Inspection Manual(s) and define the interface controls between the Contractor's Quality Control and Inspection Program and subtier contractor's.

1.6.12 Nonconformance Document Submittals

Copies of nonconformance reports initiated by the Contractor or subtier contractors and suppliers shall be submitted within 10 days of being logged in the Contractor's nonconformance tracking system.

1.6.13 Quality Status Reporting

The Contractor will report, on a monthly basis, the status of the Project Quality Program. This report may be included with other project monthly reporting requirements specified elsewhere. The quality status report should normally include, but is not limited to, summaries of:

a. Assigned quality control personnel.

b. Descriptions of specific quality control, inspection and verification tasks.

c. Procurement/contract quality activities.

d. Shop fabrication/manufacturing activities.

e. Field construction/installation activities.

f. Quality control management activities.

g. Summary of nonconformance and corrective actions.

The Contractor shall submit special handling, shipping and storage procedures and specifications for items and systems requiring special planning and control measures to assure protection and maintenance of quality attributes and characteristics, prior to implementation.

The Contractor shall submit quality verification, personnel qualification records, including inspectors, nondestructive examiners, auditors and special process test personnel requiring special training, qualifications or certification by the cited construction codes. These records shall be available at the location where the work is being performed.

Completed records of inspection and test results shall be submitted within two weeks after the completion and/or close-out of the applicable inspection or test.

1.7 INSPECTION AND TEST

The Contractor shall perform all weld inspections and tests as specified herein. As a minimum, the acceptance criteria for welds shall be in accordance with ASME B31.3.

a. All preparation work of welded fitting shall be made available for inspection by the COR prior to welding of the root pass.

b. All pressure piping butt welds shall be 100% radiographically inspected in accordance with the requirements of the applicable code of construction unless specified otherwise on the design drawings.

c. All weld root passes shall be 100% magnetic particle or liquid penetrant examined. All welds to piping shall have their cover passes 100% magnetic particle examined. All pipe fillet welds shall be 100% magnetic particle or PT examined in accordance with methods of ASME Section V, Article 7. All MT or PT results and Technique sheets shall be submitted for approval.

d. The Government shall be notified of the schedule for all nondestructive examination and may elect to witness any or all examination work. Additional hold points may be specified by the Government representative.

e. Within 10 days of RT Examination date, the Contractor shall submit RT films, reports and weld map (identifying weld locations) to COR for approval and acceptance. All films and reports shall become Government property.

f. Acceptance criteria for nondestructive testing shall be in accordance with ASME B31.3. The Government shall have final acceptance authority on all weld.

1.8 AUTHORITY AND RESPONSIBILITY

Identification shall be made of the individual with the responsibility for directing and managing the Contractor's Project Quality Control and Inspection Program and his reporting relationship to the Contractor's project management.

1.9 DRAWINGS, DESIGN CALCULATIONS, AND SPECIFICATION CONTROL

The Contractor shall establish, document and implement design management and control measures on design related documents and deliverables.

1.9.1 As-Built Design Changes and Records

The Contractor shall maintain and catalog, in an orderly and retrievable manner, all shop, field and design drawings used for fabrication, construction, inspection, coordination, etc., and update (red-line) these drawings, as the changes occur, to reflect any approved changes.

1.10 PROCUREMENT/SUBCONTRACT CONTROL

The Contractor's procurement and subcontract documents shall identify and pass through to subtier contractors all related quality control system and product quality criteria, and requirements, including Contractor required witness points and all other inspection requirements.

1.11 HIGH STRENGTH FASTENERS

1.11.1 High Strength Fasteners

The Contractor shall address in his Quality Plan procedures governing procurement and control of high strength fasteners (those with a minimum tensile strength above 125 ksi) intended for use in the work. These procedures shall include positive lot traceability to certify tests and/or inspection.

1.12 INSPECTION PROGRAM

The Quality Control and Inspection Program shall address the application of inspection and examination to the fabrication and construction process for this work. Examples of functional activities of fabrication and construction control include receiving, identification, storage, production, welding, surface treatment, assembly, shipping, handling, and installation.

1.13 CALIBRATION OF MEASUREMENT AND TESTING EQUIPMENT

The Contractor shall establish and utilize a documented metrology system to control and calibrate measurement processes in order to provide objective evidence of quality conformance. Measures should include the following:

a. Identification and calibration status of equipment.

b. Measurement standards traceable to National Institute of Standards and

Technology.

c. Procedures for the calibration and use of measures and test equipment including prerequisites.

d. Identification and maintenance of calibration and metrology records.

e. Remedial and preventive actions taken relative to nonconforming measurement standards or equipment used on contract deliverables.

