Goddard Space Flight Center

Construction Specifications

FaCETS Contract

Attachment 5 **December, 2009**

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SECTION 01010

SUMMARY OF WORK
08/98

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES

The publications listed below form a part of this section to the extent referenced:

GODDARD SPACE FLIGHT CENTER (GSFC)

GSFC GPR 1600.1A	(1990) Goddard Space Flight Center Security Manual

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals", in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Mobilization Plans, C&D Waste Plan, Utility Outage Plan

SD-07 Certificate

Annual C&D Waste Report

1.4 WORK RESTRICTIONS DUE TO GOVERNMENT OPERATIONS

Some construction activities involving work in buildings 1, 3, 5, 7, 10, 13, 14, 23, 24, 15, 28, 29,and 32; work pertaining to utilities and manholes serving those facilities; and work requiring an excavation permit will be periodically prohibited due to Government Operations. Work prohibitions will be for an average of 8 periods per year, of between 7 and 21 working days each, not exceeding 120 working days per year. The Contractor may request an exemption to the prohibition provided that he clearly demonstrates that the work has no chance of affecting critical mission operations. Evaluation of the exemption request and determination will be made by the Contracting Officer.

Government Operations occuring on weekends, holidays, and other days outside the range of normal duty hours shall not be included in the time periods indicated above.

The Contractor shall show restrictions due to Government Operations in his work schedule, and shall provide sufficient detail in his work schedule to indicate exactly which work tasks will be affected by the work restrictions. The Contractor shall revise and submit his progress schedule as necessary to reflect periodic changes in the Government Operations

schedule.

An initial Government Operations schedule will be provided at each task order preconstruction conference when applicable. An updated status report of Government Operations will be provided at regular project meetings, upon Contractor's written request, and when necessary to convey critical changes to the Government Operations schedule.

Work Restrictions due to Government Operations are highly volatile and may change with little or no notice due to factors which affect the launching/landing of the NASA Space Shuttle, and other launch vehicle missions. The Contractor shall closely coordinate schedules with the Government in order to minimize the impact of these work restrictions to the timely and successful prosecution of the work.

1.5 WORK IN SECURE AREAS

Some of the work requires access to secure Government areas. The secure areas will be indicated in the task orders.

Entrance into secure areas in portions of Building 3/13/14 complex requires a Government issued "red badge, or accompaniment by a red badged escort. The Contractor shall obtain security clearance red badges from the GSFC Security Office for some of its personnel so that all work performed by the contractor in secure areas is covered by contract red badged personnel. The contractor shall also provide escorts to accompany subcontractors working in secure areas.

1.6 NORMAL DUTY HOURS

Normal duty hours for work shall be from 7:00 a.m. to 3:30 p.m., Monday through Friday, except as noted.

Normal duty hours for work shall be from 7:00 a.m. to 3:00 p.m. in Buildings 24, 24A, 24B, 24C, and 31.

Normal duty hours for Deliveries shall be from 7:00 a.m. to 3:00 p.m. at Gate #4.

Work shall be performed only during normal duty hours, except as otherwise required or authorized by the Contracting Officer, or where such timeliness of performance is necessary to safeguard life or property.

Requests for deviation from normal working hours shall be submitted in writing to the Contracting Officer not less than 3 working days in advance of the proposed work period.

1.7 OCCUPANCY OF PREMISES

The work areas will be occupied during performance of work under this Contract. The Contractor shall take particular care when working in computer, mechanical, electrical, and communication equipment areas. Uninterrupted operation must be maintained in these areas.

PART 2 PRODUCTS

PART 3 EXECUTION

3.1 CONTRACTOR MOBILIZATION

Before work is started on each task order, the Contractor shall submit to the Contracting Officer a mobilization plan, indicating locations of office and storage trailers, staging areas, means of access to work areas, and use of approaches, corridors, and stairways.

3.2 PERSONNEL AND VEHICULAR PASSES

Personnel and vehicular passes shall be obtained in accordance with GSFC GPR 1600.1A.

3.3 GOVERNMENT-FURNISHED PROPERTY

Contractor shall accept delivery at the receiving point specified when delivery is made, paying any detention charges incurred. Contractor shall provide all handling and transportation necessary from the receiving location to the point of incorporation into the work.

Contractor shall schedule delivery and inspection of Government- Furnished Property with the Government Construction Manager assigned (Code 227.6).

Contractor shall visually inspect Government-Furnished Property during and immediately after after taking delivery from the Government. Crated materials and equipment shall be uncrated for inspection and shall be re-crated until incorporation in the work.

Submit a report for each item of Government-Furnished Property received, including accessories, indicating quantity and condition. Report dents, scratches, cracks, surface rust and burns, frays and crimps in cables, obvious missing parts, and any quantities short of those specified.

Report shall include signature of the Government inspector present at delivery and inspection with exceptions noted.

3.4 UTILITY OUTAGES AND CONNECTIONS

For task orders which involve utility outages, the Contractor shall submit a Utility Outage Plan. The Utility Outage Plan shall list all significant outages that will be necessary in the project to complete the work. The Contractor shall utilize the Outage Table shown on the Drawings as the basis for this plan, and other information which may be provided by the Government. The Utility Outage Plan shall include proposed dates/durations of outages, and it shall be updated periodically as necessary to keep current with the revisions to the work schedule.

For sprinkler and smoke outage requests, the Contractor shall request at least 3 working days in advance of the proposed outage (see Section 01411, "General Safety Requirements" for additional information. For all other outage requests, the Contractor shall request at least 7 working days in advance of the proposed outage.

Utility outages and connections required during the prosecution of work that affect existing systems shall be arranged for at the convenience of the Government and shall be scheduled outside the regular working hours, or

on weekends, as directed by the Contracting Officer or his designated Technical Representative.

Contractor shall not be entitled to additional payment for utility outages and connections required to be performed outside the regular work hours or on weekends.

Work shall be scheduled to minimize utility outages. When the work involves more than one connection to an existing utility, all connections to that utility shall be scheduled and made during a single utility outage. Contractor shall provide sufficient work force to accomplish all scheduled outage work during the approved outage period.

The following types of utility outages and connections will be prohibited during Scheduled Government Operations:

1. Any type requiring excavation permit or connection to underground utilities.

2. Any type involving work in an existing manhole or distribution transformer, or in a new in-service manhole or distribution transformer.

3. Work in Buildings 1, 3, 5, 7, 10, 13, 14, 23, 24, 15, 28, 29,and 32.

Should the Contractor request Outages for which the Government dutifully processes and expends man hours in preparing the Outage for the Contractor's use, and for which the Contractor then neglects to utilize the Outage, the Government may elect to deduct a compensatory value from the contract price, equal to the value of preparing the Outage.

3.5 PERMITS

Contractor shall secure permits for excavation work, for hot work, and for work in confined spaces. All requests shall be made in writing to the Construction Inspector, using the appropriate form. No work shall be performed until an approved permit has been obtained and posted.

Permits shall be posted at a conspicuous location in the construction area.

Permits are the property of the Government and shall be returned to the Contracting Officer upon completion of permitted work.

3.5.1 Excavation Permits

Contractor shall request an Excavation Permit not less than 3 working days prior to the proposed excavation, using form FMD-315 Excavation Request-Permit.

Excavation operations shall include surface scarifying, surface grading, driving stakes, setting post holes, trenching, general excavating, and any other activity which has the potential to damage underground utilities.

3.5.2 Hot Work Permits

Contractor shall request a Hot Permit not less than 3 working days prior to the proposed hot work. See Section 01411, "General Safety Requirements" for additional details.

Notwithstanding issuance of any permit, the Contractor shall not burn trash or rubbish on the Goddard Space Flight Center.

3.5.3 Confined Space Entry Permits

Contractor shall request a Confined Space Entry Permit not less than 3 working days prior to the proposed confined space entry. See Section 01411, "General Safety Requirements" for additional details.

3.6 SALVAGE MATERIAL AND EQUIPMENT

Items of material designated on the drawings to be salvaged shall remain the property of the Government. See Section 01730, "Demolition and Existing Conditions to Remain".

3.7 CONSTRUCTION AND DEMOLITION (C&D) WASTE

Federal Executive Order 13514 requires agencies to divert at least 50% of their Construction and Demolition (C&D) waste from landfills to recycling. C&D 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.

The Contractor shall be required to divert at least 50% (by weight) of the C&D waste from going to a landfill. An exemption for a lower diversion rate shall be allowed if it becomes cost prohibitive to transport the waste a long distance to a recycling center. Specifically, recycling centers farther than 50 miles from GSFC will be considered cost prohibitive.

In fulfillment of the requirement, the Contractor shall submit a brief C&D plan after receiving the first delivery order. The Plan shall state whether the contractor plans to segregate waste on-site for delivery to recycling centers and landfill, or transport the commingled waste off-site to a segregation facility. The Plan shall name the segregation and recycling facilities. Additionally, the Contractor shall submit a C&D Waste Report annually by November 30. This Report shall give the total tonnage of C&D waste the Contractor generated under this contract. It shall also give the total tonnage sent to a landfill and the total tonnage to various recycling streams (e.g. metal, wood, concrete, asphalt, gypsum, etc). The figures shall be certified (with signature) by the Contractor.

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SECTION 01200

PROJECT MANAGEMENT
3/98

PART 1 GENERAL

1.1 SUMMARY

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

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Progress Schedule

A Proposed Project Submittal Schedule shall be submitted showing full coordination with the project schedule. All products and tests under each submittal number shall be prioritized and linked to the progress schedule.

SD-07 Certificates

Progress Reports reflecting the current status of the work shall be submitted at the first project meeting of each month. When no project meetings are scheduled for a given month, progress reports shall be submitted before the 15th of that month.

SD-11 Closeout Submittals

As-Built Drawings

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 PRECONSTRUCTION CONFERENCE

Contractor shall attend a preconstruction conference when scheduled by the Contracting Officer or their designee. Work shall not commence prior to the conference. Subcontractor representatives shall attend.

Discussion shall address project orientation, personnel contact, safety issues, permits, deficiencies, progress meetings, progress schedule submittal, proposed project submittal schedule submittal, as-built drawings, and the location of the Contractor's office.

3.2 PROGRESS MEETINGS

Contractor shall attend weekly progress meetings scheduled by the Government. Attendance shall include the appropriate staff members and subcontractorsto address scheduled agenda topics for each meeting, and as directed by the Contracting Officer.

Meeting agenda will include the review of minutes of previous meeting, work progress, field observations, problems, decisions, status of submittals, status of progress schedule, potential factors of delay, deficiencies, material delivery schedules, safety issues, as-built drawings, and other business relating to the work.

Monthly updates of the progress schedule shall be submitted at the first meeting of each month.

3.2.1 As-Built Drawings

Contractor shall maintain one set of As-Built Drawings. As-Built Drawings shall be kept current throughout the progress of work. As-Built Drawings shall incorporate all contract changes and deviations.

Mark-ups shall be made consistent with the following color scheme:

Red = Deletions
Blue = Additions
Green = Relocations/Corrections/Substitutions

The drawings shall also indicate the Government administrative number ratifying or approving the change or deviation.

Marks made by the Contractor shall be sharp, clear, and legible. Mark-ups shall be drawn to the scale of the original drawing.

Maintaining As-built Drawings of site plans including underground utilities includes using surveying methods to record pertinent information about the constructed work including that which is not necessarily a change to the contract drawings.

Contractor shall not conceal any work until after actual field conditions have been recorded on the As-Built Drawings.

As-Built Drawings shall be presented at Progress Meetings for review by the Government.

Failure by Contractor to accurately reflect current information on the As-Built Drawings may result in determination by Contracting Officer that Contractor has failed to meet his Progress Schedule. Payment, or a portion of the payment, including final payment, may be withheld until the As-Built Drawings are current, and accepted by the Contracting Officer.

3.3 PROGRESS SCHEDULE

In accordance with FAR Clause 52.236-15, "Schedule for Construction Contracts", the Contractor shall submit his a progress schedule as hereinafter specified under paragraphs entitled "Bar Chart" or "Network Analysis"

3.3.1 Bar Chart

Contractor shall:

a. Submit, within 15 days of Notice to Proceed or issuance of D.O., the Bar Chart (unless task order specifically calls for Network Analysis), for approval by the Contracting Officer, in one reproducible and 4 copies. Update schedule and resubmit monthly beginning 7 days after return of the approved initial schedule.

b. Prepare the progress chart in the form of a bar chart utilizing form "Construction Progress Chart" (available from the Contracting Officer) or comparable format acceptable to the Contracting Officer.

c. Include no less than the following information on the progress chart:

(1) Break out by major headings for primary work activity.

(2) A line item break out under each major heading sufficient to track the progress of the work.

(3) Separate line items for training, operational readiness reviews, and O&M Manuals, for each system specified in Section 01770, "Task Order Closeout". Costs for line items shall be itemized, separately, for each system, and therefore shall not be included in (4) below.

(4) A line item showing contract finalization task which includes punch list, clean-up, and submission of As-Built Drawings.

(5) Provide each line item with a cost indicating the value of the line item.

(6) Plot on the bar chart the S-curve, indicating the estimated costing of payments from project start to completion (Dollar amount on y-axis and time on x-axis).

(7) Separate line items for materials and labor, where appropriate. Both bars shall show the scheduled percentage complete for any given date within the contract performance period. Labor bar shall also show the number of men (man-load) expected to be working on any given date within the contract performance period.

(8) Estimated cost and percentage weight of total contract cost for each material and labor bar on the chart.

(9) Separate line items for mobilization and drawing submittal and approval. (These items are to indicate no associated costs.)

3.3.2 Network Analysis

When specifically required in the Task Order, the contractor shall submit and utilize a Network Analysis scheduling tool in lieu of a Bar Chart.Contractor shall submit the initial progress schedule within 15 days of Notice to Proceed. Schedule shall be updated and resubmitted monthly beginning 7 days after return of the approved initial schedule. Updating shall entail complete revision of the graphic and data displays

incorporating changes in scheduled dates and performance periods. Redline updates will only be acceptable for use in weekly status reviews.

Contractor shall provide a single point contact from his on-site organization as his Schedule Specialist. Schedule Specialist shall have the responsibility of updating and coordinating the schedule with actual job conditions. Schedule Specialist shall participate in weekly progress meetings and present current information on the status of purchase orders, shop drawings, off-site fabrication, materials deliveries, Subcontractor activities, anticipated needs for Government furnished equipment, and any problem which may impact the contract performance period.

Graphic display shall be a standard network or arrow diagram capable of illustrating the required data. Drafting shall be computer generated on standard 24 x 36 inch (nominal size) drafting sheets or on small (11 x 17 inch minimum) sheets with separate overview and detail breakouts. Any graphic display system used shall be readily legible with a clear, consistent method for continuations and detail referencing. The critical path shall be clearly delineated on the display. When milestone dates are included in the Contract they shall be clearly indicated on the display.

Data shall be presented as a separate printout on paper or, where feasible, may be printed on the same sheet as the graphic display. Data shall be organized in a logical coherent display capable of periodic updating.

Data shall include written activity descriptions with a numerical ordering system cross referenced to the graphic display. Additionally, costs (broken down into separate materials and labor costs), duration, early start date, early finish date, late start date, late finish date, and float shall be detailed for each activity. A running total of the percent completion based on completed activity costs versus total contract cost shall be indicated. Provide a system for indicating scheduled versus actual activity dates and durations, and a S-curve indicating the costing of payments from project start to completion (Dollar amount on y-axis and time on x-axis).

Schedule shall be of sufficient detail to facilitate Contractor's control of the job and to allow Contracting Officer to readily follow progress for portions of the work. Separate line items shall be provided for training, operational readiness reviews, and O&M Manuals, for each system specified in Section 01770, "Task Order Closeout".

3.3.3 Anticipated Adverse Weather Days

The Contractors schedule shall reflect the following anticipated adverse weather delays on all weather dependent activities.

Monthly Anticipated Adverse Weather Calendar Days

J	F	M	A	M	J	J	A	S	O	N	D
4	4	4	5	5	2	2	3	2	3	4	4

3.3.4 Anticipated Government Operations Days

The Contractors schedule shall reflect the anticipated Government Operations delays as defined in Section 01010, "Summary of Work".

3.4 PROJECT SUBMITTAL SCHEDULE

The Contractor shall review the specifications and drawings and verify that the Schedule is complete, or add any submittals as necessary.

The Contractor shall review the contract and shall add to the Schedule any other submittal required under the contract but not listed in the specifications or drawings.

Within 30 days after notice to proceed, the Contractor shall have reviewed the Preliminary Project Submittal Schedule with all necessary subcontractors, and shall mark-up with suggested deletions, revisions, and additions, anticipated submission date, and submit to the Government for approval a Proposed Project Submittal Schedule.

Upon approval the Government shall provide to the Contractor an Approved Project Submittal Schedule which the Contractor shall abide by.

Approval of the Schedule by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but which have been omitted from the Schedule.

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SECTION 01330

SUBMITTALS
8/98

PART 1 GENERAL

1.1 SUMMARY

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

1.2 SUBMITTALS

A standard transmittal form provided by the Government shall be used to transmit each submittal.

Submittal Description (SD): Drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials to be furnished by the Contractor explaining in detail specific portions of the work required by the contract.

The following items, SD-01 through SD-11, and SD-99, are descriptions of data to be submitted for the project. The requirements to actually furnish the applicable items will be called out in each section.

SD-01 Preconstruction Submittals

Submittals, which are required at the outset of the basic contract, task order, or upon award of contract option or similar work breakdown, generally administrative, schedule, and/or project management oriented in content.

SD-02 Shop Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, single line diagrams, detail of fabrications, layout of particular elements, connections, and other relational aspects of the work.

SD-03 Product Data

Submittals composed of manufacturer's standard catalog cuts, brochures, circulars, specifications and product data, and other pre-printed non-project specific information. Such information shall be clearly marked as to product data that is specific to the work, including indication of specific type, size, optional features, etc., which are submitted.

Submittals may also include non-preprinted, project specific information such as equipment schedules, computerized sizing/selection data, and specific performance data or curves.

SD-04 Samples

Submittals including both fabricated and unfabricated physical examples of materials, products, and units of work as complete units or as portions of units of work.

SD-05 Design Data

Submittals comprising design calculations and analysis, electrical system analysis, mix design & component proportions, algorithms, equipment schedules, computerized sizing/selection data, specific performance data or curves, or other data specifically developed for the work.

SD-06 Test Reports

Submittals of reports (laboratory, factory, or field as specified) of findings of product performance/characteristics providing a basis for determination that the products perform, or are installed in accordance with all other submittals, manufacturer's requirements, and work performance specifications. Report must be signed by an authorized official of a testing laboratory or agency, must state the test results, and indicate whether the result is pass or fail.

SD-07 Certificates

Submittals comprising a document verifying individual or company licensing, compliance with industry recognized qualifications standards, or similar. Document shall show applicable seal or other marking of the approving licensing organization; or

Submittals comprising statements signed by responsible officials (manufacturer, installer, tester) attesting that the work (material, installation, or configuration) meets specified requirements. Statements must be dated after the award of this contract, name the project, and list the specific requirements that it is intended to attest.

Certain submittals provided on a daily or other routine basis that do not require submission to the A-E of Record. These submittals are provided directly to the Government only at the location, quantity, and format specified. Examples include Daily Reports, Hot Work/Confined Space/Excavation Requests.

SD-08 Manufacturer's Instructions

Submittals comprising printed sequential steps describing installation or testing of a product, system, or material, including material safety data sheets, specific hazards, safety precautions, and emergency awareness procedures necessary to safely install the work.

SD-09 Manufacturer's Field Reports

Submittals of written reports by the manufacturer after visiting the job site, documenting the results of the visit. May include SD-06 Test Reports also.

SD-10 Operation and Maintenance Data

Submittals comprising information intended to be incorporated into an operations and maintenance manual.

SD-11 Closeout Submittals

Submittals, which are required at the closeout of the contract, or portions of the contract work to be partially accepted, such as as-built drawings, punch list documentation completion, final invoice, release of lien, etc.

1.3 PREPARATION

1.3.1 Transmittal Form Format

Transmittal forms shall utilize GSFC form FMD-304 Material Approval Submittal Transmittal identifying the Contractor, his address, and telephone number, contract number, and date of submission. Each individual submittal shall be marked on the transmittal form, and shall be identified by submittal schedule reference number (i.e., NASA NUMBER); Subcontractor and supplier, their addresses and telephone numbers; submittal name; contract specification and drawing reference; compliance with applicable referenced specifications; and similar information to distinguish it from other submittals.

1.3.2 Drawing Format

Drawing submittals shall be prepared on sheets not less than 8-1/2 x 11 inches nor larger than 30 x 42 inches in size, except for full size patterns or templates. Drawings shall be prepared to accurate size, with scale indicated, unless other form is required. Drawings shall have dark lines on a white or translucent background.

Copies of each drawing shall have the following information clearly marked thereon:

a. The job name, which shall be the general title of the contract drawings.

b. Name of Contractor.

c. Name of Subcontractor.

d. The date of the drawings and revisions.

e. The name of the item, material, or equipment detailed thereon.

f. The number of the submittal (e.g., first submittal, etc.) in a uniform location adjacent to the title block.

Drawings shall be numbered in sequence. Contractor may use his own number system. Each drawing shall bear the number of the submittal in a uniform location adjacent to the title block. The Government contract number shall appear in the title block, for each drawing.

1.3.3 Data Format

Required data submittals for each specific material, product, unit of work, or system shall be collected into a single submittal and marked for choices, options, and portions applicable to the submittal. Marking of each copy of product data submitted shall be identical. Partial submittals will not be accepted for expedition of construction effort.

1.3.4 Sample Format

Samples shall be physically identical with the proposed material or product to be incorporated in the work, fully fabricated and finished in the specified manner, and full scale. Where variations in color, finish, pattern, or texture are inherent in the material or product represented by the sample, multiple units of the sample, showing the near-limits of the variations and the "average" of the whole range (not less than 3 units), shall be submitted. Each unit shall be marked to describe its relation to the range of the variation. Where samples are specified for selection of color, finish, pattern, or texture, the full set of available choices shall be submitted for the material or product specified. Sizes and quantities of samples shall represent their respective standard unit.

Each sample shall have a label indicating:

a. The Job name, which shall be the general title of the contract drawings.

b. Name of Contractor.

c. Name of Subcontractor.

d. The name of the item, material, or equipment.

e. Name of producer and brand

f. Specification section to which samples applies

g. Submittal Schedule Reference Number

h. Samples of finish materials shall have additional markings that will identify them under the finish schedules.

1.4 SUBMISSION REQUIREMENTS

1.4.1 Drawings Submittals

Drawings shall be suitable for electronic scanning, and reproduction on Xerographic process machines, and shall be of a quality to produce clear, distinct lines and letters.

In lieu of the number of copies indicated in FAR 52.236-21 "Specifications and Drawings for Construction", 5 total blackline or blueline prints of each drawing shall be submitted directly to the Government, 2 additional prints shall be forwarded to the Government's A-E when applicable. 3 prints, marked with review notations by the Government, shall be returned to the Contractor.

1.4.2 Data Submittals

Data shall be suitable for microfilming, scanning, and reproduction on Xerographic process machines, and shall be of a quality to produce clear, distinct lines and letters. Data shall be indexed and bound, and shall be the manufacturer's standard product data.

In lieu of the number of copies indicated in FAR 52.236-21, 5 total blackline prints of each data page shall be submitted directly to the Government, 2 additional copies shall be forwarded to the Government's A-E where

applicable. 3 copies, marked with review notations by the Government, shall be returned to the Contractor.

1.4.2.1 Final Submissions of Drawing and Data Submittals

Final submissions of Drawing and Data submittals shall be in electronic format, Microsoft Office 97 (copyrighted) products, AutoCADD R14 (copyrighted), or later releases. Submission shall be on CD-R format. Electronic submissions shall comply with FMD CADD Manual.

1.4.3 Samples

Two sets of identical samples shall be submitted. 1 sample, marked with review notations by the Government, shall be returned to the Contractor.

Samples that are intended or permitted to be returned and actually incorporated in the work are so indicated in the individual technical sections. These samples will be returned to the Contractor, at his expense, to be clearly labeled, with installation location recorded. Samples shall be in undamaged condition at the time of installation.

Where mockups and similar large samples are required by individual technical sections, it is recognized that these are a special type of sample which cannot be readily "transmitted" as specified for submittal of samples. Otherwise, and except as indicated in the individual technical sections, the requirements for samples shall be complied with and a transmittal form shall be processed for each mockup, to provide a record of the activity.

1.5.4 Variations and Substitutions

In accordance with FAR 52.236-21, variations and substitutions shall be clearly stated as such in the transmittal letters and on the shop drawings, data, or samples. Failure to point out and identify deviations may result in the rejection and removal of such work at no additional cost to the Government. All deviations are subject to Government approval.

Where the Contractor proposes to substitute materials, the Contractor shall submit 2 samples of material specified and 2 samples of material proposed for substitution, along with sufficient technical information, including test reports or other supporting information if so required by the Contracting Officer to show equality to products specified, on each item at variance with the contract requirements in sufficient time to allow the Government to compare the proposed materials.

1.5 GOVERNMENT'S REVIEW

1.5.1 Review Notations

Contracting Officer will review submittals and provide pertinent notation generally within 15 working days after receipt of submission. On complex or lengthy submittals requiring extensive review efforts by the Government, and on occasions when numerous submittals are made within a 15 day period, the aforementioned 15-day review period may be exceeded by the Government.

Submittals will be returned to the Contractor with the following notations:

a. Submittals marked "APPROVED" authorize the Contractor to proceed with the work covered.

b. Submittals marked "APPROVED AS NOTED - NO RESUBMIT" authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections. The notes shall be incorporated prior to submission of the final submittal.

c. Submittals marked "APPROVED AS NOTED - RESUBMIT" require the Contractor to make the necessary corrections and revisions and to re-submit them for approval in the same routine as before.

d. Submittals marked "REJECTED - RESUBMIT" indicate noncompliance with the contract requirements and shall be re-submitted with appropriate changes.

e. Submittals marked "REVIEW NOT REQUIRED - NO ACTION TAKEN" indicate the Government is not required to approve the submitted work or operation. Such determination by the Government shall not relieve Contractor of his responsibility to perform the work in a safe and workmanlike manner and to obtain all required permits and approvals.

f. Contractor shall make corrections required by the Contracting Officer. If 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" shall be given to the Contracting Officer. Approval of the submittals by the Contracting Officer shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Contractor shall be 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 Contractor's expense.

g. If changes are necessary to approved submittals, Contractor shall make such revisions and submission of the submittals in accordance with the procedures above.

1.5.2 Sample Approval

Contractor shall furnish, for the approval of the Contracting Officer, samples required by the specifications or by the Contracting Officer. Shipping charges shall be paid by Contractor.

Contractor shall submit to the Contracting Officer two samples of materials where samples are requested. Contractor shall transmit with each sample a letter, original and two copies, containing the above information.

Approval of a sample shall be only for the characteristics or use named in such approval and shall not be construed to change or modify any contract requirements. Before submitting samples, Contractor shall 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.

Materials and equipment incorporated in the work shall match the approved samples. If requested, approved samples, including those which may be damaged in testing, will be returned to Contractor, at his expense, upon completion of the contract. Samples of disapproved materials will also be

returned to Contractor at his 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. The Government reserves the right to disapproved 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 Contracting Officer for testing. Samples failing to meet contract requirements will automatically void previous approvals. The Contractor shall replace such materials or equipment to meet contract requirements.

Approval of Contractor's samples by the Contracting Officer shall not relieve Contractor of his responsibilities under the Contract.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

-- End of Section --

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SECTION 01411

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SECTION 01411

GENERAL SAFETY REQUIREMENTS
08/09

PART 1 GENERAL

1.1 SUMMARY
Requirements of this section apply to, and are a component part of, each section of the specifications.

1.2 REFERENCES
Publications listed below form a part of this section to the extent referenced. The GSFC references can be found at http://gdms.gsfc.nasa.gov/gdmsnew/home.jsp. The NASA references can be found at the HQ NODIS link from GDMS.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
ANSI Z136.1 (2007) SAFE USE OF LASERS

CODE OF FEDERAL REGULATIONS (CFR)
29 CFR 1910 (2008) OCCUPATIONAL SAFETY AND HEALTH STANDARDS
29 CFR 1926 (2008) SAFETY AND HEALTH REGULATIONS FOR CONSTRUCTION

GODDARD SPACE FLIGHT CENTER (GSFC)
GSFC CODE 220 POLICY (undated) POLICY AND OPERATIONAL
GSFC GPR 1700.1 OCCUPATIONAL SAFETY PROGRAM AT GODDARD SPACE FLIGHT CENTER
GSFC GPR 1700.6 CONFINED SPACE PROGRAM AT GSFC
GSFC GPR 1700.7 ELECTRICAL SAFETY
GSFC GPR 1840.1 (2005) ASBESTOS MANAGEMENT PROGRAM AT GSFC
GSFC GPR 1860.1B (2008) IONIZING RADIATION PROTECTION
GSFC GPR 1860.4 (2005) ULTRAVIOLET AND HIGH INTENSITY LIGHT RADIATION PROTECTION
GSFC GPR 1860.2A (2005) LASER RADIATION PROTECTION
GSFC GPR 1860.3 (2005) RADIO FREQUENCY RADIATION SAFETY
GSFC GPR 8710.2A (2005) EMERGENCY PREPAREDNESS PROGRAM PLAN FOR GREENBELT
GSFC GPR 8715.5 (2004) FIRE PROTECTION
GSFC GPR 8621.1A (2005) REPORTING OF MISHAPS AND CLOSE CALLS
GSFC GPR 1700.5 (2005) CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)
GSFC GPR 8719.1A CERTIFICATION AND RECERTIFICATION OF LIFTING DEVICES AND EQUIPMENT AND IT'S OPERATORS

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)
ANSI/IEEE C95.1 (2005) SAFETY LEVELS WITH RESPECT TO HUMAN EXPOSURE TO RADIO FREQUENCY ELECTROMAGNETIC FIELDS, 3 KHZ TO 300 GHZ

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)
NASA NPR 8715.3C (2009) NASA GENERAL SAFETY PROGRAM REQUIREMENTS
NASA STD 8719.11 (2008) SAFETY STANDARD FOR FIRE PROTECTION

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
NFPA 101 (2009) LIFE SAFETY CODE

NFPA 241 (2009) SAFEGUARDING CONSTRUCTION, ALTERATION AND DEMOLITION OPERATIONS
NFPA 70 (2008) NATIONAL ELECTRICAL CODE
NFPA 70E (2009) STANDARD FOR ELECTRICAL SAFETY IN THE WORKPLACE U.S. DEPARTMENT OF LABOR (USDL)

OFFICE OF MANAGEMENT AND BUDGET (OMB)
O.M.B. No. 1220-0029 RECORDKEEPING GUIDELINES FOR OCCUPATIONAL INJURIES AND ILLNESSES

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

The Contractor's Safety Plan shall indicate detailed procedures which define provisions for accident prevention, health protection, and construction activity including the name, location, and responsible representative(s) for medical facility to be used for treatment of sick or injured Contractor personnel.

SD-02 Shop Drawings

Area Separation shall indicate locations of area separation wall and other fire protection requirements.

SD-07 Certificates

The Contractor shall have Certification of license to maintain and operate radiation producing materials and equipment used in the performance of the work. Submit accident incident rate calculations monthly to the COTR and FMD (Code 220) Safety Officer not later than the 5th working day following the applicable month.

SD-08 Manufacturer's Instructions

Alternative Equivalent Measures Plan shall indicate necessary work and detailed procedures for fire protection.

Protection Plan shall indicate detailed procedures to prevent damage to existing facilities or infrastructures.

PART 2 PRODUCTS

2.1 ELECTRICAL SAFETY PRODUCTS

Locking Devices: Provide with keyed mechanisms. Combination mechanism locks are not acceptable.

Tagging Devices: Shall be of the type approved for use by FMD. Tagging devices shall be fabricated with tear and water resistant material with either a grommet that permits the tag to be installed on the locking device, or with plastic ties that cannot be easily or accidentally removed. Tags shall provide space for the name of the person installing the tag, date and time installed, and contact information (company and telephone number).

Electrical Cords: The Contractor shall provide extension cords without defects and suitable for the application in accordance with NFPA 70 and 29 CFR 1910. Do not use field fabricated extension cords with standard outlet boxes.

2.2 FALL PROTECTION PRODUCTS

Scaffolding and Temporary Work Platforms : Shall be provided with approved means of access and egress, and equipped with handrails, mid rails, and toe boards, in accordance with 29 CFR 1910 and 29 CFR 1926. When handrails are not installed, provide other approved means of fall protection for all personnel working on platforms.

Safety Harnesses: Shall be Certified, inspected, and tested within five years by manufacture, with current metal certification tag attached to the harness.

Lifelines: Shall be 19 millimeter diameter manila or equivalent with minimum breaking strength of 24,000 Newton. Lifelines which are subjected to cutting or abrasion shall be minimum 22 millimeter diameter wire core manila rope.

Safety Harness Lanyards: Minimum 13 millimeter diameter nylon, or equivalent, with maximum length to provide for a fall of no greater than 1,800 millimeters with nominal breaking strength of 24,000 Newton.

2.3 FIRE SUPPRESSION EQUIPMENT

For ordinary combustible materials classified as Class A, provide fire extinguishers rated not less than UL-rated 2A.

For flammable liquids classified as Class B, such as paints, petroleum products, and other similar products, provide fire extinguishers rated not less than UL-rated 10B when 19 liter of flammable or combustible liquids or 2.25 kilograms of flammable gas are used on the job site.

For electrical components and equipment classified as Class C, provide fire extinguishers rated not less than UL-rated 10C.

Carbon tetrachloride and other toxic vaporizing liquid fire extinguishers are prohibited.

PART 3 EXECUTION

3.1 GENERAL SAFETY PROVISIONS

Contractor shall provide all necessary safety and health measures in performing the Work, and shall:

Meet with Contracting Officer or COTR to develop a mutual understanding relative to administration of a safety plan;

Comply with applicable Federal, State, and local laws, regulations, ordinances, codes, and orders relating to safety and health;

Familiarize personnel and subcontractor's personnel with safety requirements;

Designate a singl e point -of-contact for coordination of safety concerns. Point-of-contact shall have authority to accomplish necessary corrective actions and be available at the site or by telephone during all Work. Designate an alternate poi nt-of-contact with eq ual authority when designated point-of contact is unavailable;

Advise Contracting Officer of special safety restrictions establ ished, so that Government personnel can be notified of these restrictions;

Request information on special hazards , including hazardo us materials, activities and proc esses that may exis t in work areas as a result of Government activities;

GSFC Safety Division personnel have authority to stop w ork on any operations that are deemed to present imminent hazard to personnel;

3.2 SAFETY PLANS

Submit a General Sa fety Plan to Contra cting Officer for a pproval within 10 calendar days after contract award. The General Safety Plan shall be revised throughout the period of performance as may be necessary to reflect change in policies, practices, personnel, and the like, as may b e required by the Contracting Officer.

Safety and Health Plan shall emphasize the following:

a. Description of the work to be performed on site (including unique hazards likely to be encountered.

b. Safety point of contact (on-site) for the Contractor.

c. Contractor statement of policy with regard to enforcement of safety and health program requirements.

d. Safety program objectives.

e. Methods to obtain safety objectives.

f. Responsibility of key personnel for the Contractor.

g. Safety meetings, surveys, inspections, and reports.

h. Type(s) of personal protective equipme nt that is require d, under what circumstances it will be used , and how its us e will be enforced.

i. Safety training re quired for tasks to be performed i ncluding certification and/or re-certification where applicable.

j. GSFC emergency pr ocedures defined including instructions on notification of incidents to the EMERGENCY CONSOLE.

k. Methods to comply w ith the requirement for immediate repo rting of accidents to the Contracting Officer.

l. Statement that Contractor will not invalidate the integrity of safety systems without proper authorization.

m. Procedures for emergency actions to be taken to secure dangerous conditions, to protect personnel, and secure work areas in the event of an accident or an act of nature.

n. Procedures for securing an accident site so that the area remains secure until arrival of a GSFC Safety and Environmental Branch investigator. Accident site shall remain secured until released by Contracting Officer and GSFC Safety and Environmental Branch.

o. The Safety Plan must make reference to the following documents:
NASA NPR 8715.3C
GSFC GPR 8621.1A
GSFC GPR 8710.2A
29 CFR 1910 or 29 CFR 1926 as applicable
Any State, County, or Local Safety Code applicable

p. Task Safety Analyses for major components of the contract construction work

Failure to address each of the specific requirements indicted above shall be cause for rejection of the Safety Plan.

3.3 CONTROL OF HAZARDOUS ENERGY (LOCKOUT/TAGOUT)

Institute a program for control of hazardous energy in accordance with Section 1910.147 of 29 CFR 1910, Section 926.417 of 29 CFR 1926 And GPR 1700.5 Control of Hazardous Energy (LOCKOUT /TAGOUT). Include program documents in the Safety Plan. Make training records of employees available to the Government upon request.

No person, regardless of position or authority, shall operate controls or equipment that have an attached lockout/tagout device or tag. No tag shall beremoved except as provided in this section.

Provide control of hazardous energy with both a lockout device and a tag.

Pressure and vacuum systems shall be vented completely to relieve differential pressure. Vent valves shall be locked / tagged open during work on involved systems. Where contents of piping or pressure systems may present specific hazards to employees, take necessary means to provide a safe working space prior to entry. Where applicable, perform confined space entry in accordance with provisions in this section.

Appoint an individual to be responsible for the electrical safety of each work team and restrict entry to dangerous locations, as authorized by the appointed individual or jointly with the Government. Do not perform work on energized
circuits of 100 volts to ground or greater.

3.3.1 Tag Placement

Place lockout/tagout tags in accordance with the regulations printed on the back or attached to any device that may create an unsafe condition when operated.

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

When Government-owned and operated equipment requires tagging, the Government will provide a "safety clearance" by reviewing the characteristics of the various systems, the safety of the operations, and the work to be done. Necessary actions will be taken, including voltage and pressure checks, grounding (except medium voltage feeder grounding), and venting to ensure that the system and equipment is safe to work on. Lockout/tagout tags will be applied to mechanical and electrical switches, valves, vents, and other mechanical devices to maintain safety.

3.3.2 Tag Removal

Lockout/tagout tags shall be removed only by persons who initiated the lockout/tagout tag and who retain possession of the keys. Otherwise, lockout/tagout tags may be removed only with the authorization of the GSFC Safety and Environmental Division.

3.4 ACCIDENT TREATMENT AND RECORDS

Post emergency first aid and ambulance information at project site. The Government will provide emergency response for medical and other emergencies on GSFC properties in Greenbelt, Maryland. For emergency response, dial "911" from Center telephones, or dial 301.286.9111 from other telephones.

Report injury or other mishaps in accordance with GSFC GPR 8621.1A

3.4.1 Accident Incident Rate Calculations

Submit accident incident rate calculations monthly to the COTR and FMD (Code 220) Safety Officer not later than the 5th working day following the applicable month. Calculations shall be computed in accordance with OMB No. 1220-0029 and as follows:

$$\text{Incident Rate} = \frac{\text{Total Number of Injury Cases} \times 200{,}000}{\text{Total Number of Manhours Worked}}$$

$$\text{Incident Rate (Lost Time)} = \frac{\text{Number of Lost Workday Injuries} \times 200{,}000}{\text{Total Number of Manhours Worked}}$$

$$\text{Incident Rate (Restricted Duty)} = \frac{\text{Number of Restricted Work Injuries} \times 200{,}000}{\text{Total Number of Manhours Worked}}$$

Incident rates for lost workdays and restricted workdays will indicate when lost and restricted time is the result of carryover from previously recorded injury cases.

Total Number of Man hours Worked and Total Injuries shall be from NTP through calendar month to date.

3.5 FIRE PREVENTION AND PROTECTION

Report all fires to the Emergency Console by dialing 911 from Center telephones or 301.286.9111 from outside lines. Complete all construction,

alteration, and demolition operations in accordance with NFPA 241 and NASA STD 8719.11.

3.5.1 Sprinkler Outages

These requirements apply in all facilities in which installed automatic fire suppression systems are taken out of service.

No sprinkler outage will be permitted in any area at the same time as an outage of the Evacuation Alarms.

During any sprinkler outage, all hazardous operations in the unprotected areas, including hot-work operations, shall be terminated. If the hazardous operation must continue during the outage, or is the reason for the outage, the continuation of the hazardous operation must be approved by the GSFC Safety and Environmental Division.

When any portion of an existing sprinkler system is disabled in buildings fully or partially occupied by non-construction personnel, the Contractor shall provide protective measures, as specified below. The only case in which these measures are not required is if the contract documents state that the entire building is to be vacated by all non-construction personnel for the entire construction period. These measures shall be provided for all unoccupied building areas left unprotected by the sprinkler system shutdown, except that the protective measures are not required for the following locked utility areas: mechanical equipment rooms, electrical equipment rooms, LAN rooms, telephone closets, and janitor closets.

The protective measures shall be maintained in accordance with NFPA 101 until the sprinkler system is placed back in service. The protective measures provided by the Contractor shall be one of the following:

a. A Contractor-furnished fire watch for unprotected, unoccupied areas, as specified below in "Fire Watch Requirements".

b. Fire separation of the unprotected area along with smoke detection, as specified below in "Area Separation Requirements".

c. Alternative Equivalent Measures, as specified below in "Alternative Equivalent Measures".

3.5.1.1 Fire Watch Requirements

These are the minimum requirements for a fire watch furnished by the Contractor to support a sprinkler outage. This paragraph does not cover fire watch requirements for hazardous operations such as cutting and welding, which are specified in paragraph "Hot Work". The Contractor shall provide all personnel needed for Fire Watch tours. Fire watch shall begin at the beginning of the sprinkler outage and shall continue until the system is back in service.

The fire watch shall consist of at least one person designated to perform the task of monitoring every unoccupied portion of the unprotected areas of the building for any possible fires. If a sprinkler outage extends outside of normal duty hours (as defined in Section 01010, "Summary of Work"), the fire watch during that period shall monitor all unprotected areas, including those areas which are occupied during normal duty hours.

The fire watch shall check each area at least once every hour, except in areas designated on the drawings as Mi ssion Critical or S pecial Hazard, the frequency shall be every 30 minutes or as indicated on the drawings. In the event of a fire, the fire watch shall be responsible for:

a. Activating the nearest pull station (if in service)

b. Notifying the Emer gency Console at 911 on Center pho nes, or 301.286.9111 from outside lines

c. Using portable fire extinguishers to extinguish or contain the fire where feasible (th is shall be done only by properly trained personnel, and only after notification has been made as indicated above)

Each person designat ed as a fire watch shall be instructed by the Contractor on the following topics before standing fire watch. The Contractor shall review the information on the drawings and obtain any additional information regarding the area to be watched, the building alarm systems and emergency procedures, and any special hazards in the area, from the Government Project Manager prior to scheduling the outage:

a. The areas to be watched;

b. Frequency of tours required;

c. The specifics of the fire protection impairment;

d. Appropriate emergency procedures and actions;

e. Methods for sounding the alarms;

f. Procedure for manually activating fire suppression systems;

g. Use of fire extinguishers (hands-on training required);

h. Methods for recording conduct of tours and other pertinent information in the log;

i. Location and nature of special hazards (if any) in the area;

The Contractor shall identify to the P roject Manager, in advance, which of his personnel are d esignated as fire w atch for each day o f the outage. The Contractor shall maintain a log sheet i n the field with an entry showing th e time of completion of each fire wa tch tour, and the initials of the designated person w ho conducted that t our. The log sheet shall be available for examination by the Inspector during the outage, and shall be attached to the Contactor's daily report at the conclusion of the outage.

3.5.1.2 Area Separation Requirements

The Contractor may elect to support a sprinkler outage by providing area separation and smoke detection in accordance with the following minimum requirements, instead of providing a fire watch.

If a sprinkler outage extends outside of normal duty hours (as defined in Section 01010, "Summary of Work") a fire watch shall be provided to monitor all unprotected areas, including those areas which are occupied during normal duty hours.

Unprotected construction areas shall be isolated from adjacent unprotected occupied areas by a one hour rated separation, including floor, walls up to floor slab or roof deck above, or walls and ceiling. If a suitable permanent separation is included in the scope of work, it shall be constructed prior to any sprinkler outage or demolition of sprinkler systems. The Contractor may provide an equivalent temporary barrier if a suitable permanent one is not included in the project. In either case the Contractor shall inspect the entire perimeter of the separation and provide suitable rated firestopping of any existing or new penetration through it prior to any sprinkler outage.

Along with the separation described above, the Contractor shall either:

a. maintain the existing smoke detection system in service in the construction area; or

b. provide temporary smoke detection in the construction area, compatible with the existing building detection system, and connected to the system as a temporary zone. The Contractor shall provide all wiring from the temporary devices to a point adjacent to the system panel, with sufficient length of wire to make the connections. The GSFC Fire Alarm Shop will then make the connection into the panel. The GSFC Fire Alarm Shop will also disconnect the temporary zone from the panel, and the Contractor shall remove all temporary wiring and devices when the work is completed.

The Contractor shall submit Area Separation drawings to the Project Manager, indicating the location of all separation walls, including details for sealing and firestopping. If temporary smoke detection is provided, the drawings shall also indicate the type of smoke detector to be used, locations of detectors, and tie-in point to the Government System.

The Contractor shall perform all work to provide the area separation and smoke detection as described above, prior to requesting a sprinkler outage. The work will be subject to inspection by the Government prior to acceptance of the outage request.

The smoke detection within the construction area (whether existing or temporarily provided) shall be kept functional at all times except during hot work operations. During hot work operations the Contractor shall provide a fire watch as pecified in the paragraph "Hot Work".

3.5.1.3 Alternative Equivalent Measures

The Contractor may chose to submit Alternative Equivalent Measures Plan for providing fire protection during sprinkler outages. These shall be submitted in sufficient detail to permit the Government to evaluate their equivalence to the specified measures in providing fire protection during the outage.

The submittal must be approved by the Safety and Environmental Branch as providing equivalent protection, and the contractor shall perform all work to provide alternative equivalent measures, prior to requesting the outage. The

work will be subject to inspection by the Government prior to acceptance of the outage request.

3.5.1.4 Outage Request Procedure

Requests for sprinkler outages shall be submitted to the Government at least three full working days in advance, and in accordance with Section 01010, "Summary of Work". Outages shall be scheduled to begin after 7:00 a.m., and to end before 3:30 p.m. The Government may request the Contractor to begin the outage at an alternate time or date, if outages already scheduled would prevent the Government Sprinkler Shop from isolating and draining the system at the requested time.

The request form shall include the following information, as a minimum:

a. Which fire protection measure (fire watch, separation, or approved equivalent measure) the Contractor will provide;

b. Areas unprotected during sprinkler outage;

c. Date and time to begin outage (includes drain-down time);

d. Scheduled date and time of fire protection restoration;

For outages with fie watch provided, include also:

a. Areas under fire watch;

b. Frequencies of fire watch tours;

c. Names of personnel serving as fire watch;

For outages with area separation and smoke detection provided, include also:

a. Attach to the outage request a copy of the approved submittal showing location of separation and smoke detectors in the affected area; and

b. Documentation of separation walkthrough, signed by the Government Inspector

For outages with other approved equivalent measures, include also:

a. Attach to the outage request a copy of the approved submittal describing the alternate provisions to be made by the contractor

3.5.1.5 System Isolation, Drain, And Refill Procedure

When a sprinkler outage occurs the Contractor shall be on the site at the time the outage is scheduled to begin. With the Contractor on site, the Government representative will close the appropriate sprinkler isolation valve, drain the system, and place a lock on the closed valve. The Government lock shall be tagged "GOVERNMENT" with an indication of the date and time the valve was locked, and the name of the Government representative. The Contractor shall then place his lock and tag with his name, date, and time on the sprinkler valve, in the presence of a Government representative before beginning sprinkler work.

After sprinkler work is complete, the Contractor shall notify the Government and remove his lock from the sprinkler valve. By removing his lock the Contractor takes full responsibility for the integrity of the affected sprinkler piping work that was performed. The Government representative will then remove the Government lock, open the isolation valve, and refill the sprinkler system to return it to full service. The Contractor shall remain on the site until refilling is completed and the system integrity is verified. Any damage incurred due to the lack of integrity of the sprinkler piping work performed by the Contractor shall be corrected by the Contractor at no charge to the Government.

The Contractor shall arrive on site at the scheduled outage start time and complete the work within the scheduled outage duration. If the Contractor fails to arrive within 15 minutes of the scheduled time, the Government may cancel the outage.

If the contractor fails to complete the work within the prescribed outage duration, the Contractor shall be responsible for extending the fire watch or other protective measures until the system is back in service, at no additional charge to the Government.

3.5.2 Fire And Evacuation Alarms

The Contractor shall ensure that all construction personnel working in buildings and other structures are aware of the evacuation alarm signals used in the facility. Instruct construction employees to leave the facility and report to an assembly area designated by the Contractor when the evacuation signal is activated.

When evacuation alarms are disabled due to construction operations for any period of time in buildings that are occupied or partially occupied by non-construction personnel, the Contractor shall develop an alternate evacuation alerting procedure and coordinate with building occupants. The Contractor shall obtain approval of this plan from the GSFC Safety and Environmental Division, and shall institute the approved alternate evacuation alerting system, prior to disabling evacuation alarms.

Construction shall be scheduled so that automatic sprinkler systems are fully in service any time the evacuation alarms are disabled.

3.5.3 Open Flame Heating Devices

Do not operate open-flame heating devices unless written approval is obtained from the Contracting Officer. Approval for the use of open-flame heating devices will not relieve Contractor from responsibility for damages incurred from a fire caused by an open-flame heating device.

Open fires and burning of trash, debris, or excess materials are strictly prohibited.

3.5.4 Fire Extinguishers

Provide fully charged fire extinguishers which are suitable for the existing hazards in accordance with Section 1926.150 of 29 CFR 1926 throughout all parts of the worksite under control of the Contractor, including areas with operational sprinkler systems. Provide one fire extinguisher for every 280

square meter with maximum unobstructed travel distance of 30 meters from any point in the protected area to fire extinguisher. Inspect fire extinguishers monthly and maintain in operating condition.

3.5.5 Hot Work

For all hot work operations, obtain a "Hot Work" Permit (GSFC 23-4), and conduct in accordance with GSFC GPR 8715.5. Construction activities are designated as hot work operations when flame or heat generated from welding, cutting, sweating, torching, roof kettles, etc. is capable of igniting combustible materials.

Discontinue burning, welding, or cutting operations one half hour prior to the end of the normal work day. Provide a workman at the project site for one half hour after discontinuing these operations to make a complete inspection of the area for possible sources of latent combustion. Equip person with two full 9 kilogram dry chemical fire extinguishers. Report unsafe conditions to the GSFC Safety and Environmental Division at 301.286. 5555. In an emergency, report fires by calling "911" from center phones, or 301.286.9111 from outside lines.

3.5.6 Sprinkler, Standpipe Systems, And Water Supply

In new structures, construct and place sprinkler and standpipe systems in service as soon as possible. In existing buildings that are under construction, maintain sprinkler and standpipe systems in an operational manner, except when work is being done on the systems. Complete work on sprinkler and standpipe systems and return to service as soon as possible. Install water mains and hydrants, complete and in service, prior to constructing elements inside the building's foundation walls.

3.5.7 Materials Storage

Store combustible and flammable materials in accordance with National Fire Protection Codes and applicable Federal, State, and local laws and regulations. The Contractor shall not allow combustible and flammable debris to accumulate at the work site without approval of the Contracting Officer.

3.6 USE OF EXPLOSIVES

The use of explosives is strictly prohibited unless a permit is obtained from the GSFC Safety and Environmental Division. Approval shall not relieve the Contractor of responsibility for injury to persons or for damage to property due to blasting operations.

When permitted on Government property, store and locate explosives only where directed and in storage facilities approved by the GSFC Safety and Health Branch. Keep storage facilities locked at all times except for inspection, delivery, and withdrawal of explosives. Comply with NASA STD 8719.11 for handling, storage, and use of explosives.

3.7 ELECTRICAL TOOLS AND EQUIPMENT SAFETY

Implement the Assured Equipment Grounding Program or the Ground Fault Circuit Interrupters Program for the Project site in accordance with Section 1926.404 of 29 CFR 1926. Do not implement a combination of these two programs. Include a written description of the electrical safety program in the Safety Plan

with specific procedures to be adopted by the Contractor. Designate in writing one or more competent persons as defined in Section 1926.32(i) of 29 CFR 1926 to impleme nt the program. Mak e a copy of the pr ogram available at the Project site for inspection and copying.

Inspect electrical tools and equipment for defects and da mage prior to use. Repair or replace defective tools and equipment prior to use.

3.8 WORK IN CONFINED SPACES

For work involving confined spaces such as, but not limited to, tanks, vaults, manholes, water tower, excavations, tunnel systems, air handlers, etc comply with the requirements of GSFC GPR 1700.6. Confined Space Program at GSFC.

A person is not permitted to enter a confined space until an assessment of that space is made and specific authorization by entry permit (GSFC 23-52 where required).

3.9 RADIATION SAFETY REQUIREMENTS

Comply with GSFC GPR 1860.1, 1860.2, 1860.3, 1860.4, ANSI/IEEE C95.1, ANSI Z136.1, and, and applicable regulations of the United States Nuclea r Regulatory Commission, in the use of ionizing and non -ionizing radiation. The GSFC Radiation Safety Officer (RSO) will provide technical support to the Contracting Officer's Technical Representative relating to radiation safety.

In addition to ot her reporting requ irements contained in public law , immediately report any loss of rad ioactive material to the Contracting Officer and to the GFSC Radiation Safety Officer at 301.286. 0280. (Report emergencies to 911 from center telephones, or 301.286. 9111 from outside lines).

3.9.1 License Certification

Submit certification of license to main tain and operate ra diation producing materials and equipment used in the performance of the Work.

3.9.2 Radiographic Procedure

The Contractor shall not perform work involving actual exposure of radiographic film or unshielding the source during normal daily working hours and not prior to 5p.m. on weekdays.

3.10 FACILITY OCCUPANCY CLOSURE

Do not close or ob struct streets, walks, building egress paths, and othe r facilities occupied and used by the Government withou t prior written permission from the GSFC Safety and Environmental Division. Authorization will be granted only after adequate plan s and provisions are proposed to meet the egress and emergency response needs of the facility's occupants.

In buildings that are occupied or partially occupied by personnel other than Contractor's personnel, maintain all re quired exits, exit access, and exit discharge, free of obstructions and im pediments to allow for instant use in case of fire or other emergency. Comply with NFPA 101.

In buildings occupied only by Contr actor's personnel, maintain adequate escape facilities for use by construction workers at all times.

3.11 PROTECTION OF WORK

Protect structures, utilities, sidewal ks, pavements, and other facilities located adjacent to excavations. S ubmit a Protection Plan indicating procedures to prev ent damage to exi sting facilities an d infrastructures. Immediately repair or replace damaged facilities.

3.12 ROOFING WORK

At the beginning of each work day, con tact the Government's Inspector prior to proceeding with roofing work to e nsure safe working conditions and to verify that building occupancy conditions have not changed.

3.13 HIGH NOISE LEVEL PROTECTION

Do not schedule ope rations that involv e the use of equipm ent with output of high noise level ou tput (jackhammers, air compressors, an d explosive device activated tools) in occupied areas during normal duty hours. Prior to operating high noise level equipment in occupied areas, obtain approval in writing from the Project Manager.

3.14 SEVERE STORM PLAN

In the event of a severe storm wa rning, secure outside equipment and materials and place materials suscepti ble to damage in pr otected locations. Check surrounding areas, including roof, for loose material, equipment, debris, and other o bjects that could b e blown away or blo wn against existing facilities.

Ensure that temporary erosion controls are adequate.

3.15 HAZARDOUS WASTE

Generate, handle, a nd store hazardous wastes in accordanc e with 40 CFR 260, and other applicable Federal, State and local regulations. Upon request by the Contracting Officer, provide documentation that personnel are duly trained in generating and handling hazardous waste materials.

Remove hazardous wastes generated by the Contractor at no additional expense to the Government, in coordination with Environmental office. Notify the Project Manager when Government-owned hazardous wastes are discovered and removal from the Project site is necessary. The Government Inspector will contact the GSFC Hazardous Waste specialist. Government -owned hazardous wastes will be removed by the Government.

For assistance in determining if Government-owned waste is hazardous, contact the GSFC Hazardous Waste Office at local telephone number 301.286.9233.

-- End of Section --

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SECTION 01420

SOURCES FOR REFERENCE PUBLICATIONS
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PART 1 GENERAL

1.1 REFERENCES

Reference publications are cited in other sections of the specifications along with identification of their sponsoring organizations. The addresses of the sponsoring organizations are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided.

ACOUSTICAL SOCIETY OF AMERICA (ASA)
Standards and Publications Fulfillment Center
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Soil Conservation Rd.
Beltsville, MD 20705
Ph: 301-504-9430

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)
4301 North Fairfax Dr., Suite 425
ATTN: Pubs Dept.
Arlington, VA 22203
Ph: 703-524-8800
Fax: 703-528-3816
Internet E-mail: ari@dgsys.com

AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)
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Chicago, IL 60603
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Fax: 216-892-1404

STEEL JOIST INSTITUTE (SJI)
1205 Forty-eighth Ave. No., Suite A
Myrtle Beach, SC 29577-5424
Ph: 803-449-0487
Fax: 803-449-1343

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

40 24th Street, 6th Floor
Pittsburgh, PA 15222-4643
Ph: 412-281-2331
Fax: 412-281-9992

STEEL TANK INSTITUTE (STI)
570 Oakwood Rd.
Lake Zurich, IL 60047
Ph: 708-438-0989 or 800-275-1300
Fax: 708-438-8766

STEEL WINDOW INSTITUTE (SWI)
1300 Sumner Ave.
Cleveland, OH 44115-2851
Ph: 216-241-7333
Fax: 216-241-0105

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)
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Norcross, GA 30092
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Fax: 770-446-6947
If ordering by mail:
Service Department
P. O. Box 105113
Atlanta, GA 30348-5113

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Army Adjutant General Publication Center
1655 Woodson Road
Saint Louis, MO 63114

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)
2500 Wilson Blvd, Suite 300

Arlington, VA 2201
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Fax: 705-907-7727
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Englewood, CO 80112
Ph: 800-854-7179
Fax: 303-397-2740
Internet: http://global.ihs.com

TILE COUNCIL OF AMERICA (TCA)
P.O. Box 1787
Clemson, SC 29633-1787
Ph: 864-646-8453
FAX: 864-646-2821

TRUSS PLATE INSTITUTE (TPI)
583 D'Onofrio Dr., Suite 200
Madison, WI 53719
Ph: 608-833-5900
Fax: 608-833-4360

TUBULAR EXCHANGER MANUFACTURERS ASSOCIATION(TEMA)
25 N. Broadway
Tarrytown, NY 10591
Ph: 914-332-0040
Fax: (914) 332-1541
Internet: http://www.tema.org

U.S. AIR FORCE TECHNICAL ORDERS (TO)
Air Force Logistics Command, ATTN: D.A.D.
Wright-Patterson Air Force Base, OH 45433

U.S. DEPARTMENT OF COMMERCE PRODUCT STANDARDS (PS)
Superintendent of Documents
P. O. Box 371954
Pittsburg, PA 15250-7954
Ph: 202-783-3238
Fax: 202-512-2250

U.S. DEPARTMENT OF LABOR (USDL)
Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

U.S. DEPARTMENT OF TRANSPORTATION (USDT)
Superintendent of Documents
U.S. Government Printing Office
Washington, DC 20402

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333 Pfingsten Rd.
Northbrook, IL 60062-2096
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Fax: 847-509-6249
Internet: http://www.ul.com/
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Engleood, CO 80112-9650
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Fax: 303-397-2740
Internet: http://global.ihs.com

UNI-BELL PVC PIPE ASSOCIATION (UBPPA)
2655 Villa Creek Dr., Suite 155
Dallas, TX 75234
Ph: 214-243-3902
Fax: 214-243-3907

WASHINGTON SUBURBAN SANITARY COMMISSION (WSSC)
1450 Sweitzer Lane
Laurel, MD 20707-5902
Ph: 301-206-8100

WATER QUALITY ASSOCIATION (WQA)
4151 Naperville Rd.
Lisle, IL 60532
Ph: 708-505-0160
Fax: 708-505-9637

WELDING RESEARCH COUNCIL (WRC)
345 East 47th St.
New York, NY 10017
Ph: 212-705-7956
Fax: 212-371-9622

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)
P.O. Box 23145
Portland, OR 97281
Ph: 503-639-0651
Fax: 503-684-8928

WESTERN WOOD PRESERVERS INSTITUTE (WWPI)
601 Main Street
Suite 405
Vancover, WA 98660 Ph: 360-693-9958
Fax: 360-693-9967

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)
Yeon Bldg.
522 SW 5th Ave.
Portland, OR 97204-2122
Ph: 503-224-3930
Fax: 503-224-3934

WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION (WMMPA)
507 First Street
Woodland, CA 95695
Ph: 916-661-9591
Fax: 916-661-9586

PART 2 PRODUCT (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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SECTION 01450

CONTRACTOR QUALITY CONTROL I
09/96

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to all Task Orders (TO) whose value are up to $500,000. The Contractor shall submit a Contractor Quality Control (CQC) Plan which will address and include all task orders up to $500,000.

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

1.2 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 880	(1995) Criteria for Use in Evaluation of Testing Laboratories and Organization for Examination and Inspection of Steel, Stainless Steel, and Related Alloys
ASTM C 1077	(2000) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 3666	(2000) Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D 3740	(2001) Standard Practice for Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used In Engineering Design and Construction
ASTM E 329	(2000; Rev B) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM E 543	(1999) Agencies Performing Nondestructive Testing

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

CQC Plan

Special Qualifications

SD-06 Test Reports

Test Reports

SD-07 Certificates

CQC Daily Report
Deficiency Report
DO Inspection Records

1.4 CONTRACTOR QUALITY CONTROL (CQC) PLAN

1.4.1 General

The Contractor shall furnish not later than 10 days after contract notice to proceed, the proposed CQC Plan implementing requirements of contract clause "Inspection of Construction". Construction will be permitted to begin only after acceptance of the CQC Plan.

1.4.2 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority, responsibilities of personnel, and coordination, lines of responsibility for CQC personnel not under direct control of Contractor. The staff shall include a CQC Manager (CQCM) who shall be on-site at all times during construction. The CQCM may perform other duties not related to quality control, but other duties shall not impair their performance in managing the CQC plan.

   An alternate CQCM to act in the CQCM's absence shall be provided, and shall have equal responsibility and authority as the CQCM.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. Letter of Authority to the CQCM signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQCM, including authority to stop work which is not in compliance with the contract.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.

e. Procedures for Control, verification, and acceptance testing for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test.

f. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

g. Procedures for Reporting.

h. Procedures for procuring, tracking, receiving, acceptance of materials and work delivered to the project, including identification of non-conforming materials, tracking and disposition.

i. Identification of Independent Certifying and Testing Laboratories.

j. Appendix including all forms and report formats to be used in implementing the CQC Plan.

k. Procedures for notification of and coordination with Government Quality Assurance personnel.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 QC - QA Coordination Meeting

After the Preconstruction Conference, before start of any construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Government to discuss the Contractor's proposed CQC Plan. During the meeting, a mutual understanding of the plan details shall be developed, including administration of the plan for both onsite and offsite work, and the interrelationship of Contractor's Quality Control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the contractor and the Contracting Officer or Authorized Representative. Items and understandings agreed to at this meeting shall be integrated into the CQC plan.

There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC plan or procedures which may require corrective action by the Contractor.

3.2 ACCEPTANCE OF CQC PLAN

Acceptance is conditional and shall be predicated on satisfactory performance during the construction. Implementation of the CQC Plan is subject to continuous evaluation, review, and verification by the Contracting Officer. The Government reserves the right to require the Contractor to make changes in the CQC Plan including removal of personnel, as necessary, to obtain the quality specified.

3.3 CHANGES IN CQC PLAN

The Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.4 TESTS

3.4.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.5 COMPLETION INSPECTION

3.5.1 Punch-Out Inspection

Near the completion of all work or any increment thereof established by a completion time stated in the Special Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the CQCM System Manager shall conduct an inspection of the work and develop a punch list of items which do not conform to the approved drawings and specifications. Such a list of deficiencies shall be included in the CQC documentation, as required by paragraph DOCUMENTATION below, and shall include the estimated date by which the deficiencies will be corrected. The CQCM System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

3.5.2 Pre-Final Inspection

The Government will attend this inspection to verify that the facility work is complete and ready to be accepted. A Government Pre-Final Punch List may be developed as a result of this inspection. The CQCM shall ensure that all items on this list have been corrected before notifying the Government so that a Final inspection with the customer can be scheduled.

Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

3.5.2.1 Training, O&M Manuals, and ORR's

Where required, training, O&M's, and ORR's shall be provided as indicated in Section 01770, "Task Order Closeout".

3.7.4 Final Acceptance Inspection

The Final Acceptance Inspection shall be conducted in accordance with Section 01770, paragraph entitled "Final Acceptance".

3.6 DOCUMENTATION

3.6.1 CQC Daily Report

The Contractor shall maintain current records providing factual evidence that required quality control activities ,and/or tests, and inspections have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

a. Contractor/subcontractor and their area of responsibility.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom.

d. Test and/or CQC activities performed with results and references to specifications/drawings requirements.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals reviewed, with contract reference, by whom, and action taken.

g. Off-site surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in plans and/or specifications.

j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; site and weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report

form shall be furnished to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.6.2 Identification and Data Retrieval

Contractor shall have an identification and data retrieval system.

Records, drawings, submittals, and equipment shall 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.

3.6.3 Receiving Inspection System

Contractor shall maintain a site receiving inspection system that ensures procured materials and equipment are inspected and tested.

Receiving inspection records shall accompany each procurement delivery to the construction site. Records of site receiving inspections shall be maintained by the Contractor.

Records shall show defects, discrepancies, dispositions, and waivers, including evidence of Government source inspection.

3.6.4 Master Deficiency List

The CQCM shall maintain a list of nonconformances or deficiencies discovered by the Contractor, subcontractors, suppliers or Government quality representatives to prevent their use and to correct deficient operations. The list shall identify what items need to be corrected, the date the item was originally discovered, the date the item will be corrected by, and the date the item was corrected. Attach a copy of the updated Master Deficiency List to the last daily Contractor Quality Control Report of each month.

3.6.5 Drawings and Change Control

Drawing-control system shall be maintained to provide revised drawings and ensure continuous removal of obsolete drawings from work areas. Changes involving interface with other work areas, or affecting materials controlled by others shall be controlled by the Contractor. This system shall be integrated with the document requirements of the contract.

Drawing changes shall be clearly annotated. Implemented changes shall be clearly identified and associated drawings shall be revised accordingly. Drawings that have been approved, or approved as noted, by the Contracting Officer shall be used for fabrication and inspection.

3.7 SAMPLE FORMS

FMD-325 CQC Daily report
FMD-328 Receiving Inspection checklist
FMD-329 Master Deficiency List

Forms will be provided by the Contracting Officer.