1.14 CORRECTION OF NONCONFORMITIES

When an article, material or service has been determined as not conforming to applicable drawings, specifications or other requirements after a specified verification or acceptance step in its processing, it shall be identified and documented as nonconforming, segregated, and held for disposition action. Items which have been "reworked" to conform to established requirements shall be documented and records of such "rework" items shall be submitted for record purposes. Items which do not conform to the original requirements but which are judged to be usable either "use-as-is" or through "repair" shall be considered as nonconforming.

1.14.1 Nonconformance Controls

The Contractor's Quality Control and Inspection Program shall identify and prescribe measures for the control of nonconformance items and corrective actions to prevent conditions adverse to the attainment of quality objectives. Such measures shall include:

a. Method of identification.

b. Deficiencies evaluation and disposition process.

c. Required records and documentation.

d. Remedial and preventive actions.

Nonconformance disposition recommendations of "repair" and "use-as-is" shall be submitted to the COR for approval prior to further processing of the affected item. These disposition recommendations shall include technical justification and repair procedure documentation as applicable.

Copies of completed or "closed-out" nonconformance reports shall be submitted for record within 10 days of being signed-off by the Contractor's authorized quality verification personnel as described in the Contractor's Quality Control and Inspection Program. A sample form for reporting nonconformances is attached hereto.

1.15 IDENTIFICATION AND RETRIEVAL SYSTEM

The Contractor shall implement and maintain a quality and inspection record system for all work and submittals.

Measures should include the following:

a. Identification and retrieval requirements in technical documents.

b. Part, lot, serial number identification.

c. Inspection and test status identification and indicators.

d. Date codes for materials that are subject to variation or degradation with age.

1.16 RECORDS RETENTION

The Contractor shall establish, maintain and implement procedures and policies for the identification, collection, indexing, storage, maintenance, distribution, and disposition of project documentation, forms and quality records.

1.17 GOVERNMENT INTERFACE ACTIONS AND PREROGATIVES

The activities, materials and execution of the work by the Contractor and his subtier Contractor(s) are subject to audit through review, witness, surveillance, monitoring, examination, testing, etc., by the Government's Representative(s) to determine that:

a. Functional activities which control the quality are performed in accordance with established requirements.

b. The work complies with technical, functional, performance and quality requirements as stated in these technical specifications.

c. Quality Control and Inspection documentation is complete and adequate.

The COR or (COR) shall be notified 48 hours in advance of any field test and 2 weeks in advance of any shop test. The Government reserves the right to witness any field or shop test or inspection.

PART 2 PRODUCTS

2.1 GENERAL

Materials and equipment to be provided under this contract shall be new, first-class, standard catalogue products of manufacturers regularly engaged in the manufacture of these products. Where two or more units of the same equipment class are furnished, the equipment shall be from the same manufacturer and shall be interchangeable.

2.1.1 Nameplates

Each piece of mechanical equipment, including control valves, shall bear the manufacturer's (not supplier's) name, address, catalog number, and pertinent performance data such as pressure, temperature, flow, etc., on a plate securely and prominently attached to the item of equipment.

2.1.2 Capacities

Capacities of equipment and material shall be not less than those indicated.

2.2 ANCHOR BOLTS

Anchor bolts shall be provided for equipment placed on concrete equipment pads or on concrete slabs. Unless otherwise specified, bolts shall be of the size and number recommended by the equipment manufacturer and shall be located by means of suitable templates. Installation of anchor bolts shall not degrade the surrounding concrete.

2.3 PAINTING

Refer to specification Section 09 90 00 for painting requirements.

2.4 FASTENERS

All fasteners shall be purchased from approved supplies. The list of approved suppliers shall be provided by the COR. Bolts, studs, and nuts must be marked to indicate the material and grade. Most are marked by the manufacturer, if they are not, they must be certified and stamped upon receipt.

Use coarse threads through one inch, eight thread series for larger sizes.

Where feasible, nuts should be used rather than internal threads cut into pressure system component.

When installed, there must be at least two full threads beyond the nut.

When bolts and studs are re-used, they must be examined for signs of cracking and deformation.