3.8 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer or Authorized Representative shall notify the Contractor of any detected noncompliance with the foregoing requirements as they are discovered. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer 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 or for excess costs or damages by the Contractor.

3.9 GOVERNMENT QA INSPECTIONS

Work performed under this contract will be subject to inspection by the Government or its representatives. Changes to the specifications or drawings will not be allowed without written authorization of the Contracting Officer.

When the Contracting Officer determines that inspected work needs to be corrected, the Government will be allowed 24 hours to complete reinspection of the corrected work.

-- End of Section --

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-- End of Section Table of Contents --

SECTION 01451

CONTRACTOR QUALITY CONTROL II
04/99

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to all task orders (TO) whose value exceeds $500,000. The Contractor shall submit a separate Quality Control Plan for each task order over $500,000.

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

1.2 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 880	(1995) Criteria for Use in Evaluation of Testing Laboratories and Organization for Examination and Inspection of Steel, Stainless Steel, and Related Alloys
ASTM C 1077	(2000) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 3666	(2000) Minimum Requirements for Agencies Testing and Inspecting Road and Paving Materials
ASTM D 3740	(2001) Standard Practice for Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used In Engineering Design and Construction
ASTM E 329	(2000; Rev B) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM E 543	(1999) Agencies Performing Nondestructive Testing

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

CQC Plan

SD-06 Test Reports

Test Reports

SD-07 Certificates

CQC Daily Report
Three-Phase Quality Control Records
Deficiency Report

1.4 CONTRACTOR QUALITY CONTROL (CQC) PLAN

1.4.1 General

The Contractor shall furnish not later than 10 days after receipt of each task order notice to proceed, the proposed CQC Plan implementingrequirements of Contract Clause "Inspection of Construction." Construction will be permitted to begin only after acceptance of the CQC Plan.

1.4.2 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority, responsibilities of personnel, and coordination lines of responsibility for CQC personnel not under direct control of Contractor. The staff shall include a CQC Manager (CQCM) who shall be on-site at all times during construction. The CQCM may perform other duties not related to quality control, but other duties shall not impair their performance in managing the CQC plan.

   An alternate CQCM to act in the CQCM's absence shall be provided, and shall have equal responsibility and authority as the CQCM.

b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.

c. Letter of Authority to the CQCM signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQCM, including authority to stop work which is not in compliance with the contract.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.

e. Procedures for Control, verification, and acceptance testing for each specific test to include the test name, specification paragraph requiring test, feature of work to be tested, test frequency, and person responsible for each test.

f. Procedures for implementing and tracking preparatory, initial, and

follow-up control phases and control, verification, and acceptance tests including documentation.

g. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

h. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.

i. Procedures for Reporting.

j. Procedures for procuring, tracking, receiving, acceptance of materials and work delivered to the project, including identification of non-conforming materials, tracking and disposition.

k. Identification of Independent Certifying and Testing Laboratories.

l. Appendix including all forms and report formats to be used in implementing the CQC Plan.

m. Procedures for notification of and coordination with Government Quality Assurance personnel.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 QC - QA COORDINATION MEETING

After the Preconstruction Conference, before start of any construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Government to discuss the Contractor's proposed CQC Plan. During the meeting, a mutual understanding of the plan details shall be developed, including administration of the plan for both onsite and offsite work, and the interrelationship of Contractor's Quality Control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the contractor and the Contracting Officer or Authorized Representative. Items and understandings agreed to at this meeting shall be integrated into the CQC plan.

There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC plan or procedures which may require corrective action by the Contractor.

3.2 ACCEPTANCE OF CQC PLAN

Acceptance is conditional and shall be predicated on satisfactory performance during the construction. Implementation of the CQC Plan is

subject to continuous evaluation, review, and verification by the Contracting Officer. The Government reserves the right to require the Contractor to make changes in the CQC Plan including removal of personnel, as necessary, to obtain the quality specified.

3.3 CHANGES IN CQC PLAN

The Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.4 THREE PHASE QUALITY CONTROL

CQC is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted for each definable feature of work.

3.4.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

a. A review of each paragraph of applicable specifications.

b. A review of the contract and shop drawings.

c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.

d. Review of provisions that have been made to provide required control inspection and testing.

e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.

f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.

g. A review of the appropriate activity hazard analysis to assure safety requirements are met.

h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.

i. Discussion of the Initial Phase.

j. The Government shall be notified at least 48 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQCM and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQCM and attached to the daily CQC report. The

Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.4.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.

d. Resolve all differences.

e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.

f. The Government shall be notified at least 24 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQCM and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.

g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.4.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

3.4.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if the quality of on-going work is unacceptable, if there are changes in the applicable CQC staff, onsite production supervision or work crew, if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.5 TESTS

3.5.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that

control measures are adequate to provide a product which conforms to contract requirements. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with contract requirements.

b. Verify that facilities and testing equipment are available and comply with testing standards.

c. Check test instrument calibration data against certified standards.

d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.

e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.6 COMPLETION INSPECTION

3.6.1 Punch-Out Inspection

Near the completion of all work or any increment thereof established by a completion time stated in the Special Clause entitled "Commencement, Prosecution, and Completion of Work," or stated elsewhere in the specifications, the CQCM shall conduct an inspection of the work and develop a punch list of items which do not conform to the approved drawings and specifications. Such a list of deficiencies shall be included in the CQC documentation, as required by paragraph DOCUMENTATION below, and shall include the estimated date by which the deficiencies will be corrected. The CQCM or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

3.6.2 Pre-Final Inspection

The Government will attend this inspection to verify that the work is complete and ready to be accepted. A Government Pre-Final Punch List may be developed as a result of this inspection. The CQCM shall ensure that all items on this list have been corrected before notifying the Government that a Final inspection with the customer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

3.6.2.1 Training, O&M Manuals, and ORR's

Where required, training, O&M's, and ORR's shall be provided as indicated in Section 01770, "Task Order Closeout".

3.6.3 Final Acceptance Inspection

The Final Inspection shall be conducted in accordance with Section 01770, "Task Order Closeout", paragraph entitled "Final Acceptance".

3.7 DOCUMENTATION

3.7.1 CQC Daily Report

The Contractor shall maintain current records providing factual evidence that required quality control activities ,and/or tests, and inspections have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

a. Contractor/subcontractor and their area of responsibility.

b. Operating plant/equipment with hours worked, idle, or down for repair.

c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.

d. Tests and/or CQC activities performed with results and references to specifications/drawings requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.

e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.

f. Submittals reviewed, with contract reference, by whom, and action taken.

g. Off-site surveillance activities, including actions taken.

h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.

i. Instructions given/received and conflicts in plans and/or specifications.

j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; site and weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 24 hours after the

date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.7.2 Identification and Data Retrieval

Contractor shall have an identification and data retrieval system.

Records, drawings, submittals, and equipment shall 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.

3.7.3 Receiving Inspection System

Contractor shall maintain a site receiving inspection system that ensures procured materials and equipment are inspected and tested.

Receiving inspection records shall accompany each procurement delivery to the construction site. Records of site receiving inspections shall be maintained by the Contractor.

Records shall show defects, discrepancies, dispositions, and waivers, including evidence of Government source inspection.

3.7.4 Master Deficiency List

The CQCM shall maintain a list of nonconformances or deficiencies discovered by the Contractor, subcontractors, suppliers or Government quality representatives to prevent their use and to correct deficient operations. The list shall identify what items need to be corrected, the date the item was originally discovered, the date the item will be corrected by, and the date the item was corrected. Attach a copy of the updated Master Deficiency List to the last daily Contractor Quality Control Report of each month.

3.7.5 Drawings and Change Control

Drawing-control system shall be maintained to provide revised drawings and ensure continuous removal of obsolete drawings from work areas. Changes involving interface with other work areas, or affecting materials controlled by others shall be controlled by the Contractor. This system shall be integrated with the document requirements of the contract.

Drawing changes shall be clearly annotated. Implemented changes shall be clearly identified and associated drawings shall be revised accordingly. Drawings that have been approved, or approved as noted, by the Contracting Officer shall be used for fabrication and inspection.

3.8 SAMPLE FORMS

FMD-325 CQC Daily Report
FMD-326 Preparatory Phase Checklist

FMD-327 Initial Phase Checklist
FMD-328 Receiving Inspection Checklist
FMD-329 Master Deficiency List

Forms will be provided by the Contracting Officer.

3.9 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer or Authorized Representative shall notify the Contractor of any detected noncompliance as they are discovered. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer 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 or for excess costs or damages by the Contractor.

3.10 GOVERNMENT QA INSPECTIONS

Work performed under this contract will be subject to inspection by the Government or its representatives. Changes to the specifications or drawings will not be allowed without written authorization of the Contracting Officer.

When the Contracting Officer determines that inspected work needs to be corrected, the Government will be allowed 24 hours to complete reinspection of the corrected work.

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SECTION 01500

TEMPORARY UTILITIES AND CONTROLS
3/98

PART 1 GENERAL

1.1 SUMMARY

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

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Temporary Utilities and Controls Plan indicating the proposed use and location of construction signs, temporary utility connections required, traffic plan (if encumbrance to traffic will occur), and dust control measures if needed.

SD-07 Certificates

Personnel Training Certificates indicating completion of Maryland State Department of Environment's Training Program for sediment and erosion control work.

PART 2 PRODUCTS

2.1 CONSTRUCTION SIGN

Signs required by law and such signs necessary to maintain traffic flow, promote safety (eg. "CAUTION", "DANGER", BLASTING", "HARDHAT AREA", and the like) shall be placed as required. The Contractor shall not place any other signs on the GODDARD SPACE FLIGHT CENTER without the writtten approval of the Contracting Officer.

PART 3 EXECUTION

3.1 TEMPORARY UTILITIES

Contractor shall provide temporary utilities required for construction. Materials may be new or used, shall be adequate for the required usage, shall not create unsafe conditions, and shall not violate applicable codes and standards.

Temporary utilities and connections shall be completely removed prior to the completion of the project, and the existing utilites shall be restored to a condition as was existing prior to the installation of the temporary utility.

3.1.1 Electricity

The Government will make available to the Contractor reasonable amounts of electrical power from the existing GSFC electrical distribution system.

Worksite lighting shall be provided by the Contractor.

Contractor shall make connections at location(s) designated by the Contracting Officer. Connections shall be sized to provide service required. Feeder and branch wiring with area distribution boxes shall be located so that power is available throughout the project site by use of power cords. 120/240 and 480 electrical volt feeder service is available at various locations throughout the center, but may not be convenient to all work sites.

3.1.2 Water

The Government will make available to the Contractor reasonable amounts of water from the existing GSFC water distribution system.

Contractor shall make connections to existing facilities to provide water for construction purposes at location(s) designated by the Contracting Officer.

3.1.3 Telephone Service

Contractor shall provide telephone service. Contractor shall pay costs of service. Installation and removal of telephone service shall be subject to the approval of the Contracting Officer.

3.1.4 Sanitary Facilities

Contractor shall provide temporary sanitary facilities and shall service, clean, and maintain these facilities and enclosures.

3.2 TRAFFIC PROVISIONS

3.2.1 Access to GSFC

Contractor's access to the worksite shall be restricted to the GSFC Gate #4 on Soil Conservation Service (SCS) Road for the West Campus, Gate #16 on SCS Road for the East Campus, and on-site entry gates for the outlying sites.

3.2.2 Maintenance of Traffic

Contractor shall conduct his operations in a manner that will not close any automotive or pedestrian thoroughfare, and shall not interfere in any way with automotive or pedestrian traffic without written permission of the Contracting Officer.

When encumbrance to automotive traffic is necessary, written approval from the Contracting Officer shall be obtained, and the flow of traffic shall be maintained on at least half of the roadway at all times.

Contractor shall provide, erect, and maintain, at his own expense, lights, barriers, signals, passageways, detours, etc., that may be required by the Contracting Officer.

Notwithstanding the above, Contractor shall not incumber peak traffic flows during morning rush hour (7:00 a.m. to 8:30 a.m.) and evening rush hour (4:00 p.m. to 5:30 p.m.) without written approval from the Contracting Officer.

3.3 DUST CONTROL

Contractor shall provide adequate dust control procedures and measures on the worksite. Additionally, all access roads utilized by Contractor shall be dust controlled by water sprinklers, applications of calcium chloride, or similar treatment methods.

3.4 PROTECTION OF EXISTING SYSTEMS

3.4.1 Utilities

Existing utilities and new operational utilities shall be protected from damage. Utilities damaged by Contractor shall be repaired at the Contractor's expense. Damaged utilities, not defined on drawings or identified to the Contractor, shall be reported immediately to the Contracting Officer.

3.4.2 Safety

Contractor shall protect the integrity of any installed safety systems or personnel safety devices.

If it is necessary to temporarily remove or disable personnel safety devices in order to accomplish contract requirements, Contractor shall provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and shall obtain prior approval from the Contracting Officer.

3.5 SEDIMENT AND EROSION CONTROL

The Sediment and Erosion Control Plans indicated on the Drawings have been approved by the Maryland Department of the Environment (MDE).

Contractor shall follow the Sequence of Construction indicated on the Drawings. Any proposed changes to the Sequence of Construction by the Contractor shall be re-submitted by the Contractor to the MDE for approval. Requests for additional costs or time extensions caused by re-submissions by the Contractor will not be approved.

Contractor's personnel responsible for the installation and maintenance of the sediment and erosion control work shall have attended the Maryland State Department of Environment's Training Program. The Contractor shall submit certificates for responsible personnel indicating completion of this erosion and sediment control training program.

Contractor shall be responsible for compliance with permit requirements and maintenance of sediment and erosion control measures. Fines and penalties assessed as a result of noncompliance or failure to maintain sediment and erosion control measures shall be the responsibility of the Contractor.

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SECTION 01600

MATERIAL AND EQUIPMENT
10/98

PART 1 GENERAL

1.1 SUMMARY

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

1.2 SUBMITTALS

SD-04 Samples

GOMAR Tag and Attachments
GOMAR Ceiling Markers

SD-05 Design Data

GOMAR Tagging and Marking Schedule indicating all equipment to be GOMAR tagged, GOMAR marked, and CODE tagged, including indication where all tags are to be installed.

SD-07 Certificates

Manufacturer's Certificates of compliance for each product containing information technology that the product is Year 2000 Compliant. The certificate shall address general integrity, date integrity, explicit century and implicit century date-related criteria.

1.3 SHIPMENT, DELIVERY, PROTECTION, AND STORAGE

Shipments shall be addressed to the Contractor who shall be responsible for their receipt, unloading, handling, and storage at the site.

Deliveries shall be scheduled to arrive at the worksite during normal working hours. The Government will not accept deliveries on behalf of the Contractor or his subcontractors or assume responsibility for security of materials, equipment, or supplies delivered to the site. The Contractor shall take receipt of all deliveries.

Contractor shall protect materials, supplies, equipment, and completed work. If, as determined by the Contracting Officer, materials, supplies, equipment, and completed work are not adequately protected by the Contractor, such property may be protected by the Government and the cost thereof may be charged to the Contractor or deducted from the unpaid retainage under the Contract.

Only material and construction equipment designated for performance of contract work may be stored at the construction site or located in Government-controlled warehouses or shop facilities.

Material to be salvaged or reinstalled by the Contractor shall be protected

during removal and stored to prevent damage. Material designated as salvage or for re-use and damaged by the Contractor shall be replaced at the Contractor's expense.

PART 2 PRODUCTS

Materials and equipment to be provided under this contract shall be standard catalogue products of manufacturers regularly engaged in the manufacture of the products, and shall essentially duplicate material and equipment in satisfactory service for a 1 year minimum.

Material and equipment shall meet the requirements of the contract and shall be suitable for the installation. Where two or more units of the same equipment class are furnished, the equipment shall be from the same manufacturer and shall be interchangeable. Materials and equipment shall be new and free from defects.

Material and equipment shall be installed in accordance with the requirements of the contract drawings and approved recommendations of the manufacturers.

2.1 GOMAR TAGS

GOMAR tags shall be ABS plastic, standard engraving plate stock. Size shall be 1.6 mm thick, 25.4 mm height, minimum 101.6 mm length. Lettering shall be 16 mm height centered, Arial font. A black tag with white core (lettering) shall be used for all equipment except as noted below. A red tag with white core (lettering) shall be used for the following types of GOMAR designated equipment: FCP, FCV, FDC, C, FPD, FPP, FRD, FSD, FZN, ITV, PIV, SCF, SHS, and SMD.

2.1.1 GOMAR Ceiling Markers

GOMAR Ceiling Markers shall be 3/4 inch round, self adhesive, non-peelable, color coded indicators:

Color	GOMAR Equipment Type
Red	Fire Protection
Green	Air Filtration
Blue	Airflow Control
Yellow	HVAC Fluid
Orange	Electical
Brown	Plumbing

2.1.2 CEILING Tags Required By Code

When required by Code, in addition to any other Tags or Markers indicated, equipment shall be provided with a Tag hung or affixed to the ceiling to indicate concealed equipment.

PART 3 EXECUTION

3.1 GOMAR TAG INSTALLATION

In addition to any tags or nameplate data which is attached to the equipment by the manufacturer, equipment identified on the drawings with GOMAR numbers shall be provided with a GOMAR tag. Contractor shall submit a GOMAR Tagging Schedule. Tags shall be fastened to equipment using high quality double-sided adhesive tape. GOMAR tags shall be placed on the

equipment in a conspicuous location such that they are readily visible after the equipment has been installed in the field.

Where it is inappropriate to use double-sided tape to fasten the GOMAR tag, the GOMAR tag shall be installed using metal screws.

3.2 GOMAR CEILING MARKER INSTALLATION

Markers shall be installed where GOMAR tagged equipment is concealed above ceilings. Markers shall be placed at approximately the centroid of the concealed equipment, but shall be placed only as indicated:

Lay-In	Tee bar nearest centroid
Gypsum	Access Door Frame nearest centroid

3.3 CEILING TAGS REQUIRED BY CODE

Tags shall be installed in accordance with the applicable Code.

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SECTION 01730

DEMOLITION AND EXISTING CONDITIONS TO REMAIN
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1926	(2001) Safety and Health Regulations for Construction

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Record of Existing Conditions shall be made in the presence of the Contracting Officer, documenting the condition of existing structures and improvements prior to beginning the work, both within and without areas adjacent to the work. Such record shall contain horizontal locations and vertical elevations, location and extent of cracks and other damage, and description of conditions that exist prior to the start of work. Copies of the record shall be submitted and the stated conditions verified by the Contracting Officer before starting work.

SD-05 Design Data

Itemized list of Salvaged Items

SD-07 Certificates

Utility Outage Requests
Excavation Permit Requests

SD-08 Manufacturer's Instructions

Contractor shall prepare and submit a detailed Demolition Plan of the work procedures and safety precautions to be used in the identification, demolition, handling, removal, transportation, and reclamation or disposal of removed materials.

PART 2 PRODUCTS - Not Applicable

PART 3 EXECUTION

3.1 DISCONNECTING EXISTING UTILITIES

Prior to the start of work, utilities serving each area of alteration or removal will be shut off by the Government and shall be disconnected and sealed by the Contractor.

The Contractor shall request utility outages as specified in Section 01010, "Summary of Work".

3.2 PRECAUTION AGAINST MOVEMENT

Contractor shall provide shoring and bracing or other supports to prevent movement, settlement, or collapse of facilities adjacent to areas of alteration and removal that are to remain.

3.3 EXISTING CONDITIONS TO REMAIN

Existing conditions shall not be disturbed beyond the extents indicated. Protect existing conditions not to be disturbed from damage. Repair to new condition any existing conditions that are disturbed beyond extents indicated.

3.4 SALVAGED ITEMS

Items to be salvaged shall be indicated on the drawings.

Contractor shall submit an itemized list of all salvaged items, including condition. The Government and the Contractor shall inspect and review all salvaged items listed.

Salvaged materials and equipment shall be removed in a manner that will cause the least possible damage. Contractor shall protect removed items that are to be reused in the work, or turn over items that are to be retained by the Government.

Salvaged items damaged, broken, or otherwise made unserviceable during removal shall be repaired or replaced as necessary to restore them to usable condition.

Salvaged items shall be itemized, boxed, bundled, or placed in containers, indicating the type, size, and quantity. The Contractor is responsible for storage and protection of the items.

3.5 DEMOLITION AND REMOVAL WORK

3.5.1 General

Demolition shall be in accordance with 29 CFR 1926, Sub-Part T, "Demolition".

Use of explosives shall not be permitted.

3.5.1.1 Concurrent Operations

Excavation, filling, and other earth-moving operations earthwork, new

utility installation, or other new work that is sequential to demolition work shall not be started in areas occupied by structures to be demolished until all demolition in the area has been completed and debris has been removed.

3.5.1.2 Above-Grade Demolition

Work shall be demolished, or may be removed in integral pieces, at the Contractor's option, subject to approval of the Contracting Officer.

Demolition shall proceed in a systematic manner from the top of the structure to the ground. Demolition work above each tier or floor shall be completed before the supporting members on lower levels are disturbed. Concrete and masonry shall be demolished in small sections. Structural framing members shall be removed and lowered by approved methods.
80 feet

3.5.1.3 Below-Grade Demolition

The contractor shall request Excavation Permits as specified in 01010, "Summary of Work.

Foundation walls shall be demolished to a depth of not less than 12 inches below the existing ground surface. All other work except remaining portions of wall, footings, and basement concrete slabs on ground shall be demolished and removed.

When required by the drawings, all existing below grade work, including walls, footings, and basement concrete slabs shall be completely removed.

3.5.1.4 Filling Basements and Voids

Basements and voids resulting from the demolition of structures shall be completely filled as specified in Section 02300, "Earthwork".

3.5.2 Building Components

All items not indicated by the drawings to be salvaged shall be removed and disposed. Extra care and precautions to be followed are indicated below.

3.5.2.1 Architectural and Structural Components

Concrete:

Square, straight edges shall be provided where existing concrete adjoins new work and other locations. Existing steel reinforcement shall be protected where indicated; otherwise, it shall be cut off flush with face of concrete.

Masonry:

Masonry units for reuse shall be removed, cleaned, and stacked off the ground on wood pallets. Salvaged masonry units not reused in the work shall become the property of the Contractor. Damaged units unsuitable for reuse shall be considered as debris and shall be disposed.

Structural steel:

Structural steel components shall be dismantled at field

connections and in a manner that will prevent bending or damage.

Flame-cutting torches shall not be used.

When approved, flame-cutting torches may be used where other methods of dismantling are not practical.

Carpentry:

Windows, doors and frames, and similar items to be salvaged shall be removed as units, complete with trim and accessories. Hardware shall be left intact and attached to units, except that door closers shall be removed. Open end of door frames shall be braced to prevent damage thereto.

Built-in furniture, modular partitions, lockers, and other prefabricated units shall be removed in sections.

Miscellaneous items:

Chalkboards, tackboards, toilet-room accessories, and similar surface-mounted items to be salvaged shall be removed as whole units, complete with all accessories.

Venetian blinds shall be salvaged complete with all hardware.

3.5.2.2 Mechanical Equipment and Fixtures

Mechanical hardware shall be disconnected at the nearest convenient connection to existing services that are to remain. Equipment shall not be removed until approved.

Each item of equipment and fixtures to be salvaged shall be removed as a unit; listed, indexed, tagged, stored, and protected. Each unit shall be salvaged with its normal operating auxiliary equipment. Additional requirements for items to be salvaged are as described below

Disconnection from utilities:

Mechanical equipment and fixtures shall be disconnected at fittings. Service valves shall be removed and attached to the unit.

Preparation for storage:

Water, dirt, dust, and foreign matter shall be removed from units; tanks, piping and fixtures shall be drained; and interiors, if previously used to store flammable, explosive, or other dangerous liquids, shall be steam cleaned. Openings shall be sealed with caps, plates, or plugs.

Motors attached by flexible connections shall be secured to the unit.

Lubricating systems shall be charged with the proper oil or grease.

Piping:

Piping shall be disconnected at unions, flanges and valves, and

fittings as required to reduce the pipe into straight lengths for practical storage. Salvaged piping shall be stored 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.

Piping that previously contained gas, gasoline, oil, or other dangerous fluids shall be carefully dismantled, with precautions taken to prevent injury to persons and property. Such piping shall be stored outdoors until all fumes and residues are removed.

Prefabricated supports, hangers, plates, valves, and specialty items shall be boxed according to size and type. Sprinkler heads shall be individually wrapped in plastic bags before boxing.

Refrigerants:

Demolition of refrigerant-containing equipment shall be performed in accordance with Section 15003, General Mechanical Provisions", paragraph entitled "Ozone Depleting Substances Used as Refrigerants".

Pneumatic Control Tubing:

When pneumatic control tubing is disconnected from equipment to be removed, all remaining tubing (both main supply and branch signal) shall be immediately capped, to prevent loss of pneumatic air pressure to other controls in the building. Tubing which will be reconnected to new equipment shall remain capped until the new connections are made.

Utility Control System (UCS) and Direct Digital Controls (DDC):

Provide coordination of work under this contract with related work to be performed by the UCS Contractor, in accordance with Section 15900, "UCS Controls".

As indicated on the drawings, some DDC controls, related actuators, wiring and tubing, which are part of the UCS, shall be removed by the UCS Contractor prior to the demolition of mechanical equipment under this contract.

For projects which modify existing mechanical systems, some UCS devices shall remain as indicated on the drawings. These may include: steam or chilled water flow meters; valves, dampers and actuators located in ducts or piping not being modified; controllers or zone transmitters not affected by demolition. Any control devices which remain in place shall be protected from damage by the Contractor during construction.

For projects where a mechanical equipment room is being completely rehabilitated, i.e., substantially gutted and rebuilt, some conduit and wiring related to UCS devices shall be removed under this contract, as indicated on the drawings.

Ducts:

When portions of any supply, return, or exhaust duct system remain in service during demolition and rehabilitation of another portion, temporary caps shall be installed to prevent loss of air from the supply ducts into the construction area, and to prevent intake of air from the construction area into the return or exhaust ducts

Motor and machines:

Motors and machinery items associated with the plumbing, heating, air conditioning, refrigeration, and other mechanical system installations shall be removed and salvaged. Auxiliary units and accessories shall be salvaged and boxed and stored with the main unit.

3.5.2.3 Electrical Equipment and Fixtures

Equipment shall not be removed until approved.

Each item of equipment and fixtures to be salvaged shall be removed as a unit (unless otherwise noted), listed, indexed, tagged, stored, and protected. Each unit shall be salvaged with its normal operating auxiliary equipment. Additional requirements for items to be salvaged are as described below.

Motors, motor controllers, and operating and control equipment shall be salvaged and attached to the driven equipment.

Primary, secondary, control, communication, and signal circuits shall be disconnected at the point of attachment to their distribution system.

Fixtures:

Electrical fixtures salvaged shall have unprotected glassware removed from the fixture and salvaged separately.

Incandescent lamps, mercury-vapor lamps, and fluorescent lamps to be salvaged shall be boxed and tagged for identification, and protected from breakage.

Electrical Equipment:

Switchgear, transformers, meters, instruments, circuit breakers, panelboards, disconnect switches, and similar items shall be removed and salvaged as whole units.

Wiring ducts or troughs:

Wiring ducts or troughs to be salvaged shall be removed and salvaged in unit lengths. Plug-in ducts and wiring troughs shall be disassembled into unit lengths. Plug-in or disconnecting devices shall be removed from the busway and stored separately.

Elevators and Hoists:

Elevators, hoists, and similar conveying equipment to be salvaged shall be removed as whole units, to the most practical extent. Items shall be removed and prepared for salvage without damage to any of the various parts.

Rails for structural steel shall be salvaged and stored with the equipment as an integral part of the unit.

3.6 DISPOSAL OF REMOVED MATERIALS

Debris, rubbish, scrap, and other nonsalvageded materials resulting from demolition operations shall be disposed of in accordance with all applicable federal, state and local regulations. Removed materials shall not be stored on the project site.

Burning of materials removed from demolished structures will not be permitted on Government property.

Waste materials removed from demolished structures shall be transported from Government property and legally disposed of.

The removal of demolition waste from GSFC shall comply with the requirements of SECTION 01010 paragraph 3.7.

-- End of Section --

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SECTION 01750

EQUIPMENT ALIGNMENT AND BALANCING FOR RCM

06/97

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SECTION 01750

EQUIPMENT ALIGNMENT AND BALANCING FOR RCM
06/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN PETROLEUM INSTITUTE (API)

API 670	(1993) Vibration, Axial-Position, and Bearing-Temperature Monitoring Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 109/C 109M	(1999) Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C 531	(2000) Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, and Monolithic Surfacing
ASTM C 579	(1996) Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings and Polymer Concretes
ASTM C 1107	(1999) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)
ASTM D 543	(1995) Resistance of Plastics to Chemical Reagents

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5	(2000) American National Standard for Centrifugal Pumps for Nomenclature, Definitions, Application and Operation

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 254	(1990) Belt drives -- Pulleys -- Quality, finish and balance
ISO 1940-1	(1986) Mechanical vibration - Balance quality requirements of rigid rotors - Part 1: Determination of permissible residual unbalance
ISO 1940-2	Mechanical vibration -- Balance quality requirements of rigid rotors -- Part 2: Balance errors

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (1998; Rev. 1) Motors and Generators

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification.

SD-02 Shop Drawings

Cutaway, sectional, or exploded views, drawn to scale, and showing the following:

Component arrangement of rotating equipment, including bearing support structural arrangement, and dimensions to centerline of all rotating shafts.

Part location keyed to Design Data.

SD-03 Product Data

Submit Manufacturer's Catalog Data on Grout

SD-05 Design Data

For all equipment provide the following Design Data:

Rotating speed. For equipment to be controlled by variable speed drives, indicate minimum and maximum speed. For equipment to be controlled by multiple speed drives, indicate speed at each step.

For couplings provide:

Exact type and model of couplings.

For gear drives provide:

AGMA gear class, number of teeth, and type (i.e. helical, herringbone, spur, etc.

For belt drives provide:

Belt type.
Belt length.
Diameter of drive and driven sheaves at pitch line.
Manufacturer's recommended belt tension.

For bearings provide:

Commercial Bearing Number for bearings on all equipment.

For centrifugal and axial fans and blowers provide:

Type of fan or blower.
Number of blades on fan wheel.

Number of straightening vanes (if applicable).
Number of vortex damper vanes (if applicable).

For centrifugal pumps provide:

Type of impeller.
Number of impellers or stages.
Number of vanes on each impeller.
Number of vanes in diffuser (if applicable).
Number of volutes (if applicable).

SD-06 Test Reports

Alignment Reports for Coupled or Gear-Driven Equipment shall include the following information for each piece of equipment aligned: alignment method and equipment used, residual parallel and angular misalignment, allowance made for thermal growth, shim thickness and placement, residual soft foot, and correction for bar sag if dial indicator method is used.

Alignment Reports for Belt-Driven Equipment shall include the following information for each piece of equipment aligned: final measurements of sheave misalignment, and final (fixed pitch) sheave sizes and model numbers.

Rotor Balance Reports shall include, for each piece of equipment balanced: balance instrumentation make and model, balance method (single plane or two plane) and correction plane location(s), type of rotor (overhung or between centers), operating speed of rotor, Balance Quality Grade required, calculated permissible residual unbalance, measured residual unbalance in each correction plane.

SD-07 Certificates

Statements of Qualifications demonstrating alignment experience in compliance with the paragraph entitled "Qualifications for Alignment Work".

1.3 SCOPE OF WORK

This section specifies requirements for installation, alignment and rotor balancing of rotating equipment to facilitate GSFC's RCM (Reliability Centered Maintenance) program.

No equipment shall be put into service or run until alignment and balancing is completed. The Government shall be notified not less than two working days in advance of all scheduled alignment and balance work, to have a representative witness the work and verify it is performed correctly and the mechanic demonstrates expertise in the task.

This Section applies to all rotating equipment specified in any division of this specification, except as modified by any "special equipment" requirements.

Some "special equipment" requires specific balance and alignment procedures, or tighter acceptable tolerances. Any "special equipment", and the applicable requirements, will be indicated on the drawings, and those requirements shall supercede those specified in this Section. "Special equipment" may be mission critical, high value (replacement cost over

$20k), or serving a noise-sensitive or vibration-sensitive facility. It also typically includes: equipment with a motor rated over 100hp; any equipment operating over 480 V; and any equipment rotating over 3600 rpm.

1.4 QUALIFICATIONS FOR ALIGNMENT WORK

Alignment shall be performed by workmen experienced in the operations to be performed. Submit Statements of Qualifications demonstrating each person's experience performing precision alignments of rotating equipment using a laser/detector system, including at least 15 jobs including equipment comparable to the equipment included in this contract.

1.5 OPERATION OF EQUIPMENT PRIOR TO ACCEPTANCE

Where the contractor intends to operate any equipment for his benefit prior to acceptance (for instance to provide building heating during construction), all the requirements of this section shall be completed prior to such operation. Belt driven equipment shall be equipped with fixed pitch sheaves for such use.

1.6 GOVERNMENT INSTALLED VIBRATION MONITORING

The Government may install vibration monitoring discs and labels on any rotating equipment provided under the contract, prior to acceptance. When the equipment is put into operation, the Government may collect vibration data from these monitoring locations. This data will be used by the Government to establish baseline data for use in its Reliability Centered Maintenance program; unless otherwise noted it is not a part of the acceptance criteria for the equipment furnished. However, if the data indicate any substantial defect the Government may provide the data to the contractor for review and action by the manufacturer as appropriate.

PART 2 PRODUCTS

2.1 EQUIPMENT MOUNTING ACCESSORIES

2.1.1 Alignment Shims

Shims used between equipment baseplate and machine feet, for final alignment of equipment, shall be commercially pre-cut, stainless steel precision shims. Provide shims no smaller than the machine foot supported. Shims shall be free of burrs.

2.1.2 Alignment accessories

Provide permanent equipment to allow controlled vertical and horizontal alignment, such as jackscrews, for all motors rated over 100 hp.

2.1.3 Grouts

Provide high strength non-shrink natural or metallic aggregate grout, suitable for standard equipment installations, unless otherwise indicated.

Provide high strength non-shrink epoxy resin grout, suitable for installations requiring grout resistant to chemicals, or to elevated temperatures up to 220 degrees F, where indicated in the task order.

2.1.3.1 High Strength Non-Shrink Natural or Metallic Aggregate Grout

Grout shall be a high strength non-shrink natural or metallic aggregate grout recommended for precision grouting of equipment and machinery baseplates. Grout shall conform to the performance requirements of ASTM C 1107 for volume control, Grade C. Minimum compressive strength shall be:

ASTM C 109/C 109M modified	1 day	3,000 psi
ASTM C 109/C 109M modified	28 day	8,000 psi

2.1.3.2 High Strength Non-Shrink Epoxy Resin Grout

Grout shall be a high strength non-shrink three-component epoxy resin grout recommended for precision grouting of equipment and machinery baseplates. Grout shall conform to the performance requirements of ASTM D 543 for excellent chemical resistance to most chemicals, and shall be functional at operating temperatures up to 220 degrees F 104 degrees C. Minimum compressive strength shall be:

ASTM C 579 Method B	1 day	8,000 psi
ASTM C 579 Method B	28 day	13,000 psi
ASTM C 531	14 day	0.01 %

PART 3 EXECUTION

3.1 INSTALLATION AND ALIGNMENT OF COUPLED OR GEAR-DRIVEN EQUIPMENT

These requirements apply to equipment mounted on a common rigid baseplate with the driver, connected by either a flexible coupling or a gear drive, including but not limited to centrifugal pumps.

3.1.1 Placing and Leveling of Equipment

Installation, leveling and grouting of this equipment shall be generally in accordance with HI 1.1-1.5, manufacturer's instructions, and as specified below.

Place unit on foundation and disconnect coupling halves if shipped connected; do not reconnect until all alignment operations are complete. Remove any paint on the bottom of equipment feet, or on the baseplate at the mounting locations for the feet.

Support baseplate with metal blocks and leveling shims, or leveling wedges, placed close to foundation bolts, and directly under parts of baseplate carrying greatest weight. Spacing between supports shall not exceed 24 inches . For pumps, verify that piping is level, aligned and properly supported to prevent stress on pump flanges when connected. Adjust shims or wedges under baseplate to level baseplate and shafts of the pump and driver. Equipment shall be level within 0.01 inch per foot .

Check horizontal/vertical position of pump suction and discharge flanges with a level; adjust shims or wedges under baseplate, or baseplate position as necessary to align pipe and pump flanges without strain.

Equipment shall have sufficient range of motion (minimum shim pack size) to accommodate lowering the motor shaft a minimum of 0.125 inch below the driven equipment shaft.

3.1.2 Grouting

Once leveling and pump positioning is correct, hand tighten foundation bolts snug tight.

Grout baseplate to foundation. New concrete foundation shall be a minimum of 28 days old prior to installation of grout, or as recommended by manufacturer. Surface preparation, mixing and placing of grout shall follow the manufacturers installation procedures. Baseplate shall be completely filled with grout, and baseplate shims or wedges shall be grouted in place.

Fully tighten foundation bolts only after grout is hardened (minimum 48 hours after pouring or as recommended by the manufacturer).

3.1.3 Alignment

All alignment work shall be witnessed by a Government Inspector. Notify the Government a minimum of two working days prior to performing alignment on any piece of equipment.

All alignment shall be performed using a commercially available laser alignment system.

The Government Representative shall sign and be given a copy of all field calculations, measurements or data sheets.

3.1.4 Final Soft Foot Tolerances

Measure softfoot and adjust shims as necessary to achieve a reading of residual soft foot no greater than 2 mils(except that if the equipment manufacturer's recommendations or installation instructions call for a tighter tolerance, that shall apply instead).

3.1.5 Final Alignment Tolerances

Provide final alignment of all equipment within the following tolerances (except that if the equipment manufacturer's recommendations or installation instructions call for a tighter tolerance, that shall apply instead of those below). Tolerances indicated are for machinery in operation at normal operating temperatures. Provide the necessary allowances during alignment to accommodate thermal growth from ambient to operating temperature.

Alignment Reports for Coupled or Gear-Driven Equipment shall be submitted to document the alignment performed on all such equipment.

Unless otherwise noted, the following requirements apply:

Equipment with motors rated 7.5 hp and over, but less than 20 hp, shall be in accordance with the tolerance in column B

Equipment with motors rated 20 hp and over, up to 100 hp, shall be in accordance with the tolerance in column A.

Final alignment of equipment with motors rated below 7.5 hp is not required.

MAXIMUM SPEED	PARALLEL OFFSET SHORT COUPLING	ANGULARITY GAP SIZE (mils	PARALLEL OFFSET COUPLING W/SPACER

(RPM)	(mils)		at 10 inch diam)		(mils per inch of spacer length	
CLASS:	A	B	A	B	A	B
600	5.0	9.0	10.0	15.0	1.8	3.0
900	3.0	6.0	7.0	10.0	1.2	3.0
1200	2.5	6.0	5.0	10.0	0.9	1.5
1800	2.0	4.0	3.0	8.0	0.6	1.0
3600	1.0	3.0	2.0	5.0	0.3	0.5
7200	0.5	1.0	1.0	2.0	0.15	0.25

3.2 ALIGNMENT OF BELT DRIVEN EQUIPMENT

The following requirements apply to all belt driven equipment, regardless of motor size.

Variable pitch sheaves shall be used only during air and water balancing procedures. After final air or water balancing of belt driven equipment systems, remove variable pitch sheaves and replace with fixed pitch sheaves of the size corresponding to the final adjusted size of the variable pitch sheaves.

Provide alignment of all belt-driven equipment using a laser pulley alignment system, in contact with two points on the rim of the driver and driven sheaves. Sheave misalignment shall not exceed 30 mils. Check belt tension with a tension gauge and adjust to tension recommended by manufacturer. Alignment Reports for Belt-Driven Equipment shall be submitted to document the alignment performed on all such equipment.

3.3 ROTOR BALANCING OF FANS

All rotor balancing work shall be witnessed by a Government Inspector. Notify the Government a minimum of two working days prior to performing rotor balancing on any piece of equipment.

Perform field balance of the rotating assemblies of all fans driven by motors rated 7.5 hp up to 100hp. Final balance quality grade shall be G 2.5 or better in accordance with ISO 1940-1. Rotor Balance Reports shall be submitted to document this work, for all equipment balanced.

-- End of Section --

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SECTION 01770

TASK ORDER CLOSEOUT

10/98

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SECTION 01770

TASK ORDER CLOSEOUT
10/98

PART 1 GENERAL

1.1 SUMMARY

The requirements of this Section apply to, and are a component part of, each section of the specifications. This section establishes a series of requirements that ensure an efficient and reliable final acceptance of task orders.

1.2 REFERENCES (Not Applicable)

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-04 Samples

Submit two samples of Warranty Tag

SD-10 Operation and Maintenance Data

Submit four copies and one electronic copy of the Operation and maintenance manuals.

Submit four copies and one electronic copy of the manuals prior to the proposed date for the operational readiness review.

Upon approval by the Government, incorportate any comments provided.

SD-11 Closeout Submittals

Submit schedule for task order closeout not less than 45 days prior to the anticipated date for the first equipment start-up and field test. Schedule shall include a list of equipment items and systems, field testing sequence and procedures, pre-final inspection procedures, Operation and Maintenance Manual submission, training agenda and materials, and operational readiness review procedures. When required by the task order, indicate designated portions of the work which will require a partial task order closeout. Include necessary forms, descriptions, equipment required, and Government and Contractor personnel to be involved.

Submit one complete hardcopy red-line set and one complete electronic red-line set of Final As-Built Drawings.

Final payment will be withheld until above submittals are received and approved by the Contracting Officer.

1.4 CLOSEOUT PROCEDURES

Contractor shall complete the following, in the sequence indicated, prior to requesting final inspection for final acceptance of the project:

Submit proposed schedule for task order closeout.

Conduct field testing of equipment and systems, and submit test reports.

Perform pre-final inspection of equipment and systems.

Submit Operation and maintenance manuals.

Conduct classroom training if required by specifications.

Conduct operational readiness review (ORR) of equipment and systems.

Submit project record documents.

Complete final cleaning requirements.

When the above items have been completed, request inspection for final acceptance.

1.5 PARTIAL TASK ORDER CLOSEOUT

When so indicated in the task orders, certain portions of the work shall be completed and accepted by the Government prior to the completion of the entire task order.

When the portion(s) of work designated for early completion are completed, the Government will inspect the work and issue final acceptance for it. Warranties required by the contract documents will commence on the date of final acceptance, and the Government will be responsible for maintenance of the designated portions of the work.

1.6 FIELD TESTING

Conduct field testing and submit test reports as required in the technical sections to demonstrate that installed products, equipment and systems perform as specified. Perform field testing in the presence of Government inspectors.

1.7 PRE-FINAL INSPECTION

When field testing has been completed and accepted by the Government, the Contractor shall perform a pre-final inspection of all equipment and systems to ensure that equipment and related systems and controls operate properly in accordance with their stated sequence of operation. The pre-final inspection shall be conducted by the Contractor and shall include subcontractors and other qualified parties as necessary who can properly operate the equipment and systems. Conduct pre-final inspection in the presence of Government personnel, including the Construction Manager and Inspectors.

1.8 OPERATION AND MAINTENANCE MANUALS

1.8.1 Manual Contents

Include copies of Final "approved" or "approved as noted" (AS-BUILT SHOP DRAWINGS) submittals (SDs), including test reports, excluding samples, as required in the technical sections. Include spare parts data indicating part number, manufacturer, and stock level required for maintenance and repair. Include wiring and control (Metasys) diagrams, exploded diagrams, flow diagrams, fixture lamping schedules, and other similar types of information. Include warranty information as required by this specification section. Include operation procedures which includes items such as startup, shutdown, emergency procedures, etc. Include maintenance procedures which includes items such as periodic requirements, step by step instructions if needed to perform preventative maintenance. Include only data which is applicable to the equipment installed; cross out non-relevent information as extraneous information will not be accepted. Data contained in manual shall accurately reflect as-built conditions.

All equipment in the manual shall be distinctly labelled with the appropriate GOMAR tag designation, as it is tagged in the field.

1.8.2 Manual Layout

Manuals shall be divided and grouped by building. Provide a complete set of manuals for each individual building in the work.

Within manuals, divide and group data by technical sections. Punch pages with 10 millimeter holes and bind into 3-ring loose-leaf binders. Organize data by separate index and tabbed sheets. Include an index in each manual listing the sections therein contained.

1.9 WARRANTIES

Warranty information shall be included in the Operation and Maintenance Manual.

1.9.1 Warranty of Construction

All work is provided with the standard FAR one-year Warranty of Construction. Provide Contractor's warranty contact name, address and telephone number, to whom the Government should make warranty calls.

1.9.2 Special Warranties

Provide special warranties (warranty periods exceeding the one-year Warranty of Construction) on products and installations as specified in the following Sections:

SECTION	ITEM
07550 Modified Bituminous Membrane Roofing	Roofing System
08710 Finish Hardware	Locks and Latches
16536 Exit Lighting	(LED) Exit Signs
Other items with special	As specified in task

warranties specified elsewhere orders

Additionally, provide any manufacturer's standard warranties for installed products warranted for over one year, whether or not the warranty is specified herein.

Literature shall state the duration of the warranty, and the name, address, and telephone number of the warranty contact.

1.9.3 Warranty Tags

At final Acceptance, the Contractor shall install the warranty tags, properly indicating the information below.

For each piece of equipment with a GOMAR Number, provide a durable, oil and water resistant tag, attached with copper wire (or other acceptable means of attachment) to the equipment. Tag shall indicate the following information:

EQUIPMENT/PRODUCT SPECIAL WARRANTY

GOMAR No. _____Contract & D.O. No._____
Type of Equipment/Product _____
Warranty Period _____ years
Government PM Signature _____ Contract Acceptance Date _____

General Contractor:
Name: _____
Address: _____
_____
Telephone: _____

Installer(Warranty) Contact:
Name:_____
Address:_____
_____
Telephone:_____

NASA personnel will perform only operational maintenance until warranty expires.

1.10 CLASSROOM TRAINING

Conduct training for the operation and maintenance of building systems and components in the classroom to the operating staff as designated by the Contracting Officer for the systems and time periods (in working days) indicated below:

SYSTEM

Fire Detection, Alarms and Protection
Compressed Air
Elevators
Hoists and Cranes
Other systems stipulated for training in the Task Orders

Perform training using manufacturer's factory-trained personnel or qualified representatives. Instruction shall include a review of proper operation and maintenance procedures for building systems and components, record documents, spare parts and materials lists, test reports, and data contained in the Operation and maintenance manuals. Include descriptions of flow diagrams, control diagrams and sequences, electrical diagrams, potential hazards, cleaning, and warranties. Discuss recommended procedures for start-up, on-line maintenance, and system shut down. Provide training to Government personnel, including the Construction

Manager, Inspectors, discipline engineers, operation and maintenance technicians and operators.

1.11 OPERATIONAL READINESS REVIEW (ORR)

Arrange for each installer of the following equipment and systems to meet with Government personnel and provide an operational readiness review (ORR), for the equipment/systems indicated below or as required by individual technical sections:

Fire Detection, Alarms and Protection
Elevators
Switchgear
Other equipment or systems stipulated for ORR in the task Orders

Provide instruction by manufacturer's representative if installers are not experienced in the proper operation and maintenance procedures.

Conduct ORR after each installation of the systems and equipment involved are complete, all testing of systems and equipment involved are complete, and test results are approved by the Contracting Officer. For systems where both ORR and training are required, conduct ORR within five working days after training is completed.

Instruction shall include a review of operation and maintenance procedures, record documents, spare parts list, tools, lubricants, fuels, identification systems, control sequences, potential hazards, cleaning, and warranties. As part of instruction for operating equipment, demonstrate startup, shutdown, emergency operations, noise and vibration adjustment, safety procedures, economy and efficiency adjustments, and effective energy utilization. Clearly demonstrate that the equipment operates as required.

Use checklists as provided herein, and/or other checklists that have been developed as part of the ORR procedures.
Perform ORR in the presence of Government personnel, including Project Manager, Construction Manager, discipline engineer, Inspectors, operation and maintenance personnel, Facility Operation Manager, Building Manager, and building tenant (customer). All material, equipment, instrumentation, and personnel required for the ORR shall be provided by the Contractor.

* Contractor shall coordinate requirements with UCS Contractor.

1.12 PROJECT RECORD DOCUMENTS

1.12.1 Final As-Built Drawings

Final "red-lined" As-Built Drawings shall contain all corrections, additions, deletions and other changes made during the progression of the work. Drawing markups shall be in accordance with requirements specified for As-Built Drawings in Section 01200, "PROJECT MANAGEMENT."

1.13 FINAL CLEANING

Prior to the inspection for Final Acceptance, execute final cleaning.

Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and remove labels that are not permanent labels.

Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains and films. Wet-mop clean concrete floors.

Vacuum and shampoo carpeted areas in accordance with the manufacturer's recommended procedures. In areas where existing carpet has been tread upon, the carpet shall be clean, free of spots, spillage, and stains unless they existed before construction commenced.

For new vinyl composition tile areas, clean and polish the floor in accordance with the manufacturer's recommended procedures. Polishing shall include application of two sealer coat and four finish coats. In areas where existing vinyl composition tile has been tread upon, the floor shall be stripped free of all sealers, finishes, dirt, grime, and other foreign matter unless they existed before the construction commenced. Two sealer and four finish coats shall be applied as indicated for new floor areas. All floor surfaces shall be evenly coated, with no spots, streaks, or stains.

Clean equipment and fixtures to a sanitary condition with appropriate cleaning materials. Clean surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances.

Clean site of rubbish, litter, and other foreign substances. Sweep paved areas, and remove stains, spills, and other foreign deposits. Rake clean landscaped surfaces.

1.14 FINAL ACCEPTANCE

When the requirements of this Section have been completed, Contractor shall request final inspection. The Government will inspect the work, and upon completion of the inspection, will issue a written final acceptance to the Contractor. If the work is incomplete, the Government will advise the Contractor of work that is incomplete and required for final acceptance. If necessary, inspection will be repeated.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION (Not Applicable)

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SECTION 02300

EARTHWORK
010/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117	(1995) Standard Test Method for Materials Finer than 75-microns (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1996) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(2001) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 32	(1993; R 1999) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 33	(2001) Standard Specification for Concrete Aggregates
ASTM C 387	(2000) Standard Specification for Packaged, Dry Combined Materials for Mortar and Concrete
ASTM C 700	(2000) Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 88	(1999; Rev A) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM D 698	(2000; Rev A) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,000 ft-lbf/ft3 (600 kN-m/m3)
ASTM D 1556	(2000) Standard Test Method for Density of Soil in Place by the Sand-Cone Method
ASTM D 1557	(2000) Test Method for Laboratory Compaction of Soil Using Modified Effort (56,000 ft-lbf/cu ft (2700 kN-m/cu m))

ASTM D 2216	(1998) Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures
ASTM D 2487	(2000) Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2940	(1998)Standard Specification for Graded Aggregate Material for Bases and Subbases for Highways or Airports
ASTM D 3282	(1993; R 1997) Standard Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
ASTM D 3740	(2001) Standard Practice for Evaluation of Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used In Engineering Design and Construction
ASTM D 422	(1963; R 1998) Standard Test Method for Particle-Size Analysis of Soils
ASTM D 4318	(2000) Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 448	(1998) Standard Classification for Size of Aggregate for Road and Bridge Construction
ASTM D 4832	(1995) Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 229R	(1999) Controlled Low Strength Materials (CLSM)

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1926	(2001) Safety and Health Regulations for Construction

GODDARD SPACE FLIGHT CENTER (GSFC)

GSCM-1	(1996) GSFC/FMD Geodetic Survey Control Monuments

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the

specification:

SD-01 Preconstruction Submittals

A Record of Existing Conditions shall be recorded, in the presence of the Contracting Officer, and shall include all structures and other facilities adjacent to areas of work. Such records shall contain the location of existing underground utilities, the elevation of the top of foundation walls, the location and extent of cracks and other damage, and a description of surface conditions that exist prior to the start of work. Copies of the record shall be submitted and the conditions prior to starting work shall be verified.

Excavation Plan

SD-03 Product Data

Detectable Marking Tape

SD-06 Test Reports

Proposed Materials
Field Test Reports shall be submitted the day the area is tested

SD-07 Certificates

Nuclear Density Device (if using radioactive density measuring device), which shall include GSFC Form 23-6I, Operator Qualifications, and State of Maryland Reciprocal Agreement w/NRC (if so Licensed) or General License Title (if so Licensed)

Testing agency qualifications
Shoring and Bracing Materials
Excavation Permit Requests
Daily Reports

1.3 SAMPLING AND TESTING

1.3.1 Existing Conditions and Subsurface Data

Subsurface soil boring data and logs, when shown on the drawings, represent the subsurface investigation performed during the design of the project; however, variations may exist in the subsurface between boring locations.

When additional information is provided on the drawings as to the suitability of in-situ materials different from the AREA CLASSIFICATIONS indicated below, those requirements shall supercede the requirements in these specifications.

When additional information is provided on the drawings as to the extents of in-situ material, those requirements shall supercede the requirements in these specifications.

For developing earthwork quantities, Area Classifications under building slabs, structural slabs, and pavements, on-site excavated materials shall not be considered as "satsifactory" until sampled, tested, and approved as "satisfactory". For all other Area Classfications, the Contractor shall assume for developing earthwork quantities, that on-site excavated soil is

"satisfactory" as backfill (however the requirement for classifying all materials in accordance with ASTM D 2487 remains).

1.3.2 Soil Testing and Inspection Service

Soil survey for satisfactory soil materials and samples of soil materials shall be furnished by the Contractor. A certified soil-testing service approved by the Contracting Officer shall be provided by the Contractor. Testing shall include soil survey for satisfactory soil materials; sampling and testing soil materials proposed for use in the work, and field-testing facilities for quality control during construction period.

Testing agencies shall conform to the requirements of ASTM D 3740.

1.3.3 Tests For Proposed Soil Materials

Materials shall be approved by the Contracting Officer prior to start of work.

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Satis-factory soil materials	Sieve analysis	ASTM C 136	One from each source of materials to determine conformance to definition of satisfactory soil materials; additional tests whenever there is any apparent change
	Amount of material passing No. 200 sieve	ASTM C 117	
	Liquid limit, Plastic limit, and plasticity index	ASTM D 4318	
	Mechanical analysis	ASTM D 422	
	Moisture-density (see note below)	ASTM D 698, Method C ASTM D 1557, Method C	
	Classification	ASTM D 2487	

NOTE: ASTM D 698 shall be used for grass, tree, shrub, sidewalk, and utility trench areas. ASTM D 1557 shall be used for slab and pavement areas.

1.3.4 Quality Control Testing During Construction

Soil materials shall be tested during construction as follows:

For Testing quantity purposes, lifts and Number of Tests requirements start with each work day.

Tests on a lift shall be completed before starting installation of the succeeding lift.

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Soil materials specified			All tests previously required for proposed materials if materials to be used in construction differ from originally approved materials. No new material shall be installed without all tests having been performed, submitted, and approved.
Soil material-in-place after compaction	Density of soil-in-place (see note below)	ASTM D 2922	Buildings, slabs, or other loaded surface area: For each lift: one test per 2000 square ft., or minimum of 4 tests, whichever is greater. Utility trenches: For each lift: one test per 100 ft. trench, or minimum of 1 test, whichever is greater. Sidewalk, steps and incidental slab areas: For each lift: one test per 150 ft., or minimum of 4 tests, whichever is greater. Grass, tree, and shrub areas (not including trench backfill): For each lift: one test per 10,000 square ft., or minimum of 4 tests, whichever is greater.
CLSM in-place		ASTM D 4832	Utility trenches: One per 50 foot
Footing Bearing Capacity		Geotechnical Engineer Inspection	One per isolated spread footing, at 25 ft. increments

MATERIAL	REQUIREMENT	TEST METHOD	NUMBER OF TESTS
7.6 meter increments			for strip footings.
PROOF-ROLLING		Geotechnical Engineer Inspection	Fully-loaded Tandem, passes sufficient to cover area

NOTE: Density of soil-in-place is indicated to be ASTM D 2922. Additional ASTM methods may be employed upon submission of procedure and approval by the government.

1.3.5 Evaluation of Test Results

Results of density of soil-in-place tests shall be considered satisfactory if the average of any group of four consecutive tests which are selected is in each instance equal to or greater than the specified density, and if not more than one density test in five has a value more than 2 percentage points below the specified density.

When tests indicate that earthwork has not achieved degree of compaction required, the material shall be scarified, moistened or dried, or it shall be removed and replaced with soil to depth required, and recompacted and retested until required compaction is obtained.

PART 2 PRODUCTS

2.1 EARTHWORK MATERIALS

Materials shall be free of clay clods, rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, and other deleterious matter and shall be as follows:

Note: Where material installed is a fill/backfill condition under a building slab, pavement, or other surface intended to support superimposed loads, the area shall be considered to be spread out at a 45 degree angle from the footprint of the slab, pavement, or other surface.

AREA CLASSIFICATION	EARTHWORK MATERIALS
Under footings/foundations	Undisturbed Earth or Engineered Fill
Directly under building slabs, and other structural slabs	Drainage Fill (to depth shown on the drawings, or minimum 5 inches).
Under Drainage Fill	High Quality Satisfactory Soil Material or Engineered Fill
Directly under pavements	Base Course material (to depth shown on the drawings, or minimum 12 inches).
Directly under Base Course material	Subbase Course material (to depth shown on the drawings, or minimum 12 inches).

AREA CLASSIFICATION	EARTHWORK MATERIALS
Under Subbase Course material	Medium or High Quality Satisfactory Soil Material.
Around a utility trench	Bedding (to depth shown on the drawings, or minimum 4 inchesover and under).
Utility trench (under slabs or pavements)	CLSM - flowable fill, from top of bedding to underside of slab or pavement section, unless otherwise indicated
Utility trench (not under slabs or pavements)	Low, Medium, or High Quality Satisfactory Soil Material, from top of bedding
Against surfaces having applied waterproofing	Sand (to distance indicated on drawings, or minimum of 4 inches).
Sub-surface drainage systems	Porous Fill (to extents indicated on the drawings).
Under grassed, tree, and shrub areas	Low, Medium, or High Quality Satisfactory Soil Material.
Under sidewalks	Low, Medium, or High Quality Satisfactory Soil Material.

2.1.1 Engineered Fill

Material properties, minimum thicknesses, and other performance requirements are specific to a project, and shall be shown on the design drawings as specified by a qualified professional engineer, if applicable.

2.1.2 High Quality Satisfactory Soil Material

Satisfactory soil material shall mean ASTM D 2487 soil classifications GW, GP, GM, SW, and SP.

2.1.3 Medium Quality Satisfactory Soil Material

Medium quality satisfactory soil material shall mean ASTM D 2487 soil classifications GC, SC, SM, ML, and CL.

2.1.3.1 Low Quality Satisfactory Soil Material

Low quality satisfactory soil material shall mean ASTM D 2487 soil classifications MH and CH.

2.1.4 Unsatisfactory Soil Materials

Unsatisfactory soil material shall mean ASTM D 2487 soil classifications OL,OH, and PT, and earthwork materials of any area classification that have a moisture content at the time of compaction beyond the range necessary to achieve the required density.

2.1.5 Base Course Material

Base course material shall be a naturally or artificially graded crushed gravel, crushed stone or crushed sand conforming to ASTM D 2940, Base class.

2.1.6 Subbase Course Material

Subbase course material shall be a naturally or artificially graded crushed gravel, crushed stone, or crushed sand conforming to ASTM D 2940, Subbase class.

2.1.7 Drainage Fill

Drainage fill shall be a washed, narrow graded crushed gravel, crushed stone, or sand conforming to ASTM D 448, size 56.

2.1.8 Pourous Fill

Filtering material shall be a narrowly graded crushed gravel, crushed stone, or crushed sand conforming to ASTM D 488, size 67.

2.1.9 Bedding

Bedding material shall be a naturally or artificially graded crushed gravel, crushed stone, or crushed sand conforming to ASTM D 448, size 89, 9, or 10.

2.1.10 Sand

Sand shall be natural sand.

2.1.11 Controlled Low Strength Material (CLSM)

CLSM - shall comply with ACI 229R and Section 03305, "Cast-In-Place Concrete".

2.2 DETECTABLE MARKING TAPE

Detectable marking tape shall be acid and alkili resistant polyethylene film manufactured for marking and identifying underground utilities, 6 inches wide, 4 mils thick, continuously inscribed with utility name, with a metallic core, encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep, colored as follows:

<u>Background color: Utility</u>
Red: Electric
Yellow: Gas, Oil, or Steam
Orange: Telephone or Other Communication
Blue: Water
Green: Gravity Sewer
Brown: Pressurized Sewer

2.3 SHORING AND BRACING MATERIALS

Materials need not be new, but shall be in a servicable condition.

PART 3 EXECUTION

3.1 PREPARATION

No earthwork shall be performed without a signed and approved Excavation Permit provided by the Government.

Before earthwork is started, the location of all adjacent underground utilities shall be carefully verified by hand methods. Utilities to be left in place shall be protected from damage.

No existing utility indicated for removal shall be removed without a signed and approved Utility Outage provided by the Government.

During the course of the work, the contractor shall maintain as-built drawings, clearly marking all new work, changes, and utilities encountered with accurate location and elevation. All work shall be referenced using GSCM-1.

Clearly delineate the extents of earthwork bounderies by marking as indicated in paragraph below entitled "PROTECTION".

3.2 PROTECTION

Earthwork areas shall be barricaded, taped, and posted with warning signs for the safety of persons. Warning lights shall be provided during hours of darkness.

Adjacent structures, pavements, utilities, etc. shall be protected against damage, including settlement, lateral movement, undermining, washout, or other harmful conditions. Clearly mark existing conditions not to be disturbed.

Existing conditions outside the extent of clearing and grubbing shall be protected from damage by clearing and grubbing operations.

3.3 CLEARING AND GRUBBING

Remove obstructions, trees, shrubs, grass, vegetation, and other organic matter to permit installation of new work.

Strip topsoil to whatever depths encountered to prevent intermingling with underlying soil or other material.

Completely remove stumps roots, obstructions, and debris of cleared areas. Use only hand methods for grubbing within dripline of trees remaining.

Fill depresions caused by clearing and grubbing with earthwork materials suitable for the type of area.

3.4 STOCKPILED MATERIALS

Stockpiled materials shall be placed, graded, and shaped for proper drainage. Differing materials shall be separated to preclude intermixing. Adequate sediment control shall be provided for all stockpiles. Stockpiles shall not be adjacent to excavations nor within tree drip-lines.

3.5 UNAUTHORIZED EXCAVATION

Unauthorized excavation shall consist of removal of materials beyond indicated elevation, depth or extents without specific direction and shall be replaced as specified at no additional cost to the Government.

Unauthorized excavation under foundations shall be filled by lowering the bottom elevation of the foundation to the excavation bottom without altering the approved top elevation. Reduced bearing capacities resulting from improper Contractor techniques (softening due to surface water contamination, overexcavation, etc.) shall be corrected at the Contractor's expense.

Elsewhere unauthorized excavations shall be backfilled and compacted as specified for authorized excavations of the same classification.

3.6 OSHA REQUIREMENTS FOR EXCAVATION

The Contracotr shall comply with the requirements for excavation as outlined in OSHA regulations 29 CFR 1926, Subpart P, Excavation.

Excavations shall be provided with protective systems utilizing either sloping/benching techniques or the use of shoring/bracing techniques. If sloping/benching is used, sides shall not be sloped steeper than 1.5:1 (Horizontal:Vertical)(34 degrees from the horizontal) unless designed in accordance with OSHA requirements.

Sloping/benching shall not be used in areas adjacent to vehicular traffic or other vibrational sources.

Shoring and bracing in excavations shall be maintained regardless of the length of time excavations will be open. Shoring and bracing shall be carried down with the excavation.

Wherever subsequent removal of sheet piling could permit the lateral movement of soil under adjacent structures, steel sheet piling or pressure-creosoted timber sheet piling shall be used and left permanently in place, cut off as required.

3.7 EXCAVATION FOR STRUCTURES

Excavation for structures shall conform to the dimensions and elevations indicated and shall extend a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services and other construction indicated, and for inspection.

In excavating for footings and foundations, care shall be taken not to disturb the bottom of the excavation. Excavation to final grade shall be done just before concrete is placed. Bottoms shall be trimmed to the required lines and grades to leave a solid bed to receive concrete.

Bottom of footing or foundation shall be verified to meet the bearing capacity requirements indidcated on the drawings. No footing or foundation shall be installed prior to approval of test results. Where bearing capacity is less than required, the Contracting Officer shall be notified.

3.8 EXCAVATION FOR UNDERGROUND UTILITIES

Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit, a minimum of 12 inches. Excavate trench wall vertically from trench bottom to 12 inches higher than the top of pipe or conduit, unless otherwise indicated.

Shape trench bottoms to provide uniform bearing and support of pipes or conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes, and for joints, fittings, and bodies of conduit.

Excavation to final grade shall be done just before utility is placed.

Outside building perimeter, if no profile or invert information is provided, excavate trenches to allow 30 inches minimum cover over the top of pipe to final grade.

3.9 WATER REMOVAL

Water shall not be permitted to accumulate in earthwork areas. Dewatering systems shall be provided by the Contractor to convey water away from excavations and earthwork area so that softening of foundation bottoms, footing undercutting, and soil changes detrimental to subgrade stability and foundation will not occur. Dewatering systems and methods of disposal shall be approved by the Contracting Officer.

Dewatering shall be continued until construction subject to water pressure has obtained full specified strength and backfill is completed.

Water removal from earthwork area shall be conveyed to approved collecting or runoff areas. Temporary drainage ditches and other diversions as necessary shall be provided and maintained outside of earthwork area limits. Pumped water must pass through an approved sediment control device such as a geotextile filter bag attached to the end of the pumping hose.

Trench excavations for utilities shall not be used for temporary drainage ditches.

3.10 REMOVAL OF UNSATISFACTORY SOIL MATERIALS

Unsatisfactory soil materials encountered that extend below the required elevations shall be excavated to the depth directed.

3.11 REMOVAL OF EXISTING UNDERGROUND UTILITIES

Existing underground utilities indicated to be removed shall be demolished and completely removed from the excavation.

3.12 CLOSING ENDS OF ABANDONED UNDERGROUND UTILITIES

Open ends of abandoned underground utilities indicated to remain shall be closed to completely seal the abandoned utility by capping, plugging, or bulkheading, as appropriate. Closures shall withstand any hydrostatic or earth pressure that may result after ends of the abandoned utilities have been closed.

3.13 PROOF-ROLLING

Prior to installation of fill or backfill in building slab and pavement

areas, the subgrade shall be proofrolled with a loaded tandem dump truck to identify any soft pockets or areas of excess yeilding. Notify Contracting Officer of any soft areas encountered. Do not proofroll wet or saturated subgrades.

3.14 FILLING AND BACKFILLING

3.14.1 Preparations Prior to Placement

Earthwork shall be placed as promptly as the work permits but not until completion of the following:

Completion and approval of construction below finish grade

Inspection, testing, approval, and recording location of underground utilities

Removal of falsework

Removal of shoring and bracing and filling of voids with satisfactory soil material

Removal of trash and debris

Vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials shall be removed from ground surface prior to the placement of earthwork.

Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stripped, or broken up in such manner that fill material will bond with the existing material.

3.14.2 Placement and Compaction

Earthwork materials shall be placed in lifts not more than 12 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand operated tampers. Before compaction, each lift of material shall be moistened or aerated as necessary to be compacted to the percentage of maximum density for each area classification as specified. Earthwork material shall not be placed on surfaces that are muddy, frozen, icy, or contain frost.

Earthwork materials adjacent to structures shall be brought up evenly around structures and shall be carried up to the indicated elevations.

Compaction adjacent to structures (not including reinforced manholes or valve boxes), within a horizontal distance from the face of the structure equal to the depth of earthwork material (measured from the bottom of footing or bottom of foundation) to final grade, shall be done with power-driven hand tampers.

3.14.3 CLSM Installation

CLSM shall be placed in continuous layers, and should not require any vibration for consolidation. CLSM shall be protected from freezing before hardening.

3.14.4 Detectable Marking Tape

Detectable marking tape shall be installed above all utilities at a depth of approximately 12 inches below final grade. In slab or pavement areas detectable marking take shall be on top of CLSM, not to exceed 24 inches below final grade.

3.15 COMPACTION

3.15.1 Percentage of Maximum Density Requirements

Actual density of each lift of earthwork material-in-place shall be not less than the following percentages of the maximum density of the same soil material determined by the moisture-density test specified.

AREA CLASSIFICATION	PERCENT MAXIMUM DENSITY
Waterproofed areas, sub-surface drainage systems, directly under building slabs-on-grade, bottom of utility trench	100%
Building slabs, pavements, and other structural slabs, Base and Subbase Courses	98%
Utility Trenches	90%
Sidewalk	90%
Grass, Tree, and Shrub Areas	90%

3.15.2 Moisture Control

Where the moisture content of a lift of soil material is too low before compaction, the required amount of water shall be uniformly applied to the surface of the lift of soil material and the lift of soil disked or otherwise mixed until a uniform moisture content is reached.

Moisture content of a lift of soil material that is excessive shall be removed by drying.

3.16 GRADING

Areas subjected to earthwork shall be uniformly graded. Finished surface shall be smooth, within tolerances, compacted, and with uniform levels or slopes between points where elevations are indicated or between such points and existing grades.

Areas outside the building lines for each structure shall be hand-graded to drain away from the structure and to prevent ponding of water after rains.

3.16.1 Subgrade Tolerances

AREA	TOLERANCE
Building Slabs, Concrete/Asphaltic Pavements, or Other Structural Slabs, Sidewalks, Steps, and	+/- 1/2 inch

AREA	TOLERANCE
Incidental Slab Areas	
All Other Areas	+/- 1 inch

3.17 MAINTENANCE

3.17.1 Protection of Graded Areas

Newly graded areas shall be protected from traffic and erosion and shall be maintained free of trash and debris.

3.17.2 Reconditioning Compacted Areas

Where approved compacted areas are disturbed by subsequent construction operations or adverse weather, the area (to depth required) shall be scarified, reshaped, and compacted as specified to the required density prior to further construction.

3.18 DISPOSAL OF EXCESS AND WASTE MATERIALS

Excess materials (satisfactory or unsatisfactory) shall be removed from Government property.

Waste materials, trash, and debris, shall be removed from Government property.

Permits and fees for disposal shall be paid by the Contractor.

-- End of Section --

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SECTION 02515

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SECTION 02515

WATER SYSTEMS
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 88	(1999) Standard Specification for Seamless Copper Water Tube
ASTM C177	(1997) Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot-Plate-Apparatus

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	(1999) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1,219 mm), for Water
AWWA C111	(2000) Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115	(1999) Flanged Ductile-Iron Pipe with Threaded Flanges
AWWA C150	(1996) Thickness Design of Ductile-Iron Pipe
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153	(1994) American National Standard for Ductile Iron Compact Fittings, 3 In. Through 24 In. (76 mm through 610 mm), and 54 In. Through 64 In. (1,400 mm through 1,600 mm) for Water Service

AWWA C502	(1994) Dry-Barrel Fire Hydrants
AWWA C509	(1994; Addendum A-95) Resilient-Seated Gate Valves for Water Supply Service
AWWA C550	(1990) Protective Epoxy Coatings for Valves and Hydrants
AWWA C600	(1999)Installation of Ductile Iron Water Mains and Their Appurtenances
AWWA C651	(1999) Disinfecting Water Mains

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 7005-2	(1988) Metallic Flanges Part 2: Cast Iron Flanges

MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-86	(1997) Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 291	(1995) Recommended Practice for Fire Flow Testing and Marking of Hydrants

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Erection/Installation Drawings for the Complete Water System.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Ductile-Iron Pipe
Pipe Connections
Rubber Gaskets
Copper Tubing
Gate Valves
Vacuum and Relief Valves

Tapped Tees
Valve Boxes
Fire Hydrants
Detectable Marking Tape

SD-06 Test Reports

Hydrostatic Test
Leakage Test
Sterilizing

SD-08 Manufacturer's Instructions

Manufacturer's Instructions including special provisions required to install equipment, components, and systems packages shall be submitted for the following. Special notices shall detail impedances, hazards and safety precautions.

Pipe Connections
Rubber Gaskets
Gate Valves
Vacuum and Relief Valves
Tapped Tees
Valve Boxes
Fire Hydrants

1.3 GENERAL

Work in this section relates to the installation of water systems underground.

Excavation, trenching, and backfilling for utilities shall be in accordance with Section 02300, "Earthwork", and as indicated on the drawings.

PART 2 PRODUCTS

2.1 GENERAL

Water system materials and equipment provided under this section shall conform to the requirements of Underwriters Laboratories (UL) or Factory Mutual (FM) Approval Guide, for fire protection systems.

2.2 PIPING

2.2.1 Ductile-Iron Pipe

Ductile-iron pipe shall be in accordance with AWWA C151 and AWWA C150, and shall be Pressure Class 350 unless otherwise indicated,

Ductile iron piping joints shall be the positive axial locking restrained type meeting AWWA C110 requirements, or the rubber-gasket type meeting the requirements of AWWA C111 for underground piping.

Fittings and couplings shall be ductile iron, in accordance with AWWA C111 or AWWA C153. Flanged ductile iron pipe shall be in accordance with AWWA C115.

Provide cement-mortar lining in accordance with AWWA C104 on interior surfaces of all ductile iron piping materials. Provide a factory applied

one mil thick asphaltic coating
on the exterior surfaces of all ductile iron piping materials, in accordance with the standards indicated above.

Provide polyethylene encasement for field-wrapping of all ductile iron piping materials in accordance with AWWA C105.

Components used in the underground water piping system, where possible, shall be by the same manufacturer or be used with the piping manufacturer's approval.

Bolts, nuts, and washers shall be in accordance with the recommendations of the pipe manufacturer, and shall be in accordance with AWWA C111. All nuts, bolts and rods used in the underground piping system shall be of 316 stainless steel or, if not an option, steel which shall be electro-galvanized.

Connections between cement (or asbestos-cement) pipe and ductile-iron fittings or gate valves shall be made with approved materials recommended by the pipe manufacturer.

Air vent taps shall be 20 mm with standard manufacturers factory pipe tap or field installed pipe tap saddle. Both shall be suitable double extra strong galvanized steel pipe.

2.2.2 Copper Tubing

Copper tubing shall conform to ASTM B 88, Type K, annealed. Joints for underground work shall be compression pattern, flared, for soft copper water tubing, and shall be made with approved fittings. Tubing shall be cut off square and expanded with a proper flaring tool.

2.3 VALVES

2.3.1 Gate Valves

Valves shall be designed for a minimum of 150 psi.Valves shall have bell-and-spigot ends or ends for mechanical joints. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. Operating nut or wheel shall have an arrow cast in the metal indicating the direction of opening. Valves smaller than 3 inches shall be all bronze and shall conform to MSS SP-80, Type I. Valves 3 inches and larger shall be iron-body, brass-mounted, resilient-seated conforming to AWWA C509, with epoxy coating inside and outside, conforming to AWWA C550. All nuts, bolts and rods used in the valves shall be of 316 stainless steel or, if not an option, steel which shall be electro-galvanized.

2.3.2 Valve Corrosion Protection Insulation

All underground gate valves shall be encased with a hydrophobic powder insulation consisting of approximately 100% calcium carbonate particles chemically modified to repel water and moisture. The particles shall be less than 10 micron in size and have a bulk density of approximately 879.6 kg per cubic meter and a load bearing of up to 58,640 kg per square meter. The maximum thermal conductivity measured in accordance with ASTM C177 shall be 1.01 W(m*k).

2.3.3 Post Indicator Valve Assembly (PIV)

Each valve shown on the drawings with the designation "PIV" shall be equipped with indicator post conforming to the requirements of NFPA 24.

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 or locks.

When indicated on the drawings, electrical supervisory switches shall be provided for interconnection to the building Fire Alarm System. Switches and connections shall meet the requirements of Section 13852, "Fire-Alarm Systems."

2.3.4 Vacuum and Relief Valves

Vacuum and relief valves shall be size and type to relieve pressure and prevent the formation of a vacuum. Valves shall automatically remove air from the lines when the lines are being filled and admit air into the lines when water is being withdrawn in excess of the inflow.

2.4 MISCELLANEOUS ITEMS

2.4.1 Tapped Tees

Tees shall be installed as necessary.

2.4.2 Valve Boxes

Valve boxes shall be cast iron, complete with covers. Cast-iron boxes shall be the extension type with screw or slide adjustments and with flared bases. The word "WATER" shall be cast in the cover. Boxes shall be installed over each gate valve. Boxes shall be of such a length as can be adapted, without full extension, to the depth of cover required over the pipe at the valve location.

2.4.3 Fire Hydrants

Fire hydrants shall be in accordance with AWWA C502, for dry barrel-type fire hydrant. Hydrants shall have a 6-inch bell connection, two 2-1/2-inch hose connections, and one 4-1/2-inchpumper connection. Outlets shall have American National fire-hose coupling threads. Working parts shall be bronze. Hydrants shall be connected to the mains with 6-inch diameter pipes. Hydrants shall be painted with one coat of zinc-chromate alkyd

paint primer and two finish coats of approved paint of the color required.

Hydrant barrels shall be painted white. Hydrant tops and caps shall be painted to denote flow capacity of the hydrant in accordance with color coding of NFPA 291.

2.4.4 Detectable Marking Tape

Detectable marking tape shall be acid and alkali resistant polyethylene film manufactured for marking and identifying underground utilities, 6 inches wide, 4 mils thick, continuously inscribed with utility name, with a metallic core, encased in a protective jacket for corrosion protection, detectable by a metal detector when tape is buried up to 30 inches deep. Background color shall be blue.

2.5 CONCRETE

Concrete for thrust blocks shall be a minimum of 3,000 psi.

PART 3 EXECUTION

3.1 GENERAL

Installation of system materials and equipment shall be in accordance with the recommendations and provisions of NFPA 24.

3.2 PIPE HANDLING

Pipe and accessories shall be handled in a manner to ensure delivery to the trench in an undamaged condition. Particular care shall be taken not to injure the pipe coating. When the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor at his expense in an approved manner. No other pipe or material shall be placed inside of a pipe or fitting after the coating has been applied. Pipe shall be carried into position. Use of pinch bars and tongs for aligning or turning the pipe shall be permitted only on the bare ends of the pipe. Interior of pipe and accessories shall be cleaned before being lowered into the trench and shall be kept clean during laying operations by an 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 cost to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool dark place out of the direct rays of the sun.

3.3 CUTTING OF PIPE

Cutting of pipe shall be done without damage to the pipe. Cutting shall be done with an approved mechanical cutter. Wheel cutters shall be used when practical. Cut ends shall be ground smooth, and cut ends of ductile-iron pipe for use with push-on joints shall be beveled as recommended by the manufacturer.

3.4 LOCATION

Where the location of the water pipe is not clearly defined by dimensions, the water pipe shall be laid not closer than 10 feet from a sewer horizontally, except where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, in which case the water pipe shall be laid not closer than 6 feet from the sewer horizontally. Where

waterlines cross under gravity flow sewer lines, the sewer pipe for a distance of at least 10 feet each side of the crossing shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 3 feet, horizontally, of the crossing. Waterlines shall, in all cases, cross above sewage force mains or inverted siphons and shall be not less than 2 feet above the sewer main. Joints in the sewer main closer horizontally than 3 feet, to the crossing shall be encased in concrete. Waterlines shall not be laid in the same trench with gas lines, fuel lines, or electrical wiring.

3.5 DEFLECTION

Maximum allowable deflections from a straight line or grade, as required by vertical curves, horizontal curves, or offsets, shall be 5 degrees for ductile-iron bell-and-spigot pipe and mechanical-joint pipe, or as recommended by the manufacturer.

When the alignment requires deflections in excess of the manufacturer's recommendations, special bends or a sufficient number of shorter lengths of pipe shall be furnished to provide angular deflections within the limit set forth, as approved.

3.6 PLACING AND LAYING

Pipe and accessories shall be carefully lowered into the trench by suitable equipment. Under no circumstances shall materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Poles used as levers for removing skids across trenches shall be of wood and have broad flat faces to prevent damage to the pipe or coating. Except where necessary in making connections with other lines or as authorized, pipe shall be laid with the bells facing upstream. Full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that foreign material will not enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor in an approved manner, at no additional expense to the Government. Ductile-iron piping shall be wrapped with polyethylene encasement in accordance with AWWA C105.

Pipe ends left for future connections shall be valved, plugged, or capped and anchored. Where connections are made between new work and existing mains, the connections shall be made by using special sections and fittings to suit the actual conditions. Where made under pressure, connections shall be installed in accordance with the recommendations of the manufacturer of the pipe being tapped.

Tapping into cement-asbestos or reinforced-concrete cylinder pipe shall be done in accordance with the manufacturer's recommendations. Where the manufacturer recommends that the taps be made by attaching the rubber-gasketed saddle to the outside of the pipe using U-bolts, the saddle shall be grouted in when necessary. Mortar coating shall be chipped away until even with the hole in the saddle plate, and the exposed circumferential wires removed. Cylinder and concrete core shall be drilled out, and the steel saddle and U-bolts shall be protected by concrete encasement.

Detectable marking tape shall be installed above the piping during the trench backfilling and shall be buried approximately 12 inches below final grade.

3.7 RUBBER GASKETS

Rubber gaskets shall be handled, lubricated, and installed in accordance with the pipe manufacturer's recommendations.

3.8 COUPLINGS AND JOINTS

Joints for copper tubing shall be compression pattern, flared, for soft copper water tubing and shall be made of approved fittings. Tubing shall be cut off square and expanded with an acceptable flaring tool. Installation of couplings and mechanical joints shall be in accordance with the manufacturer's recommendations. Connections between different types of pipe and accessories shall be made with transition fittings as recommended by the manufacturer. Connections between copper and iron or steel pipe shall be electrically isolated with dielectric couplings rated for the service.

3.9 FIRE HYDRANTS, VALVES, AND VALVE BOXES

Hydrants and valves shall have the interiors cleaned of all foreign matter before installation.

Each hydrant shall be connected to the main with a 6-inch branch line having at least as much cover as the distribution main, and equipped with a gate valve to isolate the hydrant. Hydrants shall be set plumb with the pumper nozzle facing the roadway, the center of the lowest outlet 18 inches above the finished surrounding grade, and the operating nut not more than 33 inches above the finished grade. Unless otherwise noted, hydrant shall be located between 3 to 4 feet from the curb or edge of pavement. hydrants shall be joined to the pipe with mechanically-restrained joints, clamps, or tie-rods capable of restraining the hydrant against shut-off pressure. At least 7 cubic feet of broken stone shall be placed around the base of the hydrant to ensure drainage. Backfill around the hydrant shall be compacted to the finished gradeline immediately after installation to obtain beneficial use of the hydrant as soon as practical.

Valves and valve boxes shall be set plumb. Valve boxes shall be centered on the valves. Valves shall be located outside the area of sidewalks, roads, streets, and parking areas. Earth fill 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 if less than 4 feet. Valves shall be joined to the pipe on each side with mechanically-restrained joints, clamps, or tie-rods capable of restraining the valve against shut-off pressure. Hydrophobic powder insulation shall be installed around all underground gate valves to a level covering the bottom of the valve box bases. Material shall be installed in accordance with the manufacturers recommendation and as detailed.

Stuffing boxes shall be tightened, and the hydrants and valves shall be inspected in open and closed positions to ensure that all parts are in working condition.

3.10 THRUST BLOCKS

Plugs, caps, tees, bends deflecting 22-1/2 degrees or more on mains 8

inches in diameter or larger, and fire hydrants shall be provided with concrete thrust blocks, size as indicated on drawings. Blocks shall be placed between solid ground and the hydrant or fitting to be anchored. Blocks shall be so placed that fitting joints will be accessible for repair.

3.11 FLUSHING AND TESTING

Piping shall be thoroughly flushed and tested in accordance with NFPA 24.

3.11.1 Hydrostatic Tests

Hydrostatic-pressure test shall be made no sooner than 72 hours after installation of thrust blocks.

After the pipe is laid, the joints completed, the fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall be subjected for 2 hours to a hydrostatic-pressure test of 200 psi. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, valves, and hydrants shall be carefully examined during the open-trench test. Joints showing visible leakage shall be replaced or remade as necessary. Leaking rubber gasketed joints shall be remade using new gaskets when necessary. Pipe, mechanical joints, fittings, valves, or hydrants discovered to be cracked or defective as a consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are approved.

3.11.2 Leakage Tests

Leakage tests shall be conducted after the pressure test has been approved. Duration of each leakage test shall be at least 2 hours. During the test, the main shall be subjected to a pressure of 200 psi. Leakage is defined as the additional quantity of water supplied into the newly 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.

Allowable leakage in gallons per hour per joint at 200 psi average test pressure shall not exceed the following:

2 quarts/hour (64 fluid ounces/hour) per 100 gaskets or joints.

Additional 1 fluid ounce/hour per inch of valve diameter for each isolation valve.

Should any test of laid pipe disclose a leakage greater than that shown, the defective joints shall be located and repaired until the leakage is within the specified tolerance, at no additional cost to the Government.

3.11.3 Test Timing

Except where concrete-reaction backing necessitates a 72-hour delay, pipelines jointed with rubber gaskets, mechanical, or bolted joints may be subjected to hydrostatic pressure, inspected, and tested for leakage after partial completion of backfill.

3.11.4 Retesting

Before permanent paving is placed over the pipeline, a measured leakage test of the entire pipeline shall be required. Leakage loss shall be within approved tolerances.

3.11.5 Sterilizing

Water piping, including valves, fittings, and other devices, shall be sterilized and tested according to AWWA C651. After successful sterilization, the piping shall be flushed before placing into service. Water for sterilization will be furnished by the Government, but disposal shall be the responsibility of the Contractor.

3.12 OPERATIONAL READINESS REVEW

Provide an Operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", ORR shall include a walk-through of the completed work, with the red-lined as-built contract drawings, pointing out locations of all valves, air vents, tees, and other connections to existing piping.

-- End of Section --

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SECTION 02535

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-- End of Section Table of Contents --

SECTION 02535

PACKAGED LIFT STATIONS
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 105/A 105M	(1998) Standard Specification for Forgings, Carbon Steel, for Piping Components
ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 36/A 36M	(2000; Rev A) Standard Specification for Carbon Structural Steel

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings

AMERICAN WATERWORKS ASSOCIATION (AWWA)

AWWA C207	(1994) Standard for Steel Pipe Flanges for Waterworks Service-Sizes 4 In. Through 144 In.

HYDRAULIC INSTITUTE (HI)

HI-01	(1994) Standards for Centrifugal, Rotary and Reciprocating Pumps

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 2858	(1975) End Suction Centrifugal Pump (Rating 16 Bar) Designation Nominal Duty Point and Dimensions
ISO 5199	(1986) Technical Specifications for Centrifugal Pumps, Class II
ISO 7005-2	(1988) Metallic Flanges Part 2: Cast Iron Flanges

MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-86	(1997) Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electric Equipment (1000 Volts Maximum)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings shall be submitted after receiving tentative approval of the equipment and the materials list but before installation, the Contractor shall submit drawings covering necessary or recommended changes to accommodate the equipment offered. Drawings shall clearly show the Design of the Chamber, with dimensions, types, and thicknesses of materials, and elevation levels with reference to those elevations indicated.

SD-02 Shop Drawings

Erection/Installation Drawings for the Manhole Chamber with the required equipment and accessories that are inclusive shall be submitted. Drawings shall clearly show the design of the chamber, with dimensions, types, and thicknesses of materials, and elevation levels with reference to those elevations indicated.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Manhole Chambers, including structural calculations
Entrance Covers
Sump Pumps
Sewage Pumps
Pump Controls
Impellers
Couplings
Stuffing Boxes
Valves
Piping
Blowers
Dehumidifier
Electric Motors

SD-03 Product Data

Equipment and Performance Data shall be submitted for the following items:

Sump Pumps
Sewage Pumps
Pump Controls
Impellers
Couplings
Stuffing Boxes
Valves
Piping
Blowers
Dehumidifier
Electric Motors

SD-06 Test Reports

Field Test Report demonstrating leak check, and operability of equipment over entire range of performance requirements.

SD-07 Certificates

Certificates of Compliance shall be submitted for the following items in accordance with the applicable reference standards and description of this section.

Sump Pumps
Sewage Pumps
Pump Controls
Impellers
Couplings
Stuffing Boxes
Valves
Piping
Blowers
Dehumidifier
Electric Motors

SD-07 Certificates

Listing of Product Installations similar to the package lift station the Contractor is installing shall be submitted.

SD-08 Manufacturer's Instructions

Manufacturer's Instructions including special provisions required to install equipment components and system packages shall be submitted for the following items:

Sump Pumps
Sewage Pumps
Pump Controls
Impellers
Couplings
Stuffing Boxes
Valves
Piping
Blowers

Dehumidifier
Electric Motors

SD-10 Operation and Maintenance Data

Operating Instructions, including standard operating procedures with startup, shutdown, and emergency operation shall be submitted for the following:

Package Lift Station
Sump Pumps
Sewage Pumps
Pump Controls
Impellers
Couplings
Stuffing Boxes
Valves
Blowers
Dehumidifiers
Electric Motors

SD-10 Operation and Maintenance Data

Safety Considerations including information relating to load limits, speed of operation, environmental criteria (temperature and pressure limitations), and personnel hazards and equipment safety precautions for the Package Lift Station shall be submitted.

SD-10 Operation and Maintenance Data

Preventative Maintenance and Inspection procedure for Package Lift Stations shall be submitted. Procedures should include frequency of preventative maintenance, inspection, adjustment, lubrication, and cleaning necessary to minimize corrective maintenance and repair.

SD-10 Operation and Maintenance Data

Special Tools that are required for maintenance and testing of the Package Lift Station shall be submitted.

SD-10 Operation and Maintenance Data

Posted Instructions consisting of labels, signs, and templates of operating instructions that are required to be mounted or installed on or near the Package Lift Station shall be submitted.

SD-10 Operation and Maintenance Data

Material, Equipment, and Fixtures List of all Major Components shall be submitted. List shall include manufacturer's catalog numbers, specification and drawing reference number, warranty information, and fabrication site.

SD-10 Operation and Maintenance Data

Spare Parts Data shall be submitted for the following, including a complete list of parts and supplies with current unit prices and source of supply. Also, list parts and supplies that are either

normally furnished at no extra cost with the purchase of equipment, or specified to be furnished as a part of the contract, and list additional items recommended by the manufacturer to ensure an efficient operation for a period of 120 days.

Sump Pumps
Sewage Pumps
Pump Controls
Impellers
Couplings
Stuffing Boxes
Valves
Piping
Blowers
Dehumidifier
Electric Motors

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals for Package Lift Stations shall be submitted, and the following shall be included, as applicable:

Equipment Description
Assembly and Installation Procedures
Adjustment and Alignment
Checkout Procedures
Procedures of Operation
Troubleshooting

1.3 DESIGN REQUIREMENTS

Actual range in capacities may vary from that stipulated if the minimum and maximum capacities specified are included.

Each station shall have two pumps with controls capable of operating the pumps either simultaneously or individually, depending on the load conditions.

Lift station shall be a complete unit with necessary appurtenances factory installed within a pump chamber and a vertical entrance tube cover and access ladder.

1.4 PROTECTION FROM MOVING PARTS

Locate and guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts in accordance with applicable OSHA standards and so that personnel are properly protected from injury.

1.5 NAMEPLATES

Each item of equipment shall have the manufacturer's name or trademark on a corrosion-resistant identification plate or cast integrally, stamped, or otherwise permanently marked in a conspicuous place. Pump identification plate shall show the pump capacity in gpm, pump head in feet, and speed of rotation. Direction of rotation shall be cast on the body of the pump. Other information considered necessary to complete identification such as the manufacturer, shall be shown on the identification plate.

1.6 FIELD REPRESENTATIVE

A representative of the lift station manufacturer shall direct the startup of the station and shall instruct representatives of the Government in startup and operation procedures.

PART 2 PRODUCTS

Materials and equipment shall conform to the referenced publications or as specified and indicated and shall be the products of manufacturers regularly engaged in the manufacture of such products.

2.1 CHAMBER

Chamber, including base, walls, and entrance tube shall be constructed of 5000 psi precast concrete designed to form an integral unit. Ladder, pipe supports, brackets, and other miscellaneous components shall be constructed of steel conforming to ASTM A 36/A 36M and hot-dipped galvanized in accordance with ASTM A 123.

Chamber, including base, entrance tube, air ducts, and similar structural parts, shall be steel conforming to ASTM A 36/A 36M. Steel shall be protected from corrosion by means of galvanizing conforming to ASTM A 123.

2.2 ENTRANCE COVER

Entrance-tube cover shall be steel. The cover shall be securely bolted to the shaft flanges.

2.3 SUMP PUMP

Pump capacity shall be as indicated on the drawings. Pump shall be a submersible, direct-motor-driven unit. Sump and pump shall be enclosed in 1/4-inch mesh of corrosion-resistant metal.

Sump pumps shall conform to the applicable requirements of Section 15445, "Sump Pumps."

2.4 SEWAGE PUMPS

Pumps shall be of the nonclogging, centrifugal type designed to pump unscreened sewage. Each pump shall have a rated capacity as specified and be capable of passing 3-inch solids. Pumps may be either horizontally mounted or vertical close coupled and shall conform to the requirements of HI-01. Pump speed shall not exceed 1,800 revolutions per minute.

Sewage pumps shall conform to the applicable requirements of Section 15135, "Centrifugal Pumps."

2.5 PUMP CONTROLS

Pump controls shall conform to the applicable requirements of Section 16286, "Overcurrent Protective Devices."

Pump operating controls shall be as recommended by the pump station manufacturer, and shall be the automatic type including necessary switches, relays, and appurtenances, complete. Controls shall be mounted on a control panel. Equipment subject to contact with sewage shall be of corrosion-resistant metal. Alternators may be electrical or mechanical and

shall automatically alternate the pump operation unless the liquid level continues to rise, in which case both pumps shall operate simultaneously. Controls shall be provided with a high-level switch for remote monitoring.

Each station shall have a three-wire receptacle for a portable generator in case there is an external power outage. Each station shall also have a double-throw switch in an enclosure conforming to NEMA 250, Type 3R. All wiring shall conform to the requirements of Section 16145, "Standard Wiring Systems."

2.6 PUMP CONSTRUCTION

Castings shall be cast iron or steel free from injurious defects. Castings shall be designed to permit easy replacement of parts. Joints shall be gasketed and shall not leak under a test pressure equal to 50 percent more than the pump discharge pressure or total dynamic head, whichever is greater. Passageways shall permit the smooth flow of sewage and shall be free from sharp turns and projections. Pump castings shall be provided with cleanout plates in the suction line and drain plugs.

2.7 IMPELLERS

Impellers shall be of cast iron, cast steel, or an alloy suitable for the service required. Impellers shall be free flowing and shall permit objects in the sewage that enter the pump to pass into the discharge pipe. Each impeller shall be keyed, splined, or threaded on the shaft and locked in such manner that lateral movement will be prevented and reverse rotation will not cause loosening.

2.8 COUPLINGS

Couplings shall be the heavy-duty flexible type, keyed to the shaft. Couplings for vertical pumps may be the universal type.

2.9 SHAFT SLEEVES

Sleeves shall be of bronze or a suitable alloy designed to protect the shaft at points in contact with the stuffing boxes and other wearing parts. Sleeves shall also protect the shaft from the liquid being pumped.

2.10 STUFFING BOXES

Boxes shall be grease-sealed with a seal ring, designed to ensure tight packing without excessive wear or friction on the shafts, and prevent the leakage of air or water. Glands shall be the split type, easily removed for repacking.

2.11 BALANCE

Rotating parts of the equipment shall be mechanically and hydraulically in balance to operate throughout the required range without excessive end thrust, vibration, and noise. Existence of defects that cannot be eliminated by adjustment will be sufficient cause for rejection of the equipment.

2.12 SHAFTS

Shafts shall be high-grade steel of a size and strength to perform the work required.

2.13 BEARINGS

Bearings shall be ball or roller type. Main bearings shall take radial and end thrust. Pumps that depend on hydraulic balance to overcome end thrust are not acceptable.

2.14 LUBRICATION

Bearings on vertical-shaft pumps shall be the grease type provided with fittings for a grease gun and, if not easily accessible, with grease tubing extending to convenient locations. Grease fittings shall be the pump manufacturer's standard type.

2.15 PIPING CONNECTIONS

Pump suction and discharge shall be provided with flanged connections of the proper size for the pump type and capacity. Pipe flanges shall conform to ASTM A 105/A 105M, ASME B16.1 or AWWA C207.

2.16 SUMP PUMP CONTROL

Sump pump shall be automatically actuated by a built-in adjustable float.

2.17 VALVES

Gate valves shall conform to MSS SP-70. Check valves shall be of horizontal, swing check type. Valves shall permit a free flow of sewage forward and provide a positive check against backflow. Body shall be iron and have a removable cover for inspection and removal of the gate assembly. Gate, gate seats, shaft, studs, and nuts shall be bronze.

2.18 PIPING

Discharge lines shall terminate 5-feet outside the lift station in flanged connections. Suction line shall include the pipe from the wet well manhole.

2.19 VENTILATING BLOWER

Blower shall be capable of one air change every 3 minutes. A manual and automatic switch shall be mounted on the side of the entrance tube for operation of the blower. Vent to atmosphere shall have covers and screens to prevent the entrance of rain, insects, and rodents. Blower shall be automatically actuated upon opening the entrance tube cover, unless overridden by the manual control.

Blower motor shall conform to the applicable requirements of Section 16225, "Motors."

Blower controls shall conform to the applicable requirements of Section 16286, "Overcurrent Protective Devices."

2.20 DEHUMIDIFIER

A packaged dehumidifier shall be furnished and installed in accordance with lift station manufacturer's recommendations. Controls shall include a humidistat and low-temperature cutout. Condensate shall be discharged to the wet well.

Dehumidifier controls shall conform to the applicable requirements of Section 16286, "Overcurrent Protective Devices."

2.21 EMERGENCY OVERFLOW

A gravity-overflow line shall be provided from the wet well. Overflow line shall terminate with a headwell and flap valve.

2.22 ELECTRIC MOTORS

Motors shall conform to the requirements of Section 16225, "Motors" and shall be 60-hertz, 3-phase.

2.23 PAINT

Equipment shall be treated and painted in accordance with the manufacturer's standard practice for sewage resistance.

PART 3 EXECUTION

3.1 GENERAL

Lift station shall be installed as indicated, in accordance with drawings and the manufacturer's instructions.

3.2 TESTS

Tests, including hydrostatic leak checking of piping and operation of equipment, shall be performed as directed.

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SECTION 02536

SANITARY SEWERAGE SYSTEMS

09/96

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SECTION 02536

SANITARY SEWERAGE SYSTEMS
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 306	(1990) Standard Specification for Drainage Structure Castings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2001) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 48/A 48M	(2000) Standard Specification for Gray)ron Castings
ASTM A 74	(1998) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM C 14	(1999) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 14M	(1999) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 150	(2000) Standard Specification for Portland Cement
ASTM C 33	(2001) Standard Specification for Concrete Aggregates
ASTM C 425	(2001) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(1998) Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 478	(1997) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443M	(1998) Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric)

ASTM C 564	(1997) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 62	(2001) Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale)
ASTM C 700	(2000) Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 76	(2000) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 76M	(2000) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 890	(1991; R 1999) Standard Practice for Minimum Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
ASTM C 891	(1990; R 1997) Standard Practice for Installation of Underground Precast Concrete Utility Structures
ASTM D 1869	(1995; R 2000) Rubber Rings for Asbestos-Cement Pipe
ASTM D 3034	(2000) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA/ANSI C 151/A 21.51	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
AWWA/ANSI C 111/A 21.11	(2000) Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

WASHINGTON SUBURBAN SANITARY COMMISSION (WSSC)

WSSC GC	General Conditions and Standard Specifications

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Record of Existing Conditions shall be submitted after a thorough inspection of the area by the Contractor in the presence of the

Contracting Officer.

SD-02 Shop Drawings

Installation Drawings showing complete detail, both plan and profile details with proper layout dimension and elevations.

SD-03 Product Data

Precast Manholes

SD-06 Test Reports

Test Reports for the following items shall be submitted. Compaction and density test shall be in accordance with Section 02300, "EARTHWORK."

SD-07 Certificates

Certificates of Compliance for the following items shall be submitted in accordance with the applicable reference standards and description of this section:

Brick for Manholes
Concrete Aggregates
Portland Cement
Rubber Gaskets
Pipe
Frames and Covers

PART 2 PRODUCTS

2.1 BRICK FOR MANHOLES

Brick shall conform to ASTM C 62, Grade SW.

2.2 CEMENT MORTAR

Mortar shall consist of 1 part portland cement and 2 parts fine sand with enough water to produce mortar of the proper consistency for the type of joint.

2.3 CONCRETE AGGREGATES

Aggregates shall conform to ASTM C 33.

2.4 RUBBER GASKETS

Rubber gaskets shall conform to ASTM C 443,ASTM C 564, and ASTM D 1869.

2.5 PIPE

Pipe shall be as follows:

Ductile iron soil pipe and fittings shall conform to AWWA/ANSI C 151/A 21.51, Class 50. Joint gaskets shall conform to AWWA/ANSI C 111/A 21.11.

Polyvinylchloride (PVC) pipe and fittings shall conform to ASTM D 3034,

Cell Classification 12454-B.

2.6 DETECTABLE MARKING TAPE

Detectable marking tape shall be acid and alkali resistant polyethylene film manufactured for marking and identifying underground utilities, 6 inches wide, 4 mils thick, continuously inscribed with utility name, with a metallic core, encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep. Background color shall be green for gravity sewer and brown for pressure sewer.

2.7 PORTLAND CEMENT

Cement shall conform to ASTM C 150, Type I/II.

2.8 FRAMES AND COVERS

Cast iron frames and covers shall be in accordance with AASHTO M 306.

Deviations in standard castings shall be acceptable only when prior approval has been granted. Frames and covers shall have a combined weight of not less than 400 pounds and shall conform to ASTM A 48, Class 30B.

The letters "SAN" or "SANITARY" at least 2 inches high shall be stamped or cast into covers so as to be conspicuously visible.

2.9 JOINTING

Cement mortar shall not be used as a pipe-jointing material except for wye branches.

Pipe joints shall be sealed with:

A rubber gasket configuration, as recommended by the pipe manufacturer for the particular type of pipe joint. Gaskets shall be installed to provide a tight fit. Rubber gaskets may be used with ductile iron soil pipe and PVC pipe, .

2.10 MANHOLES

2.10.1 Construction

Manholes shall be constructed of brick, concrete, or reinforced precast-concrete rings, with cast iron frames and covers. Frames and covers shall be bolted down and as necessary. Frames and covers shall be set so that the top of the cover is 3-inches higher than finished grade, where no pavement exists. Where pavement does exist, frames shall be flush with surface. Invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly.

Precast manholes shall conform with ASTM C 478, except as noted in this section. Manholes subject to vehicular traffic shall be designed to withstand HS20-44 loading, in accordance with ASTM C 890.

2.10.1.1 Invert Channels

Invert channels shall be formed directly in the concrete of the manhole base, or be built up with brick and mortar, or have half tile laid in concrete, orbe constructed by laying full-section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. Flooring of the manhole outside the channels shall be smooth and shall slope toward the channels, no less than 1 inch per foot nor more than 2 inches per foot. The free drop inside the manholes shall not exceed 1 foot 6 inchesmeasured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels. Drop manholes shall be constructed whenever the free drop would be greater than 1 foot 6 inches.

2.10.1.2 Concrete

Concrete used in manholes shall comply with Section 03305, "Cast-in-Place Concrete". Concrete rings shall conform to ASTM C 76, except that the length of sections may be shorter as conditions require. Wall thicknesses shall be not less than 4 inches nor less than 1/12 the diameter of the manhole for either vertical walls or cone sections and shall be reinforced with not less than 0.12 square inch of steel per foot of height. Joints between precast rings shall be full-bedded in cement mortar and shall be smoothed to a uniform surface on both the interior and exterior of the manhole.

2.10.1.3 Ladders

When the depth from the top of the cover to the invert of the main sewer exceeds 12 feet, manholes shall be provided with a straight steel ladder not less than 16 inches in width with 3/4-inch diameter rungs spaced 12 inches on center. Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feet apart vertically and installed to provide at least 6-1/2 inches of toe space between the wall and the inside of the rungs. Stringers shall be 1/2- by 1-1/2-inch steel bars. Ladder and inserts shall be galvanized after fabrication in accordance with ASTM A 123/A 123M. Wall along the line of the ladder shall be vertical its entire height.

2.10.1.4 Jointing and Plastering

Mortar for jointing and plastering shall consist of 1 part portland cement and 2 parts fine sand. For brickwork, lime may be added to the mortar in the amount of not more than 25 percent of the volume of cement. Joints shall be completely filled, smooth, and free from surplus mortar on the inside of the manhole. Brick manholes shall be plastered with 1/2 inch of mortar over the entire outside surface of the walls. Brick shall be laid radially with every sixth course laid as a stretcher course.

PART 3 EXECUTION

3.1 LOCATION

Manholes shall be set to the requirements indicated on the drawings. Predcast manholes shall be set to the requirements of ASTM C 891.

Where the location of the sewer is not clearly defined by dimensions, the sewer shall be laid not closer than 10 feet horizontally to a water supply main or service line except that where the bottom of the water pipe will be at least 12 inches above the top of the sewer pipe, the horizontal spacing

shall be a minimum of 6 feet. Water lines shall be above sewage force mains.

Where gravity-flow sewers cross above waterlines, the sewer pipe for a distance of at least 10 feet each side of the crossing shall be cast iron, steel, or other acceptable pressure pipe and without joints closer horizontally than 3 feet to the crossing, or the sewer pipe shall be fully encased in concrete. Thickness of the concrete, including that at the pipe joints, shall be not less than 4 inches.

3.2 PIPE LAYING

Bottom of trench shall be shaped to give uniform circumferential support to the lower fourth of each pipe. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid true to line and grade in a manner to form a close concentric joint with the adjoining pipe and prevent sudden offsets of the flow line. Interior of the sewer shall be cleared of superfluous materials at all times. Where cleaning after laying is difficult, a suitable swab or drag shall be kept in the pipe and pulled forward past each joint immediately after jointing has been completed. When the maximum width of the trench at the top of the pipe is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to the Government, such bedding as may be required to satisfactorily support the added load of the backfill. Trenches shall be kept free from water until the pipe-joining material has set. Pipe shall not be laid when the condition of the trench or the weather is unsuitable for such work. When work is not in progress, open ends of pipe and fittings shall be closed to prevent intrusion of foreign materials.

Detectable marking tape shall be installed above the pipe at a depth of approximately 12 inches below final grade.

3.3 LEAK TEST

Upon installation of the sewer line, leakage testing shall be conducted in accordance with the WSSC low pressure air testing criteria as given in WSSC GC. Testing shall be done from manhole to manhole with test plugs in the pipe ends. First make a determination of the groundwater depth and associated pressure. Increase the gauge pressure in the pipe section to 4 psi plus the in-situ groundwater pressure (not to exced 5.5 psi total). Then allow the pressure to decrease to 3.5 psi plus groundwater pressure. Finally, record the time for the pressure to drop by 0.5 psi. If the time exceeds the following minimum times then the pipe section is considered to have passed. If not, repairs shall be made to the joints such that the test passes.

Pipe Size	Min time for passing
102 mm	1 min 53 sec
152 mm	2 min 50 sec
203 mm	3 min 47 sec
305 mm	5 min 40 sec

3.4 WYE BRANCHES

Commercially manufactured wye branches shall be installed where sewer connections are necessary. Cutting into pipe for connections shall not be

done except as approved. When conditions are such that the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete or supported on a concrete cradle as directed. Concrete required due to faulty construction methods or negligence of the Contractor shall be installed at no additional cost to the Government.

3.5 CONNECTIONS TO EXISTING MANHOLES

Pipe connections to existing manholes shall be made in such manner that the finished work shall conform as nearly as practicable to the applicable requirements for new manholes.

3.6 ACCEPTANCE

Sections of the sewer found defective in material, alignment, grade, or joints shall be corrected at no additional cost to the Government before acceptance.

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11/99

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SECTION 02556

UNDERGROUND CHILLED WATER DISTRIBUTION
11/99

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C177	(1997) Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot-Plate-Apparatus
ASTM C 591	(2000) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation
ASTM D 1784	(1999; Rev A) Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	(1999) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1,219 mm), for Water
AWWA C111	(2000) Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C115	(1999) Flanged Ductile-Iron Pipe with Threaded Flanges
AWWA C150	(1996) Thickness Design of Ductile-Iron Pipe
AWWA C151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water
AWWA C153	(1994) American National Standard for Ductile Iron Compact Fittings, 3 In. Through 24 In. (76 mm through 610 mm), and

	54 In. Through 64 In. (1,400 mm through 1,600 mm) for Water Service
AWWA C509	(1994; Addendum A-95) Resilient-Seated Gate Valves for Water Supply Service
AWWA C550	(1990) Protective Epoxy Coatings for Valves and Hydrants
AWWA C600	(1999)Installation of Ductile Iron Water Mains and Their Appurtenances

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Provide 1:20 scale shop drawings detailing takeoffs and connections showing proposed installation of fittings, couplings and valves.

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

Pipe
Pipe Fittings and Pipe Couplings
Piping Specialties
Valves
Miscellaneous Materials
Supporting Elements

SD-05 Design Data

Material, Equipment and Fixture Lists shall be submitted for pipes, valves and specialties including manufacturer's style of catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information. Also, a complete list of construction equipment to be used shall be provided.

SD-06 Test Reports

Field Test Reports shall be submitted for the items listed below. Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the contractor, by an

authorized official of the testing laboratory or agency (if applicable), and by the Government inspector who witnessed the test.

Hydrostatic Tests
Leakage Tests

SD-07 Certificates

Listing of Product Installations for Piping Systems shall include identification of at least 5 units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. The list shall include purchaser, address of installation, service organization and date of installation.

SD-07 Certificates

Certificates of Compliance shall be submitted for pipe, valves and specialties showing conformance with test requirements as contained in the reference standards contained in this section.

Surface Resistance
Shear and Tensile Strengths
Temperature Ratings
Bending Tests
Flattening Tests
Transverse Guided Weld Bend Tests

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the items listed below, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

Pipe
Pipe Fittings and Pipe Couplings
Piping Specialties
Valves
Miscellaneous Materials
Supporting Elements

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the underground chilled water distribution system, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

SD-11 Closeout Submittals

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.

1.3 GENERAL

Excavation, trenching, and backfilling for utilities shall be in accordance with Section 02300, "Earthwork", and as indicated on the drawings.

PART 2 PRODUCTS

2.1 UNDERGROUND PIPING MATERIAL

2.1.1 General

The underground chilled water piping shall be ductile iron pipe which complies with AWWA C150 and AWWA C151. The exterior of all ductile iron pipe shall be provided with a factory applied one mil thick asphaltic coating per AWWA C151 and AWWA C115 for flanged pipe and AWWA C110 and AWWA C153 for fittings and couplings. Interior pipe lining shall be in accordance with AWWA C104.

Components used in the underground chilled water piping system, where possible, shall be by the same manufacturer or be used with the piping manufacturer's approval.

All nuts, bolts and rods used in the underground piping system shall be of 316 stainless steel or, if not an option, steel which shall be electro-galvanized.

The piping system and its components shall be rated at not less than a 355 psig working pressure for 4 inches through 24 inches and 250 psig working pressure for 30 inches. Joints shall be the positive axial locking restrained type meeting AWWA C110 requirements, or the rubber-gasket type meeting the requirements of AWWA C111 for underground piping. Air vent taps shall be 3/4 inch with standard manufacturers factory pipe tap or field installed pipe tap saddle. Both shall be suitable double extra strong galvanized steel pipe.

2.1.2 Insulation

Underground chilled water supply piping 16 inches and smaller shall be pre-insulated piping. Any chilled water piping, smaller than 18 inches, running parallel to or crossing, within 5 feet of an existing steam pipe shall be pre-insulated.

The insulation shall be polyurethane foam conforming to ASTM C 591. The jacket shall be seamless polyvinylchloride 0.25 inch wall minimum Class 12454B compound conforming to ASTM D 1784 Type 1 Grade 1. Thermal resistance of the foam shall be such that the pre-insulated assembly shall limit the heat gains of the pipe sizes as shown below with a temperature difference of 10 degrees F.

Pipe Size,(mm)	Heat Gain, watt/m/hr.
200-300	9.6
350-400	14.4
450-459	19.2

Provide polyethylene encasement of iron chilled water piping installed by the work of this project to comply with AWWA C105 and the Ductile Iron Pipe Research Association's recommendations.

2.2 VALVES - EXTERIOR, BELOW GRADE

2.2.1 Gate Valves

Valves shall be designed for a minimum of 250 psig. Valves shall have mechanical joint ends through 14 inches and restrained joint above 14 inches. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut shall have an arrow cast in the metal indicating the direction of opening with non-rising stem. Valves 3 inches and larger shall be iron-body, brass-mounted, resilient-seated conforming to AWWA C509, with epoxy coating inside and outside, conforming to AWWA C550. All nuts, bolts and rods used in the valves shall be of 316 stainless steel or, if not an option, steel which shall be electro-galvanized.

2.2.2 Valve Corrosion Protection Insulation

All underground gate valves shall be encased with a hydrophobic powder insulation consisting of approximately 100% calcium carbonate particles chemically modified to repel water and moisture. The particles shall be less than 10 micron in size and have a bulk density of approximately 879.6 kg per cubic meter and a load bearing of up to 58,640 kg per square meter. The maximum thermal conductivity measured in accordance with ASTM C177 shall be 1.01 W(m*k).

2.3 MISCELLANEOUS ITEMS

2.3.1 Valve Boxes

Valve boxes shall be cast iron, complete with covers requiring a special wrench for removal. Cast-iron boxes shall be the extension type with screw or slide adjustments and with flared bases. The word WATER shall be cast in the cover and cover painted light green to match existing covers. Boxes shall be installed over each gate valve. Boxes shall be of such a length as can be adapted, without full extension, to the depth of cover required over the pipe at the valve location. Boxes shall be installed flush with finished grade or paving. Furnish 1 wrench per 4 installed valve box covers.

2.3.2 Detectable Warning Tape

Detectable Metallic Warning Tape: Acid and alkali resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 160 mm wide and 4 mils thick minimum, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 1.2 m deep.

Tape Colors: Provide tape colors to utilities as follows:

Blue: Water systems.

PART 3 EXECUTION

3.1 PIPE HANDLING

Pipe and accessories shall be handled in a manner to ensure delivery to the trench in an undamaged condition. Particular care shall be taken not to injure the pipe coating. If the finish or lining of any pipe or fittings

is damaged, the repair shall be made by the Contractor at his expense in an approved manner. No other pipe or material shall be placed inside of a pipe or fitting after the coating has been applied. Pipe shall be carried, not dragged, into position. Use of pinch bars and tongs for aligning or turning the pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be cleaned 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 and shall be tapped with a light hammer to detect cracks. Material found to be defective before or after laying shall be replaced with sound material without additional cost to the Government.

3.2 CUTTING OF PIPE

Cutting of pipe shall be done without damage to the pipe. Unless otherwise authorized or recommended by the manufacturer, cutting shall be done with an approved mechanical cutter. Wheel cutters shall be used when practical.

3.3 LOCATION

Where the pipe line crosses other underground utilities, it shall have a minimum 300 mm of separation. Piping shall not be laid in the same trench with galvanized lines, fuel lines or electrical conduit/wiring.

3.4 DEFLECTION

Maximum allowable deflections from a straight line or grade, as required shall be as recommended by a manufacturer and as approved by the Contracting Officer.

In general, the design intent is to use the manufacturers elbow fittings and tees to accomplish the required changes in direction of the piping system, with joint deflection use only for minor alignment problems.

3.5 PLACING AND LAYING

Pipe and accessories shall be carefully lowered into the trench by means of derricks, ropes, belt slings, or other suitable equipment. Under no circumstances shall materials be dropped or dumped into the trench. Care shall be taken to avoid abrasion of the pipe coating. Poles used as levers for removing skids across trenches shall be of wood and have broad flat faces to prevent damage to the pipe or coating. Except where necessary in making connections with other lines or as authorized, pipe shall be lain in full length of each section and shall be rested solidly upon the pipe bed, with recesses excavated to accommodate bells, couplings and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. When work is not in progress, open ends of pipe, fittings and valves shall be securely closed so that vermin, water, earth or other substances will not enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by the Contractor at his expense and in an approved manner.

Pipe and associated components shall be installed in accordance with AWWA C600 and recommendations of the pipe manufacturer. Where connections are made between new work and existing mains, the connections shall be made by using special sections and fittings, approved by the piping manufacturer, to suit the actual conditions. Standard methods are readily available for making connections to various types of pipe, either under

pressure or in the dewatered condition. Where made under pressure, these connections shall be installed in accordance with the recommendations of the manufacturer of the pipe being tapped and tapping equipment utilized.

3.5.1 Detectable Warning Tape

Install warning tape directly above utilities, along center line of each pipe. Place tape minimum 600 mm above pipe.

3.6 COUPLINGS AND JOINTS

Installation of couplings and restrained joints shall be in accordance with the recommendations of the manufacturer.

3.7 SERVICE LINES

Service lines shall include the lines to and connections with, the building service at a point shown on the drawings. Where piping for future connection is installed, The Contractor shall terminate the lines at the point designated. Such lines shall be closed with blind flanged stage valves, plugs or caps as indicated. Piping stops and gate valves shall be provided with extension boxes of the lengths required by the depths of the line stops or valves. Piping connections shall be constructed in accordance with the following requirements: piping 65 mm or larger shall be connected to the main by a rigid connection and shall have a gate valve located below the frostline.

3.8 VALVES AND VALVE BOXES

Valves and valve boxes shall be installed where indicated or required and shall be set plumb. Valve boxes shall be centered on the valves and covers shall be set flush with finished grade. Valves shall be located outside the area of sidewalks, roads, streets, and parking areas unless indicated otherwise. Earth fill shall be carefully tamped around each valve box to a distance of 1220 mm on all sides of the box or the undisturbed trench face if less than 1220 mm. Stuffing boxes shall be tightened. Valves shall be inspected in open and closed positions to ensure that all parts are in working condition. After installation, and prior to insulation, the Contractor shall inspect valves for damage to coating and repair damages with epoxy or other GSFC approved material.

3.9 HYDROPHOBIC POWDER INSULATION

Hydrophobic powder insulation shall be installed around all underground gate valves to a level covering the bottom of the valve box bases. Material shall be installed in accordance with the manufacturers recommendation and as detailed.

3.10 THRUST BLOCKS

Plugs, caps, tees, bends deflecting 22-1/2 degrees or more shall be provided with concrete thrust blocks. Blocks shall be concrete of a mix not leaner than 1 part cement to 2-1/2 parts sand to 5 parts gravel. Blocks shall be placed between solid ground on the fitting to be anchored. The area of bearing shall be as indicated or as directed. Unless otherwise indicated or directed, blocks shall be so placed that fittings joints will be accessible for repair.

3.11 TESTING

All piping shall be adequately braced and supported during the test so that no movement, displacement, or damage shall result from the application of test pressure. All equipment used in testing shall be subject to the approval of the Contracting Officer and shall be such as to properly develop and maintain test pressure.

Repairs shall be made with new materials. No caulking of cracks or holes will be acceptable. Where it becomes necessary to replace pieces or pipe, the replacement shall be the same length, material and thickness of the defective piece. Tests shall be repeated until defects disclosed thereby have been made good or the work replaced.

3.11.1 Hydrostatic Tests

Hydrostatic-pressure tests shall be made no sooner than 72 hours after installation of thrust blocks, unless otherwise approved.

Perform pressure tests systematically and sequentially on pipe lengths no greater than each of the construction parts identified on the drawings. After the pipe is laid, the joints completed, and the trench partially backfilled leaving the joints exposed for examination (coordinate with Contracting Officer's Technical Representative), the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 2 hour to a hydrostatic-pressure test of 250 psig. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings and valves shall be carefully examined during the open-trench test. Joints showing visible leakage shall be replaced or remade as necessary. Pipe, mechanical joints, fittings and valves discovered to be cracked or defective as a consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are approved.

3.11.2 Leakage Tests

Leakage tests shall be conducted after the pressure test has been approved. Duration of each leakage test shall be at least 2 hours. During the test, the main shall be subjected to a pressure of 200 psi. Leakage is defined as the additional quantity of water supplied into the newly 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.

Allowable leakage in gallons per hour per joint at 250 psi average test pressure shall not exceed the following:

> 2 quarts/hour (64 fluid ounces/hour) 1.89 liters/hour per 100 gaskets or joints.
>
> Additional 1 fluid ounce/hour per inch of valve diameter for each isolation valve.

Should any test of laid pipe disclose a leakage greater than that shown, the defective joints shall be located and repaired until the leakage is within the specified tolerance, at no additional cost to the Government.

3.11.3 Test Timing

Except where concrete-reaction backing necessitates a 72-hour delay, pipelines jointed with rubber gaskets, mechanical, or bolted joints may be subjected to hydrostatic pressure, inspected, and tested for leakage after partial completion of backfill.

3.11.4 Cleaning

The Contractor shall submit a pipe cleaning/flushing procedure for the Contracting Officer's approval, 21 calendar days prior to the proposed date for the cleaning of piping. Each line shall be completely flushed and cleaned.

3.12 OPERATIONAL READINESS REVEW

Provide an Operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", ORR shall include a walk-through of the completed work, with the red-lined as-built contract drawings, pointing out locations of all valves, air vents, tees, and other connections to existing piping.

-- End of Section --

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SECTION 02585

UNDERGROUND ELECTRIC AND TELEPHONE DISTRIBUTION
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2001) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 48	(1994; Rev E1) Standard Specification for Gray Iron Castings
ASTM A 48M	(1994; Rev A) Standard Specification for Gray Iron Castings (Metric)
ASTM A 569/A 569M	(1991; Rev A) Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality
ASTM C 478	(1997) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 857	(1996) Standard Specification for Structural Design Loading for Underground Precast Concrete Utility Structures
ASTM F 512	(1993) Standard Specification for Smooth-Wall Poly (Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation

FEDERAL SPECIFICATIONS (FS)

FS TT-V-51	(Rev F) Varnish: Asphalt

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 6	(2000; 12th Ed) UL Standard for Safety - Rigid Metal Conduit

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Installation Drawings showing complete detail, both plan and profile details with proper layout dimension and elevations.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Conduit and Fittings
Separators
Detectable Marking Tape
Grounding Conductor
Ground Rods
Precast Manholes
Accessories

PART 2 PRODUCTS

2.1 CONDUIT AND FITTINGS

Conduit and fittings in duct banks shall be rigid unplasticized polyvinylchloride and shall conform to ASTM F 512, (heavy-wall, Schedule 40, polyvinylchloride designed for underground and in walls when encased in concrete).

Aluminum conduit shall not be permitted.

2.2 SEPARATORS

Separators or spacing blocks shall be made of concrete, plastic, or other suitable nonmetallic nondecaying material.

2.3 PULL LINES

Pull lines of 500 pound nylon shall be installed in all ducts.

2.4 GROUNDING CONDUCTOR

A grounding conductor shall be installed above the concrete encasement of the duct banks and shall be no smaller than a AWG No. 1/0 stranded bare copper conductor, unless otherwise indicated.

2.5 MANHOLES

Manholes shall be of the types indicated and shall be constructed in

accordance with applicable details as indicated.

Precast concrete manholes shall conform to ASTM C 478, except as noted in this section. Manholes subject to vehicular traffic shall be designed to withstand HS20-44 loading, in accordance with ASTM C 857.

2.5.1 Manhole Frames and Covers

Manhole frames and covers shall be as indicated and shall be gray cast iron with machine finished or nonrocking bearing surfaces in accordance with ASTM A 48, Class 30B Gray Iron Castings. Manhole covers shall be cast with the word "ELECTRICAL" or "TELEPHONE", as applicable. Manhole frame and cover shall have a combined weight of not less than 400 pounds and shall conform to ASTM A 48, Class 30B. Clear opening shall be 2 feet.

2.5.2 Sump Cover

Sump covers shall be as indicated. Covers shall be gray cast iron conforming to ASTM A 48, Class 30B Gray Iron Castings.

2.5.3 Pulling Irons

Pulling irons shall be 7/8-inch diameter galvanized-steel bar with an exposed triangular-shaped opening, when set, 9 inches on each side. Steel bars shall be merchant quality. Galvanizing shall conform to ASTM A 153/A 153M.

2.5.4 Cable Supports

Cable racks shall be heavy duty, hot-dip galvanized T-section steel, 2-1/2 by 2-1/4 inches by 1/4 inch in size and punched with 14 holes, 1-1/2-inches on center for attaching cable hooks. Racks shall be hot-rolled merchant-quality steel-bar-size tees. Galvanizing shall conform to ASTM A 123.

Cable hooks shall be 3/16-inch hot-galvanized sheet steel pressed to channel shape. Hooks shall be 2-1/2-inches wide and 14-inches long and shall be vertically pinned to the cable racks. Hooks shall be hot-rolled commercial-quality sheet steel conforming to ASTM A 569/A 569M. Galvanizing shall conform to ASTM A 123.

Cable supports shall be minimum 12 inches long and 1-1/2 inch wide, securely attached to and braced from cable racks.

Insulators for cable support shall be high-glazed wet-process porcelain.

2.6 DETECTABLE MARKING TAPE

Detectable marking tape shall be acid and alkali resistant polyethylene film manufactured for marking and identifying underground utilities, 6 inches wide, 4 mils thick, continuously inscribed with utility name, with a metallic core, encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep. Background color shall be red.

2.7 CONCRETE

Concrete shall conform to Section 03305, "Cast-in-Place Concrete".

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Duct Banks

Duct banks shall consist of single or multiple conduit assemblies encased in concrete. If the ductbank is not provided with elevations or profile details on the drawings, then the top of duct bank shall be not less than 30 inches below established grade.

Conduit shall be thoroughly cleaned before using or installing. During construction and after the duct line is completed, the ends of the conduit shall be plugged to prevent water from washing mud into the conduit or manholes. Conduit shall be kept clean and free of concrete, dirt, and any other foreign substance during construction. All conduit runs should be installed so they will drain throughout the run.

Duct lines shall be laid to a minimum grade of 4 inches per 100 feet. Grade may be from one manhole to the next or both ways from a high point between manholes, depending on the contour of the finished grade. Duct banks shall slope away from buildings at a minimum pitch of 4 inches per 100 feet.

Changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long-sweep bends having a minimum radius of 25 feet, except that manufactured bends may be used at ends of short runs of 100 feet or less and then only at or close to the end of the run. Long-sweep bends may be made up of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 18 inches for use with ducts of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger.

Conduit shall terminate in end bells where duct lines enter manholes.

After the duct line has been completed, a standard flexible mandrel not less than 12-inches long, with a diameter approximately 1/4 inch less than the inside diameter of the conduit, shall be pulled through each conduit, after which a brush with stiff bristles shall be pulled through each conduit to make certain that no particles of earth, sand, or gravel have been left in the line.

Pneumatic rodding may be used to draw in the lead wire.

Where connection is made to an existing duct that is of a different material and shape from the duct line being installed, a suitable coupling of a type recommended by the duct manufacturer shall be used.

Conduit joints in concrete encasement may be placed side by side horizontally but shall be staggered at least 6 inches vertically.

Separators shall be placed not greater than 4 feet on center. Ducts shall be securely anchored to prevent movement during the placement of concrete. At least 3 inches of concrete shall be provided at bottom, top, and sides.

Duct banks under or adjacent to roads or shoulders of roads shall be encased in reinforced concrete. If reinforcement is not indicated on the drawings, minimum reinforcement shall be three #4 (1/2" diameter)

longitudinal rebars per face of ductbank, and with #3 (3/8" diameter) ties spaced at not more than 5 feet on centers.

Conduit joints shall be made up in accordance with the manufacturer's recommendations for the particular conduit and coupling selected.

A grounding conductor shall be installed above the concrete encasement. Grounding conductor shall extend along all electrical duct banks including stubs through each electrical distribution system manhole and to each transformer and switching-station installation.

Detectable marking tape shall be installed above duct bank at a depth of approximately 12 inches below final grade.

3.1.2 Manholes

Frames shall be securely fastened to manholes with 3/4-inch anchor bolts.

When a manhole sump is required, as indicated, a cast-metal grille sump frame and cover shall be installed over the sump.

In paved areas, the top of manhole covers shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 3 inches above finished grade.

Where duct lines enter manholes, the sections of duct either may be cast in the concrete or may enter the manhole through a square or rectangular opening of suitable dimensions provided in the manhole walls. Where openings are provided for the entrance of duct lines, the space between ducts and between ducts and manhole walls shall be calked tight with lead wool or an approved equivalent.

Cables shall be supported on walls by hot-dip galvanized steel cable racks equipped with adjustable hooks and insulators. Cable racks shall be installed in each manhole with not less than two spare hooks installed on each cable rack. Insulators shall not be required on spare hooks.

A pulling iron shall be installed in the wall opposite each duct line entrance into the manhole.

In each manhole, at a convenient point close to the wall, a ground rod minimum 10 feet long, shall be driven into the earth before the floor is poured so that approximately 8 inches of the ground rod will extend above the manhole floor.

When precast concrete manholes are used, the top of the ground rod may be below the floor and the ground conductor brought into the manhole by means of a No. 4/0 AWG cable through a watertight sleeve in the manhole wall or floor.

Grounding and bonding shall meet the requirements of NFPA 70.

-- End of Section --

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SECTION 02635

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SECTION 02635

STORM SEWERAGE
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 198	(1994) Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets
AASHTO M 288	(1992) Standard Specification for Geotextiles Used for Substrate Drainage Purposes
AASHTO M 306	(1990) Standard Specification for Drainage Structure Castings

AMERICAN CONCRETE PIPE ASSOCIATION (ACPA)

ACPA O1-103	(1988) Concrete Pipe Installation Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48/A 48M	(2000) Standard Specification for Gray Iron Castings
ASTM A 74	(1998) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A 746	(1999) Standard Specification for Ductile Iron Gravity Server Pipe
ASTM A 760/A 760M	(2001) Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains
ASTM A 762/A 762M	(2000) Standard Specification for Corrugated Steel Pipe, Polymer Precoated for Sewers and Drains
ASTM A 798/ A798M	(2001) Standard Practice for Installing Factory-Made Corrugated Steel Sewer Pipe for Sewers and Other Applications
ASTM A 849	(2000) Standard Specification for Post-Applied Coatings, Pavings, and Linings for Corrugated Steel Sewer and Drainage Pipe

ASTM B 745/B 745M	(1997) Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains
ASTM C 12	(2000) Standard Specification for Installing Vitrified Clay Pipe Lines
ASTM C 139	(1999) Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
ASTM C 14	(1999) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 14M	(1999) Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe
ASTM C 270	(2000) Standard Specification for Mortar for Unit Masonry
ASTM C 32	(1993; R 1999) Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale)
ASTM C 361	(1999) Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
ASTM C 361M	(1999) Standard Specification for Reinforced Concrete Low-Head Pressure Pipe
ASTM C 387	(2000) Standard Specification for Packaged, Dry Combined Materials for Mortar and Concrete
ASTM C 425	(2001) Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings
ASTM C 443	(1998) Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
ASTM C 443M	(1998) Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric)
ASTM C 478	(1997) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1997) Standard Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 506	(2000) Standard Specification for Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C 506M	(2000) Standard Specification for Reinforced Concrete Arch Culvert, Storm

	Drain, and Sewer Pipe
ASTM C 507	(2000) Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C 507M	(2000) Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C 564	(1997) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 700	(2000) Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated
ASTM C 76	(2000) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 76M	(2000) Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C 890	(1991; R 1999) Standard Practice for Minimum Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
ASTM C 891	(1990; R 1997) Standard Practice for Installation of Underground Precast Concrete Utility Structures
ASTM C 923	(2000) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 923M	(1998) Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals
ASTM C 969	(1994; R 2000) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines
ASTM C 969M	(1994; R 2000) Standard Practice for Infiltration and Exfiltration Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
ASTM D 2321	(2000) Standard Practice for Sewers and Other Gravity-Flow Applications
ASTM D 2680	(1995; Rev A) Standard Specification for

	Acrylonitrile-Butadene-Styrene (ABS) and Poly(VinylChloride)(PVC) Composite Sewer Piping
ASTM D 2855	(1996) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3034	(2000) Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996; Rev A) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F 1417	(1992; R 1998) Standard Test Method for Installation Acceptance of Plastic Gravity Sewer Lines Using Low Pressure Air
ASTM F 477	(1999) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 794	(1999) Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter

AMERICAN WATERWORKS ASSOCIATION (AWWA)

AWWA C110	(1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (76 mm through 1,219 mm), for Water
AWWA C111	(2000) Rubber-Gasket Joints for Ductile-Iron and Gray-Iron Pressure Pipe and Fittings
AWWA C210	(1997) Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines

FEDERAL SPECIFICATIONS (FS)

FS RR-F-621	(Rev E) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-05 Design Data

Mix Designs for Concrete shall be submitted.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following:

Grating and Frames
Precast Concrete Manholes
Precast Concrete Base Slabs

SD-02 Shop Drawings

Installation drawings showing complete detail, both plan and profile details with proper layout dimension and elevations.

SD-01 Preconstruction Submittals

A Work Plan shall be submitted when sewer flow is to be interrupted. The following items shall be noted in the plan:

Proposed Schedules
Methods
Materials
Equipment

SD-07 Certificates

Certificates of Compliance for the following items shall be submitted in accordance with the applicable paragraphs of this section for:

Pipe
Grout
Mortar
Gaskets
Compression Joints
Manhole Frames/Covers
Grating and Frames
Precast Concrete Manholes
Precast Concrete Base Slabs
Concrete Block
Sewer Brick
Bituminous Coating
Cold Bituminous Mastic Sealer

PART 2 PRODUCTS

2.1 BEDDING AND BACKFILL

Bedding and earthwork material shall conform to Section 02300, "Earthwork."

2.2 BONDING AND SEALING MATERIALS

2.2.1 Bituminous Coating and Sealing

Coating shall be in accordance with ASTM A 849.