Diameter of bolt used must be compatible with hole size, i.e., not excessively smaller than hole diameter.

All pressure system bolting shall be ASTM A193 Gr B7 studs or bolts, with ASTM A194 Gr 2H heavy hex nuts.

Fastener lengths and quantities unless otherwise indicated, shall be the Contractor's responsibility. Installed fasteners shall have a minimum 1-1/2 diameter engagement (in tapped holes) and a minimum 2 thread exposure (with nuts). Threaded inserts shall be used for all threads tapped in aluminum.

2.5 COMPRESSION FITTINGS AND TUBING

Compression fittings that do not comply with the listed standard shall be qualified as "Unlisted Component" in ASME B31.3, and appropriate documentation shall be submitted to the Government to demonstrate such qualification to ASME B31.3 requirements.

Tubing for control air to valve actuators and other piping system controls shall be ASTM 269 316 S.S. and shall be in accordance with ASME B31.3.

2.6 GAUGES

Any gauge used in a pressure system shall be indicating English units, and must be of a safe type that is either certified by its manufacturer not to cause shrapnel upon failure of its element or that features a full blowout back and an armored plate behind the dial. Gauge shall comply with ASME B40.100 Grade 1A unless otherwise specified on the design drawings.

Maximum gauge indication range shall be 1-1/2 to 2 times the operating pressure.

2.7 WELD MATERIAL REQUIREMENTS

Weld material shall be specified in an appropriately qualified and approved

procedure in accordance with the ASME Boiler and Pressure Vessel Code, Section IV, ASME B31.3, or AWS D1.1 for supplemental pipe support steel. All Shielded Metal-Arc Welding shall be performed using low hydrogen electrodes. Filler material control procedures that address procurement, receipt, storage, issue and use are required. Actual filler material certifications for each heat and lot of weld material used shall be available on site for review prior to commencement of welding.

Filler metals shall be in accordance with AWS D1.1 or ASME BPVC Section II Part C as applicable.

2.8 SUPPORTING ELEMENTS

Necessary piping system and equipment supporting elements shall be provided, including but not limited to: building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and spring-cushion, variable, or constant supports. Supporting elements shall be suitable for stresses imposed by system pressures and temperatures and natural and other external forces normal to this facility without damage to supporting element system or to work being supported.

Supporting elements, where not specifically indicated, shall conform to requirements of ASME B31.3, MSS SP-58, and MSS SP-127 except as otherwise modified and supplemented herein.

Supporting elements shall be hot-dipped galvanized per Section 09 90 00. Materials shall be of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process.

2.9 HANGER RODS AND FIXTURES

Only circular cross section rod hangers may be used to connect building structure attachments to pipe support devices. Pipe, straps, or bars of equivalent strength shall be used for hangers only where approved.

Turnbuckles, swing eyes, and clevises shall be provided as required by support system to accommodate temperature change, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

2.10 SUPPLEMENTARY STEEL

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports such supplementary steel shall be in accordance with ASTM A 36.

2.11 TRANSPORTATION

The manufacturer shall package material requiring protection in sturdy containers. Protection shall include vapor sealants for products sensitive to moisture or exposure. Materials handling equipment shall be selected with the express purpose of minimal damage to existing work and new material.

The Contractor shall store supplies, material, and equipment so as to properly protect and preserve these items. If the COR determines that property is not adequately protected by the Contractor, such property may be protected by the Government and the cost thereof may be charged to the Contractor.

PART 3 EXECUTION

3.1 GENERAL

Quality Control, including inspections and tests required by these specifications, during off-site fabrication shall be entirely the Contractor's responsibility. The Contractor shall submit the records of such tests and inspections to the COR, at least 48 hours in advance of incorporation of the materials and/or equipment in the project.

The Contractor shall maintain normal quality control practices during field construction; however, the Government will be responsible for all field inspection and tests required by these specifications, unless noted otherwise.

Government inspection shall in no way replace Contractor inspection or otherwise relieve the Contractor of his responsibility to furnish an acceptable end item. Government inspection shall not be used by the Contractor as evidence of effective inspection by himself or subcontractors.

3.2 CONTRACTOR QUALITY CONTROL

The Contractor shall maintain an approved quality control system. This shall include purchase control and receiving inspections, control of non-conforming work, inspection/test plans and procedures, calibration control, training, and qualification programs. This shall include the following:

3.2.1 Quality Control Manager

A qualified individual whose responsibility is the day-to-day direction of the quality control system. This individual shall report directly to management, and shall have the necessary authority to control the quality of the Contractor's work.

3.3 GOVERNMENT INSPECTIONS/TESTS

Tests conducted by the Contractor will be witnessed by the Government. At least 48 hours notice shall be given the Government, and at least 2 hours shall be allowed for Government inspection, prior to any test, on site.

The Government may assess a re-inspection fee for each re-inspection if the work is not complete and ready for inspection at the time for which the inspection is called, or if corrections called for on previous inspections have not been made at the time for which the re-inspection is called. This is applicable to all inspections and tests to be conducted by or witnessed by the Government. The re-inspection fee shall be $50.00 per hour (1/2 hour minimum).

The Government will inspect at the source, supplies or services not manufactured or performed within the Government's facility, including those at Subcontractor or Vendor facilities. The Contractor shall notify the COR at least 48 hours in advance of commencement of contract work at off-site facilities; and 48 hours in advance of each in-house inspection or test, so that the Government may witness it.

3.4 HOLD POINT OF INSPECTION/TESTS

The Contractor shall schedule required inspections/tests with the COR at least 48 hours in advance, and shall provide opportunity access, and samples required. Other required inspections and tests are listed in the various technical sections of this specification.

3.4.1 Inspections

The following are required hold points for inspections to be made by the Government. At least 2 hours shall be allowed for Government inspection at each of these hold points.

BOLTING/WELDING. Performed after bolts are tightened and welds are made, but before touch-up painting or covering.

SURFACE PREPARATION. Performed after preparation for painting has been made, but before setup for painting.

NONDESTRUCTIVE EXAMINATION. Acceptance of radiographic and magnetic particle examination before setting up for painting.

UNDERGROUND PIPING. Performed after piping is in place and bedded, but before it is covered.

HOLIDAY TESTING. Required of all pipe wrap, before backfilling.

3.4.2 Tests

The following items are required hold points for tests to be made by the Contractor and witnessed by the Government. At least 2 hours notice shall be given the Government before each of these tests.

HYDROTESTING OF PIPING. Required of all piping, before covering or connection to existing systems.

3.5 REPORTING

Any discrepancies noted by the Government will be forwarded to the Contractor on the "Inspection Report" within one working day of completion of the test/inspection. The Contractor shall return these forms after noting the corrective action to be taken.

3.6 CORRECTIVE ACTION

The Contractor shall promptly correct assignable conditions which have resulted or could result in the submission to the Government of supplies and services which do not conform to:

The quality assurance provisions of the item specification.

Inspections and tests required by the contract.

Other inspections and tests required to substantiate conformance.

3.7 PRESSURE PIPING AND PRESSURE VESSEL WORK

All piping work shall be in accordance with ASME B31.3, or ASME B31.1, or ASME B31.9, as specified on the applicable design drawings.

All pressure vessel work shall be in accordance with ASME BPVC, Section VIII D1 or D2, as specified on the applicable design drawings.

Permanently installed weldment backing rings or bars shall not be used.

Cold springing of pipe for alignment is not acceptable.

3.7.1 Nondestructive Examination

All work performed shall meet the applicable code of construction. The Contractor shall submit procedures for approval for UT, MT, and VT.

Radiographic examination procedures and techniques shall be in accordance with ASME Code, Section V, Article 2.

System of identification shall be in accordance with ASME Code, Section V, Article 2.

Radiograph zero orientation and numbering direction shall be stamped on radiographer welds using a low stress stamp.

Radiographs of repairs shall be identified by an "R" and sequential numbers for each repair (R-1, R-2, etc.) in addition to the identification originally required.

In all cases, density of radiographs should be measured by a densitometer. However, a step wedge film may be used if it is traceable to the National Bureau of Standards and is recalibrated annually.

3.7.2 Repairs

The Contractor shall submit written repair procedures to the COR prior to initiation of any repairs as part of the Contractor's QA program.

Unacceptable discontinuities shall be completely removed by chipping, gouging, grinding, or other authorized methods to clean sound metal.

Repairs to correct weld defects shall be made using the same procedure used for the original weld or other previously authorized weld procedures.

The repaired areas shall be reexamined using the same inspection procedures by which the defect was originally detected and the inspection which was originally specified for the weld.

One repair attempt will be allowed on any defective area. No further attempts to repair shall be carried out without the authorization of the COR.