Coating shall be in accordance with ASTM A 849, when using materials previously coal-tar coated and for each uncoated ferrous piece used underground.

Cold mastic sealer shall be in accordance with ASTM A 849 trowel

consistency.

2.2.2 Epoxy Bonding

Epoxy adhesive shall be in accordance with AWWA C210.

2.3 FILTER MATERIAL

2.3.1 Filter Fabric

Fabric shall be in accordance with AASHTO M 288, and be water pervious, made of polyester materials.

2.3.2 Filter Aggregate

Aggregate shall be clean gravel free from organic materials, clay, or other deleterious materials, graded to the following minimal limits:

SIEVE SIZE	PERCENT PASSING
No. 4	15 to 30

2.4 MANHOLE AND CATCH-BASIN MATERIALS

Water, for use with concrete block and brick, shall be clean and potable.

2.4.1 Concrete Block and Mortar

Concrete block shall be in accordance with ASTM C 139.

Concrete mortar shall be in accordance with ASTM C 387, Type M.

2.4.2 Brick and Mortar

Brick shall conform to ASTM C 32, Grade MS.

Brick mortar shall conform to ASTM C 270, Type M.

2.5 CONDUIT PIPING, JOINTS, AND FITTINGS

2.5.1 Concrete Pipe

2.5.1.1 Reinforced Concrete Pipe (RCP)

Round RCP shall conform to ASTM C 76, be of Class IV, with wall type B and with wire fabric reinforcement and Bell and spigot ends.

Lifting holes shall be provided when using elliptical reinforcement.

Acceptability shall be in accordance with ASTM A 746.

Elliptical RCP shall conform to ASTM C 507, and be of the Horizontal type, and Class IV with wire fabric reinforcement, and Bell and spigot ends.

Lifting holes shall be provided.

Acceptability shall be in accordance with ASTM C 507.

2.5.1.2 Gaskets

Gaskets shall be in accordance with ASTM C 443, and shall be used on all RCP installations.

2.5.2 Plastic Piping

2.5.2.1 Type PSM Poly(Vinyl Chloride) (PVC) Pipe

Pipe shall be in accordance with ASTM D 3034, SDR 35, up to 12 inch millimeter diameter.

Pipe ends made for joints shall be elastomeric gasket type.

2.5.2.2 PVC Pipe Joints

Joints shall be in accordance with ASTM D 3212, push-on type.

Gaskets shall be in accordance with ASTM F 477.

2.6 FRAMES, COVERS, AND GRATINGS

Manhole, catch-basin, and sump frames, covers, and gratings shall be in accordance with AASHTO M 306.

Cast-iron materials shall be provided. The following legends shall be cast-in on every cover: STORM. Cast iron shall conform to ASTM A 48, Class 30B, minimum.

Roadway curb inlets shall be Neenah R-3246CL frame, grate, and curb box.

Lawn inlets shall be NEENAH R3251 frame and grate.

2.7 PRECAST CONCRETE MANHOLES

Concrete manholes, risers, base sections, and tops shall be pre-cast and conform to ASTM C 478, except as noted in this section. Manholes subject to vehicular traffic shall be designed to withstand HS20-44 loading, in accordance with ASTM C 890.

Precast parts shall contain wire fabric reinforcement.

Risers and grade rings shall be of the eccentric type.

Base sections shall be of the integral type.

Acceptability for tops shall be based upon proof of design testing.

2.7.1 Manhole Gaskets

Gaskets shall be in accordance with ASTM C 443 for joints between manhole sections.

2.7.2 Manhole Connectors

Connectors shall be in accordance with ASTM C 923 for joints between manhole and pipes.

2.8 MANHOLE AND CATCH-BASIN ACCESS STEPS OR LADDER

Access shall be in accordance with ASTM C 478, using steps for manholes or catch basins at least four feet deep.

PART 3 EXECUTION

3.1 EXCAVATION, BACKFILL, AND GRADING

Excavation, backfill, and removal of unsatisfactory materials shall be in accordance with Section 02300, "Earthwork."

3.2 PIPE INSTALLATION

3.2.1 Pipe Installation

Excavations shall be trimmed to required elevations. Objects which impair backfilling or compaction shall be removed. Over excavation shall be corrected with fill material of fine aggregate.

Pipe and fitting shall be inspected for defects before installing. Defective materials shall be removed from site.

Pipe interior shall be cleaned before installation. Pipe ends shall be sealed when work is not in progress.

Pipe shall be laid to line and grade, with bell end upstream.

Maximum variation from true slope shall not exceed 1/8 inch in 10 feet.

Maximum deviation from true line shall not exceed 0.20 feet for pipe 15 inches in diameter and smaller, 0.40 feet for pipe larger than 15 inches in diameter.

Corrections shall be made at a rate not to exceed 0.10 foot for one length of conduit.

3.2.2 Reinforced Concrete Pipe Installation

Reinforced concrete pipe and fittings shall be installed in accordance with manufacturer's instructions, and ACPA O1-103.

3.2.3 PVC Plastic Pipe Installation

PVC pipe and fittings shall be installed in accordance with manufacturer's instructions and in accordance with ASTM D 2321.

3.3 PIPE BEDDING

3.3.1 Bedding

Minimum compacted bedding under installed pipe shall be one-fourth of the pipe diameter in thickness, and in no case less than 4 inches or more than 12 inches.

Bedding shall be placed in layers not exceeding 6 inches in depth and compact. Additional layers shall be added until a minimum elevation of 12 inches above the pipe is achieved.

3.3.2 Trench Pipe Cradle

When required, trench pipe cradle shall be constructed monolithically of 3000 psi, air entrained concrete.

3.3.3 Compaction

Puddling or jetting shall not be permitted when compacting bedding materials.

3.4 JACKING PIPE

Jacking pipe shall not be used, unless specifically required.

3.5 UNDERGROUND STRUCTURES

Manholes shall be set to the requirements indicated on the drawings. Precast manholes shall be set to the requirements of ASTM C 891.

3.5.1 Structures

1/2-inch thick ASTM C 387, Type M mortar shall be applied to both interior and exterior surfaces.

Top of manhole and catch basin covers shall be set flush with finished pavement and lawn surfaces.

Attach steps into manhole walls with epoxy compound.

Preformed bituminous expansion-joint material shall be provided 3/4 inch thickness around drainage structures in pavements.

Joints for concrete risers and tops shall be made with flexible watertight rubber-type gaskets.

3.5.2 Concrete Construction

Concrete shall be in accordance with Section 03305, "Cast-in-Place Concrete."

3.5.3 Invert Channel Installation

Invert channels shall be smooth and fitted to each inlet, outlet, or transition for correct hydraulic flow.

3.6 STORM SEWER CONNECTIONS AND WYES

Pipe connections to existing conduit and manholes shall be provided.

Wyes for branch connections shall be provided. Field-cutting into conduit shall not be permitted. Wyes shall be sprung into existing lines. Entire wye shall be encased in concrete.

Epoxy shall be used to secure each interface connecting new and existing conduit.

3.7 FIELD QUALITY CONTROL

3.7.1 Interior Inspection of Pipe

Installed pipe shall be inspected when 2 feet of earth cover is in place and upon completion of project. Displaced or misaligned pipe, infiltration, accumulation of debris, or other defects shall be corrected by the Contractor at no additional cost to the Government.

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SECTION 02695

UNDERGROUND HEAT DISTRIBUTION SYSTEM
05/91

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 in the text by basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1	(1998) Power Piping

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1999; rev B) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 106	(1999; Rev E1) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 536	(1999; Rev E1) Standard Specification for Ductile Iron Castings
ASTM B 61	(1993) Standard Specification for Steam or Valve Bronze Castings
ASTM B 62	(1993) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM C 533	(1995) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 552	(2000) Standard Specification for Cellular Glass Thermal Insulation
ASTM C 591	(2000) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation
ASTM D 1784	(1999; Rev A) Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D 2321	(2000) Standard Practice for Sewers and Other Gravity-Flow Applications
ASTM F 477	(1999) Standard Specification for Elastomeric Seals (Gaskets) for Joining

Plastic Pipe

1.2 DEFINITIONS

The following definitions are applicable:

1.2.1 Underground Heat Distribution System

A complete underground steam distribution and condensate return system including all required components such as carrier pipes, steam pipe, condensate return pipe, and, fittings, anchors, pipe supports, expansion loops (if required), insulation, steel conduit, outer insulation anf FRP jacket, for the system supplied. The Underground Heat Distribution system does not include valve manholes and the piping and equipment inside the valve manholes, but shall include all piping and components to a point six inches inside the building (unless otherwise shown) or valve manhole walls. All underground heat distribution lines as shown on the contract drawings shall be fiberglass jacketed steel conduit. The system supplier shall have fabricated systems of the composition defined herein for at least three years. All straight sections, fittings, anchors and other accessories shall be factory prefabricated to job dimensions, and designed to minimize the number of field welds. Each system layout shall be computer analyzed by the piping system manufacturer to determine stresses and movements of the service pipe. The system design shall be in strict conformance with ANSI B31.1 latest edition, and stamped by a registered professional engineer.

All welding, all high pressure steam and condensate piping, and any portion of low pressure condensate piping defined as Pressure Vessels and Pressurized Systems (PV/S) in Section 15055, "Welding and Pressure Vessels/Systems", shall comply with the requirements of that section.

1.2.2 System Supplier

The system supplier is the company responsible for the manufacture of the Underground Heat Distribution system. This company is also responsible for directing the installation of their system and also having a representative on the job site as required and in accordance with their Installation requirements

1.2.3 System Supplier's Representative

The system supplier's representative shall be a person who regularly performs the duties specified herein, is certified in writing by the Underground Heat Distribution system supplier to be technically qualified and experienced in the installation of the system, and shall be authorized by the supplier to make and sign the daily reports specified herein. The system supplier's representative shall be present at the jobsite when the following types of work are being performed:

a. Inspection and unloading.

b. Inspection of trench prior to laying of conduit.

c. Inspection of concrete thrust blocks prior to cold springing.

d. Cold springing.

e. Hydrostatic test of all service lines.

f. Field joint closure work.

g. Air test of conduit.

h. Repair of any coating patch work.

i. Holiday test of conduit coating.

j. Initial backfill up to 10 inchesabove the top of the casing.

k. The slope of the system. Elevation readings required by paragraph VERIFICATION OF FINAL ELEVATIONS will be witnessed and recorded.

The Contractor shall not perform any of this work in the absence of the system supplier's representative. The system supplier's representative shall take prompt action to return to the factory all damaged or defective material and to order prompt replacement of such material.

1.2.4 Contractor

The company responsible for the installation of the Underground Heat Distribution system and all other components of the underground heat distribution system, including the valve manholes and the piping and equipment in the valve manholes. This responsibility includes all of the site work, purchase of the Underground Heat Distribution system from the system supplier and installation of the Underground Heat Distribution system in accordance with direction from the system supplier.

1.3 DESCRIPTION

The work includes the furnishing, installing, and testing of a direct buried underground insulated schedule 40 steel steam pipe and insulated schedule xx-strong steel pumped condensate return and drip pipe, together with all fittings and appurtenances necessary for a complete and operable system.

The design, manufacture, fabrication, installation and testing of the system and its components shall be in accordance with the following:

a. System supplier's installation guidelines. Systems with gland type end seals shall not be provided.

b. Contract drawings. Contract drawings indicate a recommended general design layout. Piping entering manholes or buildings shall align and penetrate the manhole or building walls as indicated.Contractor shall provide a detailed design layout prepared by the system supplier which shall reflect the layout of the drawings and also include system details required to show that the specified minimum insulation thickness has been met. No changes in the type of system shall be made between adjacent manholes and/or in runs from mains to buildings. Underground heat distribution connections to mains shall be made only at steam manholes.

c. Contract specifications.

1.3.1 Field Measurements and Record Data

The Contractor shall become familiar with all details of the work, verify

all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work. The existing Underground utilities shown on the drawings are a compilation of survey data and available records but are not Guaranteed correct.

Elevations noted on the profiles are the product of careful study of available site information and design blue prints and are expected within (plus or minus) 19.5 inches. Location of utilities on site are expected to be within (plus or minus) 39 inches.

1.4 SYSTEM REQUIREMENTS

1.4.1 Site Classification

The system provided shall be approved for Class B, Class C and Class D groundwater conditions.

1.4.2 Soil Conditions

The soil conditions are corrosive and cathodic protection shall be provided for metallic cased systems.

1.5.3 Operating Characteristics

The system shall be designed for a steam and high pressure condensate temperature of 375 degrees F and an operating pressure of 150 psig. Low pressure condensate return piping shall have an operating temperature of 180 degrees F and an operating pressure of 15 psig.

1.5 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals": For items which are defined as PV/S, provide additional information specified in Section 15055, "Welding and Pressure Vessels/Systems".

SD-01 Preconstruction Submittals

Work Plan

A proposed schedule of activities indicating when various items of work and tests are to be carried out and when quality control inspectors of the Underground Heat Distribution system supplier will be present at jobsite.

SD-02 Shop Drawings

Heat Distribution System

A detailed design layout of the system (plan and elevation views) showing size, type, elevations and location of each component to be used in the system, including, if applicable, transition point design to aboveground or other type systems. Also, if applicable, type and details of the cathodic protection system to be used. Drawings shall be approved by a registered Professional Engineer as certified by their stamp.

SD-05 Design Data

Pipe-Stress and System Expansion Calculations

Pipe-stress and system-expansion calculations for each expansion system using an approved three-dimensional analysis procedure.

Calculations shall be approved, certified, stamped and signed by a registered Professional Engineer.

SD-07 Certificates

Testing Firm Qualification

A Certificate of Qualification from the independent testing firm or firms certifying that weld examination methods and procedures and the interpretation of examining films will be performed in accordance with ASME B31.1, and that the firm intends to utilize the proper film exposure, techniques, and penetrameter to produce density and geometric sharpness required for first quality film, and that all radiographs will be reviewed and interpreted and reading reports signed by not less than a Certified Level III Radiographer.

Welds

A Certification of Acceptability of all welds made in the field, upon completion of the project. This certification shall consist of a letter signed by an official of the independent testing firm or firms, stating that all provisions of this specification have been complied with, and that all welds inspected radiographically have met the acceptability standards specified.

Certificate of Compliance

A notarized statement (Certificate of Compliance) signed by a principal officer of both the manufacturer and the Contractor, certifying that the system has been installed satisfactorily and in accordance with the drawings, specifications and the component requirements of the system supplier's installation requirements, upon completion of the work and before final acceptance.

SD-09 Manufacturer's Field Reports

Representative's Reports

A daily written report from the representative of the Underground Heat Distribution system supplier whenever the Underground Heat Distribution system supplier's representative is required to be on the jobsite. The report shall be checked for accuracy and the original presented no later than the next working day after the work has been performed. One copy shall be forwarded to the Underground Heat Distribution system supplier's main office. The report shall be signed by the representative. The report shall state whether or not the condition and quality of the materials used and the installation of the system are in accordance with the drawings, specifications, and manufacturer's recommendations. If anything connected with the installation is unsatisfactory, the report shall state what corrective action has been taken or shall contain the Underground Heat Distribution system supplier's recommendations for corrective action. The report shall identify

any conditions that could result in an unsatisfactory installation, including such items as open conduit ends left in the trench overnight and improper valve manhole entries.

SD-10 Operation and Maintenance Data

Heat Distribution System

The operation and maintenance manual shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Manual shall include piping and equipment layout of the system installed.

PART 2 PRODUCTS

2.1 DRAINABLE/DRYABLE SYSTEMS

2.1.1 Service Pipe

Internal piping shall be standard weight carbon steel except for pumped condensate and drip piping which shall be schedule xx-strong carbon steel. All joints shall be butt welded for sizes and larger, and socket welded for and below. Where possible, straight sections shall be supplied in (40 foot) random length with of piping exposed at each end for field joint fabrication. High pressure steam and condensate pipe shall comply with ASTM A 106, Grade B. Low pressure condensate pipe shall comply with ASTM A 53 Grade B.

2.1.2 Subassemblies

End seals, gland seals and anchors shall be designed and factory prefabricated to prevent the ingress of moisture into the system. All subassemblies shall be designed to allow for complete draining and drying of the conduit system.

2.1.3 Service Pipe Insulation

Insulation shall be cellular glass insulation, as manufactured by Pittsburgh Corning Corporation or equal, in accordance with ASTM C 552. The bore coating shall be Hydrocal B-11 gypsum cement, manufactured by U.S. Gypsum Corporation, or equal. The insulation shall be secured to the pipe by stainless steel bands. Insulation thickness shall be as shown on the following table:

Minimum Pipe Insulation Thickness (In inches)
For Steam (16 psig to 250 psig) Supply and Return

INSULATIONS
For Drainable/Dryable Systems

Nominal Pipe Diameter (inches)	Cellular Glass (carrier pipe) (inches)	Polyurethane Foam Thickness (outer conduit) (inches)
2	1.25	1
3	1.25	1
4	2	1
6	2	1
8	2.5	1

INSULATIONS

For Drainable/Dryable Systems

10	2.5	1
12	2.5	1
14	3	1

2.1.4 Outer Conduit

The steel conduit casing shall be smooth wall, welded steel conduit of the thicknesses specified below:

Conduit Size (inches)	Conduit Thickness
6 - 26	10 Gauge
28 - 36	6 Gauge
38 - 42	4 Gauge

Changes in casing size, as required at oversized casing to allow for carrier pipe expansion, shall be accomplished by eccentric and/or concentric fittings and shall provide for continuous drainage.

2.1.5 Pipe Supports

All pipes within the outer casing shall be supported at not more than intervals. These supports shall be designed to allow for continuous airflow and drainage of the conduit in place. The straight supports shall be designed to occupy not more than 10% of the annular air space. Supports shall be of the type where insulation thermally isolates the carrier pipe from the outer conduit. The surface of the insulation shall be protected at the support by a sleeve not less than , fitted with traverse and, where required, rotational arresters.

2.1.6 Outer Conduit Insulation and Jacket

Conduit insulation shall be spray applied polyurethane foam, having a nominal (2 pound per cubic foot) density for all straight lengths and fittings. The insulation thickness shall be Quality assurance procedures for the insulation shall include either a visual check prior to jacketing or infrared, or x-ray of the entire length, to insure there are no insulation voids. The urethane foam shall meet ASTM C 591 and have the minimum characteristics of 0.020 metric K-factor (watts per meter degree K) and a closed cell content of 90 to 95%. The outer jacket shall be fiberglass (FRP) and shall be filament wound, directly on to the urethane foam insulation. No PVC or Polyethylene jackets shall be allowed. All straights and fittings shall be factory jacketed.

2.2 UNDERGROUND MARKING TAPE

Detectable marking tape shall be acid and alkali resistant polyethylene film manufactured for marking and identifying underground utilities, 6 inches wide, 4 mils thick, continuously inscribed with utility name, with a metallic core, encased in a protective jacket for corrosion protection, detectable by a metal detector when tape is buried up to 30 inches deep. Color shall be blue.

2.3 VALVE MANHOLES

Valve manholes, piping, and equipment in valve manholes shall be in

accordance with the contract drawings and Section 02699, "Steam Manholes, Piping and Equipment". Otherwise, piping components shall be in accordance with the contract drawings and applicable standards and installation requirements.

PART 3 EXECUTION

3.1 INSTALLATION, INSPECTION AND TESTING

All welding, all work on high pressure steam and condensate systems, and all work on portions of the low pressure condensate system which are deined as PV/S in Section 15055, "Welding and Pressure Vesels/Systems", shall be done in accordance with that section and as specified herein.

The Underground Heat Distribution system shall be installed, inspected, and tested in accordance with the contract drawings and specifications, the system supplier's installation requirements, appropriate publications including ASME B31.1, and any directions given by the system supplier's representative. All work pertaining to the Underground Heat Distribution system shall be performed in the presence of the system supplier's representative as described in paragraph System Supplier's Representative. Piping shall be accurately cut to dimensions established at the construction site and shall be worked into place without springing or forcing, properly clearing all openings and equipment. Excessive cutting or other weakening of structural members to facilitate piping installation shall not be permitted. Pipe ends shall have burrs removed by reaming and shall be installed to permit free expansion and contraction without damage to joints. Good workmanlike procedures shall be followed.

All piping unless otherwise indicated shall be pitched with a grade of not less than 1 cm in 4.9 m toward the drain points when applicable.

Open ends of pipe lines and equipment shall be properly capped or plugged during installation to keep dirt or other foreign matter out of the system.

3.1.1 Testing

System testing shall include the testing of system piping in manholes as well as underground piping.

3.1.1.1 Piping

All carrier pipe joints shall be tested hydrostatically 1-1/2 times the working pressure, for a period of two hours. Casing conduit shall be air pressure tested to hold 100 kPa pressure for 30 minutes. Testing procedures for the outer conduit insulation shall include either a visual and/or acoustical check prior to jacketing or infrared, or x-ray of the entire length, to insure there are no insulation voids.

3.1.1.2 Welding

An approved independent testing firm or firms regularly engaged in radiographic testing shall perform a radiographic examination of field welds in the carrier piping of the heat distribution system in accordance with ASME B31.1. Fifty percent of all welds made in the field shall be inspected radiographically. The welds selected for inspection shall be representative of the whole project, both as to the number and as to type, i.e., a reasonable proportion of all girth buttwelds, branch connection fitting welds and fillet welds on socket welding fittings. Individual

welds identified for radiographic inspection shall be chosen at random by the testing firm, with no foreknowledge by the Underground Heat Distribution system supplier, the Contractor or any of their agents. If 10 percent or more of the welds examined in the field are found unacceptable, all welds in the category with an unacceptable inspection failure rate shall receive 100 percent radiographic examination at no additional cost to the Government. In such an event, the independent testing firm shall so notify the Contractor and the Contracting Officer immediately. The Contractor shall furnish a set of films showing each weld inspected, a reading report evaluating the quality of each weld, and a location plan showing the physical location where each weld is to be found in the completed project, prior to backfilling and hydrostatic testing. All radiographs shall be reviewed and interpreted by a Certified Level III Radiographer employed by the testing firm whose signature shall appear on the reading report. The Contracting Officer reserves the right to review all inspection records, and if any welds inspected are found unacceptable they will be removed, rewelded, and radiographically reexamined at no cost to the Government.

3.1.2 Bedding

Bedding material shall be sand or other materials free of sharp objects, heavy clods, bounders or frozen lumps as specified by the design engineer. The approved bedding shall be used 150 mm under, around and over the pipe. Utilize good practices that apply to buried pressure piping.

3.1.3 Pipe Expansion

For piping where the joint system does not provide expansion and contraction of the pipe, expansion loops shall be designed and installed by the pipe system supplier. Location of expansion loops shall be at the same area as the existing system and/or shall be coordinated with the COTR.

3.2 UNDERGROUND MARKING TAPE

Underground marking tape shall be installed above the piping during the trench backfilling and shall be buried approximately below final grade

3.3 VERIFICATION OF FINAL ELEVATIONS

Prior to covering the top of the casing with backfill material, but after all temporary supports have been removed and initial backfilling of the conduit system has been accomplished, the Contractor shall measure and record the elevation of the top of the casing in the trench. Elevations will be taken at every completed field joint and elbow top. This measurement shall be checked against the contract drawings. These measurements shall confirm that the conduit system has been installed to the elevations shown on the contract drawings. These measurements shall be recorded by the Contractor and given to the Contracting Officer prior to covering the casing with backfill material.

3.4 OPERATIONAL READINESS REVIEW

Provide an Operational Readiness Review (ORR) in accordance with Section 01770 "Task Order Closeout", for the underground steam and condensate system as a whole. The ORR shall include a walkthrough of the system indicating the locations of all underground piping, manholes, valves, traps, sump pumps and other equipment in manholes. For task orders which involve replacement or modification of only a portion of the system, the

ORR shall cover only the replaced or modified piping and other components.

-- End of Section --

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07/91

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SECTION 02699

VALVE MANHOLES AND PIPING AND EQUIPMENT IN VALVE MANHOLES
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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 in the text by basic designations only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1999; rev B) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 106	(1999; Rev E1) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 126	(1995) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 234	(1992a) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 733	(1989) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B 62	(1993) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM C 916	(1996; Rev E1) Standard Specification for Adhesives for Duct Thermal Insulation
ASTM C 449	(1988) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 533	(1995) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 921	(1989; R 1996) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM D 579	(1997) Standard Specification for Greige Woven Glass Fabrics

ASTM E 96	(1995) Standard Test Methods for Water Vapor Transmission of Materials

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.34	(1996) Valves - Flanged, Threaded, and Welding End
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B31.1	(1998) Power Piping
ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

FEDERAL SPECIFICATIONS (FS)

FS RR-F-621	(Rev E) Frames, Covers, Gratings, Steps, Sump and Catch Basin, Manhole
FS WW-T-696	(Rev E; Notice 1) Traps, Steam and Air

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System For Valves, Fittings, Flanges, and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(1995) Steel Pipe Unions Socket-Welding and Threaded

MILITARY SPECIFICATIONS (MS)

MS MIL-C-19565	(Rev C; Am 1) Coating Compounds, Thermal Insulation, Fire- and Water-Resistant, Vapor-Barrier

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AMS 3779A	(1990) Tape Adhesive, Pressure Sensitive Thermal Radiation Resistant
SAE AMS 3779/1A	(1990) Tape Adhesive, Pressure Sensitive Thermal Radiation Resistant, Aluminum Foil/Glass Cloth

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 16	(1991) Coal-Tar Epoxy-Polyamide Black (or Dark Red) Paint
SSPC SP 10	(2000) Near-White Blast Cleaning (Nace No. 2)

1.2 DESCRIPTION

This specification covers valve manholes and the valves and equipment shown in the manholes on the drawings. Piping, valves, and equipment for high pressure steam and condensate, and for those portions of the low pressure condensate which are defined as Pressure Vessels and Pressurized Systems (PV/S) in Section 15055, "Welding and Pressure Vessels/Systems", shall comply with that section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals". For those items defined as PV/S, submit additional information in accordance with Section 15055, "Welding and Pressure Vessels/Systems".

SD-02 Shop Drawings

Detail drawings for Valve Manholes, Pipe, and Equipment in the valve manholes, such as steam traps, valves, sump pumps, pressure gauges, thermometers and insulation, including a complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Drawings shall also contain complete wiring and schematic diagrams. Drawings shall show pipe anchors and guides, and layout and anchorage of equipment and appurtenances in valve manholes, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-04 Samples

Display Samples of insulated sections of pipe, elbow, tee, valve, support point, and terminating points. After approval of materials and prior to insulation of piping, a display shall be prepared of insulated sections showing compliance with specifications including showing fastening, sealing, jacketing, straps, waterproofing, supports, hangers, anchors, and saddles. Approved display sample sections shall remain on display at the job site during the construction period until no longer needed by Contracting Officer, then removed.

SD-10 Operation and Maintenance Data

Four copies of operation and maintenance manuals are required for the equipment furnished. Operation manuals for Valve Manholes, Pipe, and Equipment shall detail the step-by-step procedures required for equipment start up, operation, and shutdown. Operation manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals for Valve Manholes, Pipe, and Equipment shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout and simplified wiring and control diagrams indicating location of electrical components with terminals designated for wiring, as installed.

1.4 DELIVERY AND STORAGE

All materials and equipment delivered and placed in storage shall be stored with protection from the weather, excessive humidity and excessive temperature variation; and dirt, dust, or other contaminants.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.2 NAMEPLATES

Each major item of equipment such as sump pumps, motors, steam traps, and pressure reducing valves shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.3 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

2.4 ELECTRICAL WORK

Motors, manual or automatic motor control equipment, and protective or signal devices required for the operation specified shall be provided under this section in accordance with NFPA 70, and in accordance with the applicable sections of Division 16, "Electrical".

2.5 PIPING AND FITTINGS

2.5.1 General

Piping, fittings and piping accessories inside the valve manholes shall conform to the requirements of ASME B31.1 and shall be suitable for the working pressure and temperature requirements of the system. All piping in valve manholes shall be steel with joints welded except that joints and smaller may be threaded. No back welding on fittings or valves or smaller. No supports, anchors, or stays shall be attached to any piping system in places where either the installation of or the movement of the pipe and its contents will cause damage to the construction.

2.5.2 Steel Pipe

Pipe shall be black steel, seamless or electric-resistance welded, conforming to the requirements of ASTM A 53, Grade B or ASTM A 106, Grade B. Pipe up to 12 inchesin diameter shall be schedule XS (extra strong). Gauge piping, condensate piping, drip piping shall be schedule 80.

2.5.2.1 Nipples

Nipples shall conform to ASTM A 733, extra-heavy weight, as required to match adjacent piping.

2.5.2.2 Pipe Threads

Pipe threads shall conform to ASME B1.20.1. Pipe threads may be used only on pipe 3/4 inchor smaller. All pipe which is to be threaded shall be schedule 80.

2.5.3 Fittings

All fittings, valves, flanges and unions shall have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer.

2.5.3.1 Welded Fittings

Welded fittings shall conform to ASTM A 234, buttwelded or socket welded, extra strong, as required to match connecting piping. Buttwelded fittings shall conform to ASME B16.9, and socket welded fittings shall conform to ASME B16.11.

2.5.3.2 Unions

Unions shall conform to MSS SP-83, extra heavy, as required to match adjacent piping.

2.6 VALVES

2.6.1 Gate Valves

2.6.1.1 150 psi

Valves shall be rated (wsp) and shall conform to ASME B16.34.

Body end connections shall be flanged for all valves 2 inches and larger. Screwed shall be used for sizes 1 1/2 inches and under to suit specified

piping system end connection and maintenance requirements. Flange faces shall have concentric serrated finish.

Body to bonnet connection shall be union type for valves 1 1/2 inches and under and gasketed-bolted type for valves 2 inches and larger.

Screwed valves shall be class 150#SWP, rising stem, union bonnet, solid wedge, malleable iron handwheel, body, bonnet, union nut, wedge & stem shall be ASTM B 62 bronze, N/A packing, MSS SP-80. Valve shall be Milwaukee figure number 1151 or approved equal

Flanged valves shall be 150# cast carbon steel, rising stem, open stem & yoke (OS&Y), body and bonnet, gland packed, ASTM A 126 grade WCB. Valve shall be Milwaukee figure # 1550 or approved equal.

2.6.2 Globe and Angle Valves

2.6.2.1 150 psi

Valves shall be rated 150-psi working steam pressure (wsp) and shall conform to ASME B16.34.

Body end connections shall be flanged for all valves 2 inches and larger. Screwed shall be used for sizes1 1/2 inches and under to suit specified piping system end connection and maintenance requirements. Flange faces shall have concentric serrated finish.

Bronze valves, screwed, rising stem type, shall be used for condensate return up to1 1/2 inches , and for bypass valves around main steam stop valves.

Body to bonnet connection shall be union type for valves 1 1/2 inches and under; gasketed-bolted type for valves 2 inches and larger. For valves 3/8 inch and under, assembly shall be screwed type. Bonnet shall be OS&Y type, except that valves 3/8 inch and under shall be inside screw type.

Valves 1 1/2 inches and under shall be rising stem, union bonnet, gland packed, replaceable PTFE disc, ASTM B 62 cast bronze body, bonnet, union nut, disc holder & stem, malleable iron handwheel, gland packed, threaded ends, conforming to MSS SP-80 type 2. Valve shall be Milwaukee valve figure # 590T or approved equal.

Valves 2 inches and larger shall be cast carbon steel, the rising stem type, body and bonnet shall be ASTM A 126 grade WCB, flanged ends. Valve shall be Milwaukee figure # 1560 or approved equal.

Valves shall carry an identification plate, securely fastened to the body, that legibly identifies the manufacturer, valve size, manufacturer's serial number, and seat and shaft material.

2.7 STEAM TRAPS

Class of trap bodies shall be suitable for a working pressure of not less than 1.5 times the steam supply pressure, but not less than 200 psi,and traps shall be capable of operation under a steam-supply pressure as indicated. Traps shall have capacities as shown when operating under the specified working conditions. Traps shall fail open.

2.7.1 Thermodynamic Traps

Thermodynamic traps shall have automatic air discharge and conform to FS WW-T-696. Use Sarco TD52 or TD52L, Walton McDaniel Series WD-600 & WD-600L, or approved equal.

2.8 DRIP LEGS

Drip legs shall be schedule 80 steel. Diameter shall be full size of steam pipe being drained unless shown otherwise on drawings. Trap line shall be a minimum of 300 mm. below steam main. See High Pressure Trap Line detail on drawings.

2.9 STRAINERS

Strainers shall be y-type with connections the same size as the pipe lines in which the connections are installed. The strainer bodies for high pressure trap lines shall be heavy and durable, of cast steel. The strainers shall be suitable for the temperature and pressure requirements of the system on which they are installed. The bodies shall have arrows clearly cast on the sides to indicate the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment basket. The body or bottom opening shall be equipped with nipple and gate valve for blowdown. The basket shall be not less than 0.025 inch thick stainless steel, Monel or sheet brass, with small perforations of sufficient number to provide a net free area through the basket of at least 2.5 times that of the entering pipe. The flow shall be into the basket and out through the perforations.

2.10 INSULATION AND JACKETING

2.10.1 General

All piping, fittings, valves, etc. in the valve manholes shall be insulated. Insulation shall be premolded, precut or job fabricated to fit and shall be removable and reusable. Thickness of insulation shall be in accordance with Tables 1 and 2. Insulation jackets shall be provided for all pipe and fitting insulation. Do not cover trap lines from first valve to last valve.

2.10.2 Jacketing

2.10.2.1 Glass Cloth Jackets

Glass cloth shall be plain-weave glass cloth conforming to ASTM D 579, Style 141 and shall weigh not less than 7.23 ounces per square yard before sizing. Cloth shall be factory applied wherever possible.

Glass reinforcing cloth shall be a leno weave, 26-end and 12-pick thread conservation, with a warp and fill tensile strength of 45 and 30 pounds per inch of width, respectively, and with a weight of not less than 1.5 ounces per square yard. At the Contractor's option, Style 191 leno-weave glass cloth conforming to ASTM D 579 may be provided.

2.10.2.2 3-Ply Laminate

Jacketing shall be a 3-ply laminate of 35-pound per 100 square foot white-bleached kraft, bonded to not less than 0.0007-inch thick aluminum foil and reinforced with glass fiber.

Water-vapor permeance rating of the composite shall be 0.02 perm or grain per hour per square foot, per inch of mercury pressure differential, determined in accordance with ASTM E 96.

2.10.3 Tape

Glass lagging shall be a knitted elastic cloth specifically suitable for continuous spiral wrapping of insulated pipe bends and fittings and shall produce a smooth, tight, wrinkle-free surface. Tape shall conform to requirements of SAE AMS 3779A, SAE AMS 3779/1A, ASTM D 579, and ASTM C 921, and shall weigh not less than 10 ounces per square yard.

2.10.4 Insulation

2.10.4.1 Insulation Thickness

The minimum thickness of insulation for the heat distribution system and condensate return system shall be in accordance with Tables 1 and 2.

TABLE 1
Minimum Pipe Insulation Thickness (In inches)

For steam (16 psig to 250 psig) and High Temperature
Hot Water Supply and Return (250 degrees F to 450 degrees F)

Nominal Pipe Diameter (inches)	Paroc	Epitherm Delta	Kaylo-10 Thermo-12 Super Caltemp	Foamglas
1.0	2.0	2.5	4.0	4.5
1.5	2.0	2.5	4.0	4.5
2.0	2.5	3.5	4.5	5.0
2.5	2.5	3.5	4.5	5.0
3.0	3.0	4.0	5.0	6.0
4.0	3.0	4.0	5.0	6.0
5.0	3.0	4.0	5.0	6.0
6.0	3.5	4.5	5.5	6.0
8.0	3.5	4.5	5.5	6.0
10.0	4.0	5.0	6.0	6.5
12.0	4.0	5.0	6.0	6.5
14.0	4.0	5.0	6.0	6.5
16.0	4.0	5.0	6.0	6.5
18.0	4.0	5.0	6.0	6.5

NOTES:

1. Delta mineral wool board insulation V-grooved by NOVA Group.

TABLE 2
Minimum Pipe Insulation Thickness (In inches)

For Low Pressure Steam (less than 16 psig), Condensate Return
and Low Temperature Hot Water (less than 250 degrees F)
Supply and Return

Nominal Pipe Diameter (inches)	Paroc	Epitherm	Foamglas Kaylo-10 Thermo-12 Super Caltemp
1.0	1.5	2.0	3.0
1.5	1.5	2.0	3.0
2.0	1.5	2.0	3.0
2.5	1.5	2.0	3.0
3.0	2.0	2.5	3.5
4.0	2.0	2.5	3.5
5.0	2.0	2.5	3.5
6.0	2.5	3.0	4.5
8.0	2.5	3.0	4.5
10.0	3.0	4.0	5.0
12.0	3.0	4.0	5.0
14.0	3.0	4.0	5.0
16.0	3.0	4.0	5.0
18.0	3.0	4.0	5.0

2.11 SUMP PUMPS

Sump pumps with the capacities indicated shall be installed in the valve manholes as shown. The sump pumps furnished shall be a manufacturer's standard commercial product. Sump pumps shall be electrically driven and submersible, capable of operating while completely submerged. The pumps and motors shall be capable of continuously pumping liquids at a temperature of 200 degrees F. The pumps and motors shall be capable of running without damage when not submerged. Sump pumps shall have permanently lubricated bearings, monel shafts, bronze impellers, screened inlets and housings of bronze. Each sump pump shall be capable of passing a 3/8 inchsphere. The motors shall have the horsepowerindicated and shall have overload protection. The discharge piping shall be copper or shall be protected from corrosion. The pumps shall be automatically controlled by a submersible switch assembly with pump wiring and switch suitable for submersion in 200 degrees F liquids. Motors shall be 120 volts, 60 Hz, single phase. All controllers, water level switches, and electrical connections shall be suitable for service at 100 percent humidity, at 200 degrees F temperature, and occasional water submersion. The sump pumps automatic control switches shall have demonstrated 200,000 cycles at 200 degrees F and 100 percent relative humidity and shall withstand total submersion in water at 200 degrees F.

2.11 CONCRETE VALVE MANHOLES AND ACCESSORIES

2.11.1 Valve Manhole Construction

Valve manhole dimensions shall be as indicated. The valve manholes shall be constructed of reinforced concrete as indicated and in accordance with Section 03305 "Cast-In-Place Concrete". Valve manholes shall be provided with a 30 inchstandard cast iron frame and 3000lb expanded metal cover as a minimum. Cast iron frames and covers shall conform to the requirements of FS RR-F-621 and shall be the type, style and weight indicated. Valve manholes shall be drained as shown. Concrete sections shall not be less than 6 inchesthick. The top shall be poured in-place on the top of the walls. Valve manhole sides shall be constructed by one monolithic pour.

Unless otherwise indicated, the top of the manhole shall be 460 mm above

finished grade. The top shall contain two each of 760 mm round open grated steel access openings in opposite corners. The top shall also contain two each 200 mm round vents with steel grate covers located in opposite corners from the access openings. Each access opening shall be even with the inside wall of the manhole. A ladder or steps shall be placed at each access opening. The connection between the top of the manhole and the walls shall be a step keyway with a sealing gasket. Manhole shall be 100% watertight except for top openings. All pipe penetrations into the manhole shall be watertight.

Slope the manhole floor to a drain or sump pit, 20 mm/m. Install a sump pit for pump if elevation does not permit the use of a gravity drain. The pit shall not be located in a corner with an access ladder.

2.11.2 Ladders

Valve manhole ladders shall be steel, shall have nonslip surfaces, and shall consist of uprights with steps or rungs. Ladders shall not be less than 16 inches in width, with 3/4 inchdiameter rungs, spaced 12 inches apart. The two stringers shall be a minimum 3/8 inch thick and 2-1/2 incheswide. Ladders shall be adequately anchored to the wall by means of steel inserts spaced not more than 6 feetapart vertically, and installed to provide at least 6 inchesof space between the wall and rungs. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123.

2.11.3 Pipe Sleeves

Pipe sleeves of sufficient length to pass through new valve manhole walls shall be provided where shown as required. Pipe sleeves shall be zinc-coated steel pipe conforming to the requirement of ASTM A 53, Schedule 40 or standard weight. The pipe sleeves shall be secured in the proper position and location during construction of the valve manhole or building wall.

2.11.3.1 Pipe Sleeves Through Valve Manhole Cover

For manhole top penetrations, the diameter of the pipe sleeve will be large enough to allow at least 1/4 inchof clearance between the pipe insulation and the sleeve, and, the sleeve will be sized to accommodate the specific mechanical seal size used for the conduit penetration. The space between the sleeve and the pipe casing, and the caulking and sealing materials shall be selected so that there shall be NO electrical continuity between the pipe sleeve and the pipe casing when finished.

2.11.3.2 Pipe Sleeves for Conduit Penetrations

A modular mechanical type sealing assembly will be used between the valve manhole wall and the conduit casing. The mechanical seal shall consist of interlocking elastomeric links shaped to continuously fill the annular space between the casing and wall. The link material shall be a synthetic elastomeric capable of withstanding long term exposure at 400 degrees F without deterioration. The links shall be attached to each other with corrosion resistant steel bolts, nuts and pressure plates. The link, bolts, nuts and pressure plates shall be the product of single manufacturer and shall be furnished as the product of single manufacturer and shall be furnished as a package or kit. The links shall be loosely assembled with bolts to form a continuous rubber belt around the casing with a pressure plate under each bolt head and each nut. After the seal assembly is

properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the casing and the wall. The pipe wall opening diameter shall be sized so that no more than one half of the seal assembly's expansion capability is used to achieve a water seal.

2.11.4 Pipe Supports

Pipe Supports shall be in accordance with MSS SP-58 and MSS SP-69, type as shown. All pipe supports, including structural cross support members, shall be galvanized. Chains, straps, or single point supports shall not be used.

PART 3 EXECUTION

3.1 SITE WORK

3.1.1 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling of the valve manholes shall be as shown and in accordance with Section 02300, "Earthwork".

3.1.2 Electric Work

Any wiring required for the operation of the equipment specified, but not shown on the electrical drawings, shall be provided under this section in accordance with Division 16 Specifications.

A weatherproof electrical receptacle and a light shall be provided in each manhole. Electrical supply to manholes shall be protected with a GFCI breaker located inside the building, not in the manhole.

3.1.3 Painting

The heat affected zone of field welded galvanized surfaces and other galvanized surfaces damaged during installation shall be cleaned in compliance with SSPC SP 10 and painted in accordance with Section 09915, "Painting". Steel and iron appurtenances, piping, and supports shall be cleaned in compliance with SSPC SP 10 and painted with SSPC Paint 16, coal-tar epoxy-Polymer.

3.2 PIPING

3.2.1 General

All piping in valve manholes shall be steel and insulated. Pipe shall be accurately cut to measurements established at the site and shall be worked into place without springing or forcing. Pipe and insulation shall clear all openings and equipment. Excessive cutting or other weakening of structural members to facilitate piping installation will not be permitted. Burrs shall be removed from ends of pipe by reaming. Installation shall permit free expansion and contraction without damage to joints or hangers. Piping shall be installed in accordance with ASME B31.1. Joints for piping in valve manholes shall be welded, except joints at traps, strainers, unions, tee, check valve and valves and piping 3/4 inchand smaller which may be threaded. Flanged joints will be permitted for dielectric isolation only. Supports, anchors, or stays shall not be attached where either expansion or the weight of the pipe will cause damage to permanent construction. The method of attaching supports shall not interfere with

the operation of the cathodic protection system.

3.2.2 Welded Joints

Joints between sections of pipe, valves, and between sections of pipe and fittings shall be welded except where joints are allowed to be screwed for pipe sizes 1 inchand smaller. The welding shall conform to the requirements specified in paragraph WELDING.

3.2.3 Flanged and Threaded Joints

3.2.3.1 Flanged Joints

Flanged joints shall be faced true, provided with gaskets, and made perfectly square and torqued to the right tight. Flanged joints will be used only for electrical isolation and in other special cases where connected equipment is available with only flanged joints, or, when specifically shown on the drawings. Electrically isolated flange joints shall be provided at all connections to or from the heat distribution system and between dissimilar metals.

3.2.3.2 Threaded Joints

Threaded joints shall have inert filler and oil, graphite compound, or Teflon paste applied to the male threads only. Unions shall be provided at all screwed valves, strainers and connections to equipment 1 inch and smaller.

3.2.4 Reducing Fittings

Eccentric reducers in horizontal runs shall be installed with the straight side down. Changes in horizontal piping sizes shall be made through eccentric reducing fittings.

3.2.5 Branch Connections

Branches from mains shall branch off top of mains as indicated or as approved. Connections shall insure unrestricted circulation, elimination of air pockets, and shall permit the complete drainage of the system. Branch connections may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings where used shall be forged and shall be no larger than two nominal pipe sizes smaller than the main run. Branch outlet fittings shall be reinforced to withstand external strains and designed to withstand full pipe bursting strength.

3.2.6 Pipe Supports in Valve Manholes

Horizontal and vertical runs of pipe in valve manholes shall be securely supported.

3.3 WELDING

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV 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 Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site. The welder or welding operator

shall apply his assigned symbol near each weld he makes as a permanent record.

3.4 VALVE MANHOLES AND ACCESSORIES

3.4.1 Piping and Equipment in Valve Manholes

Piping and equipment in valve manholes shall be installed so as to provide easy access without stepping on piping or equipment, and to provide sufficient working room. Piping and equipment in valve manholes shall be installed and supported as shown on the drawings. All globe, angle and gate valves shall be installed with the stems horizontal, vertical or at 45 degree angle.

All piping and components shall be accessible for maintenance. Piping running parallel to the manhole floor, ceiling or walls must be a minimum of 460 mm off the surface. Trap piping and components shall be placed away from the walls

Provide sump pumps in all manholes where elevation precludes gravity drain. If the elevation permits the use of gravity drain, the drain shall be 100 mm with check valves. Sump pump discharge or gravity drain shall be piped to the closest storm sewer. The piping shall be copper within the manhole and cast iron underground.

Provide a tee with a hose bibb (valve and 40 mm hose coupling) on the sump pump outflow pipe, and a valve on the downstream side of the tee, in the line connected to the storm drain system.

All steam main shut-off valves shall be provided with a bypass globe valve for use during system warm-up periods. Gauges shall be provided upstream of all steam main shut-off valves (on both sides of valve if steam main is designed for steam flow in either direction) and shall be 200 psi/1380 kPa with pigtail and gate valve.

Drip legs shall be provided at the low point of any section of a steam main which can be isolated, and the vertical drip leg shall be the full size of the main, including a minimum 200 mm tall dirt pocket at the bottom. Only thermodynamic type impulse steam traps shall be used on steam main drip legs, and a trap bypass globe valve shall be installed. Between the drip leg and the steam trap, provide a gate valve and strainer. Strainer shall be equipped with double blow-down valves, one valve on the strainer, piped to a second valve located so as to be accessible with an extension or valve key through one of the vents or access openings. Piping shall be Schedule 80 Black Steel and discharge to the drain or sump pit. On the discharge side of the trap, provide a check valve, 15 mm tee, and gate valve. Provide 15 mm test line from tee to outside of manhole, used to check traps for blow-through.

3.4.2 Sump Pumps

Sump pumps shall be installed as indicated. Pumps shall be connected to a dedicated electrical service. Electrical circuits to the sump pumps shall be dedicated circuits. All circuit breakers and switches in the electrical power distribution to the sump pumps shall be capable of being locked in the "ON" position and will be signed as follows:

THIS CIRCUIT SUPPLIES POWER TO THE ELECTRIC SUMP PUMPS IN THE UNDERGROUND STEAMDISTRIBUTION SYSTEM. THIS CIRCUIT MUST BE "ON" AT ALL TIMES;

OTHERWISE EXTENSIVE DAMAGE WILL OCCUR TO THE UNDERGROUND STEAM DISTRIBUTION SYSTEM AND PREMATURE FAILURE WILL OCCUR.

The sign words shall be stamped on a corrosion resistant metal plate with letters 3/8 inchhigh, and the plate shall be affixed permanently near the switch or circuit breaker.

3.5 TESTS

Tests of piping in the valve manholes shall be performed as part of the testing of the direct buried conduit system. These tests shall include the piping in the valve manhole and shall be in accordance with the system supplier'srecommendations, and Section 02695, "Underground Heat Distribution System", or the contract specifications.

3.6 OPERATIONAL READINESS REVIEW

Provide an Operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for the underground steam and condensate system as a whole. The ORR shall include a walkthrough of the system indicating the locations of all yunderground piping, manholes, valves, traps, sump pumps and other equipment in manholes. For task orders which involve replacement or modification of only a portion of the system, the ORR shall cover only the replaced or modified piping and other components.

-- End of Section --

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10/01

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SECTION 02740

HOT MIX ASPHALT PAVEMENT
10/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2027	(1997) Standard Specification for Cutback Asphalt (Medium Curing Type)
ASTM D 3405	(1997) Standard Specification for Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements
ASTM D 3549	(1993; Rev A; R 2000) Standard Test Method for Thickness or Height of Compacted Bituminous Paving Mixture Specimens
ASTM D 946	(1982; R 1999) Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 977	(1998) Standard Specification for Emulsified Asphalt

FEDERAL SPECIFICATIONS (FS)

FS TT-P-1952D	(1994) Paint, Traffic and Airfield Marking, Water Emulsion Base
FS TT-B-1325C	(1993) Beads (Glass Spheres) Retro Reflective

MARYLAND DEPARTMENT OF TRANSPORTATION (MDOT)

MDOT-01	(1993) State Highway Administration Standard Specifications for Construction and Materials (including SHA Supplemental Specifications and Provisions website http://www.sha.state.md.us/ohd/hdd/spi/index.asp)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Tack Coat
Crack Filler
Striping Paint
Glass Beads
Herbicide

SD-05 Design Data

Job Mix Designs for Hot Mix Asphalt, BC & SF, including asphalt binder, aggregates, and additives

SD-06 Test Reports

Surface Smoothness and Crown Profile

SD-07 Certificates

Weight Tickets

1.3 EQUIPMENT

Trucks used for hauling HMA shall have tight, clean, and smooth metal beds, lightly coated with paraffin oil or lime solution to prevent asphalt adherence. Truck beds shall be covered.

Asphalt pavers shal be self-propelled, capable of spreading and finishing courses of HMA to the thickness, width, smoothness, and grade required.

Rollers, including sufficient number, shall be adequate to compact the HMA at the required temperatures, without crushing of the aggregates. Rollers shall be vibratory, and shall have minimum water coating system to maintain the drum in a clean condition.

PART 2 PRODUCTS

2.1 SUBBASE AND BASE COURSE MATERIALS

See Section 02300, "Earthwork" for Subbase Course and Base Course materials.

2.2 ASPHALT MATERIALS

2.2.1 Hot Mix Asphalt

Provide plant hot mix asphalt (HMA) material conforming to MDOT-01 Section 904, "Performance Graded Asphalt Binders and Hot Mix Asphalt."

Asphalt Binder shall be PG58-16 designation.

Base course HMA shall be BC mix designation.

Surface course HMA shall be SF mix designation.

2.2.2 Tack Coats

Tack shall be emulsified asphalt conforming to MDOT-01 Section 904, "Performance Graded Asphalt Binders and Hot Mix Asphalt."

2.2.3 Crack Filler

Hot-poured joint sealant for asphalt pavements conforming to ASTM D 3405.

2.3 ACCESSORIES

2.3.1 Herbicide

Commercial chemical for weed control, registered by Environmental Protection Agency, provided in granular, liquid, or wettable powder form.

2.3.2 Striping Paint

Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952D, with drying time of less than 45 minutes. Provide in white, yellow, red, blue, or black color as designated. Paint shall be reflectorized by adding glass beads in accordance with FS TT-B-1325C, Type 1, Gradation A.

PART 3 EXECUTION

3.1 WEATHER LIMITATIONS

HMA shall only be placed when the ambient air temperature is at least 40 degrees F and rising. Surfaces shall be clean and dry. HMA shall not be placed on a frozen base. Material en-route shall not be placed if weather conditions are outside of the limitations.

3.2 CRACK FILLING

Fill cracks that exceed 1/8 inch in width with crack filler. Clean entire length of crack by saw cutting, routing, or plowing to a minimum depth of one inch and a minimum width of 1/2 inch . Use power blower with specialized blow tip for final cleaning and to remove all fines and dust. Apply herbicide to areas of vegetation penetration.

Install crack filler with a portable pour pot applicator that thoroughly fills and seals entire length, width, and depth of prepared cracks. Apply crack filler uniformly and maintain a maximum width of 1/2 inch on both sides of crack. After crack filler has dried, reapply crack filler to areas which have sagged to obtain a uniform appearance. Place sand over entire length of crack to prevent tracking of crack filler.

3.3 ASPHALT PATCHES

Areas to be patched shall be squarely excavated, saw cutting pavement, and removing existing pavement, base, subbase, and subgrade material to depth indicated on drawings (or 16 inches. Patch area shall be cleaned, removing all excess material.

Install Base Course in accordance with Section 02300, "Earthwork", to a depth of10 inches .

HMA topping shall be installed: a 4 inches thick BC course, and then a 2 inches thick SF course, tacking edges and courses as indicated below.

3.3.1 Heeling-In

Where tapering of the material from the specified thickness is required to

tie into existing pavement, heel-in shall be performed.

Heel-in shall consist of cold milling existing pavement to depth of 2 inches. Mill up to and do not remove existing concrete surfaces unless concrete is spalling or delaminating. Milled surfaces shall conform to lines, grades, and cross-sections indicated. Milled surfaces shall coincide with juncture at adjacent pavements.

Care should be taken not to damage manholes or valve boxes. Surfaces resulting from cold milling operation shall be uniform and characterized by discontinuous longitudinal striations, and not gouged or torn.

3.4 PREPARATION

3.4.1 New Pavement

Subgrade, Subbase Course, and Base Course shall be constructed in accordance with the drawing requirements and as specified in Section 02300, "Earthwork."

3.4.2 Existing Pavement

When paving over existing pavement, all excess crack filling or patch material shall be removed and all spalls and potholes shall have been repaired with patch as required. All manholes, valve boxes, inlets, and other appurtenances within the paving area shall have been adjusted to new grade.

3.4.3 Tack Coat

Prior to application of tack coat, surfaces shall be cleaned of all loose and foreign materials. Tack coat shall be applied by full circulation spray bars, providing triple fanning and overlapping.

Apply tack coat to all contact surfaces of existing conditions that new asphalt abuts or lays on. Apply at rate of 0.05 to 0.15 gallon per square yard of surface.

Tack coat shall not be applied in breezy or windy conditions that could cause overspray of tack coat onto adjacent areas. Contractor shall take precautions to prevent overspray.

3.5 PLACING HMA

Temperature at time of placement shall not be less than 225 degrees F. Placement shall be by mechanical pavers (track for HMA over base course, rubber tire for HMA over HMA). Screed control shall be automatic, capable of maintaining required grade and transverse slope within plus or minus 0.1 slope percentage. Place areas inaccessible to equipment by hand. Place each course to required grade, cross-section, and compacted thickness.

Paving shall be in strips not less than 10 feet wide. Longitudinal and transverse joints in successive courses shall be staggered. Transverse joints shall be staggered the length of the paver. Longitudinal joints shall be staggered a minimum of 6 inches, and arranged so that the top course joint be within 6 inches of line dividing traffic lanes. Base course paving shall be completed and hardened before placing surface course.

Provide joints between old and new pavements, or between successive days

work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of hot-mixed asphalt course.

Sawcut and clean edges of existing pavement where new and existing paving intersect. Juncture of the new and existing paving shall be flush and made in a manner to ensure a continuous bond.

Install HMA in the following thicknesses, unless indicated otherwise:

Base Course: 4 inches.

Surface Course: 2 inches.

3.6 COMPACTION

Rolling shall consist of the following six operations in the sequence listed: Transverse Joint, Longitudinal Joint, Edges, Initial Breakdown Rolling, Second Rolling, and Finish Rolling.

Begin rolling using a 5 to 8 ton steel-wheeled tandum roller when hot asphalt mixture will bear weight of roller without excessive displacement. Compact mixture with hand tampers or vibrating compactors in areas inaccessible to rollers.

Rollers shall start at the sides and proceed longitudinally toward the center. Successive trips of the roller shall overlap by at least one-half of the width of the roller.

Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has been compacted to a minimum density of not less than 95 percent of maximum density, plus/minus 2 percent. Compaction shall be completed before the HMA cools below 185 degrees F.

After rolling, do not permit vehicular traffic on pavement until it has cooled to less than 140 degrees F and hardened. Erect barricades to protect paving from traffic until mixture has cooled and will not become marked.

3.7 FIELD QUALITY CONTROL

Contractor shall test in-place hot mixed asphalt course for compliance with requirements for thickness and surface smoothness when requested by the Contracting Officer. Contractor shall repair, or remove and replace, unacceptable paving as directed by the Contracting Officer.

3.7.1 Surface Smoothness

The Contractor shall have available, at all times, a 10 foot straightedge.

Transverse joints on each course shall be checked with a 10 foot straightedge immediately after the initial rolling. If the surface of each course varies more than 1/8 inch from true, the Contractor shall make immediate corrections so that the finished joint surface shall not vary more than 1/8 inch from true surface.

Test finished surface of each asphalt course for smoothness, using 10-foot straight edge applied parallel with and at right angle to center line of

paved areas. Surfaces which exceed the following tolerances for smoothness will not be accepted:

Milled Surfaces: 1/4 inch in 10 feet.

Base Course Surface: 1/4 inch in 10 feet.

Wearing Course Surface: 3/16 inch in 10 feet.

Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

Check surface areas at 20 foot intervals directed by the Contracting Officer.

Completed surfaces shall be free of all standing water when flood-tested. If water stands or ponds on any surface, the hot mixed asphalt surface shall be corrected to eliminate this condition without additional cost to the Government.

3.7.2 Thickness

Test in-place compacted asphalt courses for thickness in accordance with ASTM D 3549, when requested by the Contracting Officer. Asphalt thickness which exceed the following tolerances for thickness will not be accepted:

Base Course: Plus or minus 1/2 inch.

Surface Course: Plus or minus 1/4 inch.

3.7.3 Inspection

Submit weigh tickets to the Contracting Officer.

3.8 TRAFFIC AND LINE MARKINGS

Sweep and clean surfaces to eliminate loose material and dust. Apply in accordance with manufacturer's directions.

Apply paint with mechanical equipment to produce uniform straight edges. Apply at manufacturer's recommended rates to provide minimum 12 to 15 mils dry thickness. Glass beads shall be dropped or sprayed onto markings at rate of 6 pounds per gallon of paint.

Markings shall be sharply outlined with uniform thickness.

Discoloration of paint or "bleeding through" will require another application of paint to ensure adequate coverage.

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SECTION 02825

PERIMETER CHAIN LINK FENCES AND GATES
10/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 116	(2000) Standard Specification for Metallic-Coated Steel Woven Wire Fence Fabric
ASTM A 121	(1999) Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A 153/A 153M	(2001) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 390	(1995; R 2001) Standard Specification for Zinc-Coated (Galvanized) Steel Poultry Fence Fabric (Hexagonal and Straight Line)
ASTM A 392	(1996) Standard Specification for Zinc-Coated Steel Chain Link Fence Fabric
ASTM A 53/A 53M	(2001) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 584	(1997) Standard Specification for Aluminum Coated Steel Woven Wire Fence Fabric
ASTM A 702	(1989; R 2000) Standard Specification for Steel Fence Posts and Assemblies, Hot Wrought
ASTM A 780	(2001) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 817	(2000) Standard Specification for Metallic-Coated Steel Wire for Chain-Link Fence Fabric and Marcelled Tension Wire
ASTM A 824	(2001) Standard Specification for Metallic-Coated Steel Marcelled Tension Wire for Use With Chain Link Fence
ASTM A 90/A 90M	(2001) Standard Test Method for Weight (Mass) of Coating on Iron Steel Articles

	with Zinc or Zinc Alloy Coatings
ASTM C 94	(2000) Standard Specification for Ready-Mixed Concrete
ASTM F 1043	(2000) Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Link Fence Framework
ASTM F 1083	(1997) Standard Specification for Pipe, Steel Hot-Dipped Zinc Coated (Galvanized) Welded, for Fence Structures
ASTM F 1184	(1994; R 2000) Standard Specification for Industrial and Commercial Horizontal Slide Gates
ASTM F 626	(1996; Rev A) Standard Specification for Fence Fittings
ASTM F 900	(1994; R 2000) Standard Specification for Industrial and Commercial Swing Gates

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fence Fabrication/Installation Drawings
Gate Fabrication/Installation Drawings
Gate Hardware and Accessories

SD-03 Product Data

Fence
Gates
Gate Hardware and Accessories

PART 2 PRODUCTS

2.1 ZINC COATING REPAIR

Galvanizing repair material shall be a cold-applied zinc-rich coating conforming to ASTM A 780.

2.2 FABRIC

Fabric shall consist of No. 9-gage wires woven into a 2-inch diamond mesh, with dimensions of fabric and wire conforming to ASTM A 392, with zinc coating applied to steel wire before weaving according to ASTM A 817, Type II, with 1.2 ounces per square foot zinc galvanizing.

Fence heights shall have one-piece fabric widths.

2.3 TOP AND BOTTOM SELVAGES

Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

2.4 LINE, END, CORNER, AND PULL POSTS AND TOP RAIL

Pipe shall conform to ASTM F 1083, Schedule 40.

Weight of zinc coating shall not be less than 1.8 ounces per square foot, conforming to ASTM F 1043.

Line posts shall be not less than 2.375 inch O.D. pipe weighing 3.65 pounds per linear foot.

End, corner, and pull posts shall be 2.875 inch O.D. pipe weighing 5.79 pounds per linear foot.

Top rails shall be a minimum of 1.660 inches32 O.D. pipe weighing 2.27 pounds per linear foot. Expansion couplings 6-inches long shall be provided at each joint in top rails. Fabricate top rail lengths 21 feet or longer with expansion couplings to provide continuous rail along top of shain link fabric.

2.5 SLEEVES

Sleeves for setting into concrete construction shall be hot-dipped galvanized steel pipe sleeves conforming to ASTM A 53/A 53M. Size shall be not less than 150 mm length, 1-inch width greater than the diameter or dimension of the post. Flat plates shall be welded to each sleeve base to provide anchorage and prevent intrusion of concrete.

2.6 POST-BRACE ASSEMBLY

Post bracing shall match top rail for material, coating, size, and weight, including 3/8 inch adjustable truss rods and turnbuckles.

2.7 TENSION WIRE

Wire shall be 0.177 inch diameter complying with ASTM A 824, Type II galvanized, complying with Class 2 coating, 1.2 ounces per square foot.

2.8 BARBED WIRE

Wire shall be 0.099 inch diameter conforming to ASTM A 121, 2 strand, with 14-gage 4-point round barbs spaced 5 inches on center.

2.9 FENCE FITTINGS

Fence fittings shall comply with ASTM F 626, hot dipped galvanized with a minimum 1.2 ounces per square foot.

2.9.1 Barbed Wire Supporting Arms

Supporting arms shall be steel or cast iron, Type III V-shaped arm, with provisions for anchorage to posts and for attaching 5 rows of barbed wire to each arm. Supporting arms may either be attached to posts or integral with the post and line top.

2.9.2 Tension Bars

Bars shall be one-piece steel lengths equal to the full height of the fabricless two inches with a minimum cross section of 3/16 by 3/4 inch.

2.9.3 Post And Line Tops

Tops shall be steel or cast iron designed as a weathertight closure cap. One cap shall be provided for each post, unless equal protection is provided by a combination post-cap and barbed-wire supporting arm. Caps shall have an opening to permit through passage of the top rail.

2.9.4 Tension Bar Bands

Bands for securing tension bars to posts shall be 14-gage steel, minimum 3/4 inch width spaced not over 15 inches on center. Bands may also be used in conjunction with special fittings for securing rails to posts. Bands shall have projecting edges chamfered or eased.

2.9.5 Tie Wires

Tie wires for attaching fabric to posts, rails, and frames shall be standard steel round wire ties 0.106 inch diameter, with galvanized coating matching thickness of fence fabric.

Hog rings for attaching fabric to horizontal tension wire shall be steel round wire hog rings 0.106 inch diameter, with galvanized coating matching thickness of fence fabric.

2.10 SWING GATES

Swing gates shall be steel, galvanized in accordance with ASTM F 900.

2.10.1 Posts

Posts shall comply with ASTM F 900, Table 2, and shall be as follows:

Up to 6-feet wide:

2.875 inch O.D. pipe weighing 4.64 pounds per linear foot.

Over 6 feet wide and up to 12 feet wide:

4.000 inch O.D. pipe weighing 8.65 pounds per linear foot.

Over 12-feet and up to 18-feet wide:

Provide 6.625 inch O.D. pipe weighing 18.02 pounds per linear foot.

Over 18-feet and up to 24 feet wide:

Provide 8.625 inch O.D. pipe weighing 27.12 pounds per linear foot.

2.10.2 Frames

Frames shall comply with ASTM F 900, Table 1.

Frames shall be 1.90 inch O.D. pipe weighing 2.28 pounds per linear foot.

Interior bracing shall be 1.66 inch O.D. pipe weighing 1.83 pounds per linear foot.

Gate frame assembly shall be welded or assembled with special malleable or pressed-steel fittings and rivets to provide rigid connections. Hardware shall be attached with rivets or by other means that will provide equal security against breakage or removal.

Where barbed wire is indicated above gates, the end members of gate frames shall be extended approximately 1-foot above the top member with provision for attaching the wire. Vertical support arms shall be provided at intermediate points, spaced the same as line posts.

2.10.3 Hardware and Accessories

Hardware and accessories shall conform to ASTM F 900.

Hinges shall be malleable iron, forged steel, or pressed steel to suit gate size, non-lift-off type, offset to permit 180-degree opening. Swing shall be as indicated on the drawings.

Latch shall permit operation from either side of the gate, with a padlock eye provided as an integral part of the latch.

Stops and holders of malleable iron shall be provided for vehicular gates. Stops shall automatically engage the gate and hold it in the open position until manually released.

Barbed wire shall extend the width of the gate with same sectional requirements as for fence.

Where double gates are required, double gates shall be provided with a cane bolt and ground-set keeper, with latch or locking device and padlock eye designed as an integral part.

2.11 SLIDE GATES

Slide gates shall be steel, galvanized, Type II, Class 2 confirming to ASTM F 1184.

2.11.1 Posts

Up to 12-feet wide:

2.875 inch O.D. pipe weighing 4.64 pounds per linear foot.

Over 12-feet and up to 30 feet wide:

4.000 inch O.D. pipe weighing 6.56 pounds per linear foot.

2.11.2 Frames

Frames shall comply with ASTM F 1184, Table 2.

2.11.3 Roller Assembly

Internal rollers with sealed ball bearing wheels.

2.11.4 Performance Criteria

Gate shall comply with minimum performance criteria specified in ASTM F 1184, Table 3.

2.11.5 Hardware and Accessories

Latch shall permit operation from either side of the gate, with a padlock eye provided as an integral part of the latch.

Barbed wire shall extend the width of the gate, with the same sectinal requirements as for fence.

2.12 MISCELLANEOUS HARDWARE

Miscellaneous hardware shall be provided as required and shall be hot-dip galvanized, conforming to ASTM A 153/A 153M.