3.7.3 Internal Misalignment

Where the ends of piping components are to be joined by welding and the internal surface misalignment exceeds the dimensional limits of the qualified welding procedure or the ANSI/ASME B31.3 Process Piping Code, one of the following procedures shall be used to correct the condition:

a. Taper bore or grind the wall of the component extending internally using a 3 to 1 maximum taper. Such tapering shall not result in a

finished wall thickness, before welding, that is less than the nominal pipe wall thickness minus the manufacturer's mill tolerance. Further reduction of the wall thickness requires authorization of the COR.

b. Use spreaders or internal and/or external lineup clamps to correct moderate out-of-round condition.

c. Springing of pipes is not acceptable.

Pipe may be rotated to reduce misalignment to the acceptable tolerance.

3.7.4 Temporary Welds to the Pressure Piping

All temporary welds to the pressure piping, shall be performed by welders qualified in accordance with ASME BPVC Section IX, and in accordance with approved procedures.

3.7.5 Support Structure Welds

Welding shall comply with AWS D1.1. Verification inspections of welding shall be by the Contractor using AWS D1.1 certified weld inspectors.

3.8 RADIATION

No use of radioactive materials, radiation producing machines, or particle accelerator equipment shall be allowed on-site, unless a Radiation Safety Clearance Permit has been obtained from the COR.

Ames Research Center is a federal site, under the jurisdiction of the Nuclear Regulatory Commission (NRC). All non-NRC licensed radiographers must obtain a reciprocity agreement with the NRC prior to admitting a radioactive source on-site. A copy of the radiography contractor's license to conduct radiography and its company safety manual shall be kept on file with the NASA Radiation Safety Officer.

The Contractor shall conspicuously post the area, and erect barriers, as required by Title 10, Code of Federal Regulations, Part 34.42. During hours of darkness, the signs shall be conspicuously illuminated with an amber or white light. The Contractor shall maintain direct surveillance of the area to protect against unauthorized entry and shall maintain a properly calibrated survey meter on-site and conduct periodic monitoring.

The Contractor shall immediately report to the COR any loss of radioactive material at the Center or the site or any radiological health hazard or emergency.

Upon completion of radiological operations, the Contractor shall notify the NASA Representative and make certain that warning signs and ropes are removed.

Radiographs shall b performed in a manner consistent with Title 10, OCR, and approved by the COR, and in the presence of an approved radiographer. Radiography shall normally be required to be performed at other than normal working hours, when it would otherwise present a hazard to other personnel.

3.9 EXPLOSIVES

Explosives shall not be used. Powder-activated tools are not considered as explosives under this Section. Explosives shall not be stored nor

transported on-site.

3.10 CUTTING AND WELDING

Cutting, welding, and heating operations, if performed as part of the work, shall be in accordance with approved procedures which shall be included as part of the Safety Plan.

During flame cutting and welding, the Contractor shall take care and provide protection to prevent splatter from damaging facilities or causing a fire. When these operations are performed above or below ground level, at least one Contractor employee shall stand by at the ground, with firefighting equipment, ready to give assistance in an emergency.

The Contractor shall provide shields, fire blankets, and other protection devices to protect persons and property adjacent to the area of work.

3.11 PRESSURE SYSTEMS SAFETY

3.11.1 Safety Clearance Permits

Before starting work on any equipment or system, the Contractor shall ensure that safety clearance procedures are followed.

3.11.2 Isolation

Prior to work on any pressurized system or component, workers must be protected from charged sections of the line by a minimum of two closed valves with an open vent in between.

3.11.3 Adjustments

Adjustments to systems under pressure shall not be made, i.e., tightening threaded joints.

3.11.4 Liquid Systems

Although liquids, being less compressible than gases, are safer than gases in pressure systems, they do store energy. Therefore, liquid pressure systems must also be considered hazardous. A safe distance must be maintained during all hydrostatic pressure tests.

3.11.5 Pressure Testing

Hydrostatic testing at pressures above working pressures conducted to verify new designs and reevaluate older units must employ barriers for protection of personnel and must employ remote controls, unless there is no hazard to personnel. Protection against overpressure during the test must be provided at 110% of the test pressure. The protective device must allow adequate mass flow.

3.11.6 Overpressure Protection

Pressure regulators, relief valves, and/or automatic control systems must always be used on a pressure source if required to protect the downstream items from overpressure. Fixed position valves must never be used to regulate pressure for safety purposes.

-- End of Section --