2.13 CONCRETE

Concrete shall conform to Section 03305, "Cast-in-Place Concrete".

PART 3 EXECUTION

3.1 GENERAL

Fencing installation shall not begin before the final grading has been completed and finish elevations have been established, unless otherwise approved.

Unless otherwise indicated, final fencing shall provide 7 feet from grade to top post, and 1 foot from top post to top of barbed wire supporting arms.

3.2 EXCAVATION

Excavations for post footings shall be drilled holes in virgin or compacted soil, of minimum sizes as indicated.

Footings shall be spaced for line posts 10 feet on center maximum and at closer intervals when indicated.

Bottoms of the holes shall be approximately 3-inches below the bottoms of the posts. Bottom of each post shall be set not less than 36-inches below finished grade when in firm, undisturbed soil. Posts shall be set deeper, as required, in soft and problem soils and for heavy, lateral loads.

Soil from excavations shall be removed from Government property.

3.3 SETTING POSTS

Loose and foreign materials shall be removed from holes.

Tops of footings shall be trowel finished and sloped or domed to shed water away from posts. Hold-open devices, sleeves, and other accessories shall be set in concrete.

Posts set into sleeved holes in concrete shall be grouted in with an approved grouting material.

Posts set in concrete construction shall be set vertically, with tops aligned and held in position until concrete has set.

3.4 CONCRETE STRENGTH

Concrete shall have attained at least 75 percent of its minimum 28-day compressive strength, but in no case sooner than 7 days after placement, before rails, tension wires, barbed wire, or fabric are installed. Fabric and wires shall not be stretched or gates hung until the concrete has attained its full design strength.

3.5 TOP RAILS

Top rails shall run continuously through post caps or extension arms, bending to radius for curved runs. Expansion couplings shall be provided as recommended by the fencing manufacturer.

3.6 BRACE ASSEMBLY

Contractor shall 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.

Brace assemblies shall be installed so posts are plumb when the diagonal rod is under proper tension.

Two complete brace assemblies shall be provided at corner and pull posts where required for stiffness and as indicated.

3.7 TENSION WIRE INSTALLATION

Tension wire shall be installed by weaving through the fabric at the bottom selvege only and tying 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.

3.8 FABRIC INSTALLATION

Fabric shall be provided in single lengths between stretch bars with bottom barbs placed approximately 1-1/2-inches above the ground line. Fabric shall be pulled taut and tied to posts, rails, and tension wires with wire ties and bands.

Fabric shall be installed on the security side of fence, unless otherwise directed.

Fabric shall remain under tension after the pulling force is released.

3.9 STRETCHER BAR INSTALLATION

Stretcher bars shall be threaded through or clamped to fabric 4 inches on center and secured to posts with metal bands spaced 15 inches on center.

3.10 BARBED WIRE INSTALLATION

Three parallel strands of barbed wire shall be installed on the security side of the fence as specified or indicated. Wire shall be pulled taut and fastened securely to each support arm.

3.11 GATE INSTALLATION

Gates shall be installed plumb, level, and secure, with full opening without interference. Ground-set items shall be installed in concrete for anchorage as recommended by the fence manufacturer. Hardware shall be adjusted for smooth operation and lubricated where necessary.

3.12 TIE WIRES

Tie wires shall be U-shaped to the pipe diameters to which attached. Ends of tie wires shall be twisted not less than two full turns and bent so as not to present a hazard. Maximum spacing shall be 12 inches on centers to tie fabric to posts, 24 inches on centers to tie fabric to bracing.

3.13 FASTENERS

Nuts for tension bands and hardware shall be installed on the side of the fence opposite the fabric side. Ends of bolts shall be peened to prevent removal of nuts.

3.14 ZINC-COATING REPAIR

Galvanized surfaces damaged by welding or abrasions, and cut ends of fabric, barbed wire, or other cut sections shall be cleaned and repaired with specified galvanizing repair material applied in strict conformance with the manufacturer's printed instructions.

3.15 TOLERANCES

Posts shall be straight and plumb within a vertical tolerance of 1/4 inch after the fabric has been stretched. Fencing and gates shall be true to line with no more than 1/2 inch deviation from the established centerline between line posts. Defects shall be repaired as directed.

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SECTION 02930

LAWNS AND GRASSES

06/98

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SECTION 02930

LAWNS AND GRASSES
06/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602	(1995; Rev A; R 2001) Specifications for Agricultural Liming Materials

MARYLAND DEPARTMENT OF ENVIRONMENT (MDE)

MDE-01	(2000) Maryland Standards and Specifications for Soil Erosion and Sediment Control

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-06 Test Reports

Top Soil Analysis from qualified testing agency indicating compliance with specified requirements for the following:

Existing surface soil
Imported topsoil

SD-07 Certificates

Certification of Grass Seed from seed vendor for each grass seed mixture indicating the botonical and common name and percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include date of production, date of packaging, and date of being tested by a recognized independent testing agency.

1.3 QUALITY ASSURANCE

The Work of this section, including materials, preparation, seeding, hydroseeding, and sodding, shall comply with the standards and specifications for vegetative stabilization and topsoiling indicated in Sections G-20 and G-21 of MDE-01.

Grass seed shall be fresh, clean, dry, new-crop seed complying with

requirements of the Maryland State Seed Law. Seed shall have been tested by a recognized independent testing agency within the 6 months immediately preceding the date of sowing seed for Project.

If the disturbed soil area is greater than 5 acres, provide a soil analysis by a qualified independent soil testing agency indicating percentages of organic matter, inorganic matter, deletrious material, pH, and mineral and plant nutrient content of topsoil. State recommended quantities of nitrogen, phosphorous, and potash nutrients, and lime or other soil amendments required to produce a satisfactory topsoil.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver grass seed and packaged materials in original sealed containers or bags, labeled and undamaged, and showing weight, analysis, and name of manufacturer. Protect materials during delivery and store off ground and under watertight cover.

Deliver fertilizers to the site in fully labeled containers bearing name, trade name or trademark, and warranty of producer.

1.5 PROJECT CONDITIONS

Do not place topsoil when the subgrade is frozen, excessively wet, extremely dry, or in a condition detrimental to grass planting or finish grading.

Seeding and sodding shall be done between March 15th and May 1st or between September 1st and October 15th, unless otherwise permitted by the Contracting Officer. When delays in operations extend the specified work beyond the most favorable planting season, or when conditions are such that satisfactory results may be obtained, the seeding and sodding work shall be stopped and resumed only when conditions are favorable.

PART 2 PRODUCTS

2.1 GRASS MATERIALS

2.1.1 Grass Seed

Provide Maryland certified grass seed blends and mixes, proportioned by weight, with minimum percentages of purity, germination, and maximum percentage of weed as indicated in Seed Schedule at the end of this section.

Inoculant for treating legume seed in seed mixtures shall be a pure culture of nitrogen-fixing bacteria prepared specifically for the species. Do not use inoculants latter than date indicated on container. Add fresh inoculant as directed on package. For hydroseeding, use four times the recommended rate than that for seeding.

2.2 TOPSOIL

Topsoil shall be a sandy loam, clay loam, loam, silt loam, sandy clay loam, or other soil approved by the Contracting Officer. Topsoil shall not contain subsoil, slag, cinders, stones, lumps of soil, sticks, roots, trash or other extraneous materials larger than 1-1/2 inches in diameter. Topsoil shall be free of plants or plant parts of Bermuda grass, quackgrass, Johnsongrass, nutsedge, poison ivy, or Canada thistle. Topsoil shall have a pH range of 5.5 to 7.5 with soluble salt content of 500 parts

per million or less, and an organic content of not less than 1.5 percent by weight.

Re-use surface soil stockpiled on the site when acceptable. Verify suitability of surface soil to produce topsoil meeting specified requirements and amend when necessary. Clean top soil of roots, plants, sods, stones, clay lumps, and other extraneous materials.

Amend existing surface soil with fertilizer and lime to produce topsoil.

Import topsoil from off-site sources when necessary. Obtain topsoil from naturally well-drained sites where top soil occurs at least 4 inches deep. Do not obtain topsoil from bogs or marshes.

Do not place seed or sod on soil which has been treated with soil sterilants until sufficient time has elapsed to permit dissapation of toxic materials. Contractor shall be responsible for loss or damage to seed or sod through the use of sterilants, or due to failure to allow sufficient time for dissipation of toxic materials.

2.3 LIME

Lime shall be ground agricultural limestone containing at least 50 percent oxides (calcium oxide plus magnesium oxide), ground to such fineness that at least 98 percent will pass through a No. 20 sieve and at least 50 percent will pass through a No. 100 sieve, and meet the requirements of ASTM C 602, agricultural limestone Class Designation T.

2.4 FERTILIZER

Fertilizer shall be commercial grade fertilizer of neutral grade, consisting of fast and slow release nitrogen, 50 percent derived from natural organic sources of urea-form, phosphorous, and potassium.

2.5 MULCH

Straw mulch shall consist of threshed wheat, rye, or oat straw. Hay mulch shall consist of native grasses or other plant material approved by the Contracting Officer. Straw and hay mulch shall be free of noxious weed seeds as indicated in the Maryland Seed Law, and shall not be musty, moldy, caked, decayed or excessively dusty.

Fiber mulch shall consist of biodegradable dyed wood cellulose fiber, nontoxic, free of plant growth or germination inhibiters. The wood fibers shall be comprised of 100% recycled (recovered) wood. Mulch shall remain in uniform suspension in water under agitation and blend with seed, fertilizer and other additives to form a homogeneous slurry, and shall cover and hold grass seed in contact with soil without inhibiting growth of grass seedlings. Fiber length shall be approximately 10 millimeter, fiber diameter approximately 1 millimeter, pH range of 4.0 to 8.5, maximum ash content of 1.6 percent, and minimum water holding capacity of 90 percent.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Subsoil Preparation

Immediately prior to placing topsoil, loosen subgrade surfaces by disking

or scarifying to a minimum depth of 3 inches. Remove sticks, roots, rubbish, stones larger than 1-1/2 inches in diameter, and other extraneous materials.

3.1.2 Placing Topsoil

Spread topsoil uniformly on designated areas to a minimum depth of 4 inches after firming. Correct irregularities in surface resulting from topsoil installation to prevent formation of depressions or water pockets. Do not spread topsoil if frozen or muddy, or if subgrade is wet, frozen, or in condition detrimental to lawn planting.

3.1.3 Existing Topsoil Preparation

In areas where surface soil is not stripped and stockpiled, prepare existing topsoil for lawn planting. Remove and dispose of existing grass, vegetation, and turf. Do not turnover into soil being prepared for lawns. Till surface soil to a depth of 6 inches. Apply required lime and fertilizers and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture. Trim high areas and fill low depressions.

In low maintenance and rough areas, prepare seedbed by loosening soil to depth of 3 to 5 inches by disking, harrowing, or other means approved by Contracting Officer. Leave loosened soil in roughened condition. Track areas with slopes greater than 3 to 1 with ridges running parallel to contours of slope.

3.1.4 Application of Lime

Apply lime in accordance with soil test results. Otherwise, uniformly distribute lime over the topsoil surfaces at a rate of 100 pounds per 1000 square feet , unless indicated otherwise, and incorporate into the topsoil to a depth of at least 3 inches by disking, harrowing, or other means approved by Contracting Officer.

3.1.5 Application of Fertilizer

Apply fertilizer in accordance with soil test results. Otherwise, uniformly distribute fertilizer over topsoil surface at a rate of 2 pounds actual nitrogen, 4 pounds of actual phosphorous (P205), and 4 pounds of actual potassium (K20) per 1000 square feet, unless indicated otherwise, and incorporate into the topsoil to a depth of at least3 inch by disking, harrowing, or other approved means.

3.1.6 Grading

Grade areas to be seeded and sodded to a smooth and even surface. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit fine grading to areas which can be planted immediately. Remove trash, debris, stones larger than 1-1/2 inches in diameter, or other objects which may interfere with grass planting.

3.2 SEEDING

Apply grass seed using a conventional drop spreader, broadcast spreader, or cultipacker seeding machine. Do not apply grass seed when wind velocity exceeds 5 miles per hour. Evenly distribute seed by sowing in two directions at right angles to each other. Apply one-half of seed rate in

each direction.

Apply grass seed at rates indicated in Seeding Schedule. Rake seed lightly into top 1/4 inch of topsoil, roll lightly, and water with fine spray.

Protect seeded areas by spreading straw or hay mulch after completion of seeding operations. Spread straw and hay mulch at rate of 2 tons per acre. Apply to a uniform loose depth of not less than 1 inch and not more than 2 inches, with no more than 10 percent of soil surface exposed. Increase spreading rate to 2.5 tons per acre when mulch is secured with a mulch anchoring tool.

Anchor straw or hay mulch immediately after placement by one of the methods indicated in Section G-20 of MDE-01.

3.3 HYDROSEEDING

Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Mix until uniformly blended into a homogeneous slurry suitable for hydraulic application. Apply slurry uniformly to areas to be hydroseeded.

Apply wood cellulose fiber mulch at a minimum net dry weight of 1500 pounds per acre. Mix cellulose fiber with water at a maximum rate of 50 pounds per 100 gallons of water.

3.4 TEMPORARY COVER

Provide temporary cover on disturbed areas to protect soils and prevent erosion in compliance with standards and specifications for vegetative stabilization indicated in Section G-20 of MDE-01. Coordinate application of temporary cover with installation and maintenance of sediment and erosion control Work.

When temporary grass cover is unfeasible or when seeding is impractical due to weather or frozen ground conditions, mulch disturbed area without seeding.

3.5 PROTECTION

Protect seeded and sodded areas from damage due to trespassing and the work of other contractors and trades. Erect barricades with warning signs, approved by Contracting Officer, around each area immediately after the seeding and sodding is completed.

3.6 CLEANING

Keep pavements clean and work areas in an orderly condition. Remove surplus soil and waste materials, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose off the site.

3.7 MAINTENANCE

Begin maintenance of lawns immediately after each area is planted and continue until an acceptable lawn is established, but not for less than 30 days after project completion. Maintain and establish lawns by watering, mowing, trimming, and replanting. Roll, regrade, and replant bare or eroded areas and re-mulch to produce a uniformly smooth lawn.

The Government will provide a water source for watering lawn areas. Hoses, watering equipment, anti-siphon devices, fittings, and equipment necessary to connect to fire hydrants as a water source shall be provided by the Contractor, and comply with Washington Suburban Sanitary Commission's rules and regulations. The Contractor shall be responsible for coordinating water source and having adequate water available at seeded areas prior to, during, and after installation of lawns.

If portions of the grass surface become gullied or otherwise damaged following seeding or the grass seedlings have been destroyed prior to completion and acceptance of the Work, the affected area shall be repaired to re-establish the condition and grade of the soil prior to seeding and then re-seeded, re-mulched, and the grass established as specified.

3.8 SEEDING SCHEDULE

See Standard Erosion Control Drawing for Schedule.

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SECTION 02932

TREE PRESERVATION

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SECTION 02932

TREE PRESERVATION
06/98

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A 300	(1995) Tree, Shrub and Other Woody Plant Maintenance

MARYLAND DEPARTMENT OF ENVIRONMENT (MDE)

MDE-01	(2000) Maryland Standards and Specifications for Soil Erosion and Sediment Control

MARYLAND DEPARTMENT OF NATURAL RESOURCES (DNR)

DNR-01	Forest Conservation Manual

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Submit Manufacturer's Catalog Data on Fertilizer and Pesticides.

SD-07 Certificates

Submit Certificates of compliance on Cabling Hardware, Mulch, and Fence.

1.4 DEFINITIONS

Tree Diameter: Diameter at breast height (dbh) which is the average tree diameter at 4 feet 6 inches above the ground on uphill side of tree.

Tree Caliper: Diameter of tree trunk at 6 inchesabove soil for trees up to 6 inches in caliper, and diameter at 12 inches above soil for trees up to 12 inches caliper.

Root Zone: 12 inches of radius around trunk of tree for every 1 inch of

trunk diameter at 4 feet 6 inchesabove ground level on the uphill side of tree.

Tree Damage: Unauthorized encroachment into tree preservation areas or failure to comply with Contract Documents at any time during construction operations.

Tree Preservation Area: Area outside limits of construction which contain trees, and areas designated as tree preservation areas located within limits of construction and designated on the Drawings or in the field by fencing and signage.

1.5 PERFORMANCE REQUIREMENTS

Site trees designated to be preserved shall be treated to maximize their potential for survival and to improve their health and present condition. Work shall be performed in accordance with current industry standards and the most recent standards published by the National Arborist Association.

1.6 DAMAGES AND PENALTIES

Contractor shall compensate the Government for damage due to construction operations to trees marked for preservation on the Drawings or designated in the field within protection fencing. Compensation will be in the form a fine levied for each specific violation.

Contractor shall compensate the Government the sum of $500 per 1 inch of tree diameter for damaged trees over 10 inches in diameter. Diameters of trees to be preserved will be recorded by the Contracting Officer prior to the start of construction and shall be the basis for assessment of damages.

Remedial work to repair damaged trees may be substituted for penalties at the Government's option.

Contractor shall be responsible for fines and penalties assessed by the Maryland Department of Natural Resources for non-compliance with DNR-01.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Fertilizer

Granular: 30-7-7 with 50 percent of nitrogen in slow release form. Formula shall contain micronutrient compliment.

Liquid: 30-10-7 arboricultural grade. Nitrogen shall be 67 percent slow release in the form of ureaformaldehyde. Potassium shall be derived from soluble potash. Phosphorous shall be in the form of phosphoric acid.

Root Stimulant: Provide "Roots" concentrate, or approved equal.

2.1.2 Pesticides

The following pesticides are acceptable for use. Request written permission from the Contracting Officer for pesticides not listed below:

Biological Control: Bacillus thuringensis, predatory mites, parasitic nematodes, parasitic insects, predatory insects, or other biological

agents approved for use by the Contracting Officer.

Fungicides for Trees and Shrubs: Mancozeb, thiophanate methyl, or triademefon.

Miticide for Trees and Shrubs: Chinomethionate or dicofol.

Superior Oil for Trees and Shrubs: Horticultural grade, highly refined potassium salts of fatty acids.

Insecticides for Trees and Shrubs: Acephate, cyfluthrin, fluvalinate, chlorpyrifos, bendiocarb, or dimethoate.

2.1.3 Cabling Hardware

Cable: 1/4 or 5/16 inch diameter, 7-strand extra strength steel, attached with preformed cable grips.

Lag Hooks: 5/16 or 3/8 inch drop forged.

Drop Forged Eye-bolt or threaded rod with Amon eye nut.

2.1.4 Mulch

Shredded or wood chips, free of toxic or undesirable materials and comprised completely of wood fiber, bark, twig and leaf material.

2.1.5 Fencing

Tree Protection Fencing: Provide minimum 4 foot high snow fence or blaze orange plastic mesh fence with tree protection signs in accordance with DNR-01.

Silt Fencing: Provide "100X" manufactured by Mirafi Inc., or equal product approved by the Contracting Officer, in accordance with MDE-01.

PART 3 EXECUTION

3.1 GENERAL

Individual trees or groups of trees to be preserved shall be marked by the Contractor and approved by the Contracting Officer. No other construction activity shall occur until tree preservation fencing has been installed and approved. Islands in parking lot areas shall be staked and reviewed by the Contracting Officer prior to site clearing. Coordinate the tree preservaton work with other trades to prevent delay in construction operations.

Construction activity within fenced areas around trees to be preserved is prohibited, including parking of equipment, storage of materials, dumping of wastes, and trenching or grading near tree drip lines, unless written approval is obtained from the Contracting Officer. If approved, Contractor may operate equipment within the root zone of trees to be preserved only if buffered with 1/2-inch plywood over a layer of wood chips, or if ground is frozen solid and can accommodate travel without rutting.

Work required by the plans within a tree preservation area shall be performed by hand and in a manner to prevent compaction, siltation, and disturbance to the tree root mat and understory.

Tree preservation work shall be performed in the safest manner possible.

3.2 TREE PROTECTION

Install tree protection fencing at limits of disturbance around trees and groups of trees to be preserved. Flag or paint location of fencing in field and verify location with the Contracting Officer.

Install fencing continuously, or in panels, with adequate anchorage to withstand incidental contact during construction operations.

Maintain tree protection fencing during construction operations and remove at project completion.

Place signs prohibiting access to tree preservation areas every 30 feet along fencing. Signs shall be bright yellow with red letters and reading "TREE PRESERVATION AREA - KEEP OUT." Sign material shall be plastic or other weather resistant material."

3.3 SILT PREVENTION

Install silt fencing where indicated on Drawings. Install additional silt fencing as necessary to prevent silt from entering tree preservation areas.

Do not allow silt to collect in preservation areas. Silt which accumulates in tree preservation areas will be considered tree damage and will require removal by hand or with hydra-val within 48 hours of occurrence. If silt is not removed within 48 hours, the Government may have silt removed and Contractor shall be liable for all incurred costs.

Maintain silt fencing until site is stabilized and the potential for siltation in tree preservation areas is controlled. Remove silt, which occurs after silt fencing is removed, within 48 hours.

3.4 ROOT PRUNING

Perform root pruning when finish grades will be lowered within root zone of tree to be preserved. Root prune to depth of excavation, or 36 inches, whichever is less. Prune roots with a trencher or vibrating plow. For roots over 2 inches in diameter, make a clean cut on the surface of root which is attached to the tree. Make cut by hand saw or chain saw as soon as larger root is severed.

3.5 MULCHING

Mulch key trees with root zones impacted by construction with wood chips obtained from on-site pruning and tree removal operations. Apply mulch in 4 inch thickness and kept minimum 2 inches from trunk of trees. Minimum radius of mulch ring shall be 6 inches per inch of trunk diameter, or 3 feet, whichever is greater. Maximum radius of mulch ring shall be drip line of tree.

3.6 CABLING AND BRACING

Cable and brace key trees with weak structural characteristics with appropriate cabling hardware.

3.7 INTEGRATED PEST MANAGEMENT

Monitor and treat pests which threaten the health and survival of trees to be preserved. Provide the proper equipment and the services of an Integrated Pest Management Technician to monitor and treat pests. Submit a report following each visit by the IPM technician which describes pests observed and treatments applied, and indicate other issues observed which could affect the survival of trees to be preserved.

As part of the IPM program, apply water to key trees during site inspection visits by the IPM technician when soil moisture is below 40 percent of field capacity.

3.8 PESTICIDE APPLICATION

Apply pesticides under the supervision of the Certified Pesticide Applicator. Apply pesticides in strict accordance with instructions on labels and governmental regulations. Contractor shall have Material Safety Data Sheets available for all pesticides while on site.

Request permission for using pesticides from the Contracting Officer prior to application. Notify the Contracting Officer of site conditions at the time of application which may reduce the effectiveness of treatments.

3.9 FERTILIZATION

Key Trees: Fertilize with liquid fertilizer, applied at rate of 1.5 pounds of nitrogen per 1,000 square feet of root zone. Add a root stimulant to key trees affected by construction operations. Inject fertilizer using soil probe to a depth of 6 inches. Apply in a 3 foot grid pattern evenly distributed throughout tree root zone.

Other Trees: Fertilize with granular fertilizer, applied at rate of 3 poundsof nitrogen per 1,000 square feet of root zone, and dispersed using mechanical broadcast equipment.

3.10 GROUND PLANE IMPROVEMENT

Under the direction of the Contracting Officer, improve ground plane of trees to be preserved. Ground plane improvements shall include removal of undesirable trees, dead trees, marginal trees, invasive plants, and fallen woody debris greater than 5 inches in diameter.

3.11 TREE REMOVAL

Remove hazardous trees located within the tree preservation areas. Hazardous trees are trees located in close proximity to site improvements, pathways, or structures, and which could fall and damage property or injure people. Retain hazardous trees located in remote areas for wildlife habitat value.

Remove all wood and brush from the site or convert to wood chips and use on site. Avoid damaging residual vegetation. Remove tree stumps or grind to 6 inches below finish grade in site areas to be landscaped or planted with grass. Do not remove stumps located in other areas, and cut to 6 inches or less above finish grade.

3.12 REMEDIAL WORK

Respond to calls within 48 hours of notification for remedial services required due to tree damage by construction activities. Services may include vertical mulching and aeration, silt removal, fence repair, soil replacement, or other tree preservation work indicated in this section.

3.13 FIELD QUALITY CONTROL

The Contracting Officer will conduct periodic site visits to ensure compliance with tree preservation requirements. Respond promptly to the Contracting Officer's requests to correct preservation deficiencies which affect the survival of trees to be preserved.

3.14 PROTECTION

Prevent excessive dust from construction operations to accumulate on foliage of trees to be preserved. Regularly water travelled areas on the site or apply other dust control methods approved by the Contracting Officer to prevent dust accumulation.

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SECTION 03305

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10/01

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SECTION 03305

CAST-IN-PLACE CONCRETE
10/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 117	(1990) Standard Specifications for Tolerances for Concrete Construction and Materials
ACI 301	(1999) Standard Specification for Structural Concrete
ACI 302.1R	(1996) Guide for Concrete Floor and Slab Construction
ACI 304R	(2000) Guide for Measuring, Mixing, Transporting and Placing Concrete
ACI 305R	(1999) Hot Weather Concreting
ACI 306R	(1988) Cold Weather Concreting
ACI 315	(1999) Details and Detailing of Concrete Reinforcement
ACI 318	(1999) Building Code Requirements for Structural Concrete
ACI 318M	(1999) Building Code Requirements for Structural Concrete (Metric)
ACI 347R	(1994) Guide to Formwork for Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1997) Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 497	(1999) Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 53/A 53M	(2001) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 615/A 615M	(2001; Rev A) Standard Specification for

	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 706/A 706M	(2001) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 767/A 767M	(2000; Rev B) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A 775/A 775M	(2001) Standard Specification for Epoxy-Coated Reinforcing Steel Bars
ASTM A 82	(1997; Rev A) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM C 117	(1995) Standard Test Method for Materials Finer than 75-microns (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(1988; R 2001) Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate
ASTM C 128	(1997) Standard Test Method for Specific Gravity and Absorption of Fine Aggregate
ASTM C 136	(2001) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C 138/C 138M	(2001; Rev A) Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
ASTM C 143/C 143M	(2000) Standard Test Method for Slump of Hydraulic Cement Concrete
ASTM C 150	(2000) Standard Specification for Portland Cement
ASTM C 156	(1998) Standard Test Method for Water Retention by Concrete Curing Materials
ASTM C 171	(1997; Rev A) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 172	(1999) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 192/C 192M	(2000) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1997) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

ASTM C 233	(2001) Standard Test Method for Air-Entraining Admixtures for Concrete
ASTM C 260	(2000) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 29/C 29M	(1997) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM C 309	(1998; Rev A) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2000) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(2001) Standard Specification for Concrete Aggregates
ASTM C 39/C 39M	(2001) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(1999) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(1999; Rev A) Standard Specification for Chemical Admixtures for Concrete
ASTM C 566	(1997) Standard Test Method for Total Moisture Content of Aggregate by Drying
ASTM C 595	(2000; Rev A) Standard Specification for Blended Hydraulic Cements
ASTM C 618	(2000) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 70	(1994; R 2001) Standard Test Method for Surface Moisture in Fine Aggregate
ASTM C 881	(1999) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 932	(1998; Rev A) Standard Specification for Surface-Applied Bonding Agents for Exterior Plastering
ASTM C 94/C 94M	(2000) Standard Specification for Ready-Mixed Concrete
ASTM C 989	(1999) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars

ASTM C 990	(2000) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C 990M	(2000) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Section Using Preformed Flexible Joint Sealants (Metric)
ASTM D 1190	(1997) Standard Specification for Concrete Joint Sealer, Hot-Poured Elastic Type
ASTM D 1557	(2000) Test Method for Laboratory Compaction of Soil Using Modified Effort (56,000 ft-lbf/cu ft (2700 kN-m/cu m))
ASTM D 1751	(1999) Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996) Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2103	(1997) Standard Specification for Polyethylene Film and Sheeting
ASTM D 2628	(1991; R 1998) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 4397	(2000) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM E 329	(2000; Rev B) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM E 1155	(1996; R 2001) Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers
ASTM E 1155M	(1996; R 2001) Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers(Metric)
ASTM E 621	(1994; R 1999) Standard Practice for Use of Metric (SI) Units in Building Design and Construction

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1	(1991) Specification for Carbon Steel

	Electrodes for Shielded Metal Arc Welding
AWS D1.4	(1998) Structural Welding Code - Reinforcing Steel

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI MSP	(1997) Manual of Standard Practice

CORPS OF ENGINEERS (COE)

COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstops

U.S. DEPARTMENT OF COMMERCE PRODUCT STANDARDS (PS)

PS 1	(1995) Construction and Industrial Plywood

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Reinforcing Fabrication and Installation Drawings for concrete. Drawings shall be in accordance with ACI 315, and shall include material properties, strength grade, bent bar diagrams, bar schedules, arrangements, spacings, and supports.

Formwork Drawings , when required or specified, shall indicate fabrication, assembly, and all supports. All loads shall be indicated, and the work shall be prepared by a qualified professional engineer.

SD-03 Product Data

Joint Materials
Water-Vapor Barrier Subgrade Cover
Bonding Materials
Liquid Chemical Floor Hardener
Curing Materials
Slab Repair Topping Material

SD-04 Samples

Provide 12-inches x 12-inches samples of Liquid Chemical Floor Hardener

SD-05 Design Data

Mix Design Data for each class of concrete. Mix design shall indicate all mix components and compliance with references, including hardened concrete properties. The mix design shall clearly indicate by weight, total portland cement content, and total cement replacement content for each type of material in the mix.

Concrete Aggregates
Portland Cement
Blended Hydraulic Cements, data from cement material manufacturer indicating the constituent weights of Portland Cement, Pozzolan, Fly Ash, and Blast Furnace Slag contained in the blended cements, expressed in percent of the total weight of cementitous material
Cememtitious Admixtures
Chemical Admixtures
Mix design shall indicate amount of mix water to be withheld for later addition at project site

SD-06 Test Reports

Compressive Strength Laboratory Test Reports
Slab Finish Tolerance Field Test Reports

Daily Field Test Reports for concrete shall indicate slump, air content, concrete temperature, air temperature, water added at site, compressive strength cylinder sets
Location of Placement (clearly identifying extents)
Quantity in Cubic Yards of Placement
Start Time of Placement
Ending Time of Placement
Delivery Tickets Copy

SD-07 Certificates

Amounts of EPA Designated Materials used, in accordance with the Contract Requirements. To be submitted anually.

1.3 QUALIFICATIONS FOR CONCRETE TESTING SERVICE

The Contractor shall provide concrete testing which shall be performed by an approved qualified independent testing and inspection service experienced in sampling and testing concrete. Testing agency shall meet the requirements of ASTM E 329.

1.4 CONCRETE SAMPLING AND TESTING

Testing by the Contractor shall include sampling and testing concrete materials proposed for use in the work and testing the design mix for each class of concrete, and quality control testing during construction.

Personnel conducting field tests shall be certified per ACI Certification program:
Concrete Field Testing Technician - Grade I
Concrete Construction Inspector.

1.5 DELIVERY AND STORAGE OF MATERIALS

Packaged materials shall be stored on-site in their original, unopened package or container bearing label clearly identifying manufacturer's name, brand name, material, and other pertinent information, in a weathertight and dry place until ready for use in the work.

Reinforcement and other metal items shall be protected from corrosion and shall be kept free from ice, grease, and other coatings that would destroy or reduce bond.

1.6 QUALITY-CONTROL TESTING DURING CONSTRUCTION

Concrete shall be sampled and tested for quality control by the Contractor's independent testing agency during the placement of the concrete as follows:

REQUIREMENT	TEST METHOD	NUMBER OF TESTS
Sampling fresh concrete	ASTM C 172 except modified for slump per ASTM C 94/C 94M	As required for each test
Slump test	ASTM C 143/C 143M	One for each concrete load at point of discharge and one for each set of compressive strength tests
Air content by pressure method	ASTM C 231	One for each set of compressive strength tests
Compression test specimens	ASTM C 31/C 31M	One set of six standard cylinders for each compressive strength test
Concrete temperature		One for each concrete load at point of discharge when air temperature is 40 degrees F or below and 80 degrees F or above; each time a set of compression test specimens is made
Compressive strength test	ASTM C 39/C 39M	One set for each 50 cubic yards or fraction thereof of each concrete class placed in any one day; two specimens tested at 7 days, three specimens tested at 28 days and one specimen retained in reserve for testing if required
Pumped Concrete		Concrete shall be tested as indicated above, at point of delivery to pump and at discharge end

1.7 INSPECTION AND ACCEPTANCE PROVISIONS

1.7.1 Evaluation of Tests

Test results for slump, air content, concrete temperature, or added water outside the range of acceptable values shall immediately be reported to the concrete supplier and the Government. Concrete placement shall not proceed until adequate corrective measures have been implemented.

1.7.2 Evaluation of Compressive Strength Tests

Concrete quality control test will be evaluated as specified.

Compressive strength tests will be considered satisfactory if the average of three consecutive compressive strength tests equal or exceed the 28-day design compressive strength, and no individual compressive strength test falls below the required 28-day design compressive strength by more than 500 pounds per square inch.

Test reports shall be reported in writing to the Government within 1 day of testing.

1.7.3 Additional Testing of Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements, the Contractor's independent testing agency shall have cores drilled from hardened concrete for compressive strength determination shall be made in accordance with ASTM C 42/C 42M, and as follows:

At least three representative cores shall be taken from each member or area of concrete-in-place that is considered potentially deficient. Location of cores shall be approved by the Contracting Officer.

Cores shall be tested after moisture conditioning in accordance with ASTM C 42/C 42M if concrete they represent will be more than superficially wet under service.

Cores shall be air dried, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and shall be tested dry if concrete they represent will be dry under service conditions.

Strength of cores from each member or area will be 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 holes shall be filled solid with patching mortar and finished to match adjacent concrete surfaces.

1.7.4 Strength of Concrete Structure

Strength of concrete structure in place will be considered deficient if it fails to comply with requirements which control strength of structure, 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.

1.7.5 Testing by the Government

The Government may inspect and test concrete separate from the Contractor's responsibilities. This will be done at no cost to the contractor, unless the inspection and testing indicates deficient concrete, for which the contractor shall reimburse the Government for the actual cost of inspection and testing.

1.7.6 Repairing Strength Deficient Concrete

Concrete work that is found inadequate by an "Strength of Concrete Structure" requirements indicated above shall be corrected in a manner approved by the Contracting Officer.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

2.1.1 Architectural Concrete

When concrete is indicated as "Architectural Concrete" on the drawings, special care shall be used to ensure that cements, aggregates, other ingredients, or combinations thereof are supplied from a single source, to provide hardened concrete that has uniform visual appearance. Additional requirements regarding formwork, fomwork tolerances, aggregates, color pigments and admixtures, samples and mockups, finish and exposed aggregate treatments shall be indicated on the drawings as applicable.

2.1.2 Concrete Aggregates

Fine and coarse aggregates shall conform to ASTM C 33, severe weathering class.

2.1.3 Cementitious Blends

Cement shall be one of the following blends:

a) portland cement - cementitious admixture blend, or
b) portland cement - blended hydraulic cement blend, or
c) portland cement - blended hydraulic cement - cementious admixture blend.

Final mix designs shall not contain less, nor more than the following total cement replacement (% by weight).

	% MINIMUM	% MAXIMUM
Flyash (alone)	10	25
GGBF Slag (alone)	10	50
Flyash/GGBF Slag (combined)	10	50*

* - Flyash shall not constitute more than 25% of the maximum

Use of cementitious materials in concrete which will have surfaces exposed in the completed structure shall be restricted so there is no change in color, source, or type of cementious material.

2.1.4 Cementitous Materials

2.1.4.1 Portland Cement

Portland Cement shall conform to ASTM C 150, Type I/II or Type II.

2.1.4.2 Blended Hydraulic Cements

Blended hydraulic cement shall be one of the following types, and shall conform to ASTM C 595.

Type IS - Portland Blast-Furnace Slag Cement, slag shall constitute between 25 percent and 70 percent of the mass of the blend.

Type IP-Portland-Pozzolan Cement, pozzolan shall constitute between 15 percent and 40 percent of the mass of the blend.

Type I(PM) - Pozzolan-Modified Portland Cement, pozzolan shall constitute no more than 15% of the mass of the blend.

Type I(SM) - Slag-Modified Portland Cement, slag shall constitute no more than 25% of the mass of the blend.

2.1.5 Cementitious Admixtures

2.1.5.1 Pozzolan (Fly Ash)

Fly ash shall conform to ASTM C 618, Class C or F.

2.1.5.2 Ground Granulated Blast-Furnace Slag

GGBF Slag shall conform to ASTM C 989, Grade 100 or 120.

2.1.6 Chemical Admixtures

2.1.6.1 Air-Entraining Admixtures

Air-entraining admixtures shall conform to ASTM C 260.

2.1.6.2 Other Admixtures

Water-reducing admixtures, retarding admixtures, accelerating admixtures, water-reducing and accelerating admixtures, and water-reducing and retarding admixtures shall conform to ASTM C 494/C 494M.

2.1.7 Water

Water shall be potable.

2.2 CLASSIFICATION AND QUALITY OF CONCRETE

2.2.1 Concrete Classes and Usage

Concrete classes, compressive strength, requirements for air entrainment, and usage shall be as follows:

CONCRETE CLASS	MIN. 28-DAY COMPRESSIVE STRENGTH PSI	AVE. COMPRESSIVE STRENGTH MEGAPASCAL (per ACI)	USAGE
CLSM	100 min, 150 max		(see Section 02300)
25	3,000	33.5	For all project requirements, unless indicated otherwise
30	4,000	38.5	For concrete work where indicated
35	5,000	43.5	For concrete work where indicated

2.2.2 Limits for Concrete Proportions

Limits for maximum water/cement ratio (by weight) for each concrete class shall be as follows:

CONCRETE CLASS	MAX. WATER/CEMENT RATIO BY WEIGHT
CLSM	0.70
25	0.50
30	0.45
35	0.40

2.2.3 Maximum Size of Aggregate

Size of aggregate, designated by the sieve size on which maximum amount of retained coarse aggregate is 5 to 10 percent by weight, shall be as follows:

MAXIMUM SIZE OF AGGREGATE	ASTM C 33 SIZE NUMBER	TYPE OF CONSTRUCTION
3/4 inch	67	6 inches All project requirements except as indicated
		1 inch

MAXIMUM SIZE OF AGGREGATE	ASTM C 33 SIZE NUMBER	TYPE OF CONSTRUCTION
3/8 inch	8	Slabs less than 3 inches depth or clear spacing between rebar less than 1 inch
	9 or 10	For all CLSM uses

Maximum size of aggregate may be that required for most critical type of construction using that concrete class.

2.2.4 Slump

Slump for concrete at time and in location of placement shall be not less than 1 inch nor more than 4 inches.

Slump for CSLM only shall be 7 - 9 inches.

2.2.5 Total Air Content

Air content of concrete, unless otherwise indicated, shall be approximately 5-1/2 percent, plus/minus 1-1/2 percent.

Air content for CLSM shall be between 0 percent and 10 percent.

2.3 READY-MIX CONCRETE

Concrete shall meet the requirements of ASTM C 94/C 94M. Manufacturer must be certified according to the National Ready Mixed Concrete Association's Certification of Ready Mixed Concrete Production Facilities.

Ready-mixed concrete manufacturer shall provide duplicate delivery tickets with each load of concrete delivered. Delivery tickets shall provide the following information in addition to that required by ASTM C 94/C 94M:

Type and brand cement

Cement content in 94-pound bags per cubic yard of concrete

Maximum size of aggregate

Amount and brand name of admixtures

Total water content expressed by water/cement ratio

Amount of water allowed to be added at project site (to conform to approved mix design water/cement ratio)

2.4 FORM FACING MATERIALS

2.4.1 Forms for Class A, B, and C Finish (Exposed to View or Surfaced)

Exterior grade plywood shall conform to PS 1, B-B, concrete form, Class 1, not less than 5/8-inch thick, mill oiled and edge sealed. Other form materials may be used provided the smoothness and appearance of the concrete produced is equivalent to plywood forms.

2.4.2 Forms for Class D Finish (Concealed)

Plywood, lumber, metal, or another approved material. Lumber shall be dressed on at least two edges and one side for tight fit.

2.4.3 Forms for Curb, Curb and Gutter, and Pavement

Forms shall be straight, free of distortion, and extend the full depth of the concrete. Forms may be of wood or steel, of ample strength to resist springing during concrete placement.

2.4.4 Chamfer Strips

Chamfer strips shall be wood, metal, PVC, or rubber strips 3/4 inch by 3/4 inch.

2.4.5 Form Release Agent

Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

2.4.6 Form Ties

Factory fabricated, removable or snap-off, metal or glass-fiber-reinforced plastic, designed to prevent spalling of concrete on removal, and will leave no corrodible metal closer than 1 inch to concrete surface.

2.5 REINFORCEMENT MATERIALS

2.5.1 Reinforcing Bars

Reinforcing bars shall conform to ASTM A 615/A 615M and Supplemental S1, Grade 60.

2.5.2 Steel Wire

Wire shall conform to ASTM A 82.

2.5.3 Joint Dowels

Dowels shall conform to ASTM A 615/A 615M, Grade 60. Dowel pipe shall be steel conforming to ASTM A 53/A 53M.

2.5.4 Welded Wire Fabric

Fabric shall conform to ASTM A 185.

2.5.5 Supports for Reinforcement

Supports shall include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening reinforcing bars and wire fabric in place.

Supports shall be wire bar type conforming to ACI 315 and CRSI MSP.

Legs of supports in contact with formwork shall be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

2.6 JOINT MATERIALS

2.6.1 Waterstops

Waterstops shall be 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. Corners, intersections, and directional changes shall be factory fabricated.

Waterstops shall be polyvinylchloride (PVC) conforming to COE CRD-C 572.

2.6.2 Preformed Joint Filler Strips

Filler strips shall be nonextruding and resilient bituminous type conforming to ASTM D 1751.

2.6.3 Joint Sealant Compound

Compound shall be hot-poured, elastic type conforming to ASTM D 1190.

2.7 WATER-VAPOR BARRIER SUBGRADE COVER

Cover shall be clear polyethylene sheeting, 10-mil, conforming to ASTM D 2103 and ASTM D 4397

2.8 BONDING MATERIALS

2.8.1 Concrete Bonding Agent

Agent shall be an aqueous-phase, film-forming, nonoxidizing, freeze and thaw-resistant compound suitable for brush or spray application conforming to ASTM C 932.

2.8.2 Epoxy-Resin Adhesive Binder

Binder shall be two-component, epoxy-polysulfide polymer type with an amine-type curing-agent conforming to ASTM C 881.

2.9 LIQUID CHEMICAL FLOOR HARDENER

Hardener shall be a colorless aqueous solution containing a blend of magnesium fluorosilicate and zinc fluorosilicate combined with a wetting agent. Solution shall contain not less than 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.

2.10 CONCRETE CURING MATERIALS

2.10.1 Absorptive Cover

Cover shall be burlap cloth conforming to ASTM C 171.

2.10.2 Moisture-Retaining Cover

Cover shall be polyethylene film conforming to ASTM C 171.

2.10.3 Water

Water shall be potable.

2.10.4 Membrane-Forming Curing Compound

Compound shall be liquid type conforming to ASTM C 309, Type 1, clear, for interior work; and Type 2, white, pigmented for exterior work.

PART 3 EXECUTION

3.1 INSTALLATION OF CLSM

Installation and field testing of CLSM shall be in accordance with Section 02300, "Earthwork".

3.2 FORMWORK

3.2.1 General

Forms shall be constructed to conform to shapes dimensions, lines, elevations, and positions of cast-in-place concrete members as indicated. Forms shall be supported, braced, and maintained sufficiently rigid to prevent deformation under load in accordance with ACI 301 and ACI 347R.

Construct formwork so that finished concrete is of size, shape, alignment, elevation and position indicated, with tolerance limits of ACI 117.

Concrete surface irregularities shall be gradual when encountered and shall comply as follows:

Class A Finish (1/8 inch) - Surfaces prominantly exposed to public view, or given only a paint coating.

Class B Finish (1/4 inch) - surfaces to receive plaster, stucco, or wainscoting.

Class C Finish (1/2 inch) - general standard for surfaces not otherwise classified as Class A, B, or D.

Class D Finish (1 inch) - surfaces where roughness is not objectionable, backfilled foundations, permanently concealed surfaces not requiring Class B finish.

Forms shall be tight to prevent leakage of cement paste during concrete placing.

Form facing materials shall be supported by structural members spaced close to prevent deflection of form facing material. Forms placed in successive units for continuous surfaces shall be fitted to accurate alignment to ensure a smooth completed surface within the tolerances specified. Where necessary to maintain tolerances, such as long spans where immediate supports are not possible, formwork shall be cambered for anticipated deflections in formwork due to weight and pressure of fresh concrete and to construction loads.

Exposed joints, edges, and external corners shall be chamfered a minimum of 3/4 inch by moldings placed in corners of column, beam, and wall forms.

Temporary openings shall be provided in wall forms, column forms, and at other points where necessary to permit inspection and to facilitate cleaning.

Forms shall be readily removable without impact, shock, or damage to concrete.

3.2.2 Form Ties

Form ties fabricated at the project site or wire ties of any type are not acceptable.

3.2.3 Preparation of Form Surfaces

Contact surfaces of forms shall be coated with form-coating compound before reinforcement is placed. Form-coating compound shall be a commercial formulation that will not bond with, stain, nor adversely affect concrete surfaces and will not impair subsequent treatment of concrete surfaces that entails bonding or adhesion nor impede wetting of surfaces to be cured with water or curing compounds. Excess form-coating compound shall not be allowed to stand in puddles in the forms nor to come in contact with concrete against which fresh concrete will be placed. Thinning of form-coating compound shall be made with thinning agent of the type, in the amount, and under the conditions recommended by form-coating compound manufacturer's printed or written directions.

3.2.4 Removal of Forms

Formwork for curbs, curb and gutter, and pavements may be removed 12 hours after placing concrete.

Formwork that does not support weight of concrete, such as sides of beams, walls, columns, and similar vertical parts of the work, may be removed after cumulatevely curing at not less than50 degrees F 24 hours after placing concrete, provided concrete is sufficiently hard not to be damaged from form-removal operations, and profided curing and protection operations are maintained.

Formwork that supports weight of concrete, such as beam soffits, slabs, and similar horizontal parts of the work, shall remain in place at least until concrete has attained design minimum laboratory compressive strength at 28 days for applicable concrete class specified.

Form facing material may be removed before concrete has attained its required 28-day compressive strength but in no case less than 7 days after placing concrete, provided shores and other vertical supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports. Shores and other vertical supports shall remain in place until concrete has attained its required 28-day compressive strength.

Results of control tests will be used as evidence that concrete has attained sufficient strength to permit removal of supporting forms. Test specimens shall be removed from molds at the end of 24 hours and stored in the structure as near points of sampling as possible; shall receive same protection from elements during curing as is given those portions of the structure which they represent; and shall not be removed from the structure for transmittal to the laboratory prior to expiration of three-fourths of proposed period before removal of forms. Supporting forms of shoring shall not be removed until strength of control-test specimens has attained a value of at least 1,500 psi for columns and 2,000 psi for other work. Contractor shall ensure that newly unsupported portions of the structure are not subjected to heavy construction or material loading.

Tie-rod clamps to be removed from wall shall be loosened 24 hours after concrete is placed; form ties, except for a sufficient number to hold forms in place, may be removed at that time. Ties wholly withdrawn from wall shall be pulled toward inside face.

When formwork is removed during concrete curing period, exposed concrete shall be cured as specified.

3.2.5 Re-Use of Forms

Surfaces of forms that are to be re-used shall be cleaned and repaired, except that split, frayed, or delaminated form facing material shall not be re-used. Contact surfaces of re-used forms shall be coated as specified.

3.3 REINFORCEMENT FABRICATION AND INSTALLATION

3.3.1 General

Details of reinforcement shall be in accordance with ACI 315, ACI 318M, ACI 347R, and as specified.

3.3.2 Fabrication

Reinforcing bars shall be shop fabricated, bent cold, to conform to shapes and dimensions indicated for reinforcement:

Fabrication tolerances shall be in accordance with ACI 304R, ACI 315, and ACI 117.

Hooks and bends shall be in accordance with ACI 315, and ACI 318M.

Rebending of a reinforcing bar that has been bent incorrectly shall not be permitted. Bending shall be in accordance with standard approved practice and by approved machine methods.

Reinforcing bars shall be delivered bundled, tagged, and marked. Tags shall be metal with bar size, length, mark, and other information pressed in by machine. Marks shall correspond with those used on the placing drawings.

Reinforcement which has any of the following defects shall not be used:

Bar lengths, depths, and bends beyond specified fabrication tolerances

Bends or kinks not indicated on drawings or approved shop drawings

Bars with reduced cross-section due to rusting or other cause

Defective reinforcement shall be replaced with new reinforcement having required shape, form, and cross-section area.

3.3.3 Placing Reinforcement

Reinforcement shall be placed in accordance with ACI 315 and ACI 318M.

Clean reinforcement of loose rust and mill scale, earth, and other foreign materials.

Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcment with bar supports to maintain minimum concrete cover.

Welded wire fabric shall be installed in lengths as long as possible.

Reinforcements shall be secured to supports by means of tie wire. Wire shall be black, soft iron wire, not less than 16 gage.

3.4 JOINTS

Joints shall be installed as indicated on the drawings. Joints not indicated shall be made and located so as not to impair strength and appearance of the structure and shall be as approved. Construct joints true to line with faces perpendicular to surface plane of concrete.

3.4.1 Construction Joints

Construction joints shall be located as follows:

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

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

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 shall offset a distance to twice the width of the beam. Transfer of shear through construction joint shall be made by use of inclined reinforcement.

In slabs on ground, so as to divide slab into areas not in excess of 1,200 square feet

Construction joints shall not be used in curb, curb and gutter, or pavements. Joints shall be in accordance with the pattern as shown on drawings.

Keyways at least 1-1/2-inches deep shall be provided in construction joints.

Joints shall be perpendicular to main reinforcement. Reinforcement shall be continued across construction joints, unless otherwise indicated.

Apply a concrete bondin agent where fresh concrete is placed against hardened or partially hardened concrete surfaces.

3.4.2 Waterstops

Waterstop shall be provided in construction joints as indicated, and where required for non-indicated construction joints.

Waterstops shall be installed to form a continuous diaphragm in each joint. Adequate provision shall be made to support and protect waterstops during progress of work. Field joints in waterstops shall be made in accordance with waterstop manufacturer's printed instructions, as approved.

Waterstops protruding from joints shall be protected from damage.

3.4.3 Isolation Joints in Slabs-on-Grade

Joints shall be provided at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

Joints shall be filled with premolded joint filler strips 1/2 inch thick, extending full slab depth. Filler strips shall be installed 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 will be sealed with sealing compound and not less than 1/4 inch in depth where joint sealing is not required. Wood strip shall be removed after concrete has set. Contractor shall clean groove of foreign matter and loose particles after surface has dried.

3.4.4 Control Joints in Slabs-on-Grade

Joints shall be provided to form panels as indicated.

Under and on exact line of each control joint, 50 percent of welded wire fabric reinforcement shall be cut before placing concrete.

Joints shall be 1/8-inch wide by 1/4 of slab depth and shall be formed after initial floating by grooving and finishing. Repeat grooving after applying surface finish.

3.4.5 Expansion Joints in Curb and Gutter and Sidewalks

Transverse expansion joints shall be provided as indicated, maximum of 50 foot intervals. Expansion joints shall be provided where concrete abuts other structures, sidewalks, pavements, manholes, building walls, etc. Expansion joint shall be pre-molded joint filler, not less than 1/2 inch nor more than 1 inch below finished surface.

3.4.6 Control Joints in Curb and Gutter

Transverse control joints shall be provided as indicated. Control joints shall be spaced at 10 foot intervals. Joints shall be constructed with metal separator plates. Depth of joint shall be approximately 2 inches.

3.4.7 Control Joints in Sidewalks

Transverse control joints shall be spaced at intervals equal to the sidewalk width, maximum of 10 foot intervals. Joints shall be formed using grooving tool, 1/8 inch wide by 1/4 sidewalk depth.

3.4.8 Dowel Joints

Install dowel sleeves and dowels where indicated.

3.5 INSTALLATION OF ANCHORAGE DEVICES

3.5.1 General

Anchorage devices and embedded items required for other work that is attached to, or supported by, cast-in-place concrete shall be set and built

in as part of the work of this section, using setting drawings, templates, instructions, and directions furnished with items to be embedded.

3.5.2 Placing Anchorage Devices

Anchorage devices and embedded items shall be positioned accurately and supported against displacement. Openings in anchorage devices such as slots and threaded holes shall be filled with an approved, removable material to prevent entry of concrete into openings.

3.6 PREPARATIONS FOR CONCRETE PLACING

3.6.1 General

Surfaces against which concrete is to be placed shall be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.

Do not add water to concrete during delivery, at project site, or during placement unless specifically required by the concrete mix design, or unless approved by the Engineer of Record.

3.6.2 Subgrade Under Foundations and Footings

When subgrade material is semiporous and dry, subgrade surface shall be sprinkled with water as required to eliminate suction at the time concrete is deposited. When subgrade material is porous, subgrade surface shall be sealed by covering surface with specified water barrier subgrade cover; this may also be used over semiporous, dry subgrade material instead of water sprinkling.

3.6.3 Subgrade Under Slabs on Ground

Before construction of slabs on ground, underground work on pipes and conduits shall have been completed and approved.

Previously constructed earthwork shall be inspected by the Contractor for Drainage fill surface under interior slabs on ground shall be covered with specified water-vapor barrier subgrade cover immediately prior to placing reinforcement. Subgrade cover shall be installed to avoid puncture or tear. Punctures or tears over 12 inches shall be patched with separate sheets lapped not less than 6 inches. All punctures or tears less than 12 inches shall be sealed with pressure-sensitive vapor barrier tape not less than 2-inches wide. Lapped joints shall be sealed with vapor barrier adhesive or pressure-sensitive vapor barrier tape not less than 2-inches wide. Subgrade cover sheets shall be laid with not less than a 6-inch lap at edges and ends and in direction in which concrete is to be placed.

3.6.4 Formwork

Formwork shall be complete and approved.

3.6.5 Reinforcement and Other Embedded Items

Reinforcement, joint materials, and other embedded materials shall be secured in position, inspected, and approved before start of concrete placing.

3.7 CONCRETE CONVEYING

3.7.1 Transfer of Concrete At Project Site

Concrete shall be handled from point of delivery and transfer to concrete conveying equipment and to locations of final deposit as rapidly as practical by methods which will prevent segregation and loss of concrete mix materials.

3.7.2 Mechanical Equipment for Conveying Concrete

Equipment shall ensure a continuous flow of concrete at delivery end and shall be as approved. Runways for wheeled concrete-conveying equipment shall be provided from concrete delivery point to locations of final deposit. Interior surfaces of concrete conveying equipment shall be free of hardened concrete, debris, water, snow, ice, and other deleterious substances.

3.7.3 Pumping

Pumping shall not result in separation or loss of materials nor cause interuptions to permit loss of plasticity between successive increments. Loss of slump in pumping equipment shall not exceed 2 inches. Pipe size shall not change rapidly, nor shall the diameter be less than three times the maximum aggregate size.

3.8 CONCRETE PLACING

Mixed concrete shall be discharged within 1-1/2 hours after introduction of mixing water to the cement/aggregate. Concrete shall be placed within 15 minutes after it has been discharged from the truck.

3.8.1 Cold Weather Concreting

Protect concrete work from physical damage or reduced strength that could be caused by lack of heat; comply with ACI 306R, and as follows:

When air temperature has fallen to or is expected to fall below 40 degrees F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F and not more than 80 degrees F at point of placement.

Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.

Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

3.8.2 Hot Weather Concreting

When air temperature is above 90 degrees F, reduce mixing and delivery time from 1-1/2 hours to 1 hour.

Protect concrete work from quality degradation that will be caused by any combination of excessive heat, low relative humidity, and wind velocity; comply with ACI 305R, and as follows:

Cool ingredients before mixing to maintain concrete temperature below 90 degrees F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately befoe embedding in concrete.

Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.8.3 General Placing Requirements

Concrete shall be deposited continuously or in layers of such thickness that no concrete will be 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, construction joints shall be provided as specified. Concrete placing shall be performed at such a rate that concrete which is being integrated with fresh concrete is still plastic. Concrete shall be deposited as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Concrete shall not be subjected to procedures which will cause segregation.

Concrete to receive other construction shall be screeded to proper level to avoid excessive skimming or grouting.

Concrete which becomes nonplastic and unworkable or does not meet quality control limits as specified or has been contaminated by foreign materials shall not be used. Use of retempered concrete will not be permitted. Rejected concrete shall be removed from the site.

3.8.4 Placing Concrete in Forms

Concrete placed in forms shall be deposited in horizontal layers not exceeding 24 inches.

Concrete placed in forms shall be consolidated by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Vibrators shall be designed to operate with vibratory element submerged in concrete and shall maintain a speed of not less than 9,000 impulses per minute when submerged in concrete. Vibrating equipment shall be adequate in number of units and power of each unit to properly consolidate concrete. Vibration of forms and reinforcement shall not be permitted. Vibrators shall not be used to transport concrete inside forms. Vibrators shall be inserted and withdrawn vertically at uniformly spaced points not farther apart than visible effectiveness of machine. Vibrator shall not be inserted into lower courses of concrete that have begun to set. At each insertion, duration of vibration shall be limited to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of concrete mix.

Placing of concrete in supporting elements shall not be started until concrete previously placed in columns and walls is no longer plastic and has been in place a minimum of 2 hours.

3.8.5 Placing Concrete Slabs

Concrete for slabs shall be placed and consolidated in a continuous operation, within the limits of approved construction joints until placing of panel or section is completed.

During concrete placing operations, concrete shall be consolidated by mechanical vibrating equipment so that concrete is worked around reinforcement and other embedded items and into corners. Concrete placed in beams and girders of supported slabs and against bulkheads of slabs on ground shall be consolidated by mechanical vibrators as specified. Concrete in remainder of slabs shall be consolidated by vibrating bridge screeds, roller pipe screeds, or other approved method. Consolidation operations shall be limited to time necessary to obtain consolidation of concrete without bringing an excess of fine aggregate to the surface. Concrete to be consolidated shall be as dry as practical and surfaces thereof shall not be manipulated prior to finishing operations. Concrete shall be brought to correct level with a straightedge and struck-off. Bull floats or darbies shall be used to smooth surface, leaving it free of humps or hollows. Sprinkling of water on plastic surface shall not be permitted.

Finish of slabs shall be as specified.

3.8.6 Bonding

Surfaces of set concrete at joints, except where bonding is obtained by use of concrete bonding agent, shall be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Surfaces shall be roughened in a manner that will expose the aggregate uniformly and will not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Bonding of fresh concrete that has set shall be obtained 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 shall 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, and other structural members; and at joints in work designed to contain liquids; the roughened and cleaned surface of set concrete shall be dampened but not saturated and covered with a cement grout coating.

Cement grout shall consist of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Cement grout shall be applied with a stiff broom or brush to a minimum thickness of 1/16 inch. Fresh concrete shall be deposited 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. Such bonding material shall be applied to cleaned concrete surface in accordance with approved printed instructions of bonding material manufacturer.

3.9 FINISHING OF FORMED SURFACES

3.9.1 Repairing and Patching Defective Areas

Immediately after removal of forms, defective areas shall be repaired and patched with cement mortar. Defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

Honeycomb, rock pockets, voids over 1/2 inch in any dimension, and holes left by tie rods and bolts shall be cut out to solid concrete, but in no case to a depth of less than 1 inch Edges of cuts shall be perpendicular to surface of concrete. Before placing cement mortar, area to be patched at least 6 inches adjacent thereto shall be cleaned, dampened with water, and brush coated with bonding agent. Cement mortar for patching shall consist of one part standard portland cement to two parts fine aggregate passing No. 16 mesh sieve and as little water as necessary for handling and placing. Where concrete surface will be exposed to view, portland cement portion of cement mortar shall be a blend of white and standard portland cement so that when dry, cement mortar will match surrounding concrete in color. Cement mortar shall be compacted in place and struck off slightly higher than the surrounding surface. Holes extending through concrete shall be filled by means of a plunger type gun or other suitable device from unexposed face, using a stop held at exposed face to ensure complete filling.

Fins and other projections shall be removed and rubbed down with wood blocks, so as not to exceed projections previously indicated for class A, B, C, or D finishes. Abrupt irregularities shall be removed and ground down so as to have a gradual transition.

3.9.2 Smooth (Class A) Final Finish

Finish shall be given to concrete surfaces that are to be prominently exposed to public view.

Not later than one day after form removal, moisten concrete surface and rub with carborundum brick or other abrasive until producing a uniform color and texture. Do not apply cement grout other than created by the rubbing process.

3.9.3 Smooth(Classes B and C) Final Finish

Finish shall be the concrete surface having texture imparted by form facing material used.

3.9.4 Rough (Class D) Final Finish

Finish shall be the concrete surface having texture imparted by form facing material used.

3.9.5 Related Unformed Surfaces

Tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces shall be struck off smooth after concrete is placed and shall be finished to a texture matching that of adjacent formed surfaces. Final surface treatment on formed surfaces shall continue uniformly across adjacent unformed surfaces.

3.10 FINISHING OF SLABS

Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

Surface shall uniformly slope to drains where indicated.

3.10.1 Scratch Finish

A scratch finish shall be given to slab surfaces that are to receive concrete floor topping, mortar setting beds, or other bonded, applied, cementitious finish flooring material

While still plastic, texture concrete surface using stiff brushes, brooms, or rakes, after the surface has been screeded and bull-floated or darbied.

3.10.2 Float Finish

A float finish shall be given to slab surfaces that are to receive trowel finish and other finishes as specified and to slab surfaces that are to be covered with membrane waterproofing, membrane roofing, or terrazzo.

After placing is completed, concrete shall not be worked further until ready for floating. Floating shall begin when water has disappeared, or when concrete mix has stiffened sufficiently to permit proper operation of a power-driven float, or when both conditions have occurred. Any surface water remaining shall be removed before floating. Surface shall then be consolidated with power-driven floats. Hand floating shall be used in locations inaccessible to power-driven floats.

3.10.3 Trowel Finish

Finish shall be given to slab surfaces that are to be exposed to view, and to slab surfaces to be covered with resilient flooring, paint, or other finish coating system.

After completion of float finish, the surface shall receive a trowel finish. First troweling after completion of float finish shall be done by a power-driven trowel and shall produce a smooth surface which is free of defects but which may contain some trowel marks.

Additional trowelings shall be done by hand after surface has hardened sufficiently. Final troweling shall be started when a ringing sound is produced as trowel is moved over surface. Surface shall be consolidated by hand troweling operation. Finished surface shall be free of trowel marks, uniform in texture and appearance. Surface defects of sufficient magnitude to show through floor covering shall be removed by grinding.

3.10.4 Slab Flatness and Levelness Tolerance

3.10.4.1 Straightedge Method

For slab areas not exceeding 900 square meters, surface finish shall be measured using straightedge method.

Measure surface so gap at any point between concrete surface and an unelevevated free-standing 10 foot long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed the following:

a. 1/4 inch - all slabs not requiring 3 millimeter tolerance

b. 1/8 inch - thin floor-covering, such as paint finish or vinyl composition tile.

3.10.4.2 F-Number System

For slab areas exceeding 900 square meters, surface finish shall be measured using F-Number system.

Finish surfaces to the following tolerances, measured within 24 hours according to ASTM E 1155/ E 1155M for randomly traffiked floor surface:

a. F_F17, F_L15 (both MLV) all slabs not requiring finish below
b. F_F24, F_L17 (both MLV) thin floor covering such as paint or vinyl composition tile

3.10.5 Repair Slab Surfaces

Slab surfaces which have been tested for surface tolerances, and fall outside the allowable tolerance, shall be corrected for low and high areas by cutting, patching, and grinding as necessary. The repaired slab shall be durable, matching the adjacent slab in uniformity, quality, and finish. Repairs shall provide a smooth, plane, and level surface.

After concrete has cured at least 14 days, correct high areas by grinding.

Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar.

Correct other low areas with a repair topping. Cut out low areas to ensure a minimum topping depth of 1/4 inches to match adjacent floor elevations. Prepare, mix and apply repair topping according to manufacturer's written instructions.

3.10.6 Non-Slip Broom Finish

Finish shall be given to surfaces of exterior concrete steps, and sidewalks.

Immediately after completion of trowel finish, surface shall be slightly roughened by brooming with a fiber-bristle brush in a direction transverse to that of main traffic.

3.11 FINISHING OF CURB, CURB AND GUTTER, AND PAVEMENTS

Finish surfaces shall be provided with steel troweling to hard, dense finish with corners, intersections, and terminations rounded as indicated on the drawings.

3.12 CONCRETE CURING AND PROTECTION

3.12.1 General

Freshly placed concrete shall be protected from premature drying and cold or hot temperature and shall be maintained without drying at a relatively constant temperature for the period of time necessary for hydration of cement and proper hardening of concrete.

Initial curing shall start as soon as free water has disappeared from surface of concrete after placing and finishing. Concrete shall be kept moist for minimum 72 hours.

Final curing shall immediately follow initial curing and before concrete has dried. Final curing shall continue 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 totalled 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. Rapid drying at end of final curing period shall be prevented.

3.12.2 Curing Methods

Curing shall be accomplished by moist curing, by moisture-retaining cover curing, by membrane curing, and by combinations thereof, as specified.

Moist curing:

Moisture curing shall be accomplished by any of the following methods:

Keeping surface of concrete wet by covering with water

Continuous water-fog spraying

Covering concrete surface with absorptive cover for curing concrete saturated with water and keeping absorptive cover wet by water spraying or intermittent hosing. Absorptive cover shall be placed to provide coverage of concrete surfaces and edges with a slight overlap over adjacent absorptive covers.

Moisture-retaining cover curing:

Moisture-retaining cover curing shall be accomplished by covering concrete surfaces with moisture-retaining cover for curing concrete. Cover shall be placed directly on concrete in widest practical width, with sides and ends lapped at least 3 inches. Cover shall be weighted to prevent displacement; tears or holes appearing during curing period shall be immediately repaired by patching with pressure-sensitive, waterproof tape or other approved method.

Membrane curing (RESTRICTIVE, see 2nd paragraph):

Membrane curing shall be accomplished by applying specified membrane-forming curing compound to damp concrete surfaces as soon as moisture film has disappeared. Curing compound shall be applied uniformly in a two-coat operation by power-spraying equipment using a spray nozzle equipped with a wind guard. Second coat shall be applied in a direction at right angles to direction of first coat. Total coverage for two coats shall be not more than 200 square feet per gallon of curing compound. Concrete surfaces which are subjected to heavy rainfall within 3 hours after curing compound has been applied shall be resprayed by method and at rate specified. Continuity of coating shall be maintained for entire curing period and damage to coating during this period shall be repaired immediately.

Membrane-curing compounds shall 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 chemical floor hardener, waterproofing, damproofing, membrane roofing, painting, vinyl composition tile, and other coatings and finish materials.

3.12.3 Curing Formed Surfaces

Curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces shall be accomplished 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, final curing of formed surfaces shall be accomplished by any of the curing methods specified above, as applicable.

3.12.4 Curing Unformed Surfaces

Initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, shall be accomplished by membrane curing.

Unless otherwise specified, final curing of unformed surfaces shall be accomplished by any of curing methods specified above, as applicable.

Final curing of concrete surfaces to receive liquid floor hardener of finish flooring shall be accomplished by moisture-retaining cover curing.

3.12.5 Temperature of Concrete During Curing

When temperature of atmosphere is 40 degrees F and below, temperature of concrete shall be maintained 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, arrangements shall be made 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 will cause too rapid drying of concrete, arrangements shall be made 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 shall be uniform and shall not exceed 5 degrees F in any 1 hour nor 50 degrees F in any 24-hour period.

3.12.6 Protection from Mechanical Injury

During curing period, concrete shall be protected from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.12.7 Protection After Curing

Finished concrete surfaces shall be protected from damage by construction operations.

3.12.8 Liquid Chemical Floor-Hardener Treatment

Liquid chemical floor hardener shall be applied according to the manufacturer's written instructions. Do not apply to concrete that is less than seven days old, unless specifically instructed by the manufacturer's instructions.

Liquid-chemical floor hardener shall be applied where indicated after curing and drying concrete surface. Liquid hardener shall be diluted with water and applied in three coats. First coat shall be one-third strength, second coat one-half strength, and third coat two-thirds strength. Each coat shall be applied evenly and allowed to dry 24 hours between coats.

Approved proprietary chemical hardeners shall be applied in accordance with manufacturer's printed directions.

3.12.9 Sealing Joints

Prepare, clean, and install joint sealant according to manufacturer's written instructions.

Isolation, expansion, and control joints which will not be covered with finish flooring material shall be sealed with joint sealing compound after concrete curing period. Groove shall be slightly underfilled with joint sealing compound to prevent extrusion of compound. Excess material shall be removed as soon after sealing as possible.

Sealing shall not be required for joints which will be covered with finish flooring material, or for exterior joints. Groove shall be left ready to receive filling material that will be provided as part of finish floor covering work.

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SECTION 03900

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10/01

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SECTION 03900

CONCRETE RESTORATION AND CLEANING
10/01

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES (Not Applicable)

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data for each product to be used, and shall include instructions for preparation and application of material.

PART 2 PRODUCTS

2.1 MATERIALS

Material shall be as follows or an approved equal.

A-H Emery Epoxy Topping as manufactured by Antihydro Company, Newark, NJ

A-H Epoxy Patch No. 122 as manufactured by Antihydro Company, Newark, NJ

Kwik Patch as manufactured by Chem-Masters Corp., Chagrin Falls, OH

Polytops 40, 43, 44, or 46 as manufactured by Chem-Masters Corp., Chagrin Falls, OH

Hytron as manufactured by Chem-Masters Corp., Chagrin Falls, OH

Kemset as manufactured by Chem-Masters Corp., Chagrin Falls, OH

EUCO Firmix Nonshrink Metallic Grout as manufactured by Euclid Chemical Company, Cleveland, OH

EUCO N-S Nonshrink Nonmetallic Grout as manufactured by Euclid Chemical Company, Cleveland, OH

EUCO High-Strength Epoxy Grout as manufactured by Euclid Chemical Company, Cleveland, OH

EUCO Polysulfide Epoxy as manufactured by Euclid Chemical Company, Cleveland, OH

EUCO Polyamide Epoxy as manufactured by Euclid Chemical Company, Cleveland, OH

Tigerbond 306 as manufactured by Garon Products Inc., Edison, NJ

Teflite 400 as manufactured by Garon Products Inc., Edison, NJ

Hy-Speed 500 as manufactured by Garon Products, Inc., Edison, NJ

Supreme Grout as manufactured by Gifford-Hill & Company, Inc., Charlotte, NC

Supreme Plus Grout as manufactured by Gifford-Hill & Company, Inc., Charlotte, NC

EMBECO 636 Grout as manufactured by Master Builders, Los Angeles, CA

EMBECO 201 Grout as manufactured by Master Builders, Los Angeles, CA

Probond ET-180 as manufactured by Protex Industries, Inc., Denver, CO

Probond PC-201D as manufactured by Protex Industries, Inc., Denver, CO

Proflow 30/30XF as manufactured by Protex Industries, Inc., Denver, CO

PART 3 EXECUTION

3.1 PREPARATION

Surfaces to be restored shall be cleaned. Cleaning may be by scraping, wire brushing, chipping, sand blasting, or other approved method as recommended by the manufacturer of the material to be used.

Remove all loose material, spalls, honeycombs, etc. down to solid concrete, but to a minimum of 1 inch depth. Expose rebar around when necessary. Do not cut or damage rebar.

3.2 PATCHING

Holes and cracks shall be filled with a patch, grout, or topping as specified and in accordance with manufacturer's approved printed instructions.

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SECTION 04200

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03/98

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SECTION 04200

MASONRY UNIT
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 306R	(1988) Cold Weather Concreting
ACI 530.1	(1995) Specifications for Masonry Structures

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE-02	(1999) Handbook, HVAC Applications (IP Edition)
ASHRAE-05	(1999) Handbook, HVAC Applications (SI Edition)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 116	(2000) Standard Specification for Metallic-Coated Steel Woven Wire Fence Fabric
ASTM A 153/A 153M	(2001) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 167	(1999) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 575	(1989) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 615/A 615M	(2001; Rev A) Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 641	(1991) Standard Specification for Zinc Coated (Galvanized) Carbon Steel Wire
ASTM A 641M	(1991) Standard Specification for Zinc Coated (Galvanized) Carbon Steel Wire (Metric)

ASTM A 82	(1997; Rev A) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM B 224	(1992) Standard Classification of Coppers
ASTM B 370	(1998) Standard Specifications for Copper Sheet and Strip for Building Construction
ASTM C 140	(1995; Rev A1) Standard Methods of Sampling and Testing Concrete Masonry Units
ASTM C 144	(1993) Standard Specification for Aggregate for Masonry Mortar
ASTM C 150	(2000) Standard Specification for Portland Cement
ASTM C 155	(1988; R 1992) Standard Classification of Insulating Fire Brick
ASTM C 207	(1991; R 1992) Standard Specification for Hydrated Lime for Masonry Purposes
ASTM C 216	(1995) Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	(2000) Standard Specification for Mortar for Unit Masonry
ASTM C 33	(2001) Standard Specification for Concrete Aggregates
ASTM C 331	(1994) Standard Specification for Lightweight Aggregates for Concrete Masonry Units
ASTM C 34	(1993) Standard Specification for Structural Clay Load-Bearing Wall Tile
ASTM C 387	(2000) Standard Specification for Packaged, Dry Combined Materials for Mortar and Concrete
ASTM C 404	(1997) Standard Specification for Aggregates for Masonry Grouts
ASTM C 426	(1995) Standard Test Method for Drying Shrinkage of Concrete Block
ASTM C 516	(1980; R 1990) Standard Specification for Vermiculite Loose Fill Thermal Insulation
ASTM C 518	(1991) Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus

ASTM C 549	(1981; R 1995) Standard Specification for Perlite Loose Fill Insulation
ASTM C 55	(1995) Standard Specification for Concrete Building Brick
ASTM C 56	(1993) Standard Specification for Structural Clay Non-Load-Bearing Tile
ASTM C 568	(1989) Standard Specification for Limestone Dimension Stone
ASTM C 62	(2001) Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale)
ASTM C 641	(1982; R 1991) Standard Test Method for Staining Materials in Lightweight Concrete Aggregates
ASTM C 67	(1994) Standard Test Methods of Sampling and Testing Brick and Structural Clay Tile
ASTM C 744	(1995; Rev A) Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C 861	(1993) Standard Practice for Determining Metric Dimensions of Standard Series Refractory Bricks and Shapes
ASTM C 90	(1995) Standard Specification for Load-Bearing Concrete Masonry Units
ASTM C 91	(1995) Standard Specification for Masonry Cement
ASTM D 1056	(2000) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1752	(1984; R 1996) Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 2000	(1999) Standard Classification System for Rubber Products in Automotive Applications
ASTM D 226	(1994) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 227	(1994) Standard Specification for Coal-Tar-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM E 119	(2000; Rev A) Standard Test Methods for Fire Tests of Building Construction and

	Materials
ASTM E 84	(2001) Standard Test Method for Surface Burning Characteristics of Building Materials

BRICK INSTITUTE OF AMERICA (BIA)

BIA Tech Note 20	(1990) Cleaning Brick Masonry

BUILDING OFFICIALS & CODE ADMINISTRATORS (BOCA)

BOCA-01	(1995) The BOCA International Plumbing Code

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO-01	(1997) Uniform Building Code

SOUTHERN BUILDING CODE CONGRESS INTERNATIONAL (SBCCI)

SBCCI-01	(1994) Standard Building Code

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA-02	(1993) Architectural Sheet Metal Manual

UNDERWRITERS LABORATORIES (UL)

UL 723	(1996; Rev thru Dec 1998) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials

1.2 MASONRY-WALL PANEL

Before starting installation of masonry work, the Contractor shall erect a sample masonry wall in an approved location for approval.

Exterior brick faced walls shall be open-cavity construction.

Sample wall shall be 4 feet high by 6 feet long, with a corner return of 2 feet. Wall shall consist of an exterior wythe of face bricks and an interior wythe of masonry units representative of the type required. Facing brick shall be from the same production run as the brick to be used for construction. Wall shall be constructed with anchors or ties, insulation, concealed flashing, weep slots, and cavity typical of the construction.

Sample wall shall show the full color range, texture, type of bond, joint treatment. Wall shall be pointed and cleaned.

Sample wall panel shall be approved before commencing work. Unsatisfactory sample walls shall be removed and additional sample walls erected until approval is obtained. Approved sample wall shall remain and shall be properly protected until completion and acceptance of the work.

Approved sample wall panel shall be the standard of quality for workmanship and materials. Masonry work shall be at least equal in quality to that of the sample wall panel.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Erection Drawings shall be furnished for the following items. Methods of anchoring masonry work to other trades shall be shown.

Reinforcing Steel in Lintels
Reinforcing Steel in Beams
Reinforcing Steel in Piers
Reinforcing Steel in Walls
Special Block
Special Brick
Special Masonry Shapes
Unit Sizes and Wall Patterns
Anchoring Methods

SD-04 Samples

Submit the following samples in sufficient numbers to show full range in color, texture, shapes and sizes (minimum of three each).

Clay Brick
Block Masonry
Concrete Brick

Joint Reinforcement - one piece of each type of reinforcement 18 inches long, showing at least two cross joints.

Brick Sample Panels shall be constructed according to the paragraph entitled, "Masonry-Wall Panel," of this section.

Block Sample Panels shall be constructed according to the paragraph entitled, "Masonry-Wall Panel," of this section.

Anchors and Ties - one of each type.

SD-06 Test Reports

Test Reports shall be furnished for the following items in accordance with the paragraph entitled, "Sampling and Testing," of this section.

Brick Material
Block Masonry Units
Prefaced Block Masonry Units
Mortar

SD-07 Certificates

Certificates of Compliance shall be furnished stating that Brick Materials furnished have been produced from sources known from experience to be nonexpansive. Brick materials shall conform to applicable reference standards contained within this section.

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted for the following items:

Special Block
Special Brick Shapes
Anchor Devices
Detergent Cleaning Compounds

1.4 SAMPLING AND TESTING

1.4.1 Testing Services

Laboratory testing and inspection service shall be provided as part of the work. Testing services shall be approved and shall include quality control sampling and testing of block masonry and mortar during construction.

1.4.2 Quality Control During Construction

Materials shall be sampled and tested for quality control during construction as follows:

MATERIAL	REQUIREMENT	TEST	NUMBER/TESTS
Brick materials	Material, workmanship, finish, texture, color range, and size	ASTM C 216 and ASTM C 67	One test each 10,000 bricks or fraction thereof
	Efflorescence	ASTM C 67	One test each 10,000 bricks or fraction thereof
	Compressive strength	ASTM C 67	One test each 10,000 bricks or fraction thereof
Block masonry units and prefaced block masonry units	Visual inspection	ASTM C 90	3 units each shipment
	Dimensional variation	As specified*	3 units each shipment
	Face shell and web thickness	ASTM C 90	3 units each shipment
	Compressive strength	ASTM C 140	One test each 10,000 blocks or fraction thereof
	Absorption	ASTM C 140	One test each 10,000 blocks or fraction thereof

MATERIAL	REQUIREMENT	TEST	NUMBER/TESTS
	Drying shrinkage	ASTM C 426	One set per project. Additional test when material or source changes
Mortar	Air entrainment	ASTM C 91	One test set for each 10,000 bricks or each 3,000 block masonry units
	Compressive strength	ASTM C 91	
	Water retention	ASTM C 91	

*Specified under paragraph entitled, "Quality."

1.4.3 Quality Control Reports

Testing service shall report test results in writing.

1.4.4 Evaluation of Test Results

Materials that do not conform to specifications shall be removed from the site.

When the tests indicate nonconformance, additional tests of units in the shipment shall be made. When 10 percent or more of the additional units tested also indicate nonconformance, the shipment will be rejected.

1.5 DELIVERY AND STORAGE

Masonry units shall be delivered, carefully stacked on pallets to avoid chipping, and stored to prevent soiling. Masonry units shall be kept dry until placed by storing in a weathertight structure or, when stored in the open, shall be covered with approved moisture-resistant covers, completely enclosing the material.

Facing brick shall be packed in substantial containers or banded on pallets for delivery and storage.

Cement materials shall be furnished in bags displaying the manufacturer's trademark and type. Material shall be dry and free of lumps when delivered. Upon delivery, material shall be stored in dry, weathertight, properly ventilated structures. Different brands or types of mortar shall be stored separately and shall not be intermixed.

Aggregates shall be stored and handled in such manner as to prevent intermixing with foreign matter.

Masonry reinforcement shall be protected from contact with the soil. Anchors and ties shall be stored in containers in a weathertight structure.

1.6 PROTECTION OF MATERIALS AND WORK

Contractor shall protect materials from damage when stored and during construction.

Top of masonry walls shall be kept dry by covering when work is not in progress. Covers shall be lapped at least 6 inches at joints and shall overhang the top of the wall at least 2 feet on each side. Exposed ends of walls shall be covered and the covers lapped at least 2 feet on each side of the wall.

After erection, finished masonry walls shall be protected from damage due to subsequent building operations. Damaged facing units shall be removed and replaced.

PART 2 PRODUCTS

2.1 BRICK

2.1.1 Facing Brick

Facing brick shall match brick on existing building in size, color, range, face texture, and approved sample, and shall conform to ASTM C 216, Type FBS, Grade SW.

Main Campus: Continental Brick, #470, Potomac Valley Brick
East Campus: Glen-Gery Brick, Amherst, Glen-Gery Brick
East Campus (Accent Only): Glen-Gery Brick, Iron Forge, Glen-Gery Brick

2.1.2 Building Brick

Building brick shall be modular size: 7-5/8 by 2-1/4 by 3-5/8 inches, matching approved samples, and shall conform to ASTM C 62, Grade SW.

2.2 CONCRETE MASONRY UNITS

2.2.1 Unit Types

Units shall be normal weight concrete, load-bearing, hollow or solid and shall conform to ASTM C 90, Type I.

2.2.2 Quality

Units shall be modular in size and shall include special shapes as required for corners, sash, control joints, jambs, heads, lintels, headers, and bonding block.

Net overall dimensions: Width, height, or length shall differ by not more than 1/8 inch from the specified standard dimensions. Units shall be uniform as to dimension, with arrises and exposed vertical edges free from warp. Face surface shall be planar, with no variations greater than 1/32 inch.

Units shall have a face shell thickness conforming to ASTM C 90, and shall be sufficient to adequately embed masonry reinforcement.

Units exposed to view shall be selected for smoothness and uniformity in appearance and texture and shall be free of imperfections, spalls and chips

larger than 1/2 inch, chipped corners, cracks, or defects.

External corners and window and door openings throughout habitable spaces shall have 1-inch radius bullnose corners.

When determined by the chemical-analysis method, the iron stain deposited on the filter paper from a 200-gram sample shall not exceed 1.5 milligrams of ferric oxide.

2.3 PRECAST LINTEL UNITS

Units intended for use over openings in walls of masonry units shall be cast with the same type cement and aggregate used for the masonry units.

Units shall be cast of concrete having a 28-day compressive strength of not less than 3,000 pounds per square inch (psi). Cast-on-site lintels shall not be permitted.

Lintels shall be of length sufficient to bear 8 inches (minimum) on each side of opening.

2.4 MORTAR

2.4.1 Cementitious Materials

Mortar materials and proportions shall conform to ASTM C 270, with the following amendments:

> Portland cement-lime mix, packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207.

Type S mortar, as defined in Table 2 of ASTM C 270, shall be used.

Mortar colors shall match the following:

Main Campus: Flamingo C320, Riverton Cement Co.
East Campus: G-209 Colored Mortar Blend, Glen-Gery
East Campus (Accent Only): Tamms 2606 Colored Mortar Blend

2.4.2 Aggregate for Mortar

Aggregate for mortar shall comply with ASTM C144, except for joints less than 1/4 inch thick, use aggregate graded with 100% passing the No. 16 sieve.

2.4.3 Aggregate for Grout

Aggregate for grout shall comply with ASTM C 404.

2.4.4 Admixtures for Mortar

Calcium chloride admixtures, antifreeze liquids, salts, or other substances shall not be used to lower the freezing point.

Pigments shall be natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixtures

2.4.5 Water

Water shall be potable.

2.5 MASONRY ANCHORS AND TIES

2.5.1 Zinc Coating

Zinc coating of anchors and ties shall conform to ASTM A 153/A 153M, Class B-2 as required. Zinc coating of wire for joint reinforcing shall conform to ASTM A 116, Class 1.

2.5.2 Dovetail Slots, Anchors, and Ties

Dovetail slots shall be 20-gage galvanized steel, 1-inch wide by 5/8-inch face by 1-inch deep.

Dovetail anchors shall be 14-gage galvanized steel crimped brick anchors, 1-inch wide by length as required for masonry unit, turned up 1/4 inch at outer end.

Dovetail brick ties for cavity walls with 2-inch air space between brick facing and concrete shall be 9-gage hot-dip-galvanized steel wire ring.

Dovetail-type anchors for use with embedded slots or inserts shall be sheet steel not lighter than 0.0598-inch (16-gage) thick, 1-inch wide, flat anchors for block masonry units and structural-clay-tile facing, and steel wire not lighter than 0.1483-inch (9-gage) diameter for brick and split-block facing.

2.5.3 Individual and Adjustable Wall Ties

Individual wall ties shall be galvanized steel 7/8-inch wide by 7-inches long by No. 22 gage.

Individual cavity wall ties shall be galvanized steel rods, 1/4-inch diameter, 8-inches long, Z-bar.

Individual cavity wall ties and adjustable wall ties shall be galvanized steel rods, 1/4-inch diameter, in triangular shape.

Adjustable wall ties shall be rectangular type, 3/16-inch diameter high-tensile cold-drawn galvanized-steel wire conforming to ASTM A 82.

2.5.4 Column Anchors, Beam Anchors, and Ties

Column anchors shall be steel bars, formed of merchant quality hot-rolled carbon steel conforming to ASTM A 575, 1/4 by 3/4 inch, shop painted, length as required by wall thickness.

Column anchors shall be galvanized steel rods, 1/4-inch in diameter, in triangular shape.

Beam anchors shall be steel bar shapes, formed from carbon steel conforming to ASTM A 575, 3/16 by 1 inch, shop painted, length as required by wall thickness.

Column clips for ties between masonry fireproofing and steel columns shall be 10-gage galvanized steel wire clips. Clips shall be installed 24 inches

on center.

Flexible ties for tying masonry to structural steel shall be galvanized steel straps, 1/2 by 1/8 inch by 9-inches long, tack-welded to steel 16 inches on center, with 3/16-inch mill-galvanized wire ties, rectangular or triangular design, size as required by wall thickness.

2.5.5 Partition Anchors

Masonry partition anchors shall be Z-bars formed from carbon steel conforming to ASTM A 575, 1-1/2 by 1/4 by 28-inches long, hot-dip galvanized.

2.5.6 Reinforcing Steel

Reinforcing bars shall be deformed billet steel bars conforming to ASTM A 615/A 615M, Grade 60.

2.6 WALL REINFORCEMENT

2.6.1 Joint Reinforcement

Joint reinforcement shall be cold-drawn steel wire conforming to ASTM A 82. Deformations shall be in accordance with ASTM A 615/A 615M. Wire shall have a tensile strength of 80,000 psi. Side rods shall be deformed steel wire. Cross ties or truss members may be plain or deformed steel wire.

Joint reinforcement shall be ladder or truss design, with side rods and cross ties flush-welded in a single plane.

Truss design reinforcement shall not be used in cavity wall construction.

Joint reinforcement shall be galvanized after fabrication with 1.0-ounce per square foot zinc coating in accordance with ASTM A 641, Class 3.

Joint reinforcement for corners and intersecting walls shall be fabricated as corner and T-shapes and shall be the same gage and finish wire.

Outside width of side rods shall be approximately 2 inches less than the nominal width of the wall. Cross ties or rods shall be spaced not more than 16 inches on center.

Joint reinforcement shall be furnished in flat sections in maximum practical length. Reinforcement furnished in rolls shall not be permitted.

Joint reinforcement for cavity walls may be of two-part construction, with ladder and eye section, and with pintle section.

2.6.2 Gage of Joint Reinforcement

Cross ties or cross rods shall be 9-gage, spaced not more than 16 inches on center, either plain or deformed steel wire.

Side rods shall be 3/16-inch diameter.

2.7 CONTROL-JOINT MATERIAL

2.7.1 Flexible-Joint Filler Strip

Flexible-joint filler strips for use in control joints formed with sash blocks or built-in between block masonry and concrete or brick shall be molded from natural or synthetic rubbers conforming to ASTM D 2000, Grade 4AA730B13l14, and neoprene conforming to ASTM D 1056, Grade SCE 42. Strips shall be T-shaped, approximately 2-5/16-inches long by 1-7/16-inches wide, with 11/16-inch flanges. Strips shall have factory-applied adhesive on one face.

2.7.2 Bond Breaker Strips

Bond breaker strips for use in end webs of concrete masonry units at indicated control joints shall be 15-pound per 100 square foot asphalt roofing felt, conforming to ASTM D 226.

2.7.3 Steel and Masonry Isolation Liners

Isolation liners for use between masonry and structural steel frame shall be treated asphalt-impregnated cellular paper, 1/4 inch (single thickness) and 1/2 inch (double thickness). Material shall be applied in double thickness, except where wall dimensions do not permit.

2.7.4 Expansion-Joint Material

Material shall be preformed, nonextruding and nonbituminous, sponge-rubber joint filler, thickness as indicated, conforming to ASTM D 1752, Type I.

2.7.5 Joint Fillers and Sealants

Externally applied joint fillers, back-up materials for sealants, and joint sealants are specified in the Section 07920, "Sealants and Calkings."

Expansion joint fillers, metal expansion strip isolation liners, and bond breakers shall be built-in as the masonry wall is laid up.

2.8 FLASHING

2.8.1 Materials

Sheet-metal flashing shall be 6-ounce, 10-ounce, or 16-ounce copper conforming to ASTM B 370, cold rolled and soft temper.

2.8.2 Location

Through-wall flashing of masonry walls with a cavity over 3/4-inch wide between inner and outer wythes, and the head and sill flashing of masonry wall openings with a cavity over 3/4-inch wide, shall consist of 10-ounce sheet-copper flashing.

Spandrel flashing shall be 6-ouncecopper-coated flashing.

Building expansion-joint flashing shall be 16-ouncecopper formed in a bellows or U-flange profile.

Termite barriers shall be 16-ounce copper flashing.

Through-wall flashing below copings shall be 16-ouncecopper. Flashings shall be crimped, ribbed, or corrugated to provide an integral mortar key and shall be formed to preclude pockets of water.

2.8.3 Flashing Mastic

Mastic for lap joints of corrosion-resistant steel flashings shall be a non-skinning, non-sagging, flexible butyl sealant.

2.9 INSULATION MATERIALS

2.9.1 Loose-Fill Insulation

Loose-fill insulation shall be vermiculite conforming to the requirements of ASTM C 516, Grade 3.

2.9.2 Board Insulation

Board insulation shall be rigid and not more than 1-1/2- to 2-inches thick to provide a coefficient-of-heat transmission of U-value through the completed wall construction air-to-air not in excess of 0.18 Btu hour/square foot/degree F temperature difference when determined for winter conditions in accordance with recognized methods in agreement with ASHRAE-02. Computations to determine insulation thickness shall be approved. Flame-spread rating shall not exceed 25 when tested in conformance with ASTM E 84.

2.9.3 Foam Insulation

Foam insulation shall be a two-part system consisting of resin and a foaming agent. Components, when combined in approved equipment, shall produce a low-density foam insulation.

Typical Physical Properties:

PROPERTY	TEST	RESULTS
Thermal conductivity	ASTM C 518	K = 0.232 Btu per hour per foot per degree F
Thermal resistance	ASTM C 518	R = 4.30 degree F by square foot by hour per Btu
Surface burning characteristics	UL 723	
	Flame spread	15
	Fuel contributed	0
	Smoke developed	5

PART 3 EXECUTION

3.1 ERECTION OF MASONRY WALLS

3.1.1 Masonry Work

Masonry work shall be laid out before installation to ensure proper location of openings, joints, building returns, and offsets. Dimensions shall be adjusted only when approved and when required by variations in the

masonry unit dimensions.

Masonry work shall be plumb and true to line, with courses level and spaced to the vertical dimensions indicated. Except where stack bond is indicated, each course shall break joint with the course below. Bond pattern shall be kept plumb throughout.

Masonry walls shall be bonded in each course and bonded or anchored to connecting work with metal reinforcement ties. Masonry header ties shall be used only where indicated.

In unexposed masonry, deviations from running bond in vertical joints shall be less than 2 inches.

Walls abutting or touching steel columns shall be anchored thereto with flexible steel anchors or ties spaced not more than 16 inches on center vertically. Nonbearing walls or partitions abutting exterior walls shall be anchored thereto with metal anchors or ties spaced not more than 16 inches on center vertically.

Masonry walls shall be isolated from the structural steel frame by means of asphalt-impregnated cellular-paper isolation liners. Ties and anchors shall be the flexible type to permit independent movement of each material.

Wall chases and recesses shall be plumb and smooth and shall have at least 8 inches of masonry between the edge of chase and jamb openings.

Size of any two adjacent units shall be within permitted tolerances so that the difference between the vertical faces shall not exceed 1/8 inch for block masonry or 1/16 inch for brick masonry when used in exposed-to-view or painted walls.

Units in exposed-to-view locations or painted walls shall be free from chipped edges or other imperfections detracting from the appearance of the finished work.

Any masonry unit that is moved or disturbed after laying shall be removed, cleaned thoroughly, and relaid in fresh mortar.

Unfinished masonry work shall be racked or stepped back. Toothing will not be permitted without prior approval.

Units having 1-inch minimum radius bullnose shall be provided throughout interior spaces at vertical external corners of interior block-masonry-unit walls and partitions that will be exposed to view or painted, except at door jambs, window jambs, and at external corners in attics, crawl spaces, and closets.

3.1.2 Height of Interior Partitions

Interior masonry walls and partitions shall be carried to the full height of the story to the bottom of the floor above or roof deck, and the joint filled with mortar.

3.1.3 Built-In Work

Electrical piping and equipment, expansion strips, wall flashings, anchors, ties, wall plugs, reglets, flashing receivers, and accessories shall be built in as the masonry work progresses. Spaces around metal door frames

shall be solidly filled with mortar. Built-ins shall be solidly bedded in mortar or grout.

3.1.4 Fire-Rated Walls and Partitions

Construction of fire-rated masonry walls shall be in accordance with ICBO-01.

3.1.5 Cold-Weather Provisions

Unless proper precautions are taken, masonry shall be erected only when the ambient temperature is at least 40 degrees F and rising. Approved methods shall be provided to protect the work from freezing. Use of admixtures or antifreeze agents to lower the freezing point of mortars is prohibited.

Along with the following requirements, approved methods shall comply with the cold weather construction ACI 306R and ACI 530.1.

All materials, including brick, block and mortar ingredients shall be maintained at a minimum temperature of 40 degrees Fprior to and during erection, and for a period of 24 hours after erection of the masonry wall.

Temperature of materials shall be measured as required. Mortar ingredients shall be heated when required to produce mortar temperatures between 40 and 100 degrees F. Sand shall be heated when required to 70 to 80 degrees F. Water shall be heated when required to 90 to 100 degrees F. Masonry units shall be kept dry, and heated when required to 40 to 50 degrees F.

Protective enclosures and supplemental heat shall be provided when required to provide a minimum ambient air temperature of 40 degrees F during erection and for a period of 24 hours after erection of the masonry wall.

3.1.6 Mortar

Mortar shall be mixed in accordance with ASTM C 270.

Hand mixing, when permitted, shall be performed in a tight mortar mixing box. Mixing time shall be not less than that required to reproduce results obtained by machine mixing after the required amount of water has been added.

Mortar shall be used and placed in final position within 1-1/2 hours after mixing. Mortar not used within the specified time limit shall be discarded.

3.1.7 Joints

Except for joints to be calked or raked, all exposed joints shall be tooled evenly to a dense concave profile, with surface and edges compacted and sealed. Tooling shall be performed after joints are "thumbprint" hard.

Exterior joints below grade shall be trowel pointed. Concealed joints and walls to receive plaster or plastic wall covering shall have flush mortar joints.

Joints to be tuck pointed shall be raked out to a depth of 1/2 inch. Immediately before pointing, the joint shall be saturated with clean water and filled solidly with mortar.

Joint thickness shall average 3/8 inch or where required to match adjacent coursing in an existing structure. Joints shall have a minimum thickness of

1/4 inch and a maximum thickness of 1/2 inch. Where approved, joint thickness shall be gradually increased or decreased to meet indicated wall dimensions and to avoid cutting, squeezing, or opening of joints at ends of runs or lifts.

Exterior and interior joints between metal frames and masonry, wood frames and masonry, joints between mechanical equipment and masonry, and between other joints indicated shall be raked out to the required depth and left ready for sealant.

3.1.8 Control Joints

A movement joint shall be provided through the outer wythe of a cavity wall on each side of an external corner when the wall extending into it is 50 feet or more in length and at intersecting cavity wall junctions, pilasters, and concealed and exposed columns.

Expansion joints in brick masonry shall be complete with joint fillers and left ready for sealant.

Control joints in straight wall runs of block masonry shall be constructed by using standard stretcher units to provide a continuous unbroken vertical joint, 1/2-inch wide, through the entire thickness of the wall. One side of the joint shall be lined with roofing felt and a flexible joint filler installed where indicated. Core space shall be completely filled with mortar and the joint raked clean and ready for sealant.

Control joints in block masonry at intersecting partitions, between block masonry and reinforced concrete, and between block masonry and brick masonry shall be constructed with sash block and flexible joint filler.

To secure freedom of movement at control joints, slip-planes of building paper or other approved material shall be placed in mortar joints between the portion of prefabricated or block masonry lintels required for bearing and supporting jamb sections that form a part of control joint and between the adjacent end face of such lintels and adjoining masonry units. Control jointing carried above such openings shall be located in the same vertical plane as the slip joint formed at the end of the lintel.

3.1.9 Weep Holes

Weep holes shall be provided at 24-inch intervals. Holes shall be joint width and brick height.

Weep holes shall be provided at lintels, at flashed wall openings, at top of wall, and at foundations in cavity-wall construction.

Removable weep hole fillers shall be preformed sponge-rubber joint filler material, conforming to ASTM D 1752, Type I. Filler shall be full vertical joint height, 3/8-inch thick, by 8-inches long.

3.1.10 Flashing

Flashing shall be provided beneath copings, over wall openings, at spandrels, under sills, at building expansion joints, for termite barriers, and in locations where flashing is built into the masonry.

Flashing of wall openings and through-wall flashings shall conform to SMACNA-02. Flashing shall extend 4 inches or more beyond edge of lintels

and sills and turn up edge on sides and back to form pan and to direct moisture to exterior. Flashing shall terminate 1/2 inch from the face of the wall.

Joints in concealed flashing shall be made by interlocking or laps. Lap joints shall be sealed with mastic. Spaces around dowels and openings in flashings shall be sealed with mastic before covering the flashing with mortar.

Building expansion-joint flashing shall be formed as shown in SMACNA-02. Unit lengths shall be not less than 8-foot sections and shall be continuous from top of wall to bottom of footing. Joints shall be lapped 4 inches in the direction of water flow. Joints below grade shall be soldered or welded. A folded edge on each flange shall be provided and the flange shall be built 4 inches into masonry.

Continuous concealed flashing shall be provided in cavity walls and at the bottom of the cavity.

3.1.11 Facing Brick

Facing brick shall be laid in running bond, with the better face of the brick exposed. Face and ends, corners, and reveals shall be uniformly straight and true, free from chips and spalls, and uniform in color and texture.

Where indicated, accent bands shall be laid in soldier coursing.

Face brick shall be laid out and adjusted to each wall space. No course shall finish at external corners or at jambs with less than a full header. Header shall center on the stretcher or on the joints of adjoining courses.

Closers shall be avoided where possible. When necessary to maintain bond, closers shall be placed symmetrical with the center line of openings. No closer shall be less than 2-inches wide.

Brick masonry units shall be wetted prior to laying. When being laid, units shall have sufficient suction to hold the mortar and to absorb excess moisture but shall leave mortar plastic and workable.

Bricks shall be laid with bed and vertical joints evenly and solidly filled with mortar. Mortar beds shall be spread smooth and the ends of the brick shall be buttered with sufficient mortar to completely fill the end joint when the brick is in place.

Vertical longitudinal joints in all exterior walls, except cavity walls, shall be completely filled by pargeting, either the face of the masonry backup, or back of the facing, or by pouring the vertical joint full of grout, or by shoving to obtain a wall entirely free from voids or open joints.

Interior face-brick walls shall be laid as specified, with full bed and vertical mortar joints; the vertical longitudinal joint between inner and outer wythes need not be pargeted or filled.

3.1.12 Building Brick

The following shall be constructed of building brick:

Walls not exposed to view and indicated as brick

Brick masonry backup walls and piers indicated as building brick

Exterior brick-wall facing below grade

Exterior or interior walls indicated as building or common brick

Building brick, when laid as an exterior wall facing below grade, with 8-inch concrete masonry backup, shall be bonded to the backing every 16-inches vertically with full brick headers. Block masonry walls shall be reinforced with continuous metal-tie reinforcing.

A minimum of 8 inches of solid masonry shall be laid in walls to receive lintels, metal joists, structural steel, or concrete beams in utility rooms and in rooms not exposed to public view.

Building brick shall not be exposed in finished rooms.

3.1.13 Installation of Joint Reinforcement

Joint reinforcement shall be installed in bed joints at 16-inch vertical spacing starting at 16-inchesabove the first course. Reinforcement shall also be in the first and second bed joints, 8-inches apart, immediately above lintels and below sills of openings. Reinforcement in the second bed joint above and below openings shall extend 2-feet beyond jambs. All other reinforcement shall be continuous except that it shall not pass through vertical masonry control or expansion joints. Side rods shall be lapped 6 inches at splices. Reinforcement shall be placed to ensure a minimum of 5/8-inchmortar cover on the exterior face of the wall and 1/2-inch mortar cover on interior faces.

3.1.14 Installation of Masonry Anchors and Ties

3.1.14.1 Dovetail Slots, Anchors, and Ties

Dovetail slots shall be installed at a maximum spacing of 2 feet on center.

Dovetail anchors and ties shall be installed at a maximum vertical spacing of 16 inches on center.

3.1.14.2 Individual and Adjustable Wall Ties

Individual and adjustable wall ties shall be installed 24 inches on horizontal center and 16 inches on vertical center.

3.1.14.3 Column and Beam Anchors and Ties

Anchors shall be installed a maximum of 48 incheson center.

Column clips shall be installed 24 inches on center.

3.1.15 Block Masonry

Block masonry units shall be handled carefully to protect edges and exposed surfaces from damage.

Block masonry units shall not be dampened or wet before laying or during the process of laying in the wall.

Block masonry units shall be laid in running bond except in walls where stack bond or special shapes are indicated. Walls, corners, and reveals shall be laid plumb, true to line, and leveled in accurately spaced courses. Each course shall be bonded and interlocked at corners and intersections. Vertical joints shall be broken at 3 inches, minimum.

Intersecting nonbearing block masonry walls shall be tied to other masonry walls by strips of galvanized metal lath or 1/4-inchmesh galvanized hardware cloth placed across the joint between the two walls in alternate courses. When walls are exposed-to-view finished walls, a vertical control joint shall be constructed where the two walls meet. Control joint shall be raked out to a depth of 3/4 inch and left ready for sealant.

Intersecting bearing walls shall not be tied together in masonry bond except at corners. One wall shall terminate at the face of the other wall with a control joint at that point. Walls shall be tied together with a steel tie bar, 1/4 by 1-1/4 by 28-inches long, with 2-inch bends at each end, spaced 32 inches on vertical center. Bars shall be embedded at each end in mortar-filled cores. When walls are exposed at finished walls or walls subject to weather, the control joint shall be raked out to a depth of 3/4 inch and left ready for sealant.

Block masonry units shall be laid in a full, mortar bed, full thickness of the face shell, except that full mortar bedding shall be provided under the first or starter course of units laid on footings and solid foundation walls and in all courses of piers, columns, and pilasters. Mortar shall be applied over the full thickness and height of the face shell to form the vertical mortar joint.

Horizontal and vertical joints of solid units and concrete building brick shall be filled solid. Mortar shall be spread over the full horizontal and end areas of the unit.

Joint thickness and tooling shall be as specified in paragraph entitled, "Joints."

Block masonry walls shall be reinforced with continuous wire joint reinforcement. Building brick, solid block masonry, or concrete brick shall be provided at the top of walls and under joists, beams, and concentrated loads, unless a bond beam or other structural member is indicated. Top course of block masonry units shall be filled with mortar or concrete. A layer of metal lath shall be used in the joint below to positively hold the mortar when rodded into the core space.

Where block masonry is the finished wall surface, bearing for metal joists, structural steel, or concrete shall be three courses of solid concrete brick or block masonry the same color and texture as adjacent block masonry.

3.1.16 Bond Beams

Units filled with concrete of the indicated design shall be provided. Concrete fill shall have a minimum compressive strength of 3,000 psi at 28 days. Bond beam reinforcement shall be placed as necessary.

3.1.17 Cavity Walls

Inner and outer wythes of cavity walls shall be completely separated by a continuous air space not less than 2-inches nor more than 4-inches wide,

except for masonry returns indicated at jambs of openings. Two wythes shall be securely tied together by continuous wire reinforcement spaced not to exceed 16-inches apart vertically. Additional cavity wall ties shall be placed within 8 inches of the jambs of all openings and not more than 2-feet apart vertically except where the wythes are bonded together with masonry returns at jambs. Inner and outer wythes of cavity walls shall be provided with control joints and joint reinforcement. At control joints, the alignment of both wythes shall be maintained by ties 16 inches on center vertically along each side of the control joint. Parge the outerface of the block backing with mortar 3/8-inch thick, troweled to a smooth, dense surface. Air space between the facing and backing wythes shall be kept clear and clean of mortar droppings by temporary wood strips laid on the wall ties and carefully lifted out before the next row of ties or anchors is placed.

Weep holes shall be provided 24 inches on center in mortar joints of the exterior wythe along the bottom of the cavity over foundations, bond beams, and other water stops in the wall, above grade line. Weep holes shall also be provided near the top of the cavity.

Weep holes and flashing for cavity walls shall be in accordance with paragraphs entitled, "Weep Holes" and "Flashing."

3.1.18 Cutting, Fitting, and Patching

Cutting and fitting masonry as required to meet building dimensions or to accommodate mechanical and electrical piping and equipment shall be performed by masonry mechanics.

Work shall be performed such that edges are unbroken and cut plumb and true.

Patching shall be performed such that original adjacent surfaces shall be matched in materials and workmanship.

3.1.19 Coping and Sill Installations

Coping and sills shall be laid in full mortar bed with thru-wall flashing placed in the center of mortar bed.

Dowels shall attach ends of each coping unit.

Joints shall be "soft" with backer rod and sealant at each joint in coping.

Sill shall have solid mortar joints.

3.1.20 Lintels

Lintels for openings 22-inches wide or less shall be formed of single whole tile. Lintels for openings over 22-inches wide shall be precast with top and bottom cores filled solid with gypsum mortar reinforced full length with not less than one continuous 1/2-inch rod. Lintels shall be set in full bed of mortar and blocked up as necessary to provide a full 1/2-inch clearance above top of frames. Lintels shall bear a minimum of 8 inches on each side of the opening.

3.2 INSULATING OF EXTERIOR MASONRY WALLS

3.2.1 Insulation

Exterior cavity walls shall be insulated by installing rigid board-type insulation in the airspace against the inner wythe.

Exterior single-wythe block-masonry-unit walls shall be insulated by completely filling the cells of the units with water-repellent loose-fill insulation.

Insulation shall be completely brought up to the elevations indicated for the underside of door and window sills, bond beams, lintels, through-wall flashing, and similar interruptions through the cavity before installing these items.

3.2.2 Loose-Fill Insulation

Loose-fill insulation shall be brought up alternately with the masonry with not more than a 4-foot high section of wall completed before insulation is poured in the airspace between the wythes. Not more than a 2-foot high section of wall shall be completed before insulation is poured in the cells of block masonry units. Insulation shall be poured from the top of each height of wall section completed and allowed to assume its natural density. Loose-fill insulation shall not be tamped.

3.2.3 Rigid-Board Insulation

Rigid-board insulation shall be applied directly to the masonry with adhesive. Impaling of insulation on cavity-wall ties or anchors will not be permitted. Insulation shall be applied in parallel courses with joints breaking midway over the course below, shall be applied in moderate contact with adjoining units without forcing, and shall be cut to fit neatly against adjoining surfaces.

3.2.4 Foam Insulation

Foam insulation shall be gun-applied to areas indicated by an applicator approved by the manufacturer and in strict accordance with the manufacturer's printed instructions.

3.3 POINTING AND CLEANING

Masonry walls shall be dry brushed at the end of each day's work.

Upon completion of the work, holes and defects in exposed mortar joints shall be raked as required, filled with fresh mortar, and tooled.

After mortar is set and cured, mortar particles shall be removed with wood paddles, brushes, and scrapers before wetting the wall.

Brick masonry walls shall be cleaned in accordance with BIA Tech Note 20.

Detergent cleaning compound shall be type formulated to reduce metallic stains. Cleaning compounds shall be used in accordance with the manufacturer's instructions.

Glazed brick limestone units and prefaced masonry units shall be carefully wiped clean with a soft cloth immediately after laying. At completion of

work, surfaces shall be given a final cleaning with water and a cleaning compound applied with a soft sponge or brush as recommended by the manufacturer.

Block masonry shall be cleaned with stiff brushes and clear water. Acid shall not be used in the cleaning process. Joints shall be rubbed with a carborundum stone to remove burrs and rough edges.

Sandblasting techniques for cleaning will be permitted only when approved.

3.4 ADDITIONS TO EXISTING STRUCTURES

3.4.1 Matching Existing Work

New masonry work shall match existing in coursing, bonding, color, and texture.

3.4.2 Connections with Existing Structures

New masonry work shall be "toothed" into the existing masonry work.

New masonry work shall be separated from existing masonry work by expansion joints, if indicated on drawings.

3.4.3 Cutting and Patching

Cutting existing masonry work shall be performed in a manner that will ensure edges cut plumb and true, without damage to adjacent joints.

Patching of existing masonry work, after the installation of new masonry work, shall match the quality and the material of existing adjacent surfaces if so indicated on individual task orders.

-- End of Section --

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SECTION 05120

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10/01

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SECTION 05120

STRUCTURAL STEEL
10/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC M013	(1983; 8th Ed) Detailing for Steel Construction
AISC M021	(1989) Manual of Steel Construction, ASD, 9th Edition (M016); (1992) Manual of Steel Construction, Connections (M017)
AISC M024	(1994) Manual of Steel Construction, LRFD, Metric Conversion of the 2nd Edition (M022); (1994) Connections (M023)
AISC S303	(2000) Code of Standard Practice for Steel Buildings and Bridges
AISC S341	(1997) Seismic Provisions for Structural Steel Buildings
AISC S350L	(1999) Load and Resistance Factor Design for Structural Steel Buildings

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.22.1	(1965; R 1998) Plain Washers

AMERICAN RAILWAY ENGINEERING ASSOCIATION (AREA)

AREA-01	(Current Until Jul 31, 1991) Manual for Railway Engineering (Fixed Properties)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 1	(2000) Standard Specification for Carbon Steel Tee Rails
ASTM A 106	(1999; Rev E1) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 108	(1999) Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A 123/A 123M	(2001) Standard Specification for Zinc

	(Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 148/A 148M	(2001) Standard Specification for Steel Castings, High Strength, for Structural Purposes
ASTM A 153/A 153M	(2001) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 242/A 242M	(2000; Rev A) Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A 27/A 27M	(1995; R 2000) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 276	(2000; Rev A) Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A 307	(2000) Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 325	(2000) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength
ASTM A 325M	(2000) Standard Specification for High Strength Bolts for Structural Steel Joints (Metric)
ASTM A 36/A 36M	(2000; Rev A) Standard Specification for Carbon Structural Steel
ASTM A 449	(2000) Standard Specification for Quenched and Tempered Steel Bolts and Studs
ASTM A 490	(2000) Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 490M	(2000) Standard Specification for High-Strength Steel Structural Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 500	(2001) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(2001) Standard Specification for Hot-Formed Welded and Seamless Carbon-Steel Structural Tubing
ASTM A 514/A 514M	(2000; Rev A) High-Yield-Strength,

	Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 529/A 529M	(2000) Standard Specification for High Strength Carbon-Manganese Steel of Structural Quality
ASTM A 53/A 53M	(2001) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 563	(2000) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2000) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A 572/A 572M	(2000; Rev A) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(2000; Rev A) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 inch (100 mm) Thick
ASTM A 618	(2001) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 668/A 668M	(1996) Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use
ASTM A 759	(2000) Standard Specification for Carbon Steel Crane Rails
ASTM A 780	(2001) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 786/A 786M	(2000; Rev B) Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low Alloy, and Alloy Steel Floor Plates
ASTM A 992/A 992M	(2000) Standard Specification for Steel for Structural Shapes for Use in Building Framing
ASTM B 695	(2000) Coatings of Zinc Mechanically Deposited on Iron and Steel
ASTM C 1107	(1999) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)
ASTM C 150	(2000) Standard Specification for Portland Cement
ASTM C 404	(1997) Standard Specification for

	Aggregates for Masonry Grouts
ASTM C 658	(1998) Chemical-Resistant Resin Grouts for Bricks or Tile
ASTM D 2939	(1998) Standard Test Method for Emulsified Bitumens Used as Protective Coatings
ASTM E 142	(1992) Standard Method for Controlling Quality of Radiographic Testing
ASTM E 164	(1997) Standard Practice for Ultrasonic Contact Examination of Weldments
ASTM E 165	(1995) Standard Test Method for Liquid Penetrant Examination
ASTM E 329	(2000; Rev B) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM E 709	(1995) Standard Guide for Magnetic Particle Examination
ASTM E 94	(2000) Standard Guide for Radiographic Testing
ASTM F 1554	(1999) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength
ASTM F 436	(1993; R 2000) Standard Specification for Hardened Steel Washers
ASTM F 436M	(1993; R 2000) Standard Specification for Hardened Steel Washers (Metric)
ASTM F 959	(2001) Standard Specification for Compressible-Washer-Type Direct Tenstion Indicators for Use with Structural Fasteners

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1	(2000) Structural Welding Code - Steel

MATERIAL HANDLING INSTITUTE (MHI)

MHI CMAA 70	(2000) Specifications for Top Running Bridge & Gantry Type Multiple Girder Electric Overhead Traveling Cranes

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 1	(1994) Surface Preparation Specification No. 1, Solvent Cleaning
SSPC SP 2	(1982) Hand Tool Cleaning
SSPC SP 3	(1995) Surface Preparation Specification No. 3, Power Tool Cleaning
SSPC SP 10	(2000) Near-White Blast Cleaning (Nace No. 2)
SSPC Paint 25	(1997) Paint Specification Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication and Installation Drawings shall indicate the members, detail connections (including areas not to be painted), indicate steel grades, indicate welding electrodes, indicate bolt and washer grades and sizes, indicate weld size and length, indicate copes and cuts, and indicate all details necessary to ensure adequate review. Drawings shall conform to AISC M013. Shoring and temporary bracing (if necessary) shall be designed and sealed by a registered professional engineer and provided for record purposes.

Connections designed by the fabricator shall be by a qualified registered professional engineer. Drawings shall be sealed.

SD-03 Product Data

Paint Materials.

SD-06 Test Reports

Daily Inspection Report

SD-07 Certificates

Steel Inspection/Testing Service

Welder Qualifications shall include the type of welding and positions each operator is qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests.

Fabricator Category Certification

Erector Category Certification

1.3 QUALIFICATIONS FOR STRUCTURAL STEEL WORK

Fabricator shall be certified by AISC to perform structural steel work at Category Sbd.

Erector shall be certified by AISC to perform structural steel work at Category CSE.

1.4 QUALIFICATIONS FOR WELDING WORK

Welders shall be certified to have been qualified by tests in accordance with AWS D1.1.

1.5 QUALIFICATIONS FOR STEEL INSPECTION/TESTING SERVICE

Steel testing shall be performed by an approved laboratory and inspection service experienced in inspection and testing of steel. Testing agency shall meet the requirements of ASTM E 329.

1.6 SYSTEM REQUIREMENTS

Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be in accordance with AISC S303, and either AISC M024/ AISC S350L(LRFD) or AISC M021
(ASD), as indicated below, except as modified by this specification.

Design of members and connections for any portion of the structure not indicated shall be completed by the fabricator and indicated on detail drawings.

Structural steel shall be fabricated and assembled in the shop to the greatest extent possible.

Structural steel shall be provided with erection marks.

Where structural steel members will join with existing work, accurate and detailed field measurement shall be performed prior to submitting shop drawings.

1.6.1 Load and Resistance Factor Design

Where the design drawings indicate that design is in accordance with Load Resistance Factor Design (LRFD) practices, the following shall govern the work: AISC M024, and AISC S350L shall be the current Specification.

1.6.2 Allowable Stress Design

Where the design drawings indicate that design is in accordance with Allowable Stress Design (ASD) practices, the following shall govern the work: AISC M021.

1.6.3 Seismic Provisions

In addition to AISC M021 or AISC M024/AISC S350L requirements, steel shall also comply with AISC S341 when the drawings indicate a Seismic Design Category D.

1.6.4 Structural Steel Tolerances for Cranes

Structural steel (columns, girders, rails, etc) supporting cranes shall be within tolerances specified and those cited in MHI CMAA 70, superceding tolerances specified in the AISC S303, where CMAA requirements are more stringent.

PART 2 PRODUCTS

2.1 STRUCTURAL SHAPES

Unless noted otherwise on the design drawings, structural shapes shall be as follows.

2.1.1 Wide Flange (W) Shapes

High strength steel shall conform to ASTM A 992/A 992M.

2.1.2 Miscellaneous (M), American Standard (S), and Bearing Pile (HP) Shapes

Carbon grade steel shall conform to ASTM A 36/A 36M.

2.1.3 American Standard (C) and Miscellaneous Channels (MC), and Angle (L) Shapes

Carbon grade steel shall conform to ASTM A 36/A 36M.

2.1.4 Hollow Structural Shapes (HSS)

Round HSS shall conform to ASTM A 500, Grade B (42 ksi).

Square and rectangular HSS shall conform to ASTM A 500, Grade B (46 ksi).

2.1.5 Steel Pipe

Steel pipe shall conform to ASTM A 53/A 53M, Type E or Type S, Grade B. Pipe shall be Standard Weight, unless otherwise indicated on the drawings.

2.1.6 Crane Rails

ASCE 60 and 85 pound rails shall conform to ASTM A 1.

Bethlehem 104, 135, 171, and 175 pound rails shall conform to ASTM A 759.

Rails shall be provided with tight end joints suitable for crane service, joint bars matching the rail section, and joint bar bolts and nuts conforming to ASTM A 325, complete with AREA-01 alloy steel spring washers and manufacturer's standard fixed or floating type rail clamps.

2.2 STRUCTURAL PLATE (PL)

Carbon grade steel plate shall conform to ASTM A 36/A 36M.

2.3 STRUCTURAL BAR

Carbon grade steel shall conform to ASTM A 36/A 36M.

2.4 RAISED PATTERN FLOOR PLATE

Raised pattern floor plate shall conform to ASTM A 786/A 786M, using ASTM A 36/A 36M steel.

2.5 HIGH-STRENGTH THREADED FASTENERS

High-strength bolts shall conform to ASTM A 325.

Hardened steel washers shall conform to ASTM F 436.

Heavy hex nuts shall conform to ASTM A 563.

2.6 STEEL CASTINGS

Castings shall be high-strength steel for structural purposes conforming to ASTM A 148/A 148M, Grade 80-50.

2.7 STUD SHEAR CONNECTORS

Connectors shall be made of cold-finished, carbon steel conforming to ASTM A 108, Grade 1015 through 1020, headed-stud type; AWS D1.1, Type B.

2.8 LOW-CARBON STEEL THREADED FASTENERS

Bolts shall conform to ASTM A 307, Grade A.

Nuts shall conform to ASTM A 563.

Round washers shall be plain, conforming to ANSI B18.22.1, Type B.

2.9 ANCHOR RODS (BOLTS)

Unheaded anchor rods, nuts and washers shall conform to ASTM F 1554, Grade 55. Galvanize according to ASTM A 153/A 153M.

2.10 WELDING MATERIALS

Welding materials shall conform to AWS D1.1, 70XX electrodes.

2.11 PROTECTIVE COATING

Except as indicated below, steelwork shall be primed in accordance with SSPC Paint 25.

Where steelwork is architecturally exposed structural steel (AESS), or other work where steel work is given an architectural or fireproofing coating system, then steelwork shall be prepared and primed in accordance with the architectural section specifications.

Class B coating shall be used for slip-critical surfaces if painted.

Primer shall not be applied to surfaces to be welded, contact surfaces of high-strength bolted connections, surfaces of crane rails, or surfaces to be galvanized.

Steelwork, where indicated on the drawings to be galvanized, shall be hot dipped galvanized as indicated in accordance with ASTM A 123/A 123M. Abraded surfaces and cut ends of galvanized members shall be touched up

with zinc-dust, zinc-oxide primer, or an approved galvanizing repair compound.

Steelwork embedded in concrete shall be coated with a bituminous mastic conforming to ASTM D 2939.

2.12 BEDDING MATERIALS

2.12.1 Shrink-Resistant Grout

Shrinkage-resistant grout shall be a premixed, non-metallic, and packaged grouting compound conforming to ASTM C 1107.

2.12.2 Mixing Water

Water shall be potable.

2.13 GALVANIZING

Galvanizing shall be zinc coating by hot-dip process conforming to ASTM A 123/A 123M

PART 3 EXECUTION

3.1 GENERAL

Erection of structural steel shall be in accordance with the AISC S303, with modifications and additional requirements as specified.

3.2 ERECTING EQUIPMENT

Equipment shall be suitable and safe for workers. Falsework shall be maintained in a safe and stable condition until the steel structure is fully self-supporting.

3.3 ANCHOR RODS (BOLTS)

Anchors and other connections between structural steel and foundations or existing structural steel shall be performed as part of the work.

Anchors shall be accurately located and built into connecting work and shall be preset by the use of templates or other methods as may be required to locate anchors and other connections. Accurate verification of masonry, concrete, and existing stel bearing surface or connection location and elevation shall be performed prior to steel erection.

Anchors not indicated on drawings to resist uplift may be installed using high-strength chemical anchors if submitted on shop drawings and approved by the Government.

3.4 SETTING COLUMN BASES AND BEARING PLATES

Column base plates and bearing plates for beams and similar structural members shall be aligned with wedges or shims and shall be bedded with shrink-resistant grout, packed solidly, so that no voids remain.

Concrete and masonry bearing surfaces shall be clean. Concrete surfaces shall be roughened. Bottom surface of base or bearing plates shall be cleaned.

3.5 ERECTION

Structural steel frames shall be assembled to lines and elevations indicated. Various members forming parts of a completed frame or structure after being assembled shall be aligned and adjusted before being fastened. Fastening of splices of compression members shall be done after abutting surfaces have been brought completely into contact. Bearing surfaces and surfaces that will be in permanent contact shall be cleaned before members are assembled.

Splices will be permitted only where indicated. Erection bolts used in welded construction shall be removed and the holes shall be filled with plug welds.

Welding for re-drilling will not be permitted. Holes shall not be enlarged more than 1/16-inch larger than the specified hole size without approval of the Contracting Officer.

3.6 FIELD CONNECTIONS

High-strength bolted connections shall be snug tightened unless indicated as slip-critical or pretensioned connections on the drawings. Connections so indicated shall use direct tension indicator tightening method only.

Welded connections shall have any primer or other detrimental material or contamination removed prior to welding, and shall be sequenced to maintain alignment and minimize distortion.

3.7 GAS CUTTING

Use of a 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 Contracting Officer.

3.8 CRANE RUNWAYS

Runways shall be erected complete with columns, girders, beams, bracing, crane rails, crane stops, and other required components. Gage, alignment, and elevation of rails shall be accurate to a tolerance of plus or minus 1/8 inch. Rail joints shall be staggered with respect to each other on opposite sides of the runway and shall not coincide with girder joints. Top of rails shall be flush at joints.

3.9 SHEAR CONNECTORS

When shear connectors are field installed, they shall be welded through the deck to supporting steel according to AWS D1.1. Remove and discard arc shields after welding shear connectors.

3.10 CLEANING AND TOUCHUP

Immediately after erection of structural steel, the Contractor shall touch up bolt heads and nuts, field welds, and abrasions in the shop coat.

Surfaces shall be cleaned in accordance with SSPC SP 1, SSPC SP 2, and SSPC SP 3 as necessary. Touchup shall be applied within 6 hours after surface preparation. Touchup shall be the same coating as applied in the

shop. Application shall be by spray.

Abrasions in galvanized surfaces shall be cleaned in accordance with SSPC SP 1, SSPC SP 2, and SSPC SP 3, and applied with galvanizing repair paint according to ASTM A 780.

3.11 INSPECTION AND ACCEPTANCE PROVISIONS

3.11.1 General Inspection

Inspection by the Contractor shall include inspection marking of appropriate materials (shapes/joists/deck/other accessory material) and conformance to AISC S303.

3.11.2 Inspection of Welds

Visual inspection of welds shall include proper surface preparation, size, gaging location, and acceptability, including operation and current characteristics of welding sets in use.

Where required by the drawings for specific welds, additional inspection of welds shall be performed in accordance with AWS D1.1, and as follows:

Liquid penetrant inspection of the welds shall conform to ASTM E 165.

Magnetic particle inspection of the welds shall conform to ASTM E 709.

Radiographic inspection of the welds shall conform to ASTM E 94 and ASTM E 142.

Ultrasonic inspection of the welds shall conform to ASTM E 164.

3.11.3 Inspection of High-Strength Bolted Connections

Inspection of high-strength bolted connections shall be performed in accordance with AISC M021 or AISC M024/AISC S350L, as applicable. Inspection shall include verification of bolt size, grade, and tensioning.

Ten percent of all installed bolts shall be tested, but not less than 2 bolts per connection.

Inspection of load-indicator washer gap shall be in accordance with ASTM F 959.

3.11.4 Inspection of Stud Shear Connector

Inspection of studs shall be in accordance with AWS D1.1. Inspection shall include size, number, and spacing of stud shear connectors. Bend tests shall be performed on any stud that shows less than full 360-degree flash.

3.11.5 Daily Inspection Report

The Contractor shall furnish a Daily Inspection Report that indicates areas of steel, joists, deck, studs, etc. erected, documenting inspections and tests performed, and includes results of inspections and tests performed.

3.11.6 Government Inspection

The government may perform inspection and testing at its discretion. This

shall be at no cost to the Contractor, unless the results of such tests indicate deficiencies. In such case the Contractor shall reimburse the Government for costs of inspection and testing performed.

-- End of Section --

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SECTION 05210

STEEL JOISTS

10/01

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-- End of Section Table of Contents --

SECTION 05210

STEEL JOISTS
10/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN CONCRETE INSTITUTE (ACI)

ACI 503R	(1993) Use of Epoxy Compounds with Concrete

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC M013	(1983; 8th Ed) Detailing for Steel Construction

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 194/A 194M	(2001) Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
ASTM A 242/A 242M	(2000; Rev A) Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A 307	(2000) Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 325	(2000) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength
ASTM A 325M	(2000) Standard Specification for High Strength Bolts for Structural Steel Joints (Metric)
ASTM A 36/A 36M	(2000; Rev A) Standard Specification for Carbon Structural Steel
ASTM A 370	(1997; Rev A) Standar Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 490	(2000) Standard Specification for Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 490M	(2000) Standard Specification for High-Strength Steel Structural Bolts, Classes 10.9 and 10.9.3, for Structural

	Steel Joints (Metric)
ASTM A 563	(2000) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2000) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A 568/A 568M	(2000; Rev B) Standard Specifications for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A 1011/A 1011M	(2001) Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A 572/A 572M	(2000; Rev A) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 6/A 6M	(2001) Standard Specification for Rolled Structural Steel Bars, Plates, Shapes, and Sheet
ASTM A 606	(1998) Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM C 1107	(1999) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-Shrink)
ASTM C 150	(2000) Standard Specification for Portland Cement
ASTM C 404	(1997) Standard Specification for Aggregates for Masonry Grouts
ASTM E 165	(1995) Standard Test Method for Liquid Penetrant Examination
ASTM E 709	(1995) Standard Guide for Magnetic Particle Examination
ASTM F 436	(1993; R 2000) Standard Specification for Hardened Steel Washers
ASTM F 436M	(1993; R 2000) Standard Specification for Hardened Steel Washers (Metric)
ASTM F 568M	(1998) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.22.1	(1965; R 1990) Plain Washers

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A5.1	(1991) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1	(2000) Structural Welding Code - Steel

STEEL JOIST INSTITUTE (SJI)

SJI-01	(1994) Load Tables and Weight Tables for Steel Joists and Joist Girders

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PS 14.01	(1991) Steel Joist Shop Painting System
SSPC Paint 15	(1991) Steel Joist Shop Paint
SSPC SP 2	(1982) Hand Tool Cleaning

1.2 DESIGN REQUIREMENTS

1.2.1 Design

Design of joists, bridging, and accessories shall conform to the requirements of the SJI-01.

1.2.2 Deflection

Deflection shall not exceed 1/360 of the clear span under the indicated uniform live load; including point loads where indicated.

1.2.3 Loads

Uniform loads, concentrated loads, and uplift loads for design purposes shall be as indicated by the design drawings.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication and Installation Drawings shall include details and layouts indicating wall, structural framing, and other supports; location, lengths, spacing and marking of steel joists corresponding to sequence and procedure to be followed in placing and fastening, bridging type and location, location and type of fasteners, and sequence of welded connections. Drawings shall

also indicate steel grades, indicate welding electrodes, indicate bolt, nut, and washer grades and sizes, indicate weld size and length, and indicate all details necessary to ensure adequate review. Drawings shall conform to AISC M013.

SD-03 Product Data

Steel Joists
Grout
Paint Material

SD-05 Design Data

Design Analysis and Calculations shall be submitted to establish conformance with joist strength requirements of SJI-01.

SD-07 Certificates

Welder Qualifications shall include the type of welding and positions each operator is qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification tests.

1.4 QUALIFICATIONS FOR WELDING WORK

Welders shall be certified in accordance with Section 05120, "Structural Steel".

1.5 DELIVERY, STORAGE, AND HANDLING

Joists stored at the site before erection shall be stored off the ground on platforms or other supports and covered.

PART 2 PRODUCTS

2.1 JOISTS AND ACCESSORIES

Steel materials and fabrication requirements for joists and accessories shall conform to SJI-01.

2.2 OTHER STRUCTURAL MATERIALS

High strength threaded fasteners, low carbon steel threaded fasteners, anchor rods, welding materials, bedding materials, bearing plates, etc. shall conform to Section 05120, "Structural Steel".

2.3 SHOP PAINTING

Except as indicated below, joists and accessories shall be given one coat of the specified paint in accordance with SSPC PS 14.01. Paint shall be shop paint primer conforming to SSPC Paint 15.

Where joists and accessories are exposed architectural steel, or other work where steel work is given an architectural or fireproofing coating system, then joists and accessories shall be prepared and primed in accordance with the architectural section specifications.

PART 3 EXECUTION

3.1 GENERAL

Steel joists, bridging, and accessories shall be installed in accordance with the approved shop drawings and descriptive data, and in accordance with SJI-01.

Care shall be exercised in handling and placing joists. Joists shall be fastened in place and bridging installed prior to receiving construction loads. Contractor shall coordinate joist location with access space and fixture-placing requirements of other trades.

Special fittings for headers and openings, extended end overhangs, and ceiling extensions shall be furnished when required and/or indicated on the drawings.

3.2 WELDING

Welding shall conform to AWS D1.1.

3.3 ANCHORS RODS (BOLTS)

Anchor rods (bolts) and other anchors required for connection of steel joists supported on, attached to, or built into masonry or concrete construction shall be correctly located. Anchors shall be set by use of templates or other methods required to locate the anchors accurately. Accurate verification of masonry, concrete, and existing steel bearing surface or connection location shall be performed prior to joist erection.

3.4 SETTING JOIST BEARING PLATES

Joist bearing plates supported on masonry or concrete construction shall be fully bedded on wedges or shims and shall be bedded with shrink-resistant grout, packed solidly, so that no voids remain.

Masonry and concrete bearing surfaces shall be clean. Concrete surfaces shall be roughened. Bottom surface of plates shall be clean.

3.5 ERECTION

Supporting members shall be in place before placing of joists is started. Joists shall be placed on the supporting framework and adjusted and aligned accurately, with ends bearing on supporting members, before being permanently fastened.

3.6 BRIDGING

All joists 40 feet and over shall have a row of bolted bridging in place before slackening of hoisting lines.

As soon as steel joists are placed, bridging shall be completely installed.

Each line of bridging shall be securely anchored to walls or supports at the ends of the line and to each joist by welding or bolting.

3.7 FASTENING STEEL JOISTS

Steel joists resting on end supporting members shall be connected as

indicated on the approved shop drawings.

3.8 CLEANING AND TOUCHUP

Immediately after joist installation, the Contractor shall touch-up field welds, bolt heads and nuts, and abrasions in the shop coat. Surfaces shall be cleaned in accordance with SSPC SP 2. Touch-up shall be applied within 6 hours after surface preparation. Touchup shall be the same coating as applied in the shop.

3.9 INSPECTION AND ACCEPTANCE PROVISIONS

See Section 05120, "Structural Steel", for inspection and acceptance provisions.

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STEEL DECK

10/01

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SECTION 05310

STEEL DECK
10/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-973	(1996) Cold Formed Steel Design Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M	(2001) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 780	(2001) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM D 1056	(2000) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM E 119	(2000; Rev A) Standard Test Methods for Fire Tests of Building Construction and Materials

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A5.1	(1991) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1	(2000) Structural Welding Code - Steel
AWS D1.3	(1998) Structural Welding Code - Sheet Steel

STEEL DECK INSTITUTE (SDI)

SDI-30	(2000) Design Manual for Composite Decks, Form Decks, and Roof Decks

1.2 SYSTEM DESCRIPTION

1.2.1 Performance Requirements

Properties of metal floor deck sections shall be computed on the basis of the effective design width, as limited by the provisions of AISI SG-973.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication and Installation Drawings shall include the following:

Field measurements shall be taken prior to preparation of drawings and fabrication details and layouts indicating the structural framing, location, length and markings of the metal deck units; location, type, and pattern of attachments; deck unit cross section, with dimensions, and complete computations of unit section properties; accessories and methods of installation, including reinforcement at openings; size and number of openings to be cut in the metal decking.

When both fire-resistance-rated and non-rated construction are required, the location of fire-resistance-rated construction shall be shown.

SD-03 Product Data

Submit Manufacturer's Catalog Data for the following:

Deck units of each type required
Accessories
Fasteners
Flexible closure strips and adhesive

SD-07 Certificates

Welder Qualifications.

1.4 QUALIFICATION FOR WELDING WORK

Welding procedures shall be in accordance with AWS D1.1 and AWS D1.3.

Welders shall be certified to have been qualified by test in accordance with AWS D1.1.

1.5 DELIVERY, STORAGE, AND HANDLING

Decking stored at the site before erection shall be stacked on platforms or pallets and covered to provide a weathertight enclosure, and protection against the weather.

PART 2 PRODUCTS

2.1 FIRE TEST-RESPONSE CHARACTERISTICS

Provide steel deck units tested for fire resistance per ASTM E 119 by an independant testing and inspection agency.

Where indicated by FM or UL listing designations provide steel deck units so tested.

Steel deck units shall be identified with appropriate markings of applicable testing and inspection agency.

2.2 STEEL SHEET

Steel sheet shall be ASTM A 653/A 653M, structural steel, Grade 33, with G90 galvanized zinc coating.

2.3 ROOF DECK

Steel roof deck panels shall be fabricated in accordance with SDI-30 and the following:

Profile shall be Type F Intermediate Rib, 1-1/2 inches depth, thickness and sectional properties as indicated on the design drawings.

Panels shall be sufficient length to extend over three or more spans where possible.

Sidelaps shall be interlocking seam.

2.4 COMPOSITE FLOOR DECK

Composite floor deck panels shall be fabricated with integrally embossed or raised pattern ribs and interlocking sidelaps in accordance with SDI-30 and the following:

Profile shall be 1-1/2inches depth, thickness and sectional properties as indicated on the design drawings.

Panels shall be sufficient length to extend over three or more spans where possible.

2.5 ACCESSORIES

Provide manufacturer's standard accessory materials, meeting the following minimum requirements:

Mechanical fasteners shall be corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

Side-lap fasteners shall be corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

E60XX welding electrodes complying with AWS D1.1.

Flexible closure strips shall be vulcanized, closed cell, synthetic rubber, conforming to ASTM D 1056.

Pour stops, opening reinforcements, end closures, Z-closures, cover plates, ridge and valley plates, and other metal deck accessories shall be the same material and finish as the deck, thickness shall be as required by SDI or manufacturer to suit span or overhang condition.

Recessed sump pans shall be single-sheet, 0.0747 inches thick, same material and finish as the deck, with 3 inchwide flanges and recessed pan of 1-1/2 inches minimum depth.

Weld washers shall be uncoated steel, shaped to fit deck rib, 0.0747 inchesthick, with factory punched hole of 3/8 inch minimum diameter.

2.6 GALVANIZING REPAIR PAINT

Galvanizing repair paint shall be ASTM A 780 with dry film containing mimimum 94% zinc dust by weight.

PART 3 EXECUTION

3.1 INSTALLATION

Deck panels and accessories shall be installed in accordance with specifications and commentary of SDI-30, manufacturer's instructions, and requirements of this section.

Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to decking.

Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.

Comply with AWS D1.3 welding requirements and procedures.

When fire-rated deck panels are used, installation methods shall be as specified by the rating agency's specifications.

If fastening requirements are indicated on the drawings, fastening shall be per the drawings. If fastening requirements are not shown on the drawings, then fastening shall be as follows:

Spacing of welds shall be 6 inches on center at endlaps and 12 inches on center at each intermediate support, parallel and perpendicular to deck span.

For spans exceeding 4 feet, sidelaps between adjacent panels shall be fastened together at intervals of 30 inches by welding (1-1/2 inch long welds), button punch, or mechanical fastener.

Fasten deck panels to supporting steel members by arc spot (puddle) welds, 3/4 inch diameter, using welding washers when required.

Mechanical fasteners may be used in lieu of welding to fasten deck.

3.2 ROOF DECK INSTALLATION

Deck panel end bearing shall extend over supporting frame a minimum of 1-1/2 inches with end joints lapped a minimum 2 inches.

Sump pans shall be fastened with welds not more than 12 inches on center, with at least one weld at each corner.

Install flexible closure strips over walls, partitions, and locations where indicated on the drawings. Install with adhesive according to manufacturer's written instructions.

Other accessories shall be installed per manufacturer's written instructions to ensure complete closure.

3.3 COMPOSITE FLOOR DECK INSTALLATION

Deck panel end bearing shall extend over supporting frame a minimum of 1-1/2 inches with end-joints being butt-lapped.

Pour stops, girder fillers, and deck closures shall be welded to the supporting steel according to manufacturer's written instructions.

3.4 CLEANING AND TOUCH-UP

After decking installation, the deck shall be cleaned and touch-up provided. Scarred areas including welds, weld scars, and bruises shall be painted with galvanizing repair paint in accordance with ASTM A 780.

3.5 INSPECTION AND ACCEPTANCE PROVISIONS

Se Section 05120, "Structural Steel", for inspection and acceptance provisions.

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SECTION 05500

METAL FABRICATIONS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC M017	(1992) Manual of Steel Construction, Volume II, Connections

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.22.1	(1965; R 1998) Plain Washers
ANSI B18.22M	(1981; R 1990) Metric Plain Washers

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1	(1981; R 1992) Square and Hex Bolts and Screws, Including Hex Cap and Lag Screws (Inch Series)
ASME B18.2.3.8M	(1981; R 1991) Metric Hex Lag Screws
ASME B18.21.1	(1990) Lock Washers
ASME B18.21.2M	(1990) Lock Washers (Metric Series)
ASME B18.6.3	(1972; R 1991) Machine Screws and Machine Screw Nuts
ASME B18.6.7M	(1985; R 1993) Metric Machine Screws

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2001) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 27/A 27M	(1995; R 2000) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 283/A 283M	(1993; Rev A) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates

ASTM A 307	(2000) Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 36/A 36M	(2000; Rev A) Standard Specification for Carbon Structural Steel
ASTM A 366/A 366M	(1996) Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 446/A 446M	(1993) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
ASTM A 467/A 467M	(1993) Machine and Coil Chain
ASTM A 47	(1990) Standard Specification for Ferritic Malleable Iron Castings
ASTM A 47M	(1990) Standard Specification for Ferritic Malleable Iron Castings (Metric)
ASTM A 48	(1994; Rev E1) Standard Specification for Gray Iron Castings
ASTM A 48M	(1994; Rev A) Standard Specification for Gray Iron Castings (Metric)
ASTM A 500	(2001) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(2001) Standard Specification for Hot-Formed Welded and Seamless Carbon-Steel Structural Tubing
ASTM A 513	(1994) Electric-Resistance-Welded Carbon an Alloy Steel Mechanical Tubing
ASTM A 525	(1993) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 525M	(1991; Rev A) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process (Metric)
ASTM A 526/A 526M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM A 53	(1999; rev B) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM A 563	(2000) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2000) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A 569/A 569M	(1991; Rev A) Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality
ASTM A 570/A 570M	(1996) Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 575	(1989) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 786/A 786M	(2000; Rev B) Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low Alloy, and Alloy Steel Floor Plates
ASTM B 26/B 26M	(1995) Standard Specification for Aluminum-Alloy Sand Castings
ASTM C 387	(2000) Standard Specification for Packaged, Dry Combined Materials for Mortar and Concrete
ASTM C 514	(1994) Standard Specification for Nails for the Application of Gypsumboard
ASTM E 621	(1994; R 1999) Standard Practice for Use of Metric (SI) Units in Building Design and Construction
ASTM F 568	(1995) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1	(1991) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1	(2000) Structural Welding Code - Steel

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	(2001) Occupational Safety and Health Standards

FEDERAL SPECIFICATIONS (FS)

FS FF-B-588	(Rev D) Bolt, Toggle; and Expansion Sleeve, Screw

FS FF-S-325	(Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
FS RR-T-650	(Rev D) Treads, Metallic and Non-Metallic, Skid Resistant

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	(1988; MBG 531S-89) Metal Bar Grating Manual

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25	(1997) Paint Specification Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
SSPC Paint 20	(1991) Zinc-Rich Primers (Type I - Inorganic and Type II - Organic)
SSPC SP 10	(2000) Near-White Blast Cleaning (Nace No. 2)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings for the following items shall be in accordance with the paragraph entitled, "General Fabrication," of this section.

Structural Steel
Joints
Castings

Installation Drawings for Miscellaneous Metal Items shall include location, dimensions, size, and weight or thickness as applicable to the members, type and location of welded connections, location and details of anchorage devices that are to be embedded in cast-in-place concrete and masonry construction, and any other pertinent construction and erection details.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Structural Steel Plates, Shapes, and Bars
Structural Steel Tubing
Bars and Bar Size Shapes
Hot-Rolled Carbon Steel Sheets
Cold-Rolled Carbon Steel Sheets
Galvanized Carbon Steel Sheets
Gray Iron Castings

Malleable Iron Castings
Raised Pattern Steel Floor Plates
Steel Bar Grating
Access Panels and Frames
Roof Scuttles
Steel Pipe Railing
Wheel Guards
Wire Mesh Partitions
Wire Mesh Window Guards
Anchorage Materials
Paint Materials
Miscellaneous Metal Items

SD-04 Samples

Contractor shall submit one full-size sample, each type, for the following. After approval, full-size samples may be used in the construction, provided each sample is clearly identified and its location recorded.

Cast Abrasive Thresholds
Metal Safety Hosing for Concrete Treads
Anchorage Devices and Fasteners
Lock Cylinder

SD-07 Certificates

Submit Certificates of Compliance for the following:

Welder Qualifications shall be in accordance with the paragraph entitled, "Qualifications for Welding Work," of this section.

Welding Procedures shall be in accordance with AWS D1.1.

Miscellaneous Metals Items showing conformance with the referenced standards contained in this section.

SD-08 Manufacturer's Instructions

Manufacturer's Instructions covering installation of Miscellaneous Metal Items shall be submitted.

1.3 METALWORK REQUIREMENTS

For items not specifically described in these specifications, materials and workmanship shall conform to the accepted standard practices of the trades. Supplementary parts necessary to complete each item shall be furnished and installed. Anchors, sockets, or fastenings required for securing metal work to other structures shall be furnished to the appropriate trades promptly. Details and specifications of items for which standard products are available are representative guides of minimum requirements for such items. Standard products, generally meeting such requirements, will be accepted subject to approval. Welding shall be continuous along entire area of contact except where tack welding is noted. Tack welding will not be permitted on exposed surfaces. Items specified to be galvanized shall be hot-dip galvanized after fabrication. Weight of coating shall be not less than 1.25 ounces per square foot of surface.

Templates and patterns for proper fitting of hardware and other accessories

shall be used wherever practical.

Substitutions of materials or modification of details, or both, shall be made only when warranted and approved.

1.4 QUALIFICATIONS FOR WELDING WORK

Welders shall be certified to have been qualified by tests in accordance with AWS D1.1.

1.5 DRAINAGE HOLES

Drainage holes shall be drilled to eliminate water traps. Hole locations and diameter of holes shall be 1/2 inch and shown on detail drawings for Contracting Officer's approval. Hole size and locations shall not affect structural integrity.

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL PLATES, SHAPES, AND BARS

Plates, shapes, and bars shall conform to ASTM A 36/A 36M.

Plates to be bent or cold formed shall conform to ASTM A 283/A 283M, Grade C.

2.2 STRUCTURAL STEEL TUBING

Square or rectangular tubing shall be hot formed, welded or seamless, conforming to ASTM A 501.

2.3 HOT-ROLLED CARBON STEEL BARS AND BAR-SIZE SHAPES

Bars and bar sizes shall conform to ASTM A 575, Grade M1020.

2.4 HOT-ROLLED CARBON STEEL SHEETS AND STRIP

Sheets and strip shall be uncoated and shall conform to ASTM A 569/A 569M.

2.5 COLD-ROLLED CARBON STEEL SHEETS

Sheets shall be uncoated and shall conform to ASTM A 366/A 366M.

2.6 GALVANIZED CARBON STEEL SHEETS

Sheets shall conform to ASTM A 526/A 526M; galvanizing shall conform to ASTM A 525, G90.

2.7 GRAY IRON CASTINGS

Castings shall conform to ASTM A 48, Class 30.

2.8 MALLEABLE IRON CASTINGS

Castings shall conform to ASTM A 47, Grade 32510 or Grade 35018.

2.9 RAISED PATTERN STEEL FLOOR PLATES

Plates shall be structural-quality steel having a raised figure pattern at

regular intervals on the surface, and shall be flatback style carbon steel conforming to ASTM A 786/A 786M, except that the steel shall conform to ASTM A 36/A 36M.

2.10 STEEL BAR GRATING

Grating shall conform to NAAMM MBG 531 steel shall conform to ASTM A 36/A 36M and finish shall be shop-applied paint instead of galvanized. End-banding bars, anchors, and other components shall be provided as required to suit conditions indicated. Steel grating exposed to the weather shall be galvanized after fabrication.

2.11 ANCHORAGE MATERIALS

Threaded-type concrete inserts shall be galvanized ferrous castings having an enlarged base with not less than two nailing lugs, length not more than thickness of concrete section less 3/4 inch, and internally threaded to receive 3/4-inch diameter machine bolt. Ferrous castings shall be ferritic malleable iron conforming to ASTM A 47, Grade 32510 or Grade 35018, or may be medium-strength cast steel conforming to ASTM A 27/A 27M, Grade U-60-30. Inserts shall be galvanized after fabrication in accordance with ASTM A 153/A 153M.

Threaded inserts shall not be removable when embedded in 3,000 pounds per square inch (psi) concrete and subjected to a 10,000 pound tension load test in an axial direction.

Carbon steel bolts having special wedge-shape heads, nuts, washers, and shims shall be provided. Such hardware items shall be galvanized in accordance with ASTM A 153/A 153M.

Slotted-type concrete inserts shall be galvanized, pressed steel plate, welded construction, box type with slot designed to receive 3/4-inch diameter square head bolt and to provide lateral adjustment of the bolt. Length of insert body less anchorage lugs shall be not less than 4-1/2 inches. Inserts shall be provided with knockout cover. Steel plate shall be not less than 1/8 inch thick and shall conform to ASTM A 283/A 283M, Grade C. Inserts shall be galvanized after fabrication in accordance with ASTM A 153/A 153M.

Slotted inserts shall not be removable when embedded in 3,000 psi concrete and subjected to a 6,000 pound tension load test in an axial direction.

Masonry anchorage devices shall be expansion shields conforming to FS FF-S-325 Group, Type, and Class as follows:

Lead expansion shields for machine screws and bolts 1/4 inch and smaller shall be head-out embedded-nut type, single-unit class, conforming to Group I, Type 1, Class 1.

Bolt anchor expansion shields for lag bolts shall be zinc-alloy long-shield anchors class, conforming to Group II, Type 1, Class 1.

Toggle bolts shall be tumble-wing type of the class and style best suited for the work, and shall conform to FS FF-B-588, Type II.

2.12 FASTENING MATERIALS

Standard bolts shall be regular hexagon head type, low-carbon steel, coarse

thread series, conforming to ASTM A 307.

Nuts shall be plain hexagon, regular style, carbon steel, conforming to ASTM A 563, Grade A.

Lag bolts shall be square head, gimlet point or cone point, carbon steel, conforming to ASME B18.2.1.

Machine screws shall be carbon steel, cross-recess drive, flat-head, conforming to ASME B18.6.3.

Wood screws shall be carbon steel, single thread, flat countersunk head, cross-recess drive, conforming to ASME B18.2.1.

Plain washers shall be round, general-assembly-grade, carbon steel class, conforming to ANSI B18.22.1.

Lockwashers shall be helical spring, carbon steel class, of the style best suited for the work, conforming to ASME B18.21.1.

Electrodes for manual shielded metal arc welding shall meet the requirements of AWS D1.1, and shall be mild steel electrodes conforming to AWS A5.1, E60 series.

2.13 PAINT MATERIALS

Paint for carbon steel shall be as specified in Section 09915, "Painting."

2.14 GENERAL FABRICATION

2.14.1 Workmanship

Fabricated steel shall be in accordance with AISC M017.

Joints shall be milled to a close fit. Corner joints shall be coped or mitered, well-formed, and in true alignment. Joints exposed to the weather shall be formed and fabricated to exclude water.

Castings shall be sound and free from warp or defects that impair strength and appearance. Exposed surfaces shall have a smooth finish and sharp, well-defined lines and arrises. Joints shall be milled to a close fit.

2.14.2 Holes for Other Work

Holes shall be provided as indicated for securing items to metal work.

2.14.3 Galvanizing

Fabricated metal items specified to be galvanized shall be covered with a zinc coating applied by the hot-dip process after fabrication.

Galvanizing of iron and steel hardware shall be in accordance with ASTM A 153/A 153M.

Galvanizing of rolled, pressed, and forged steel shapes, plates, bars, and strip, 1/8-inch thick and heavier, shall be in accordance with ASTM A 123.

Galvanizing of assembled steel products shall be in accordance with ASTM A 123.

2.14.4 Shop Painting

Fabricated metal work, except metal surfaces embedded in concrete or masonry, surfaces and edges to be field welded, and galvanized surfaces shall be shop primed in accordance with Section 09915, "Painting."

2.15 MISCELLANEOUS METAL ITEMS

2.15.1 Access Panels and Frames for Masonry Walls

Panels and frames shall be provided at each pipe space and plumbing chase in masonry walls and at other locations as indicated.

Panels and frames shall be flush panel type for masonry construction, with door size not less than 16 inches by 20 inches.

Frames shall be fabricated from 16 gage, cold-rolled carbon steel sheets with exposed flange not less than 7/8 inch wide, with welded joints and with anchorage for securing to building construction. Panels shall be fabricated from 14-gage, cold-rolled carbon steel sheets, with stiffened edges and with welded attachments. Panels shall be completely assembled with two hinges and one lock per door. Hinges shall be concealed spring type; locks shall be flush-face, turn-screw-operated latch type. Finish shall be prime coat of baked enamel.

2.15.2 Floor Gratings and Frames

Gratings shall be carbon steel with parallel bearing bars either right angle or diagonal cross members, conforming to NAAMM MBG 531. Grating panel sizes and bearing bar sizes shall be as indicated. Each panel shall be provided with end-banding bars, four saddle clip anchors designed to fit over two bearing bars, and four stud bolts, each with a plain washer and nut.

Frames shall be structural steel angles, all-welded construction, and fabricated so that the tops of frames and floor grating finish flush with the finished floor elevation. Anchors welded to the frame shall be provided, spaced not more than 6 inches from ends of frame sections, not more than 6 inches from corners, and not more than 24 inches on center between end and corner anchors. Anchors shall be structural steel bars, 3/4-inch wide by 3/8-inch thick with length as required for a minimum embedment of 6 inches in the concrete.

Grating panels shall be removable. Stud bolts to receive saddle clip anchors shall be field welded to the frame. Notching of bearing bars at supports will not be permitted. Openings in the grating shall be provided as indicated.

Exterior gratings and frames, including fasteners and clips, shall be galvanized. Interior grating and frames, including fasteners and clips, shall be galvanized where indicated.

2.15.3 Floor Plate Covers and Frames

Covers shall be carbon steel plates having a raised figure pattern at regular intervals on the surface, conforming to ASTM A 786/A 786M.

Cover sections shall be the width and thickness indicated. Length shall be

limited by total weight not to exceed 100 pounds. Each floor plate cover section shall be provided with two flush lifting rings, (one located at each end of the section). Covers shall be free of sharp edges and burrs. Covers shall be provided with holes to receive flathead machine screws.

Frames shall be structural steel angles and steel bar stops, all-welded construction, and fabricated so that the tops of frames and floor plate covers finish flush with the finished floor elevation. Anchors welded to the frame shall be provided, and shall be spaced not more than 6 inches from ends of frame sections and corners and not more than 24 inches on center. Anchors shall be structural steel bars 3/4-inch wide by 3/8-inch thick with the length as required for a minimum embedment of 6 inches in the concrete. Frames shall be drilled and tapped to receive machine screws.

Plate covers shall be removable and shall be secured to frame with 3/8-inch machine screws spaced not more than 3 inches from each cover end and not more than 12 inches on center. Machine screws shall be zinc-or cadmium-coated. Openings in plate covers shall be provided as indicated.

Exterior plates and frames shall be galvanized. Interior plates and frames shall be galvanized where indicated.

2.15.4 Ladders

Ladders shall be fixed-rail type, located and detailed as indicated and specified. Rungs shall be 3/4-inch, solid-section structural steel rods, spaced 12 inches on center. Side rails shall be structural steel flat bars with rounded edges 2-1/2 inches by 1/2 inch spaced 16 inches apart, and conforming to 29 CFR 1910, Section 27. Rungs shall be fitted into punched holes in the side rails, welded, and ground smooth. Splices and connections shall have a smooth transition with original members without projections that are sharp or more extensive than required for joint strength. Ladders shall be provided with structural steel brackets, drilled to receive anchor bolts, and welded to side rails. Bracket spacing shall not exceed 10 feet on center.

Exterior and interior ladders, including brackets and fasteners, shall be galvanized where indicated.

2.15.5 Ladder Safety Cages

Cages shall be basket guard hoop type, located and detailed as indicated and specified. Cages shall be fabricated from structural steel flat bars and assembled by bolting or welding. Top and bottom hoops and intermediate hoops at intervals of not more than 20 feet between top and bottom hoops, shall be 4 inches by 5/16 inch. Hoops between 4-inch wide hoops shall be 2 inches by 5/16 inch and spaced not more than 4 feet on center. Vertical bars shall be 2 inches by 5/16 inch and spaced not more than 9 inches or 40 degrees on center. Hoops shall be fastened to the steel ladder side rails with 1/2-inch steel bolts or be shop welded.

Exterior and interior ladder safety cages, including fasteners, shall be galvanized.

2.15.6 Loose Steel Lintels

Lintels shall be provided for openings and recesses in masonry walls and partitions as indicated.

Lintels shall be structural steel shapes as indicated. Lintels consisting of more than one member shall be welded together to form one unit. Bearing at each side of openings shall be not less than 6 inches.

Lintels installed in exterior walls shall be galvanized.

2.15.7 Control Joint Covers

Provide control joint covers to be located on wall surfaces of concrete, masonry and tile work. Provide protective coating on the surface in contact with concrete, masonry or tile.

2.15.8 Expansion Joint Covers

Provide expansion joint covers constructed of extruded aluminum with anodized satin aluminum finish for walls and ceilings and with standard mill finish for floor covers and exterior covers. Furnish plates, backup angles, expansion filler strip, and anchors as indicated. Expansion joint system shall provide hourly fire ratings equal to the surrounding construction.

2.15.9 Guard Posts (Bollards)

Provide glavanized standard weight steel pipe as specified in ASTM A 53. Anchor posts in concrete as indicated and fill solidly with concrete with minimum compressive strenght of 2,500 psi

2.15.10 Structural Steel Door Frames

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.

Where track, guides, hoods, hangers, operators, and other such accessories are required, provide support as indicated.

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 inch diameter floor bolts for adjustment.

Provide spreaders between bottoms of floor jamb members. When floor construction permits, they may be left in place, concealed in the floor.

2.15.11 Miscellaneous Steel Framing and Supports

Miscellaneous steel framing and supports that do not form a part of the structural steel framework shall be provided to complete the work.

Miscellaneous steel framing and supports shall be fabricated of structural steel plates, shapes, bars, and tubing, of sizes and arrangement indicated.

Exterior and interior fabricated steel framing and supports shall be galvanized as indicated.

2.15.12 Shelf Angles

Angles attached to concrete framing shall be structural steel angles of the sizes indicated. Angles shall be provided with slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from each shelf angle end and

not more than 24 inches on center.

Angles to be installed in exterior walls shall be galvanized.

Wedge-type concrete inserts, complete with fasteners, shall be provided for the attachment of shelf angles to cast-in-place concrete.

2.15.13 Steel Pipe Railings and Guardrails

Steel pipe railings shall include guarding at open-sided areas consisting of top rail, intermediate rail and posts, and handrails at walls, as indicated.

Minimum railings shall be 1-1/2-inch nominal size and standard weight, conforming to ASTM A 500, Grade B, ASTM A 501; or may be 1-1/2-inch nominal size, 2.72 pounds weight per foot round structural-steel tubing.

Joining of post, rails, and corners shall be made by one of the following methods:

Flush-type steel railing fittings, welded and ground smooth, with railing splice locks secured with 3/8-inch hexagonal recessed-head setscrews.

Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall be butted and reinforced by a tight-fitting interior sleeve not less than 6 inches long.

Railings may be bent at corners instead of joining, provided the bends are made in suitable jigs and that the cylindrical cross section of the pipe is maintained throughout the entire bend.

Removable railing sections shall be provided as indicated.

Kickplates shall be provided between railing posts where indicated. Kickplates shall be steel flat bars 1/4-inch thick by not less than 6 inches high. Kickplates shall be secured as indicated.

Exterior and interior railings, including pipe, fittings, brackets, fasteners and other ferrous metal components where indicated shall be galvanized; interior railings not indicated galvanized shall be black.

2.16 STEEL DOOR FRAMES

Steel door frames shall be made of steel shapes of the sizes and weights indicated. Frames shall be fabricated by welding and shall be uniform, square and true. Built-up members shall be plug welded; exposed joints shall be continuously welded, with welds ground smooth. Steel bar stops shall be 1-1/2 inches by 5/8 inch and shall be plug welded to frames except where stops are indicated to be removable. Removable stops shall be secured to frame with machine screws, uniformly spaced not more than 10 inches on center. Any necessary reinforcement shall be made and the frames shall be drilled and tapped as required for finish hardware.

Anchors shall be provided for securing door frames into adjoining concrete or masonry. Anchors shall be structural steel bars 1/8 inch by 2 inches by length as required for a minimum embedment of 4 inches in the concrete or masonry. Anchors shall be welded to frames. Anchors shall be located on

jambs not more than 12 inches from both the bottom and head of frame and at uniformly spaced intermediate intervals not exceeding 30 inches on center between anchors.

Exterior and interior steel door frames shall be galvanized where indicated.

2.17 WIRE MESH PARTITIONS

Partition panels shall be 5-feet wide by the height indicated, fabricated of steel wire mesh securely clinched into the panel frames. Frames shall be fabricated of steel channels with corners mortised and tenoned and with vertical members having 1/4-inch diameter holes spaced not more than 12 inches on center for bolting to adjacent panels. Horizontal reinforcement shall be one steel channel with the wire mesh woven through the reinforcement channel, or it may be two steel channels, one on each side of the wire mesh and riveted together. Horizontal reinforcement shall be tenoned to the panel frame vertical members and shall be located approximately 42 inches above the bottom of the panel. Size of partition panel components shall be as follows:

Wire mesh shall be 6-gage (0.192-inch) steel wire woven into 2-inch diamond mesh.

Frame horizontal members shall be 1-1/2- by 3/4- by 1/8-inch hot-rolled carbon steel channels.

Horizontal reinforcement shall be 1-1/2- by 3/4- by 1/8-inch hot-rolled carbon steel channels.

Frame vertical members shall be the same as horizontal members or may be 1-1/4- by 5/8-inch cold-formed C-channels fabricated from 11-gage (0.120-inch) cold-rolled carbon steel sheets.

Measurements shall be made at the building for final location of pipes, ducts, electrical conduit, and other items that will pass through wire mesh partitions. At such locations, openings shall be framed using the same size steel channels as those specified for the partition panels.

Bolts, hardware, accessories, field bracing, and other components shall be provided as required for a complete installation.

2.17.1 Vertical Reinforcement

Vertical reinforcement shall be provided between partition panels. Vertical reinforcement shall be hot-rolled carbon steel flat bars. Bars shall be provided with bolt holes to match those in partition panels and shall be of the following sizes:

5/16-inch by 1-3/4-inches for partitions not exceeding 14 feet in height

5/16-inch by 2-1/2-inches for partitions over 14 feet not exceeding 17 feet in height

2.17.2 Top Capping

Top capping bar shall be provided for wire mesh partitions. Top capping shall be provided with 1/4-inch diameter holes spaced not more than 24 inches on center for U-bolting to the partition panels, and shall be 3-inch

structural steel channel weighing 4.1 pounds per foot for use with 2 inch diamond mesh.

2.17.3 Corner Posts

Corner posts shall be provided at wire mesh partition corners. Posts shall be provided with bolt holes to match those in partition panels and shall be 1-3/4- by 1-3/4- by 1/8-inch hot-rolled carbon steel angles for 2-inch diamond mesh.

2.17.4 Swing Doors

Door construction shall match that of partition panels. Door frames shall be covered on four sides with hot-rolled carbon steel flat bar the same width as the frame and 1/8-inch thick. Each swing door shall be provided with one and one-half pairs of butts riveted to both the door frame and jamb.

2.17.5 Sliding Doors

Sliding doors shall be the size indicated. Door construction shall be the same as that specified for partition panels. Door frames shall be covered on four sides with hot-rolled carbon steel flat bar the same width as the frame and 1/8-inch thick. Each sliding door shall be provided with two four -wheel roller bearing hangers traveling in an enclosed track, with a bottom guide rail.

2.17.6 Door Hardware

Bronze mortise lock capable of receiving the lock cylinder without modification. Lock shall be key-operated on the outside and recessed turn-knob-operated on the inside.

2.17.7 Service Windows

Service windows shall be provided where indicated. Windows shall be slide-up type with shelf. Window openings shall be 24 inches nominal width by 15-inches nominal height. Window frame and wire mesh shall be the same as that specified for the partition panels. Shelf shall be 24 inches nominal width by 12 inches in depth and shall be formed from 12-gage, hot-rolled carbon steel sheet. Windows shall be provided with spring catches that lock window in the open or closed position.

2.18 WIRE MESH WINDOW GUARDS

Guards shall be fabricated from 10-gage (0.135-inch)steel wire woven into 1-1/2-inch diamond mesh clinched into the frame. Frame shall be fabricated from 1- by 1/2- by 1/8-inch hot-rolled carbon steel channels with corners mitered and welded. Window guards 5 feet and over in height shall be provided with center horizontal reinforcement consisting of two 1-by 3/8-by 1/8-inchhot-rolled carbon steel channels, one on each side of the wire mesh riveted together. Horizontal reinforcement shall be welded to the frame vertical members.

Subframes shall be 1-1/4- by 1-1/4- by 1/8-inch hot-rolled carbon steel angles with 1/4-inch diameter holes spaced not more than 12 inches on center for bolting to the building construction.

Each window guard shall be provided with one pair of tamperproof hinges for

window guards 5 feet and less in height and one additional hinge for each 3-foot increase, or fraction thereof, in height over 5 feet. One tamperproof padlock hasp shall be provided with each hinge used.

Window guards, subframes, hardware, and fasteners shall be galvanized.

PART 3 EXECUTION

3.1 GENERAL

Fabricated metal work shall be installed in accordance with the approved detail drawings and descriptive data for each item of fabricated metal, and as specified.

Fabricated metal items shall be securely fastened plumb and true to lines and levels.

3.2 ANCHORAGE DEVICES EMBEDDED IN OTHER CONSTRUCTION

Anchorage devices, such as concrete inserts, anchor bolts, and fabricated metal items having integral anchors, which are to be embedded in cast-in-place concrete and masonry construction, shall be delivered in time to be installed before the start of cast-in-place concrete operations and masonry work.

Setting drawings, templates, instructions, and directions shall be provided for the installation of the anchorage devices.

3.3 FASTENING TO CONSTRUCTION-IN-PLACE

Anchorage devices and fasteners shall be provided where necessary for fastening fabricated metal items to construction-in-place. Fastening shall include threaded fasteners for concrete inserts embedded in cast-in-place concrete; masonry anchorage devices and threaded fasteners for solid masonry and concrete-in-place; toggle bolts for hollow masonry and stud partitions; through bolting for masonry and wood construction; lag bolts and wood screws for wood construction; and connections for structural steel. Fastening shall be provided as indicated and as specified. Fastening to wood plugs in masonry or concrete-in-place will not be permitted.

3.4 CUTTING AND FITTING

Cutting, drilling, and fitting required shall be performed for the installation of fabricated metal work. Cutting, drilling, and fitting shall be executed carefully; when required, work shall be fitted in place before fastening.

3.5 SETTING MASONRY ANCHORAGE DEVICES

Masonry anchorage devices shall be set in masonry or concrete-in-place construction in accordance with the anchorage device manufacturer's printed instructions. Holes shall be of the recommended depth and diameter and shall be drilled as recommended by the manufacturer of the particular anchorage device used. Drilled holes shall be left rough, not reamed, and free of drill dust.

3.6 FIELD WELDING

Procedures for manual shielded metal arc welding, the appearance and quality of welds made, and the methods used in correcting welding work shall conform to AWS D1.1, "Workmanship" and "Technique."

Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connection of fabricated metal work in place shall not be permitted. Exposed connection of fabricated metal work in place shall not be tack welded. Exposed welds shall be ground smooth.

3.7 THREADED CONNECTIONS

Where exposed to view, bolt and screw heads shall be flat and countersunk, unless otherwise specified. Threaded connections shall be made up tightly so that the threads will be entirely concealed by fitting.

3.8 STEEL PIPE RAILINGS AND GUARDRAILS

Railings shall be adjusted prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Posts shall be spaced not more than 6 feet on center and shall be plumb in each direction. Posts and rail ends shall be secured to building construction as follows:

Concrete anchorage for posts shall be by means of pipe sleeves set and anchored into the concrete. Sleeves shall be galvanized, standard weight steel pipe not less than 6 inches long and have an inside diameter not less than 1/2 inch greater than the outside diameter of the inserted pipe post. Steel plate closure shall be provided, secured to the bottom of the sleeve, and shall be of width and length not less than 1 inch greater than the outside diameter of the sleeve. After posts have been inserted into sleeves, the annular space between post and sleeve shall be filled solid with molten lead, sulfur, or a quick-setting hydraulic cement. Anchorage joint shall be covered with a steel round flange welded to the post.

Steel anchorage for posts shall be made by means of steel oval flanges, angle or floor type required by conditions, welded to posts and bolted to the structural steel supporting members.

Concrete and masonry anchorage for rail ends shall be by means of steel round flanges welded to rail ends and anchored into the wall construction with lead expansion shields and bolts.

Steel anchorage for rail ends shall be by means of steel oval or round flanges welded to rail ends and bolted to the structural steel members.

Handrails shall be secured to walls by means of wall brackets and wall return fitting at handrail ends. Brackets shall be malleable iron castings with not less than an 3-inch projection from the finished wall surface to the center of the pipe handrail and with the wall plate portion of the bracket drilled to receive one 3/8-inch bolt. Brackets shall be located not more than 60 inches on center. Wall return fittings shall be cast-iron castings, flush-type, with the same projection as that specified for wall brackets. Wall brackets and wall return fittings shall be secured to building construction as follows:

Concrete and solid masonry anchorage shall be by means of bolt anchor

expansion shields and lag bolts.

Hollow masonry and stud partition anchorage shall be by means of toggle bolts having square heads.

3.9 STRUCTURAL STEEL DOOR FRAMES

Bottom of frames shall extend below the finish floor elevation and shall be secured to the concrete slab by means of steel angle clips and expansion shields and bolts. Angle clips shall be welded to frames.

3.10 TOUCHUP PAINTING

After installation of fabricated metal work, the Contractor shall touch up field welds, field bolt heads and nuts, screw heads, damaged galvanized steel, and scarred surfaces on fabricated metal work and on adjacent ferrous metal surfaces. Touchup and repair shall be accomplished as soon as possible after the damage or installation has occurred. Surfaces shall be degreased, as required, prior to subsequent surface preparation. Degreasing shall be accomplished by steam cleaning or washing with a solution of trisodium phosphate in water followed by a fresh water rinse. Cuts, welds, and large damaged areas shall be sandblasted to near white SSPC SP 10. Blasting abrasive shall be sharp silica sand, size 16 to 35 mesh. When sandblasting is prohibited or impractical, mechanical cleaning by needle gun or abrasive disks or wheels shall be used. Minor abrasions and scars where extensive rusting has not occurred shall be rendered clean and dry and touched up without further surface preparation. Repair coating shall be applied within 6 hours after surface preparation or before rusting or re-contamination occurs. Touchup and repair material shall be the same inorganic zinc coating as applied in the shop. Application shall be by airless or conventional spray. Compressed air used for blasting and coating shall be free of moisture and oil. Manufacturer's recommended procedures shall be followed and the requirements of Section 09915, "Painting," shall apply.

3.11 RAISED PATTERN FLOOR PLATES

Floor plates, except floor plates indicated as removable, shall be welded to supporting members. Removable plates shall be fabricated to sizes indicated and secured with flush countersunk bolts. Joints in plates shall occur only over supports. Openings in flooring shall be provided as indicated.

3.12 STEEL BAR GRATING

Panels, except panels indicated as removable, shall be welded to supporting members. Removable panels shall be fabricated to sizes indicated and secured with stud bolt anchors welded to supporting member. Anchors shall be designed to fit over two bearing bars, and four anchors shall be provided for each removable panel. Joints in panels shall occur only over supports. Notching of bearing bars at supports to maintain elevations will not be permitted. Openings in flooring shall be provided as indicated.

-- End of Section --

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SECTION 05510

METAL STAIRS
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 314	(1990) Standard Specification for Steel Anchor Bolts

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC M017	(1992) Manual of Steel Construction, Volume II, Connections

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.22.1	(1965; R 1998) Plain Washers
ANSI B18.22M	(1981; R 1990) Metric Plain Washers

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1	(1981; R 1992) Square and Hex Bolts and Screws, Including Hex Cap and Lag Screws (Inch Series)
ASME B18.2.3.8M	(1981; R 1991) Metric Hex Lag Screws
ASME B18.6.1	(1981; R 1991) Wood Screws (Inch Series)
ASME B18.6.3	(1972; R 1991) Machine Screws and Machine Screw Nuts
ASME B18.6.7M	(1985; R 1993) Metric Machine Screws

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 108	(1999) Steel Bars, Carbon, Cold-Finished, Standard Quality
ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2001) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 27/A 27M	(1995; R 2000) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 283/A 283M	(1993; Rev A) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 29/A 29M	(1993) Standard Specification for Steel Bars, Carbon and Alloy, Hot-Wrought and Cold Finished, General Requirements
ASTM A 307	(2000) Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 325	(2000) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength
ASTM A 325M	(2000) Standard Specification for High Strength Bolts for Structural Steel Joints (Metric)
ASTM A 36/A 36M	(2000; Rev A) Standard Specification for Carbon Structural Steel
ASTM A 366/A 366M	(1996) Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 446/A 446M	(1993) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
ASTM A 449	(2000) Standard Specification for Quenched and Tempered Steel Bolts and Studs
ASTM A 47	(1990) Standard Specification for Ferritic Malleable Iron Castings
ASTM A 47M	(1990) Standard Specification for Ferritic Malleable Iron Castings (Metric)
ASTM A 48	(1994; Rev E1) Standard Specification for Gray Iron Castings
ASTM A 48M	(1994; Rev A) Standard Specification for Gray Iron Castings (Metric)
ASTM A 500	(2001) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 512	(1994) Cold-Drawn Buttweld Carbon Steel Mechanical Tubing

ASTM A 525	(1993) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 525M	(1991; Rev A) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process (Metric)
ASTM A 526/A 526M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM A 53	(1999; rev B) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 568/A 568M	(2000; Rev B) Standard Specifications for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A 569/A 569M	(1991; Rev A) Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality
ASTM A 570/A 570M	(1996) Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM A 575	(1989) Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 6/A 6M	(2001) Standard Specification for Rolled Structural Steel Bars, Plates, Shapes, and Sheet
ASTM C 514	(1994) Standard Specification for Nails for the Application of Gypsumboard
ASTM C 636	(1992) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E 488	(1990) Standard Test Methods for Strength of Anchors in Concrete and Masonry Elements
ASTM F 568	(1995) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	(2001) Occupational Safety and Health

Standards

INDUSTRIAL FASTENER INSTITUTE (IFI)

IFI 502	(1982) Metric Tapping Screws

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	(1988; MBG 531S-89) Metal Bar Grating Manual

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25	(1997) Paint Specification Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings for the following items shall be in accordance with the paragraph entitled, "General Fabrication," of this section.

Metal Stairs
Iron and Steel Hardware
Steel Shapes, Plates, Bars and Strips
Handrails and Guardrails

Installation Drawings shall include the following information:

Plans and elevations at not less than 1 inch to 1 foot scale.

Details of sections and connections at not less than 3 inches to 1 foot scale.

Setting drawings, diagrams, templates for installation of anchorages, including concrete inserts, anchor bolts, and miscellaneous metal items having integral anchors.

Metal Stair Assemblies

SD-03 Product Data

Manufacturer's Catalog Data shall include two copies of manufacturers specifications, load tables, dimension diagrams, and anchor details for the following items:

Structural Steel Plates, Shapes, and Bars
Structural Steel Tubing
Hot-Rolled Carbon Steel Sheets and Strips
Cold Finished Steel Bars
Hot-Rolled Carbon Steel Bars
Cold-Rolled Carbon Steel Sheets

Galvanized Carbon Steel Sheets
Cold-Drawn Steel Tubing
Gray Iron Castings
Malleable Iron Castings
Concrete Inserts
Anchorage Materials
Paint Materials
Steel Pan Stairs

SD-05 Design Data

Design Analysis and Calculations

SD-07 Certificates

Certificates of Compliance for the following:

Welder Qualification shall be in accordance with the paragraph entitled, "Qualifications for Welding Work," of this section.

Welding Procedures shall be in accordance with AWS D1.1.

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions shall be submitted for the following products to be used in the fabrication of steel stair work.

Structural Steel Plates, Shapes, and Bars
Structural Steel Tubing
Hot-Rolled Carbon Steel Sheets and Strips
Cold Finished Steel Bars
Hot-Rolled Carbon Steel Bars
Cold-Rolled Carbon Steel Sheets
Galvanized Carbon Steel Sheets
Cold-Drawn Steel Tubing
Gray Iron Castings
Malleable Iron Castings
Paint Materials
Anchorage Device

1.3 QUALIFICATIONS FOR WELDING WORK

Welders shall be certified to have been qualified by tests in accordance with AWS D1.1.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

Items shall be preassembled in the shop to the greatest extent possible. Units shall be disassembled only to the extent necessary for shipping and handling. Units shall be clearly marked for reassembly and coordinated installation.

For the fabrication of work exposed to view, only materials that are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names, and roughness, shall be used. Blemishes shall be removed by grinding, or by welding and grinding, prior to cleaning,

treating, and application of surface finishes, including zinc coatings.

2.2 STRUCTURAL STEEL PLATES, SHAPES, AND BARS

Structural-size shapes and plates, except plates to be bent or cold-formed, shall conform to ASTM A 36/A 36M, unless otherwise noted.

Steel plates to be bent or cold-formed shall conform to ASTM A 283/A 283M, Grade C.

Steel bars and bar-size shapes shall conform to ASTM A 36/A 36M, unless otherwise noted.

2.3 STRUCTURAL STEEL TUBING

Structural steel tubing, hot-formed, welded or seamless, shall conform to ASTM A 500, Grade B, unless otherwise noted.

2.4 HOT-ROLLED CARBON STEEL BARS

Bars and bar-size shapes shall conform to ASTM A 575, grade as selected by the fabricator.

2.5 COLD-FINISHED STEEL BARS

Bars shall conform to ASTM A 108, grade as selected by the fabricator.

2.6 HOT-ROLLED CARBON STEEL SHEETS AND STRIPS

Sheets and strips shall conform to ASTM A 568/A 568M and ASTM A 569/A 569M, pickled and oiled.

2.7 COLD-ROLLED CARBON STEEL SHEETS

Sheets shall conform to ASTM A 366/A 366M.

2.8 GALVANIZED CARBON STEEL SHEETS

Sheets shall conform to ASTM A 526/A 526M, with galvanizing conforming to ASTM A 525, G90.

2.9 COLD-DRAWN STEEL TUBING

Tubing shall conform to ASTM A 512, sunk drawn, butt-welded, cold-finished, and stress-relieved.

2.10 GRAY IRON CASTINGS

Castings shall conform to ASTM A 48, Class 30.

2.11 MALLEABLE IRON CASTINGS

Castings shall conform to ASTM A 47, grade as selected.

2.12 STEEL PIPE

Pipe shall conform to ASTM A 53, type as selected, Grade B; primed finish, unless galvanizing is required; standard weight (Schedule 40).

2.13 CONCRETE INSERTS

Threaded-type concrete inserts shall consist of galvanized ferrous castings, internally threaded to receive 3/4-inch diameter machine bolts; either malleable iron conforming to ASTM A 47 or cast steel conforming to ASTM A 27/A 27M, hot-dip galvanized in accordance with ASTM A 153/A 153M.

Wedge-type concrete inserts shall consist of galvanized box-type ferrous castings designed to accept 3/4-inch diameter bolts having special wedge-shaped heads; they shall be either malleable iron conforming to ASTM A 47 or cast steel conforming to ASTM A 27/A 27M and hot-dip galvanized in accordance with ASTM A 153/A 153M.

Carbon steel bolts having special wedge-shaped heads, nuts, washers, and shims shall be provided and galvanized in accordance with ASTM A 153/A 153M. Slotted-type concrete inserts shall consist of galvanized 1/8-inch thick pressed steel plate conforming to ASTM A 283/A 283M; they shall be of box-type welded construction with slot designed to receive 3/4-inch diameter square-head bolt with knockout cover; and shall be hot-dip galvanized in accordance with ASTM A 123.

2.14 MASONRY ANCHORAGE DEVICES

Masonry anchorage devices shall consist of expansion shields complying with AASHTO M 314, ASTM E 488 and ASTM C 514 as follows:

Bolt anchor expansion shields shall be provided for bolts; closed-end bottom bearing class, Group II, Type 2, Class 1.

Toggle bolts shall be tumble-wing type, conforming to ASTM A 325, ASTM A 449 and ASTM C 636, type, class, and style as required.

2.15 FASTENERS

Zinc-coated fasteners shall be galvanized in accordance with ASTM A 153/A 153M and shall be used for exterior applications or where built into exterior walls or floor systems. Fasteners shall be selected for the type, grade, and class required for the installation of steel stair items.

Standard bolts and nuts shall be regular hexagon-head conforming to ASTM A 307, Grade A.

Lag bolts shall be square-head conforming to ASME B18.2.1.

Machine screws cadmium-plated steel conforming to ASME B18.6.3.

Wood screws shall be flat-head carbon steel conforming to ASME B18.6.1.

Plain washers shall be round, general-assembly-grade, carbon steel conforming to ANSI B18.22.1.

Lockwashers shall be helical spring, carbon steel conforming to ASME B18.2.1.

2.16 FABRICATION, GENERAL

Contractor shall use materials of size and thicknesses indicated or, if not indicated, of required size and thickness to produce adequate strength and durability in finished product for intended use. Materials shall be worked

to dimensions indicated on approved detail drawings, using proven details of fabrication and support. Type of materials indicated or specified shall be used for the various components of work.

Exposed work shall be formed true to line and level with accurate angles and surfaces and straight sharp edges. Exposed edges shall be eased to a radius of approximately 1/32 inch. Metal corners shall be bent to smallest radius possible without causing grain separation or otherwise impairing the work.

Corners and seams shall be welded continuously and in accordance with the recommendations of AWS D1.1. Exposed welds shall be ground smooth and flush to match and blend with adjoining surfaces.

Exposed connections shall be formed with hairline joints that are flush and smooth, using concealed fasteners wherever possible. Exposed fasteners of the type indicated shall be used or, if not indicated, Phillips flathead (countersunk) screws or bolts shall be used.

Anchorage of the type indicated shall be provided and coordinated with the supporting structure. Anchoring devices shall be fabricated and spaced as indicated and as required to provide adequate support for the intended use of the work.

Hot-rolled steel bars shall be used for work fabricated from bar stock unless work is indicated or specified to be fabricated from cold-finished or cold-rolled stock.

2.17 PROTECTIVE COATING

Steelwork shall be shop primed with red oxide primer in accordance with SSPC Paint 25.Exterior steelwork shall be hot dipped galvanized as indicated in accordance with ASTM A 123. Abraded surfaces and cut ends of galvanized members shall be touched up with zinc-dust, zinc-oxide primer, or an approved galvanizing repair compound.

2.18 STEEL PAN STAIRS

2.18.1 General

Welding shall be used for joining pieces together. Units shall be fabricated so that bolts and other fastenings do not appear on finish surfaces. Joints shall be made true and tight, and connections between parts shall be lightproof tight. Continuous welds shall be ground smooth where exposed.

Stair units shall be constructed to sizes and arrangements indicated. Entire assembly shall be constructed to support a minimum live load of 100 pounds per square foot. Framing, hangers, columns, struts, clips, brackets, bearing plates, and other components shall be provided as required for the support of stairs and platforms.

2.18.2 Stair Framing

Stringers of structural steel channels, or plates, or a combination thereof shall be fabricated as indicated. Closures for exposed ends of strings shall be provided.

Platforms of structural steel channel headers and miscellaneous framing

members shall be constructed as indicated. Headers shall be bolted to stringers and newels. Framing members shall be bolted to stringers and headers.

2.18.3 Riser, Subtread, and Subplatform Metal Pans

Metal pans shall be formed of 0.1084-inch (12-gage) thick galvanized structural steel sheets, conforming to ASTM A 446/A 446M, Grade A, with zinc coating conforming to ASTM A 525, G90. Shape of pans shall conform to configuration indicated.

Riser and subtread metal pans shall be constructed with steel angle supporting brackets, of size indicated, welded to stringers. Metal pans shall be secured to brackets with rivets or welds.

Subplatform metal pans shall be secured to platform frames with welds.

2.18.4 Steel Floor Plate Treads and Platforms

Raised pattern shall be steel floor plate fabricated from steel complying with ASTM A 36/A 36M. Pattern shall be as selected from manufacturer's standard patterns.

Treads shall be formed of 1/4-inch thick steel floor plate with integral nosing and back edge stiffener. Steel supporting brackets shall be welded to strings and treads to brackets.

Platforms of steel floor plate shall be fabricated to thickness indicated. Floor plates shall be secured to platform framing members with welds.

2.18.5 Floor Grating Treads and Platforms

Floor grating treads and platforms shall comply with ASTM A 6/A 6M, ASTM A 29/A 29M and NAAMM MBG 531, "Metal Bar Grating Manual." Pattern, spacing, and bar sizes shall be as indicated:

Galvanized finish shall conform to ASTM A 123.

Painted finish shall be manufacturer's baked-on primer.

Grating treads shall be fabricated with steel plate nosing on one edge and with steel angle or steel plate carrier at each end for string connections. Treads shall be secured to strings with bolts.

Grating platforms shall be fabricated with nosing matching that on grating treads at landings. Toe-plates shall be provided at open-sided edges of floor grating to platform framing members.

2.18.6 Stair Railings and Handrails

Newels shall be fabricated from steel tubing. Newel caps shall be gray iron castings as indicated.

Steel pipe railings, consisting of top rail, intermediate rail, posts and handrails, shall be provided at walls. Unless otherwise indicated, 1-1/2-inch nominal size, standard weight, carbon steel pipe shall be provided and shall conform to ASTM A 53, Type E or Type S, Grade B. Railings shall conform to requirements of 29 CFR 1910, Section 23.

Posts, rails, and corners shall be joined by one of the following methods:

Flush-type steel railing fittings, welded and ground smooth, with railing splice locks secured with 3/8-inch hexagonal recessed-head setscrews

Mitered and welded joints made by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth, butt railing splices, reinforced by a tight-fitting interior sleeve not less than 6 inches long.

Railings may be bent at corners instead of joining, provided the bends are uniformly formed in jigs with cylindrical cross section of pipe maintained throughout the entire bend.

Removable railing sections shall be provided as indicated.

Kickplates shall be provided between railing posts where indicated, and shall consist of 1/8-inch steel flat bars not less than 6 inches high. Kickplates shall be secured as indicated.

Exterior railings shall be provided and interior railings shall be galvanized where indicated, including pipe, fittings, brackets, fasteners, and other ferrous metal components. Black steel pipe shall be provided for interior railings not indicated as galvanized.

Railings, including pipe, fittings, brackets, fasteners, and other ferrous metal components, shall be galvanized.

2.18.7 Steel Framing for Concrete Stairs

Fabricated units shall be customized to the dimensions and details indicated, and modified as required to fit actual dimensions of the supporting structure. Welded construction shall be used for fabrication of steel components. Unless otherwise indicated, 14-gage steel risers shall be provided. Components shall be arranged to receive finish materials as indicated.

PART 3 EXECUTION

3.1 STAIR RAILINGS AND HANDRAILS

Railings shall be adjusted prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length. Posts shall be spaced not more than 8 feet on center. Posts shall be plumbed in each direction. Posts and rail ends shall be secured to building construction as follows:

Posts shall be anchored in concrete by means of pipe sleeves set and anchored into concrete. Sleeves of galvanized, standard weight, steel pipe, not less than 6 inches long, and having an inside diameter not less than 1/2-inch greater than the outside diameter of the inserted pipe post shall be provided. Steel plate closure secured to the bottom of the sleeve shall be provided; closure shall be of width and length not less than 1-inch greater than the outside diameter of the sleeve. After posts have been inserted into sleeves, the annular space between post and sleeve shall be filled with molten lead, sulfur, or a quick-setting hydraulic cement. Anchorage joint shall be covered with a round steel flange welded to the post.

Posts shall be anchored to steel with steel oval flanges, angle type or floor type as required by conditions, welded to posts and bolted to the steel supporting members.

Rail ends shall be anchored into concrete and masonry with steel round flanges welded to rail ends and anchored into the wall construction with lead expansion shields and bolts.

Rail ends shall be anchored to steel with steel oval or round flanges welded to tail ends and bolted to the structural steel members.

Handrails shall be secured to walls by means of wall brackets and wall return fitting at handrail ends. Brackets of malleable iron castings shall be provided, with not less than 3-inch projection from the finish wall surface to the center of the pipe drilled to receive one 3/8-inch bolt. Brackets shall be located not more than 60 inches on center. Wall return fittings of cast iron castings, flush-type, with the same projection as that specified for wall brackets shall be provided. Wall brackets and wall return fittings shall be secured to building construction as follows:

For concrete and solid masonry anchorage, bolt anchor expansion shields and lag bolts shall be used.

For hollow masonry and stud partition anchorage, toggle bolts having square heads shall be used.

3.2 FIELD WELDING

Procedures of manual shielded metal arc welding, appearance and quality of welds made, and methods used in correcting welding work shall comply with AWS D1.1.

3.3 TOUCHUP PAINTING

Immediately after installation, field welds, bolted connections, and abraded areas of the shop paint shall be cleaned, and exposed areas shall be painted with the paint used for shop painting. Paint shall be applied by brush or spray to provide a minimum dry-film thickness of 2 mils.

-- End of Section --

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SECTION 05700

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SECTION 05700

ORNAMENTAL METAL
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ALUMINUM ASSOCIATION (AA)

AA 45	(1980) Designation System for Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.13	(1987) Screw and Washer Assemblies
ANSI B18.13.1M	(1991) Screw and Washer Assemblies (Metric Series)
ANSI B18.21.1	(1990) Lock Washers (Inch Series)
ANSI B18.21.2M	(1990) Lock Washers (Metric Series)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1	(1981; R 1992) Square and Hex Bolts and Screws, Including Hex Cap and Lag Screws (Inch Series)
ASME B18.2.2	(1987; R 1999) Square and Hex Nuts (Inch Series)
ASME B18.2.3.8M	(1981; R 1991) Metric Hex Lag Screws
ASME B18.2.4.1M	(1979; Rev 1989) Metric Hex Nuts
ASME B18.22.1	(1965; R 1990) Plain Washers
ASME B18.22M	(1981; Rev 1990) Metric Plain Washers
ASME B18.3.3M	(1986; R 1993) Hexagon Socket Head Shoulder Screws (Metric Series)
ASME B18.6.1	(1981; R 1991) Wood Screws (Inch Series)
ASME B18.6.3	(1972; R 1991) Machine Screws and Machine Screw Nuts
ASME B18.6.7M	(1985; R 1993) Metric Machine Screws

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2001) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 27/A 27M	(1995; R 2000) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 283/A 283M	(1993; Rev A) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 47	(1990) Standard Specification for Ferritic Malleable Iron Castings
ASTM A 47M	(1990) Standard Specification for Ferritic Malleable Iron Castings (Metric)
ASTM B 209	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 211	(1995) Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire
ASTM B 211M	(1995) Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire (Metric)
ASTM B 221	(1995; Rev A) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM B 221M	(1996) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes (Metric)
ASTM B 247	(1995; Rev A) Standard Specification for Aluminum and Aluminum-Alloy Die and Hand Forgings and Rolled Ring Forgings
ASTM B 247M	(1995; Rev A) Standard Specification for Aluminum and Aluminum-Alloy Die and Hand Forgings and Rolled Ring Forgings
ASTM B 26/B 26M	(1995) Standard Specification for Aluminum-Alloy Sand Castings
ASTM B 316/B 316M	(1995) Standard Specification for Aluminum and Aluminum-Alloy Rivet and Cold Heading Wire and Rods

ASTM B 429	(1992; Rev A) Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM C 514	(1994) Standard Specification for Nails for the Application of Gypsumboard
ASTM C 636	(1992) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM D 1730	(1967; R 1993) Standard Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting
ASTM D 1752	(1984; R 1996) Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM G 104	(1989) Standard Test Method for Assessing Galvanic Corrosion Caused by the Atmosphere

AMERICAN WELDING SOCIETY (AWS)

AWS A5.3	(1991) Specification for Aluminum and Aluminum Alloy Electrodes for Shielded Metal Arc Welding
AWS D1.2	(1990) Structural Welding Code - Aluminum

FEDERAL SPECIFICATIONS (FS)

FS A-A-344	(Rev A) Lacquer (Clear Gloss)
FS RR-W-360	(Rev A) Wire Fabric, Industrial

INDUSTRIAL FASTENER INSTITUTE (IFI)

IFI 502	(1982) Metric Tapping Screws

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC-01	(1993; 3rd Ed) Good Painting Practice Steel Structures Painting Manual, Volume 1

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Existing Conditions shall be documented on drawings showing the relationship to new ornamental metals.

Fabrication Drawings shall be submitted for Ornamental Metal Items

in accordance with the paragraph entitled, "Fabrication in General," of this section.

Installation Drawings shall be submitted for the following items showing location, dimensions, size, and weight or gage as applicable of each ornamental item; type and location of shop and field connections; and other pertinent construction and erection details. Drawings shall show location and details of anchorage devices embedded in cast-in-place concrete and masonry construction.

Ornamental Metal Items
Shop and Field Connections
Construction Details

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items listing all ornamental metal accessories including casting, forgings, fasteners and anchorage devices.

Installation Materials
Metals for Fabrication
Ornamental Metal Items

SD-04 Samples

Manufacturer's Standard Color Charts for the following items shall be approved by the Contracting Officer prior to work.

Shop Paint
Finish Paint

Samples for the following items shall be standard size as used in construction. After approval, full-sized samples may be used in construction, provided each sample is clearly identified and its location recorded.

Aluminum Finish
Architectural Metal Items
Building Letters (2)
Anchorage Devices and Fasteners

SD-06 Test Reports

Test Reports for Welding Tests shall be in accordance with AWS D1.2, "Qualifications of Procedures and Personnel."

SD-07 Certificates

Certificates of Compliance for Ornamental Metal Items shall be submitted in accordance with the paragraphs entitled, "Metals For Fabrication" and "Ornamental Metal Items."

Certificates of Welder Qualifications shall be in accordance with the paragraph entitled, "Qualifications for Welding Work," of this section.

Submit Certificate of compliance for aluminum welding.

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions shall be submitted for Ornamental Metal Items.

Preventative Maintenance and Inspection shall be in accordance with the aluminum producer's recommended Cleaning Materials and Application Methods including precautions in the use of cleaning materials that may be detrimental to the aluminum finish when improperly applied.

1.3 QUALIFICATIONS FOR WELDING WORK

Welders shall be certified to have been qualified by tests in accordance with AWS D1.2.

1.4 DELIVERY, STORAGE, AND HANDLING

Architectural metal items shall be stored off the ground.

Materials shall be kept free from dirt and grease and shall be protected from corrosion.

Packaged materials shall be stored in their original, unbroken containers in a dry area, until ready for installation.

1.5 FIELD MEASUREMENTS

Field measurements shall be taken prior to preparation of shop drawings and fabrication.

PART 2 PRODUCTS

2.1 INSTALLATION MATERIALS

2.1.1 Concrete Inserts

Wedge-type concrete inserts shall be galvanized, box-type, ferrous castings with integral anchor loop at back of box and be designed to accept bolts having special wedge shape heads. Ferrous castings shall be malleable iron conforming to ASTM A 47, Grade 32510 or Grade 35018, or may be medium-strength cast steel conforming to ASTM A 27/A 27M, Grade U-60-30. Inserts shall be hot-dip galvanized after fabrication in accordance with ASTM A 153/A 153M. Carbon steel bolts shall be provided with special wedge shape heads, nuts, washers, and shims. Such hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

Slotted-type concrete inserts shall be hot-dip galvanized, pressed steel plate, welded construction, box-type, with slot to receive square head bolt and to provide lateral adjustment of the bolt. Length of insert body less anchorage lugs shall be not less than 4-1/2 inches. Inserts shall be provided with knockout cover. Steel plate shall be not less than 1/8 inch thick and shall conform to ASTM A 283/A 283M, Grade C. Inserts shall be hot-dip galvanized after fabrication in accordance with ASTM A 123.

Concrete inserts shall not be removable when embedded in concrete of 3,000 pounds per square inch compressive strength and subjected to a 6,000-pound tension load test in an axial direction, nor shall the concrete indicate

any evidence of failure attributable to the anchoring device itself.

2.1.2 Masonry Anchorage Devices

Masonry anchorage devices shall be expansion shields conforming to ASTM C 514, Group, Type, and Class as follows:

Lead expansion shields for machine screws and bolts shall be head-out embedded nut type, single-unit class, conforming to Group I, Type 1, Class 1.

Bolt anchor expansion shields for lag bolts shall be zinc-Alloy long-shield anchors class, conforming to Group II, Type 1, Class 1.

Bolt anchor expansion shields for bolts shall be closed-end bottom bearing class, conforming to Group II, Type 2, Class 1.

2.1.3 Toggle Bolts

Toggle bolts shall be tumble wing type of the class and style best suited for the work, conforming to ASTM C 636, Type II. Toggle bolts shall be made of corrosion-resistant chromium-nickel steel conforming to AISI Type 302, 303, 304, 305, or 316.

2.1.4 Standard Bolts and Nuts

Standard bolts shall be regular hexagon head, corrosion-resistant steel, coarse thread series, conforming to ASME B18.2.1, Type II.

Standard nuts shall be plain hexagon, regular style, corrosion-resistant steel, conforming to ASME B18.2.2, Type II, Style 4.

2.1.5 Lag Bolts

Lag bolts shall be square head, gimlet point or cone point, corrosion-resistant steel, conforming to ASME B18.2.1, Type I, Grade C.

2.1.6 Machine Screws

Machine screws shall be corrosion-resistant steel, cross-recess drive, flat head, conforming to ASME B18.6.3, Type III, Style 2C.

2.1.7 Wood Screws

Wood screws shall be corrosion-resistant steel, single-thread, flat head with cross-recess drive, conforming to ASME B18.6.1.

2.1.8 Plain Washers

Plain washers shall be round, general-assembly, corrosion-resistant steel, conforming to ASME B18.22.1, Type A, Grade I, Class B.

2.1.9 Lock Washers

Lock washers shall be helical spring, corrosion-resistant steel (nonmagnetic), conforming to ANSI B18.13 and ANSI B18.21.1.

2.1.10 Welding Filler Metal

Welding filler metal for welding of aluminum alloys shall conform to AWS A5.3. Filler metal shall be the aluminum-alloy recommended by the aluminum producer for the work.

2.2 METALS FOR FABRICATION

2.2.1 Aluminum-Alloy Extrusions

Extrusions shall be 6063, temper T5, conforming to ASTM B 221.

Aluminum-alloy extrusions to receive an integral-color anodized coating shall be the aluminum alloy and temper recommended by the aluminum producer for the specified finish with integral-color anodized coating, and shall have mechanical properties equal to, or exceeding, those of aluminum alloy 6063, temper T5, conforming to ASTM B 221.

2.2.2 Aluminum-Alloy Sheets and Plates

Aluminum-alloy sheets and plates, unless otherwise specified, shall be aluminum alloy 3003, temper H16, conforming to ASTM B 209.

Aluminum-alloy sheets and plates to receive a clear or integral-color anodized coating shall be the aluminum alloy and temper recommended by the aluminum producer for the specified coating, and shall have mechanical properties equal to, or exceeding, those of alloy 5005, temper H16 of ASTM B 209.

2.2.3 Aluminum-Alloy Castings

Aluminum alloy castings shall be alloy 5140, temper F, sand castings, conforming to ASTM B 26/B 26M.

Aluminum-alloy castings to receive a clear or an integral-color anodized coating shall be the casting alloy and condition recommended by the aluminum producer for the specified finish with integral-color anodized coating, and shall have mechanical properties equal to, or exceeding, those of alloy 5140, temper F, conforming to ASTM B 26/B 26M.

2.2.4 Aluminum-Alloy Forgings

Aluminum-alloy forgings shall be aluminum alloy 6061, temper T6, conforming to ASTM B 247.

Aluminum-alloy forgings to receive an integral-color anodized coating shall be the aluminum alloy and temper recommended by the aluminum producer for the specified finish with integral-color anodized coatings, and shall have mechanical properties equal to or exceeding those of aluminum alloy 6061, temper T6, conforming to ASTM B 247.

2.2.5 Metals for Fasteners

Aluminum-alloy bolts and screws shall be made from rod conforming to ASTM B 211, alloy 2024 and temper T351.

Aluminum-alloy nuts shall be made from rod conforming to ASTM B 211, alloy 6061 and temper T6.

Aluminum-alloy washers shall be made from sheet conforming to ASTM B 209, alloy 2024 and temper T4.

Aluminum-alloy rivets shall be made from rod or wire conforming to ASTM B 316/B 316M, alloy 6053 and temper T61.

Corrosion-resistant steel fasteners shall be made of chromium-nickel steel, AISI Type 302, 303, 304, 305, or 316, with form and condition best suited for the application.

2.2.6 Shop Paint for Aluminum

Shop paint shall be an inhibitive epoxy polyamide primer conforming to SSPC-01, Chapter 16 and ASTM G 104.

2.3 ORNAMENTAL METAL ITEMS

2.3.1 Aluminum Building Letters

Aluminum building letters shall be the style, size, and letters indicated on drawings.

Aluminum letters shall be made of aluminum-alloy castings. Letters shall be drilled and tapped to receive threaded fasteners for concealed mounting.

Finish of exposed face of letters shall be satin finish with Class 1 clear anodized coating.

Letter mountings shall be concealed projected type. Letters shall be projected 1/2 inch from the backing surface with corrosion-resistant steel spacer sleeves and corrosion-resistant steel threaded studs. Studs shall be not less than 1/4 inch in diameter. Holes shall be drilled in the backup material to receive studs. Studs shall be set in drilled holes with mastic cement. Letter spacing and drilled holes shall be in accordance with the aluminum letter manufacturer's letter spacing and drilling template.

2.3.2 Aluminum Joint Cover Assemblies

Aluminum joint cover assemblies shall be designed for horizontal movement and the joint width indicated.

Floor joint cover assemblies shall consist of continuous frame unit on each side of floor-to-floor joints or on one side of floor-to-wall joints as required by construction conditions. Assemblies shall include floor cover plates, filler strips, anchors, and other accessories as required to complete the installation, and as follows:

Floor frame units shall be aluminum-alloy extrusions fabricated to provide an integral curb edge bar for the expansion joint edges, integral grooves to receive anchor bolts, and floor cover plate and filler strip surfaces that will finish flush with the finished floor elevation when the floor cover assembly is installed. Corrosion-resistant coated aluminum alloy or steel anchor bolts and nuts shall be provided, spaced not more than 3 inches from each end and not more than 18 inches on center between end anchors. Frame splice connectors shall be provided as required to complete the installation.

Plain type floor cover plates shall be aluminum-alloy extrusions with

smooth surface.

Recessed type floor cover plates shall be aluminum-alloy extrusions with recess to receive resilient floor covering. Depth of recess shall be that required to provide a resilient floor covering surface flush with the finished floor elevation.

Nonslip-type floor cover plates shall be aluminum-alloy castings with abrasive grit embedded uniformly into the walking surface at the time of casting. Abrasive grit shall be 20-grain aluminum oxide.

Floor cover plates shall be of the patterns and widths indicated. Lengths shall be as long as practical. Metal thickness shall be not less than 1/4 inch. Fixed edge of floor cover plates shall be drilled and countersunk to receive flathead screws, spaced not more than 3 inches from each cover plate end and not more than 18 inches on center between the end screw holes. Screws for securing floor cover plates shall be made of corrosion-resistant steel.

Finish of exposed-to-view surfaces shall be mill finish.

Filler strips shall be rubber and cork composition tape with pressure-sensitive adhesive coating on one face and smooth suede surface on the exposed face, conforming to ASTM D 1752. Filler strip shall be not less than 1-1/2 inches wide and depth as required to provide a surface flush with the finished floor elevation.

Wall and ceiling joint cover assemblies shall consist of continuous anchor strips on one side of the wall or ceiling expansion joint; wall and ceiling cover plates; and seals, anchors, and other accessories as required to complete the installation, and as follows:

Wall and ceiling anchor strips shall be aluminum-alloy extrusions fabricated to provide an integral curb bar edge and integral lugs to receive snap-on cover plates. Fixed edge of anchor strips shall be field drilled with holes to receive screws, spaced not more than 3 inches from each end and not more than 12 inches on center between the end screw holes. Cadmium-plated screws with masonry anchorage devices or toggle bolts shall be provided as required by construction conditions.

Wall and ceiling cover plates shall be aluminum alloy extrusions of the patterns and widths indicated, designed for snap-on application over anchor strips, fabricated with integral grooves to receive sealing gaskets, and having a smooth exposed-to-view surface.

Vinyl sealing gaskets shall be provided for exterior wall joint cover assemblies.Finish of exterior wall joint cover assembly exposed-to-view surfaces shall be frosted finish with Class II clear anodized coating.

2.3.3 Extruded Aluminum Gravel Stop System

Extruded aluminum gravel stop system sections shall be of the shapes and dimensions indicated.

Gravel stop system shall consist of gravel stop sections, fascia sections, soffit sections, welded mitered inside and outside corner sections, concealed cover plates, concealed sheet metal flashing, and other components standard with the gravel stop system manufacturer as required to

complete the installation.

Exposed gravel stop system components shall be made of aluminum-alloy extrusions having wall thickness not less than 0.05 inch. Concealed components shall be made of aluminum-alloy sheets not less than 0.025-inch thick.

Finish of exposed-to-view surfaces shall be frosted finish with integral clear anodized coating.

2.4 FABRICATION IN GENERAL

2.4.1 Workmanship

Metalwork shall be well formed to shape and size, with lines, angles, and curves true. Necessary rabbets, lugs, and brackets shall be provided so that the work can be assembled. Fasteners shall be concealed where practical.

Exterior ornamental metal items shall be designed to withstand expansion and contraction of the component parts at an ambient temperature of 100 degrees F without causing harmful buckling, opening of joints, overstressing of fasteners, or other harmful effects.

Welded fabrication shall meet requirements as specified in AWS D1.2. Welds behind finished surfaces shall be made without distortion or discoloration of the exposed side. Welded joints shall be cleaned of flux and shall be dressed on exposed and contact surfaces.

Holes for fasteners shall be drilled or punched. Drilling and punching shall produce clean true lines and surfaces.

Joints shall be milled to a close fit. Corner joints shall be coped or mitered, well formed, and in true alignment. Joints exposed to weather shall be formed and fabricated to exclude water.

Castings shall be sound and free from warp or defects that impair their strength and appearance. Exposed surfaces shall have a smooth finish and sharp well-defined lines and arrises. Joints shall be milled to a close fit.

2.4.2 Holes for Other Work

Holes shall be provided where indicated for securing other work to metal work.

2.4.3 Protection of Aluminum from Dissimilar Materials

Aluminum surfaces that will come in contact with dissimilar metals, or masonry, concrete, or wood, shall be protected with epoxy polyamide conforming to SSPC-01, Chapter 16.2, and topcoated with aliphatic polyurethane conforming to ASTM G 104.

Aluminum surfaces to be painted shall be prepared by the acid pickling method conforming to ASTM D 1730, Type B, Method 2 or Method 3.

Paint shall be applied to dry, clean surfaces by brush or spraying to provide a minimum dry-film thickness of 1.5 mils (0.0015 inch).

2.4.4 Aluminum Finishes

Finish of exposed-to-view aluminum surfaces of Architectural metal items shall conform to AA 45 and shall have the finish specified for each item and as follows:

Mill finish shall be the aluminum producer's as-fabricated finish, conforming to AA M10, as specified in AA 45.

Frosted finish with Class I clear anodized coating shall be a medium matte chemical etch finish and Architectural Class I (0.7 mil and greater thick) anodized coating producing natural aluminum color finish. Finish shall conform to AA C22-A41, as specified in AA 45.

Satin finish with Class II clear anodized coating shall be a medium satin directional textured mechanical finish and Architectural Class II (0.4- to 0.7-mil thick) anodized coating producing natural aluminum color finish. Finish shall conform to AA M32-A31, as specified in AA 45.

Matte finish with Class II clear anodized coating shall be a medium matte nondirectional textured mechanical finish and Architectural Class II (0.4- to 0.7-mil thick) anodized coating producing natural aluminum color finish. Finish shall conform to AA M42-A31, as specified in AA 45.

Finish color and appearance shall match that of the aluminum finish sample approved for each Architectural metal item within the aluminum producer's standard color range.

PART 3 EXECUTION

3.1 GENERAL PROVISIONS

Ornamental metal work shall be installed in accordance with the approved shop drawings and descriptive data for each ornamental metal item, as specified.

Ornamental metal items shall be securely fastened plumb and true to lines and levels.

3.2 ANCHORAGE DEVICES EMBEDDED IN OTHER CONSTRUCTION

Anchorage devices, such as concrete inserts, anchor bolts, and ornamental metal items having integral anchors that are to be embedded in cast-in-place concrete and masonry construction, shall be delivered to the project site in time to be installed before the start of cast-in-place concrete operations and masonry work. Setting drawings, templates, instructions, and directions for the installation of the anchorage items shall be provided.

3.3 FASTENING TO CONSTRUCTION-IN-PLACE

Anchorage devices and fasteners shall be provided where necessary for fastening ornamental metal items to construction-in-place. Fastening shall include threaded fasteners for concrete inserts embedded in cast-in-place concrete; masonry anchorage devices and threaded fasteners for solid masonry and concrete-in-place; toggle bolts for hollow masonry and stud partitions; through bolting for masonry and wood construction; lag bolts and wood screws for wood construction; and threaded fasteners for structural steel. Fastening shall be provided as indicated and as

specified. Fastening to wood plugs in masonry or concrete-in-place is not permitted.

3.4 CUTTING AND FITTING

Cutting, drilling, and fitting required shall be performed for the installation of ornamental metal work. Cutting, drilling, and fitting shall be executed carefully; when required, work shall be fitted in place before fastening.

3.5 SETTING MASONRY ANCHORAGE DEVICES

Masonry anchorage devices shall be set in masonry or concrete-in-place construction in accordance with the anchorage device manufacturer's printed instructions. Holes shall be of the recommended depth and diameter and shall be drilled to the size recommended by the manufacturer of the particular anchorage device used. Drilled holes shall be left rough, not reamed, and free of drill dust.

3.6 WELDING PROCEDURES

Procedures for welding, appearance, and quality of welds made, and the methods used in correcting welding work shall conform to AWS D1.2.

Exposed welds shall be ground smooth.

3.7 THREADED CONNECTIONS

Where exposed to view, bolt and screw heads shall be flat and countersunk, unless otherwise specified. Threaded connections shall be made up tightly so that the threads will be entirely concealed by fitting.

3.8 CLEANING

Before final acceptance, exposed-to-view aluminum surfaces shall be washed with clean water and soap and rinsed with clean water. Acid solutions, steel wool, or other harsh abrasives shall not be used. Stains that remain after washing shall be removed or the finish shall be restored in accordance with the aluminum producer's recommendations.

3.9 INSPECTION AND ACCEPTANCE PROVISIONS

3.9.1 Finished Ornamental Metal Work Requirements

Ornamental metal work will be rejected for any of the following deficiencies:

Finish of exposed-to-view aluminum surfaces having color and appearance that are outside the color and appearance range of the approved samples for aluminum finish

Installed ornamental metal items having stained, discolored, abraded, or otherwise damaged exposed-to-view aluminum surfaces that cannot be removed by cleaning or repairing

Installed ornamental metal items that do not match the approved sample

Aluminum surfaces in contact with dissimilar materials that are not protected as specified

3.9.2 Repair of Defective Work

Defective work shall be removed and replaced with ornamental metal materials that meet the requirements of this section.

3.10 MAINTENANCE INSTRUCTIONS

Contractor shall submit maintenance instructions as follows:

Aluminum producer's recommended cleaning materials and application methods including precautions in the use of cleaning materials that may be detrimental to the aluminum finish when improperly applied.

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SECTION 06100

ROUGH CARPENTRY
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B18.22.1	(1965; R 1998) Plain Washers
ANSI B18.22M	(1981; R 1990) Metric Plain Washers

AMERICAN PLYWOOD ASSOCIATION (APA)

APA E30	(1994) Design/Construction Guide, Residential and Commercial

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307	(2000) Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 36/A 36M	(2000; Rev A) Standard Specification for Carbon Structural Steel
ASTM A 525	(1993) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 525M	(1991; Rev A) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process (Metric)
ASTM D 2016	(1974; R 1983) Moisture Content of Wood
ASTM E 84	(2001) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F 568	(1995) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1	(1981; R 1992) Square and Hex Bolts and Screws, Including Hex Cap and Lag Screws (Inch Series)

ASME B18.2.3.8M	(1981; R 1991) Metric Hex Lag Screws
ASME B18.6.1	(1981; R 1991) Wood Screws (Inch Series)

AMERICAN WOOD PRESERVERS BUREAU (AWPB)

AWPB LP 2	(1988) Softwood Lumber, Timber and Plywood Pressure Treated with Water-Borne Preservatives for Aboveground Use

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA A3	(1991) Determining Penetration of Preservatives and Fire Retardants
AWPA C1	(1995) All Timber Products - Preservative Treatment by Pressure Processes
AWPA C20	(1993) Structural Lumber - Fire-Retardant Treatment by Pressure Processes
AWPA C27	(1993) Plywood - Fire-Retardant Treatment by Pressure Processes
AWPA P5	(1994) Standards for Waterborne Preservatives
AWPA P8	(1991) Oil-Borne Preservatives

FEDERAL SPECIFICATIONS (FS)

FS FF-B-588	(Rev D) Bolt, Toggle; and Expansion Sleeve, Screw
FS FF-N-105	(Rev B; Int Am 4) Nails, Brads, Staples, and Spikes: Wire, Cut, and Wrought
FS FF-S-325	(Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
FS TT-W-571	(Rev J) Wood Preservation: Treating Practices

INDUSTRIAL FASTENER INSTITUTE (IFI)

IFI 502	(1982) Metric Tapping Screws

NATIONAL FOREST PRODUCTS ASSOCIATION (NFOPA)

NFOPA-03	(1988) Manual for House Framing

NATIONAL INSTITUTE FOR STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(1983) Construction and Industrial Plywood
NIST PS 20	(1970; Rev 1986) American Softwood Lumber Standards

REDWOOD INSPECTION SERVICE (RIS)

RIS-01 (1987) Grades of California Redwood Lumber

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB 1001 (1994) Grading Rules

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB Std 17 (1991) Standard Grading Rules for West Coast Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA-01 (1991) Western Lumber Grading Rules 91

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-07 Certificates

Certificates of Compliance shall be submitted for the following laboratory test reports.

Tests for Moisture Content of wood shall be in accordance with ASTM D 2016, Method A, Oven Drying Method. Material tested shall be the same material proposed for use in the project. Moisture test shall be dated no earlier than 3 months prior to the delivery of lumber materials. An additional test report will be required if the materials species or stress grade changes.

Fire-Retardant-Treated Lumber Tests shall be according to the paragraph entitled, "Fire-Retardant-Treated Lumber," of this section.

SD-07 Certificates

Certificates of Compliance shall be submitted for the following items showing conformance with the referenced standards contained in this section. Certificates for wood-framing materials, shall include grade, species and moisture.

Wood-Framing Materials
Fasteners
Wood-Preservative Treatment

1.3 DELIVERY, HANDLING, AND STORAGE

Wood materials shall be securely bundled and shipped with adequate moisture-resistant covers to preclude damage by weather or handling during delivery, when stored, and during construction.

Wood materials that must be stored outdoors before immediate use shall be placed in orderly piles and stored on blocks above ground. Lumber shall be stored in stacks with provision for air circulation within stacks.

Material shall be protected from the elements with moisture-resistant covers.

PART 2 PRODUCTS

2.1 WOOD MATERIALS

2.1.1 General Requirements

Each piece of framing lumber, board lumber, and plywood shall bear the trademark and grade identification of the manufacturer's association or the authorized inspection bureau under rules of which the lumber is manufactured and graded.

Softwood lumber shall be seasoned S4S and kiln-dried or air-dried to the specified moisture content. Dressed sizes shall conform to NIST PS 20.

Structural framing lumber shall be stress graded, with each piece being rated for strength and stamped to indicate the grade and fiber stress in bending; or it shall be certified with manufacturer's certificate of inspection.

Moisture content shall conform to the rules of the lumber association or the inspection bureau under which the lumber is graded but shall not exceed 15 percent for boards and dimensional lumber 2 inches or less in thickness.

2.1.2 Structural Framing Materials

Structural framing lumber shall be southern yellow pine, west coast hemlock, coast region Douglas fir, inland Douglas fir, or larch, with the following minimum allowable unit stresses:

Minimum extreme fiber in bending (f): 1,500 psi

Compression parallel to grain (c): 1,000 psi

Compression perpendicular to grain: 365 psi

Modulus of elasticity (e): 1,540,000 psi

2.1.3 Light-Framing Materials

Light-framing materials and studs over 10 feet in length shall be of the following species:

Southern yellow pine	No. 2 KD dimensions, SPIB 1001
Douglas fir, coast region; western larch; west coast hemlock, white fir, ponderosa pine, western red cedar, Idaho white pine, sugar pine	Standard grade, WCLIB Std 17 and WWPA-01 Grading Rules
Sitka spruce, western red cedar	Standard grade WCLIB Std 17
Redwood	Construction grade, RIS-01

2.1.4 Stud-Framing Materials

Stud-framing materials for 2- by 4-inch studs, 10 feet or less in length, shall conform to the following:

Southern yellow pine	KD stud grade, SPIB 1001
Douglas fir, coast region, western larch, western hemlock	West Coast Studs, WCLIB Std 17; No. 2 and better, WWPA-01 Grading Rules

2.1.5 Board Materials

Board materials shall be one of the following species:

Southern yellow pine	No. 2 boards SPIB 1001
Western red cedar, west coast hemlock, Douglas fir, larch	Utility Grade boards, WCLIB Std 17
White fir, ponderosa pine, western cedar, incense cedar, Idaho white pine, sugar pine	Utility Grade, WWPA-01 Grading Rules

2.1.6 Framing for Wood Shelving

Uprights, cleats, and framing for wood shelves shall be C-finish boards of southern yellow pine, sugar pine, Douglas fir, white fir, Englemann spruce, or western red cedar, graded in accordance with the rules under which the lumber is manufactured and graded.

2.1.7 Plywood Sheathing

Plywood sheathing shall be unsanded exterior-grade sheathing, grade stamped "Ext-DFPA," and manufactured in accordance with NIST PS 1, Group 1, or when so indicated, fire-retardant treated, tongue-and-groove exterior grade sheathing, 5/8-inch minimum thickness, grade stamped "C-C Ext-DFPA," and manufactured in accordance with NIST PS 1, Group 1. After manufacture, plywood shall be fire-retardant treated as specified under "Fire-Retardant-Treated Lumber."

2.1.8 Fire-Retardant-Treated Plywood

Plywood sheathing shall be fire-retardant treated by means of an approved pressure impregnating process in accordance with AWPA C1, AWPA C20 (solid wood), and AWPA C27 (plywood).

Contractor shall submit reports of the results of retention-penetration test boring cores, weight test of plywood panels, and performance ratings. Treatment and performance inspection shall be performed by an independent, qualified test agency that establishes the performance rating.

After treatment, wood materials shall have a flame-spread rating not greater than 25, with no evidence of significant progressive combustion when tested for 30 minutes duration in accordance with ASTM E 84. Fuel contributed shall not exceed 15; smoke developed shall not exceed 5.

Approved fire-retardant materials shall bear identification showing the fire performance rating thereof issued by an approved testing agency.

After treatmentplywood shall be kiln-dried to reduce moisture to not more than 15 percent.

2.1.9 Preservative Treated Lumber

The following wood members shall be pressure-preservative treated in accordance with FS TT-W-571 or AWPB LP 2. Each piece shall bear the AWPB stamp, indicating point of treatment, preservative symbol, symbol of standard, date of treatment, and moisture content after treatment:

Wood sills, plates, rough bucks, and frames in exterior masonry wall openings

Wall plates and furring in contact with exterior masonry or concrete

Nailers that are set into, or are in contact with, concrete or masonry

Blocking and nailers for roof deck, sub fascia members, roof cants and saddles

Preservative shall be either water-borne, conforming to AWPA P5, or oil-borne conforming, to AWPA P8.

Nailers to receive membrane waterproofing and wood members to receive finish materials shall be treated with a water-borne preservative to eliminate preservative bleed-through at nails.

Wood treated with oil-borne preservatives shall be clean, free from surface oil, and properly seasoned for use.

Wood treated with water-borne preservatives shall be air-dried or kiln-dried to reduce maximum moisture content to 15 percent.

Cut surfaces of preservative-treated materials shall be brush coated with at least two coats of copper naphthenate as specified in AWPA P8.

Treated wood exposed in the final structure shall be free from objectionable odors and shall not be harmful or corrosive to adjacent materials or anchorages.

2.2 ANCHORAGE AND FASTENER MATERIALS

2.2.1 Nails and Staples

Nails, staples, and tacks shall conform to FS FF-N-105.

Nails for roof blocking, cants, and nailers shall be galvanized.

Power-driven staples shall be galvanized Type III, Style 3.

2.2.2 Bolts, Nuts and Screws

Bolts and nuts shall be carbon steel, galvanized, conforming to ASTM A 307, Grade A.

Wood screws shall be carbon steel, galvanized, conforming to ASME B18.6.1.

Lag screws or lag bolts shall be commercial steel, galvanized, conforming to ASME B18.2.1.

Expansion shields, expansion nails, and drive screw devices shall conform to FS FF-S-325.

Toggle bolts shall conform to FS FF-B-588.

Washers shall be carbon steel, galvanized, general assembly purpose type, conforming to ANSI B18.22.1.

2.2.3 Bar or Strap Anchors

Bar or strap anchors shall be steel conforming to ASTM A 36/A 36M. Hot-dip galvanized coating shall be in accordance with ASTM A 525, G90.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

Members shall be framed for the passage of ducts and pipes and shall not be cut, notched, or bored more than one quarter of their depth without approved reinforcement.

Washers shall be provided under bolt heads or nuts in contact with wood. Lumber shall be bored to receive bolts.

Nailers, blocking, and furring shall be furnished in lengths that minimize joints.

3.1.2 Interior Partitions

Partitions shall be framed with nominal 100 millimeter studs spaced 400 millimeter on center. Framing shall be closely fitted, accurtly constructed to true plane lines and levels, and rigidly secured in place.

Partition plates shall be secure to concrete floor with anchor bolts, expansion sleeves, and lag bolts. Power-driven fasteners may be used. One anchor shall be provided near each end of the partition plate and at intermediate intervals at a maximum spacing of 1200 millimeter on center.

Studs shall be doubled at openings anscorners constructed of no less than three studs. End studs of partitions abuting concrete or masonry shall be anchored thereto with 13 millimeter expansion bolts, one near each end and at intermediate maximum intervals of 1200 millimeter, or with power-driven threaded fasteners, same size and spacing.

Partitions shall have two top plates and a single bottom plate with one continuous row of horizontal blocking the full with of the partition, wedge and secured in place at midheight. Partitions shall be framed for the installation of the facing material, trim, cabinets, plumbing, and other work.

3.1.2 Blocking, Cant Strips, and Nailers

Nailing strips, blocking, cant strips, and sub fascia wood members shall be continuous, cut with square ends and in maximum practical lengths.

For bolted connections, sub fascia members shall be fastened to structural steel members or concrete with 1/2-inch bolts at a maximum spacing of 4 feet on center, one bolt near each end of the member. Bolt heads shall be countersunk flush with the surface of the wood. Sub fascia members shall be held to a tolerance of 1/8 inch in 10 feet.

Perimeter roof blocking, nailers, and cants shall be groove-cut to provide ventilation for insulation. Groove cuts shall be matched for continuity or new vent grooves cut when wide vents are built of more than one width of wood.

Bottom half of nailers shall be cut to provide a net open area equivalent to 10 percent of the edge face.

Wood vents for parapet walls and other vertical surfaces shall be 1-inch nominal thickness, treated boards, installed continuously. Wall side of vent shall be cut to provide a net open area equivalent to 20 percent of the thickness edge.

3.1.3 Wood Furring

Furring strips shall be erected plumb and rigid, using wood shims wherever necessary to adjust the face of the furring to a true, even plane to receive finish materials.

Exterior masonry walls shall be furred to receive dry-wall finish where indicated.

Furring shall be 1- by 3-inch continuous strips, 16 inches on center, installed vertically. Furring shall be secured to masonry or concrete with nailing plugs, clips, or masonry nails. Fasteners shall be provided at top and bottom and at 24 inches on center.

Furring strips fastened to concrete masonry units shall be secured by toggle bolts, anchor bolts, or screw expansion sleeves.

3.1.4 Wood Sheathing

Plywood sheathing shall be of indicated thickness and installed in accordance with APA E30.

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SECTION 06200

FINISH CARPENTRY
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 133	(1990) Standard Specification for Preservatives and Pressure Treatment Processes for Timber

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A208.1	(1993) Wood Particleboard
ANSI B18.6.1	(1981) Screw, Wood

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036	(1991; R 1997) Standard Specification for Flat Glass
ASTM D 1037	(1985; R 1994) Standard Test Method for Evaluating the Properties of Wood-Base Fiber and Particle Panel Materials
ASTM D 1760	(1995) Standard Specification for Pressure Treatment of Timber Products
ASTM D 4689	(1990) Standard Specification for Adhesive, Casein Type
ASTM E 84	(2001) Standard Test Method for Surface Burning Characteristics of Building Materials

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI-01	(1986) Architectural Casework - General

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.18	(2000) Materials and Finishes
BHMA A156.6	(2001) Architectural Door Trim
BHMA A156.9	(1994) Cabinet Hardware

FEDERAL SPECIFICATIONS (FS)

FS A-A-1932	(Rev A) Lockset, Rim
FS FF-N-105	(Rev B; Int Am 4) Nails, Brads, Staples, and Spikes: Wire, Cut, and Wrought
FS L-P-508	(Rev H; Notice 1) Plastic Sheet, Laminated, Decorative, and Nondecorative
FS MMM-A-130	(Rev B; Int Am 3) Adhesive, Contact
FS MMM-A-181	(Rev D) Adhesives, Phenol, Resorcinol, or Melamine Base

HARDWOOD PLYWOOD & VENEER ASSOCIATION (HPVA)

HPVA HP-1	(1992) Standard for Hardwood and Decorative Plywood

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA LD 3	(1991) High-Pressure Decorative Laminates

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA IFH CH14	(1990) Wood Products (Industrial Fire Hazards Handbook)

NATIONAL INSTITUTE FOR STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(1983) Construction and Industrial Plywood

NATIONAL WOOD WINDOW AND DOOR ASSOCIATION (NWWDA)

NWWDA I.S. 1	(1987) Wood Flush Doors

UNDERWRITERS LABORATORIES (UL)

UL 723	(1996; Rev thru Dec 1998) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication and Installation Drawings shall be submitted for the following items in accordance with Part 3, "Execution," of this section.

Finish Carpentry Materials
Hardwood Plywood Paneling
Fire Retardant Paneling
Cabinets, Counters, and Caseworks

Wood Trim
Plastic Laminated Counter Tops, Edges and Backsplashes
Shelving
Homogeneous Plastic Vanity Tops

SD-07 Certificates

Certificates of Compliance shall be submitted for the following items showing certification of UL-labeled materials indicating the flame spread, fuel-contributed, and smoke-developed ratings and moisture content of hardwood paneling.

Plywood Paneling Materials
Fasteners and Adhesives
Solid Wood Materials
Cabinets, Counters, and Caseworks
Cabinet Hardware
Plastic Laminates
Priming and Sealing
Homogeneous Plastic

SD-04 Samples

The following samples shall be submitted:

At least three sample flitches from each log for architectural-grade, Hardwood Plywood.

Panels of Pre-Finished Plywood and Solid Wood Paneling 12 by 18 inches.

Wood Trim 12-inches.

Plastic Laminate 3 by 6 inches for each color and pattern.

Homogeneous Plastic 3 by 6 inches for each color and pattern.

Manufacturer's Standard Color Charts showing recommended colors and finishes for finish carpentry materials.

1.3 DELIVERY, HANDLING, AND STORAGE

Contractor shall protect materials from damage during delivery, when stored, and during construction. Damaged and defective materials shall be removed and replaced with new.

Trim, paneling, cabinet work, and other finish millwork items shall be delivered and brought into the building only after the building has dried out, following the installation of wet materials, and when there is no danger of damage to materials due to excessive moisture.

Hardboard, plywood paneling and particleboard shall be stored in accordance with manufacturer's directions for at least 48 hours in the room in which they are to be installed. Plywood paneling shall be removed from cartons and stacked flat, with 1-inch stripping under and between each pair of face-to-face panel. Face panels shall be separated by a slipsheet.

1.4 SITE CONDITIONS

Field measurements shall be taken before fabrication and installation of materials to verify and supplement the indicated dimensions.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Plywood Shelving, Utility Usage

Plywood for utility shelving and for utility usage shall be sanded interior grade plywood, 3/4-inch thick, graded "B-D Int-DFPA" in accordance with NIST PS 1.

2.1.2 Plywood Core Material

Plywood for core material for plastic laminate and homogeneous plastic finish work shall be 3/4-inch thick, graded "B-B Int/with exterior glue line DFPA" in accordance with NIST PS 1.

2.1.3 Fasteners and Adhesives

2.1.3.1 Nails and Staples

All nails and staples, whether hand driven or mechanically driven, shall conform to FS FF-N-105.

2.1.3.2 Adhesives

Adhesives for interior millwork and trim shall be moisture-resistant type conforming to ASTM D 4689, Type II, water- and mold-resistant.

2.1.3.3 Wood Screws

Wood screws shall be carbon steel or brass, conforming to ANSI B18.6.1. Wood screws exposed to view shall be brass with an oval head with cross recess drive.

2.1.4 Solid Wood

2.1.4.1 Quality and Appearance

Solid wood finish materials shall be Custom Grade in accordance with the AWI-01 Standards.

2.1.4.2 Millwork

Solid wood trim shall be 300-S-4, Custom Grade, and milled to the indicated profile. Moldings, joint tolerances, miters, construction quality, and surface finish shall conform to AWI-01requirements for "Standing and Running Trim & Rails."

Material shall be furnished in the maximum practical length for the end use.

Material shall be kiln-dried. Moisture content shall not exceed 12 percent at the time of delivery to the building site.

Corners shall be mitered, tightly butted, and secured.

Wood trim shall be carefully selected to match hardwood plywood paneling.

Exposed nailing shall be countersunk finishing nails. Countersunk holes shall be filled with matching wood filler or putty.

Wood trim shall be hand sanded at the jobsite to a smooth clean finish, free of machine or tool marks, abrasions, raised grain, or similar imperfections.

2.2 HOMOGENEOUS PLASTIC VANITY TOPS

Homogeneous plastic shall be an impervious material equal to one of the following:

"Avonite" by Avonite, Inc., Sylman, CA 91342
"Fountainhead" Nevamar Corporation, Dallas, TX 75229
"Corian" by DuPont Co., Wilmington, DE 19801

2.3 CABINETS, COUNTERS, AND CASEWORK

2.3.1 Cabinets

Design shall be as indicated on the drawings and shall meet AWI-01 Section 400-B, Premium Grade. Door design shall be solid flush face. Plywood shall be sound grade to receive shop applied plastic laminate, applied to all exposed surfaces including edges, conforming to FS L-P-508, Style d-decorating, Type 1, Class 1, 0.050 inches thick. The cabinets may be constructed with frame fronts and solid ends or frame construction throughout. Frame member shall be 3/4 by 1-1/2 inch kiln-dried hardwood, mortised and tenoned, dovetailed or doweled, and glued together. Top and bottom corners shall be braced with hardwood blocks that are glued with water-resistant glue and nailed in place and faced with plastic laminate material matching door facing. Cabinets shall be provided with an integral toe space. Back and bottom of cabinets shall be 3/16-inch hardwood plywood, sound grade, or 1/8-inch tempered hardwood. Bottoms shall be braced with wood members glued in place.

Construction shall be plumb, square and true; accurately milled and fabricated to details with clean-cut profiles and lines. Accurately size the cabinets to the indicated dimensions. Where possible, conceal fastenings; where not possible, locate fastenings in inconspicuous places. Mortise, tenon, spline, house, joint, block, nail, screw, glue, or bolts together, as approved, in a manner to provide rigidity, to avoid swelling or shrinking, and to insure work remaining in place without warping, splitting, and opening of joints. Furnish and securely install cleats, nailers, strips, blocking, hangers, anchors, moldings, and the like, required to neatly and securely install cabinets and cabinet work.

2.3.2 Cabinet Hardware

2.3.2.1 General Standards

Cabinet finish hardware shall conform to the types and styles of BHMA A156.9. Screws and attachments shall be finished to match the hardware item. Finishes shall be in accordance with BHMA A156.18.

Cabinet hardware shall match finish hardware, as specified in Section 08710, "Door Hardware."

2.3.2.2 Adjustable Shelf Supports and Rests

Surface-applied, adjustable shelf supports shall be B24062, wrought brass, nickel plated, with 1/2-inch increment adjustment slots and with provision for screw fastening 6 inches on vertical center.

Flush-applied, adjustable shelf supports shall be B24072, wrought brass, nickel plated with 1/2-inch increment adjustment slots and with provision for screw fastening 6 inches on vertical center.

Shelf rests shall be Type B240Q2, wrought brass, nickel plated. Rests shall have a minimum projection of 3/4 inch and a minimum width of 9/16 inch.

Shelf rests for use in drilled holes shall be B84021, wrought steel, nickel plated with 1/4-inch diameter pin, 3/8-inch long, overall length 1-1/4 inches.

2.3.2.3 Cabinet Hinges

Cabinet hinges shall be wrought steel, designated size and finish and shall conform to BHMA A156.9, as follows:

Semiconcealed cabinet hinges for flush plywood gates and doors shall be B21201, 5-knuckle, button tip, finish 639 or 652.

Continuous hinges shall be B81491, wrought steel, chrome plated, 0.032 inch thick with 0.090-inch steel pin, countersunk screw holes 2 inches on center, width when open, 1-1/16 inches.

2.3.2.4 Cabinet Catches

Magnetic catches shall be B43141, Type 1, aluminum case, minimum 4-pound pull.

2.3.2.5 Pulls

Door and drawer pulls shall be B12012, contemporary-design, cast bronze, 3-inch centers, screw attached from inside of door or drawer.

Knob-type pulls shall be B22132 or B42132, 1-1/2-inch diameter, brass knob and shank.

2.3.2.6 Drawer Slides

Drawer slides shall be B85072, ball bearing full extension drawer slides for attachment to each side of drawer. Rubber stops shall be provided at striking points.

2.3.2.7 Locks

Locks shall conform to FS A-A-1932 and shall be all brass, BHMA A156.18, finish US26D, pin-tumbler type with dead bolt, as follows:

Drawer locks and cabinet locks shall be half-mortise, 5 or more pin tumblers, 1-1/8-inch diameter cylinder, 5/16-inch throw dead bolt with brass strike.

Sliding cabinet door locks shall be push-bolt type, 4-pin tumbler, 1-inch

diameter cylinder with brass cup strike.

2.3.2.8 Sliding Door Hardware

Track for all-glass sliding cabinet doors shall be a steel, zinc-plated, ball bearing assembly consisting of upper channel guide, shoes for glass doors, ball-bearing carrier, and a lower track.

Upper channel guides shall be 15/16-inch wide by 5/8-inch high and shall weigh a minimum of 17 ounces per linear foot.

Shoes for glass doors shall be designed for 1/4-inch thick glass and shall be 7/16-inch high with a curved underside, weighing a minimum of 2.1 ounces per linear foot.

Ball bearing carrier shall carry hardened steel ball bearings spaced 3 inches on center with two-point suspension between shoe and anvil of lower track. Carrier shall weigh at least 2.4 ounces per linear foot.

Lower track shall be 1-inch high by 1-inch wide double-channel track, designed with a center anvil in each channel to carry the ball bearings and shall weigh at least 12.1 ounces per foot.

2.3.3 Plastic Laminates

2.3.3.1 Counter Tops, Edges, and Backsplashes

Counter top surface, edge, and backsplash shall be 0.050-inch thick, high-pressure laminated, melamine plastic, general-purpose type, conforming to NEMA LD 3, Style D-decorative, Type I, Class 1.

Color, pattern, and finish shall be as selected by the Contracting Officer from samples of the approved manufacturer(s).

2.3.3.2 Vertical Surfaces

Plastic laminate surfaces for counter fronts, gates, and paneling shall be 0.031-inch thick, high-pressure laminated, melamine plastic, vertical surface type, conforming to NEMA LD 3, Style D-decorative, Type I, Class 1. Color, pattern, and finish shall be as selected by the Contracting Officer from samples of the approved manufacturer(s).

2.3.3.3 Backing Sheets

Backing sheets for plastic-laminate panels shall be 0.020-inch minimum thick laminated plastic conforming to NEMA LD 3.

Backing sheets for plastic-laminate veneer panels shall be bonded to the core material with an adhesive as recommended by the plastic laminate manufacturer.

2.3.3.4 Adhesive

Adhesives for plastic-laminate panels shall be phenol-resorcinol and melamine conforming to FS MMM-A-181 or contact adhesive conforming to FS MMM-A-130.

2.4 FINISHING

2.4.1 Priming and Sealing

2.4.1.1 Plywood Paneling

Plywood paneling shall be factory finished, with back surfaces sealed.

2.4.1.2 Cabinets, Casework, and Trim

Mill-fabricated cabinets, casework, and solid wood trim shall be delivered to the project unsealed and ready to receive the specified finish.

Mill-fabricated cabinets, casework, and solid wood trim scheduled for paint finish shall receive one mill-applied coat of clear sealer or prime paint of a type compatible with the final finish.

Mill-fabricated cabinets, casework, and solid wood trim scheduled for stain finish shall receive one mill-applied coat of approved stain-sealer of a type compatible with the final finish.

Mill-fabricated cabinets, casework, and solid wood trim scheduled for clear, natural finish shall receive one mill-applied coat of an approved clear sealer of a type compatible with the final finish.

PART 3 EXECUTION

3.1 PREPARATION

Finished millwork items shall be installed only when temperature and humidity conditions approximate the interior conditions that will exist when the building is occupied. Relative humidity in the building at the time of installation of materials shall be within the limits recommended by the manufacturer.

3.2 INSTALLATION

3.2.1 Wood Trim

Wood trim shall be set straight, plumb and level, closely fitted, and rigidly fastened. Nail heads of exposed work shall be countersunk and the holes filled with matching wood filler.

Joints shall be tight and formed to conceal shrinkage. Shop miters over 4 inches shall be glued and splined.

Furring and framing to receive paneling shall be checked for plumb and true plane surface. Adjustments shall be made before proceeding with the work.

3.2.2 Counters, Cabinets, and Casework

Continuous back panels shall be provided for all counters, cabinets, shelving, and casework. Open-backed or skeleton-framed units will not be accepted. Back panels shall be 1/4-inch minimum thick hardwood plywood or tempered hardboard when painted or concealed. Exposed or semi-exposed backs shall be hardwood plywood of the same veneer as the face of the cabinet.

Exposed backs of counters, desk fronts, partitions, and island or peninsula

cabinets shall be 3/4-inch minimum thickness and shall be dadoed and glued under pressure into the cabinet sides.

Cabinet bases shall be constructed of 2 by 4-inch framing, with toe space of the indicated height and depth. Cross rails shall be provided at cabinet ends, points of concentrated loads, and intervals not to exceed 24 inches.

Cut out for sinks shall be of size indicated.

Exposed nailing shall be countersunk finishing nails; the countersunk holes shall be filled with a matching wood filler or putty. Staples will not be permitted in exposed cabinet or case work.

Exposed wood surfaces shall be machine sanded at the mill to the specified standard and then shall receive a final sanding at the site to a smooth clean finish, free of machine or tool marks, abrasions, raised grain, or similar imperfections.

3.2.3 Plastic Laminate Counter Tops, Edges and Backsplashes

Plastic laminate shall be bonded to substrate as specified in paragraph entitled, "Particleboard Core Materials," or to close-grained hardwood plywood, Graded DFPA "B-D," or better.

Core shall be at least 3/4-inch thick for horizontal applications and at least 1/2-inch thick for vertical application.

Plastic laminate shall be bonded to the approved core material with adhesives as recommended by the laminate manufacturer.

Exposed edges and ends of counter tops and backsplashes shall be the same plastic laminate material specified for the counter top. Color shall match that for the counter top. Exposed edges shall be rounded to 1/32-inch radius.

3.2.4 Shelving

Shelving shall be constructed and assembled in accordance with AWI-01, specified grade.

Uprights and wall cleats shall be solid wood, 1 by 3-inch minimum size, nailed to walls and to shelving with finishing nails.

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SECTION 07115

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09/96

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SECTION 07115

BITUMINOUS DAMPPROOFING
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 140	(1993) Sampling Bituminous Materials
ASTM D 1668	(1994) Glass Fabrics (Woven and Treated) for Roofing and Waterproofing
ASTM D 173	(1994) Bitumen-Saturated Cotton Fabrics Used in Roofing and Waterproofing
ASTM D 43	(1994) Creosote Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 449	(1989; R 1994) Asphalt Used in Dampproofing and Waterproofing
ASTM D 450	(1991) Coal-Tar Pitch used in Roofing, Dampproofing, and Waterproofing

FEDERAL SPECIFICATIONS (FS)

FS SS-C-153	(Rev C) Cement, Bituminous, Plastic

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Creosote Primer
Coal-Tar Pitch
Coal-Tar-Saturated Fabric Reinforcement
Mastic Fibrous Asphalt
Semi-Mastic Fibrous Asphalt

SD-04 Samples

Contractor shall submit the following samples:

Three 1-quart containers each of Bitumen, Primer, Emulsion, Mastic

Fibrous Asphalt, and Semi-Mastic Fibrous Asphalt.

Three pieces, 12 inches by the width of the roll, of Woven Glass Fabric or Cotton Reinforcement Fabric.

SD-06 Test Reports

Test Reports for the following items shall be in accordance with the paragraph entitled, "Bitumen Sampling and Testing," of this section.

Asphalt
Coal-Tar Pitch

SD-07 Certificates

Certificates of Compliance shall be submitted for the following items showing conformance with referenced standards contained in this section.

Hot-Applied Dampproofing Materials
Cold-Applied Dampproofing Materials

1.3 QUALIFICATIONS FOR DAMPPROOFING WORK

Bituminous dampproofing shall be installed by mechanics experienced and specializing in this type of work. Supervisory personnel assigned to this project shall have a minimum of 5 years of experience in bituminous dampproofing. Personnel working pursuant to this section, may at the Contracting Officer's option, be required to demonstrate technical competence by performing sample work and/or by displaying their state qualifications/certificates, at no additional cost to the Government.

1.4 BITUMEN SAMPLING AND TESTING

Bitumen shall be sampled and tested in accordance with ASTM D 140 and as follows:

Asphalt for dampproofing shall meet or exceed the physical requirements listed in ASTM D 449, Table I, and shall be sampled and tested for softening point, flash point, penetration, ductility, loss on heating, bitumen soluble in carbon disulfide, bitumen soluble in carbon tetrachloride, ash, and coarse particles.

1.5 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered to the site in original, unbroken, and labeled packages. Only approved materials shall be brought to the site.

Fabric rolls shall be labeled to indicate grade, weight, and type of saturant.

Materials shall be stored above ground and shall be protected from the weather. Fabric rolls shall be stacked on end and stored in an area maintained at temperatures not lower than 50 degrees F for at least 24 hours before use.

1.6 PROTECTION OF PROPERTY

Flame-heated equipment shall be located and used so it will not endanger the structure, other materials on the site, or adjacent property. Fire extinguishers of an appropriate type and capacity shall be provided and maintained.

Before starting work, the paving and the faces of building walls adjacent to the work shall be protected. Heating kettles shall be placed not closer than 30 feet from any structure. Protection shall be maintained for the duration of the work.

Work or materials damaged by this work shall be cleaned, restored to the original condition, or replaced with new materials without additional cost to the Government.

1.7 WEATHER RESTRICTIONS

1.7.1 Inclement Weather

Dampproofing shall not be applied in wet or rainy weather.

Surfaces shall be dry before and during installation of materials.

1.7.2 Cold-Weather Limitations

Dampproofing shall be applied when the ambient temperature is no lower than 50 degrees F unless positive and approved methods are provided to protect the work during and after installation.

PART 2 PRODUCTS

2.1 HOT-APPLIED DAMPPROOFING

Hot-applied dampproofing shall be used for any repair work greater than 10 square feet.

Hot-applied dampproofing materials shall conform to the following:

Creosote primer shall conform to ASTM D 43.

Coal tar pitch shall conform to ASTM D 450, Type II, when used in dampproofing below ground level under uniformly moderate temperature conditions.

Coal tar pitch shall conform to ASTM D 450, Type II, when used in dampproofing vertical surfaces above ground and when not exposed to temperatures in excess of 125 degrees F.

Coal-tar-saturated fabric reinforcement shall be coal-tar-saturated glass fabric conforming to ASTM D 1668 or coal-tar-saturated woven cotton fabric conforming to ASTM D 173.

2.2 COLD-APPLIED DAMPPROOFING

Cold-applied dampproofing materials shall be as follows:

Mastic fibrous asphalt shall be a solvent cutback asphalt preparation conforming to FS SS-C-153, Type I. Materials shall be stabilized with

bentonite clay to produce a trowel consistency. Mastic shall not sag when applied at the specified thickness and shall remain easily moldable at room temperature after solvent has evaporated.

Semi-mastic fibrous asphalt shall be a solvent cutback asphalt preparation conforming to FS SS-C-153, Type I. Material shall be stabilized with bentonite clay to produce a brush or spray consistency. Material shall not sag when applied at the specified thickness and shall remain easily moldable at room temperature after solvent has evaporated.

PART 3 EXECUTION

3.1 PREPARATORY WORK

Surfaces to receive dampproofing shall be carefully inspected before starting work. Surfaces shall be smooth, clean, dry, free of ice, frost, deleterious substances, and projections. Holes, honeycombs, cracks, and cavities shall be filled and finished flush. Mortar joints shall be neatly struck. Top surfaces of projecting masonry or concrete ledges below grade shall be pitched to drain.

Dampproofing shall not be installed until unsatisfactory surface conditions are corrected.

3.2 HEATING BITUMEN

Solid bitumen shall be broken up on a clean surface free of dirt and debris.

Bitumen shall be heated in kettles designed to prevent direct contact of the flame with surfaces in contact with the bitumen. Flue effluent from the combustion system shall not exceed 475 degrees F. A flue-outlet thermometer shall be installed and kept in calibration and working order. Kettle temperature shall not exceed 375 degrees F. All kettles shall employ a fume recovery system with an afterburner and safety loader to minimize smoke, fumes, odors, and emissions.

Cutting back, adulterating, or fluxing bitumen will not be permitted.

3.3 INSTALLATION

Dampproofing shall be applied in accordance with the manufacturer's printed instructions and as specified.

Temperature of surfaces shall be 40 degrees F or higher.

Dampproofing shall be applied to the exterior surfaces of walls below grade in locations as indicated and shall extend from the bottom of footing to within 4 inches of the finished grade.

Dampproofing shall be applied to exterior surfaces of walls enclosing excavated basements or other subsurface spaces indicated.

Walls having brick or stone facing backed by concrete and extending below grade shall have dampproofing applied to the concrete backing up to a line 1 foot above the finished grade or to the top of the concrete where the concrete does not extend 1 foot above the grade.

Dampproofing shall be extended to include integral piers and other exterior

wall projections, area walls, and wing walls as indicated.

Dampproofing shall be applied to interior surfaces of concrete and masonry walls where indicated. Dampproofing shall be extended from the floor line to the full height of the wall.

Dampproofing shall be applied to interior surfaces of exterior walls except where such wall surfaces are to be finished walls of rooms. Attic spaces and other unfinished spaces shall have interior surfaces of exterior walls dampproofed. Dampproofing shall be applied to jambs and heads of openings and to all recessed spaces and shall extend to not less than 1 foot in from exterior walls on interior masonry or concrete walls or partitions except where the surfaces of such walls or partitions are to be the finished walls of rooms. Wall surfaces behind shower linings and other surfaces so indicated shall be coated with interior dampproofing.

Interior dampproofing shall be applied before wall furring or furring strips are installed.

Finished surface shall be smooth and glossy. Dull or porous areas shall be recoated.

3.4 HOT-APPLIED COAL-TAR PITCH DAMPPROOFING

A uniform brush or roller coat of creosote primer shall be applied at not less than 1 gallon for each 100 square feet. Primer shall be allowed to penetrate and dry.

Specified type of coal-tar pitch shall be mopped into the surface at not less than 25 pounds per 100 square feet and allowed to dry.

A second mopping of pitch shall be applied at not less than 25 pounds per 100 square feet.

Fabric reinforcement strips shall be applied and embedded completely. Fabric shall not show in the finished surface.

Exterior surfaces shall be given either a priming coat of creosote oil and two mop coats of hot coal-tar pitch or a priming coat of nonfibrous asphalt and two mop coats of hot asphalt. Mop coats shall be applied uniformly using not less than 25 pounds per 100 square feet per coat. Pitch or asphalt shall be heated to flow freely but not more than 375 degrees F for coal-tar pitch and 400 degrees F for asphalt.

3.5 COLD-APPLIED DAMPPROOFING

3.5.1 Mastic Fibrous Asphalt

Two coats of mastic fibrous asphalt shall be applied by trowel without voids. Material shall not be thinned.

First coat shall be applied using not less than 4-1/2 gallons per 100 square feet and shall be allowed to dry for at least 12 hours before application of the second coat.

Fabric reinforcement strips shall be applied and embedded completely in mastic.

A second coat of mastic shall be applied to provide a minimum total

thickness of 1/8 inch for both coats. Rate of application shall be uniform using not less than 4-1/2 gallons per 100 square feet.

3.5.2 Semi-Mastic Fibrous Asphalt

Semi-mastic fibrous asphalt shall be uniformly brushed, sprayed, or rolled in a two-coat application applied without voids. Material shall not be thinned.

First coat shall be applied using not less than 2 gallons per 100 square feet and allowed to dry for at least 12 hours before further application.

Fabric reinforcement strips shall be applied as specified and embedded completely in place.

Second coat of mastic shall be applied using not less than 2 gallons per 100 square feet and allowed to dry for at least 12 hours before backfilling.

3.5.3 Asphalt Dampproofing

Asphalt dampproofing shall be uniformly brushed or sprayed on the interior of exterior walls above grade, where indicated, in a two-coat application applied without voids. Asphalt shall not be thinned.

First coat shall be applied at a rate of at least 1-1/2 gallons per 100 square feet of surface and allowed to dry for at least 12 hours before further application.

Second coat shall be applied at a rate of at least 1 gallon per 100 square feet of surface and allowed to dry.

Exterior surfaces shall be given a priming coat of nonfibrous asphalt and a coat of semi-mastic fibrous asphalt applied uniformly using not less than 30 pounds per 100 square feet to fill pores completely and bond to the wall surface.

3.6 DAMPPROOFING STONE BACKUP

Masonry backup for stone facings shall be dampproofed with a nonfibrous asphalt dampproofing formulated for stone backup use.

Dampproofing shall be brush-applied to masonry backup in one full covering coat free of voids and skips.

Where indicated, interior surfaces and surfaces back of stone facing shall be given a coat of nonfibrous asphalt and a heavy coat of semi-mastic fibrous asphalt applied uniformly, using not less than 30 pounds per 100 square feet to cover pores completely and bond to wall surface; or, at the Contractor's option, then may be given a priming and a second coat of asphalt-base emulsion. Priming coat shall be applied in accordance with the manufacturer's printed directions at the rate of 1 gallon per 100 square feet and the second coat at the rate of 3 gallons per 100 square feet of surface.

3.7 FABRIC REINFORCEMENT

Exterior face of dampproofed walls below grade shall be reinforced with the specified fabric reinforcement at construction joints, at the horizontal joints between the bottom of the walls and the tops of the footings, at

corners, projections, or changes in plane in walls, and where a wall is penetrated by utility service lines.

Reinforcement shall consist of two plies of fabric strips. First strip shall be at least 12 inches wide and shall be covered by a second strip at least 18 inches wide. Each strip shall be laid in and embedded completely with no fabric visible.

3.8 BACKFILLING

Backfilling shall follow completion of dampproofing as promptly as the work permits.

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SECTION 07130

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06/98

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SECTION 07130

SHEET MEMBRANE WATERPROOFING
06/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 412	(1992) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 4716	(1987) Test Method for Constant Head Hydraulic Transmissivity (In-Plane Flow) of Geotextiles and Geotextile Related Products
ASTM D 570	(1995) Standard Test Method for Water Absorption of Plastics
ASTM E 154	(1988; Rev 1993) Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM E 96	(1995) Standard Test Methods for Water Vapor Transmission of Materials

1.2 SYSTEM PERFORMANCE

Provide sheet waterproofing products that have been produced and installed to establish and maintain a continuous watertight seal. Ensure compatibility of waterproofing materials with each other, and with the materials on which they will be applied. Materials shall conform to the applicable performance requirements indicated when tested in accordance with referenced ASTM Standards.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Submit Manufacturer's Catalog Data, including description and physical properties, application details, recommendations regarding shelf life, application procedures, protective covering

requirements, and precautions for flammability and toxicity, for the following items:

Sheet membrane materials
Accessories
Prefabricated Drainage Panels
Protective board

SD-07 Certificates

Certificates of Compliance shall be submitted for sheet membrane materials and accessories, showing conformance with referenced standards contained in this section.

1.4 QUALITY ASSURANCE

Obtain primary waterproofing products from a single manufacturer. Provide secondary products as recommended by sheet membrane manufacturer.

Preinstallation Conference: Prior to installing waterproofing and associated work, meet at the Project site with the installer of each component of associated work, and installers of work requiring coordination of waterproofing work, and the Contracting Officer. Review material selections and procedures to be followed in performing the Work. Notify the Contracting Officer at least 48 hours before conducting meeting.

1.5 DELIVERY, STORAGE AND HANDLING

Deliver materials to the site in the manufacturer's original packaging with product identification clearly marked. Only approved materials shall be brought to or stored at the site. Materials shall be stored and protected from contact with soil and from the weather. Rolls shall be stacked on end.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not apply waterproofing during inclement weather or when there is ice, frost, surface moisture, or visible dampness on surfaces to receive waterproofing and when ambient and surface temperatures are 40 degrees F or below.

PART 2 PRODUCTS

2.1 SHEET MEMBRANE MATERIAL

Self-adhered, cold-applied composite sheet waterproofing, 60 mil total thickness; comprised of 56 mil thick rubberized asphalt and 4 mil thick cross-laminated polyethylene film, and conforming to the following performance requirements:

2.2 ACCESSORIES

2.2.1 Liquid Membrane

Two-component, cold-applied trowel-grade material manufactured by sheet membrane manufacturer. Liquid membrane shall be used as fillet and reinforcment material at inside corners, flashing material around drains

and other protrusions, and sealing material at terminations, as recommended by sheet membrane manufacturer.

2.2.2 Primer

Asphalt composition, conforming to ASTM D 41, or synthetic polymer in solvent as recommended by sheet membrane manufacturer.

2.2.3 Mastic

Polymer modified asphalt-based mastic designed to seal terminations, edges of patches, and overlaps as recommended by the sheet membrane manufacturer.

2.2.4 Adhesive

Provide type of adhesive recommended by sheet membrane manufacturer for application of prefabricated drainage panel or protection board to sheet membrane system.

2.3 PREFABRICATED DRAINAGE PANELS

Composite drainage panels, 3-dimensional, nonbiodegradeable, manufactured with a permeable geotextile bonded to molded plastic sheet drainage core and designed to effectively convey water.

Geotextile: Nonwoven fabric of polypropylene or polyester fibers, or a combination of both.

Minimum Flow Rate: 15 gallons per minute per foot at hydraulic gradient of 1.0 and 3600 pounds per square foot normal pressure when tested in accordance with ASTM D 4716.

2.4 PROTECTION BOARD

At vertical surfaces, provide expanded polystyrene protection board, one inch thick, with nominal density of 1.0 lbs/cubic foot.

At horizontal surfaces, provide type of protection board as recommended by sheet membrane manufacturer.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Before beginning the Work, verify that surfaces to be waterproofed are in satisfactory condition. Notify the Contracting Officer of defects or conditions that will prevent a satisfactory application. Do not begin application of waterproofing system until defects and conditions have been corrected.

3.2 SURFACE PREPARATION

Ensure that surfaces to be waterproofed are clean, dry, frost-free, smooth, and free from deleterious substances and projections. Cut off high spots or grind smooth. Fill holes, honeycombs, cracks, and cavities and finish flush with adjacent surfaces with cement mortar. Masonry mortar joints shall be neatly struck.

Apply primer to substrate surfaces at rate recommended by sheet membrane manufacturer. Prime only areas that will be covered by waterproofing membrane in the same working day. Reprime areas not covered by waterproofing membrane within 24 hours.

3.3 MEMBRANE INSTALLATION

Install membrane on surfaces in accordance with sheet membrane manufacturer's printed installation instructions. Remove release paper layer and apply with tacky surfaces of sheet membrane in contact with the dried primer. Roll out on substrate with mechanical roller to encourage full contact bond. Minimize wrinkles and bubbles in sheet membrane.

Lap sheets at edges and ends a minimum of 2-1/2 inches over the preceding sheet. Reinforce membrane at corners and joints with second ply of membrane material. Flash drains and projections with a second ply of membrane for a distance of 6 inches from the drain or projection. Weatherlap joints in direction of drainage. Seal terminated edges of sheet membrane with mastic or liquid membrane.

For vertical and sloped wall conditions, finish top edge of sheet membrane in reglet, or under flashing or masonry joint. Seal top edge with mastic or liquid membrane material at finish grade level.

3.4 FIELD QUALITY CONTROL

Before completed membranes are covered by protection boards or other work, test membranes installed on horizontal surfaces for leaks. Notify Contracting Officer two days prior to date of performing tests.

Testing shall consist of damming and covering horizontal surfaces with a minimum 2 inches of ponded water. After 24 hours, inspect waterproofed areas for leaks. If leaking is found, remove water and repair leaking areas with new waterproofing materials as directed by the Contracting Officer. Repeat tests and repairs until no leaks remain. Do not proceed with work that conceals membrane waterproofing until waterproofed area is proven watertight and accepted by the Contracting Officer.

3.5 PREFABRICATED DRAINAGE PANELS

Place and secure drainage panels in accordance with manufacturer's written instructions. Use adhesives recommended by manufacturer that do not penetrate waterproofing. Lap edges and ends of geotextile to mainatain continuity. Protect installed panels during subsequent construction.

3.6 PROTECTIVE COVERING

After installation has been inspected and approved by the Contracting Officer, install protection board over the sheet membrane waterproofing in accordance with manufacturer's installation instructions. Scribe and cut protection board around pipes, projections, and interruptions. Cover entire waterproofed surface with protection board.

3.7 PROTECTION

On vertical surfaces, backfilling shall immediately follow installation of protective covering.

Protect completed membrane during installation of other materials over

membrane and throughout remainder of construction period. Do not permit traffic of any type on unprotected or uncovered membrane.

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SECTION 07210

BUILDING INSULATION
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 390	(1995; R 2001) Standard Specification for Zinc-Coated (Galvanized) Steel Poultry Fence Fabric (Hexagonal and Straight Line)
ASTM B 479	(1995) Standard Specification for Annealed Aluminum and Aluminum-Alloy Foil for Flexible Barrier Applications
ASTM C 1139	(1990) Standard Specification for Fibrous Glass Thermal Insulation and Sound Absorbing Blanket and Board for Military Application
ASTM C 1289	(1995) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C 208	(1995) Standard Specification for Insulation Boards (Cellulosic Fiber) Structural and Decorative
ASTM C 519	(1984) Density of Fibrous Loose-Fill Building Insulations
ASTM C 553	(1999) Standard Specification for Mineral Fiber Blanket and Felt Insulation (Industrial Type)
ASTM C 578	(1995) Standard Specification for Preformed, Cellular Polystyrene Thermal Insulation
ASTM C 591	(2000) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation
ASTM C 612	(2000) Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C 665	(1994) Mineral Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing

ASTM C 764	(1994) Mineral Fiber Loose-Fill Thermal Insulation
ASTM C 892	(1993) Standard Specification for High-Temperature Fiber Blanket Thermal Insulation
ASTM E 154	(1988; Rev 1993) Test Methods for Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM E 84	(2001) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Standard Test Methods for Water Vapor Transmission of Materials

FEDERAL SPECIFICATIONS (FS)

FS FF-N-105	(Rev B; Int Am 4) Nails, Brads, Staples, and Spikes: Wire, Cut, and Wrought
FS UU-B-790	(Rev A; Int Am 1) Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Glass Fiber Insulation Board
Batts and Rolls
Rigid Polystyrene Board
Rigid Polyurethane Board
Vapor Barrier
Vapor Barrier Tape
Water-Vapor Barrier Subgrade Covers
Fasteners
Adhesive
Nails
Staples
Wire Netting
Vapor-Barrier Adhesive
Sand

SD-04 Samples

Contractor shall submit the following samples:

Three Glass-Fiberboard samples, full thickness by 12-inches wide by

12-inches long.

Three Vapor-Barrier samples, 12 by 12 inches.

Vapor Barrier Tape
Vapor Barrier Subgrade Covers
Fasteners
Adhesives
Wire Netting

SD-06 Test Reports

Test Reports shall be submitted for Water-Vapor Barrier Subgrade Covers for resistance to decay and permeance.

SD-07 Certificates

Certificates of Compliance shall be submitted for the following items showing conformance with referenced standards contained in this section.

Glass Fiber Insulation Board
Batts and Rolls
Vapor Barrier
Vapor Barrier Tape
Water-Vapor Barrier Subgrade Covers
Staples
Wire Netting
Fire-Retardant Treated Wood Furring Strips

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted for installation of the following items:

Fasteners
Pneumatic Blowing Machine
Vapor-Barrier Adhesive

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered to the project site in their original, unopened packages or containers bearing labels identifying the manufacturer's name, brand name, material, and other information.

Materials shall be stored in their original unbroken packages or containers in a weathertight and dry area, and protected from damage until ready for use.

PART 2 PRODUCTS

2.1 THERMAL-INSULATION MATERIALS

2.1.1 Glass-Fiber Insulation Board

For informational purposes, a list of known sources for recycled building insulation is provided below. Note that the Contractor is not limited to these sources. An approved product from other sources may be submitted for the Government's approval during construction.

Acceptable manufacturer's include, but are not limited to:

Certain Teed Corporation
Guardian Fiberglass, Inc.
Manville Building Products Corp.
Owens-Corning Fiberglass Corp.
Western Fiberglass, Inc.

2.1.1.1 Board

Glass-fiber insulation board shall have a minimum thermal resistance of R-8, width and length as required to suit construction conditions. Insulation shall have a 10-mil thick, white, puncture-resistant woven-glass cloth with vinyl facing on one side. Insulation shall conform to ASTM C 208, ASTM C 1139, or ASTM C 612, non-load bearing for use at temperatures up to and including 400 degrees F; the composite insulation shall have a UL rating of 25/50 when tested in accordance with ASTM E 84.

Glass-fiber insulation board shall contain a minimum content of 9 percent recovered materials.

2.1.1.2 Batts and Rolls

Glass-fiber insulation batts and rolls shall be of nominal thickness and width for the indicated R value. Insulation shall conform to ASTM C 665 for the following:

Type I, unfaced insulation

Type II, Kraft faced insulation

Type III, foil faced insulation having a UL rating of 25/50 when tested in accordance with ASTM E 84.

Glass-fiber insulation batts and rolls shall contain a minimum content of 20 percent recovered materials.

2.1.2 Rigid Polystyrene Board

Rigid polystyrene board shall beof a thickness indicate and shall and be extruded polystyrene conforming to ASTM C 578, Type IV.

2.1.3 Rigid Polyurethane Board

Rigid polyurethane board shall be of thickness indicated and shall conform to ASTM C 1289 or ASTM C 591.

2.1.2 Vapor Barrier

Vapor barrier shall be fire-retardant, high-vapor transmission and aluminum-foil-laminated-to-creped-paper type, conforming to ASTM B 479.

2.1.3 Vapor-Barrier Tape

Vapor-barrier tape shall be not less than 2 inches wide with a fire-retardant pressure-sensitive adhesive coating on one face. Vapor-barrier material shall be fire-retardant, high-vapor transmission and aluminum-foil-laminated-to-creped-paper type, conforming to ASTM B 479.

2.1.4 Water-Vapor Barrier Subgrade Covers

Water-vapor barrier subgrade covers shall be resistant to decay when tested in accordance with ASTM E 154, shall have a water-vapor permeance after exposure in the resistance-to-decay test not exceeding 0.5 perm when tested in accordance with ASTM E 96, Water Method, and shall be one of the following materials:

Clear polyethylene sheeting, 0.008 inch thick

Polyethylene-coated barrier paper consisting of 0.002-inch thick polyethylene film laminated to one surface of rot-resistant, water-resistant, uncreped and reinforced barrier paper; paper shall conform to FS UU-B-790, Type I, Grade A, Style 4.

Asphalt-core board, surfaced both sides with asphalt-saturated and asphalt-coated felt, weighing not less than 60 pounds per 100 square feet, and not less than 1/8-inch thick

2.2 FASTENING MATERIALS

2.2.1 Fasteners

Fasteners shall have a 2- by 2-inch perforated plate, minimum 3/4-inch wide prong, of sufficient length to bend to the bottom of the notch. Fasteners shall be cold-rolled carbon steel, zinc coated. Washers shall be 1-1/2-inch diameter, slotted type, zinc coated.

2.2.2 Adhesive

Adhesive shall have a bonding strength of 70 pounds per clip after a 3-day drying time at 70 degrees F and shall have a temperature range of minus 20 degrees to plus 225 degrees F.

2.2.3 Nails

Nails shall be zinc-coated steel, common style, of the size required to suit the application, conforming to FS FF-N-105, Type II, Style 10.

2.2.4 Staples

Staples shall be galvanized steel, flat top crown, of the size required to suit the application, conforming to FS FF-N-105, Type II, Style 3.

2.2.5 Wire Netting

Wire netting shall be hexagonal zinc-coated steel poultry netting having a 1-1/2-inch mesh size and 0.048-inch-diameter (18-gage) wire, conforming to ASTM A 390.

2.2.6 Vapor-Barrier Adhesive

Vapor-barrier adhesive shall be fire resistant, suitable for bonding laps in the vapor-barrier material, and as recommended by the manufacturer of each type of vapor-barrier material used in the work.

2.2.7 Sand

Sand for ballast over water-vapor barrier subgrade covers in crawlspaces shall be natural sand.

PART 3 EXECUTION

3.1 GENERAL

Building insulation shall be installed in accordance with approved descriptive data and as specified.

Insulation material shall be cut and fit as necessary to fully insulate small areas between closely spaced framing members and to accommodate piping, conduit, outlet boxes, and other construction penetrating the insulation material.

Vapor barriers, both those affixed to the principal face of the insulation material and those separately attached, shall be installed to provide a continuous vapor-barrier seal. Tears, breaks, or ruptures that might interfere with the effectiveness of the vapor barrier shall be prevented.

3.2 CONDITIONS AT BUILDING

Insulation shall be installed only after building construction has progressed to the point that inclement weather will not damage or wet the insulation material.

Electrical wiring, plumbing, and other concealed work shall be completed and approved prior to the start of building insulation work.

3.3 PREPARATION OF SURFACES

Surfaces on which thermal-insulation materials are to be applied shall be clean, smooth, dry, and free from projections that might puncture the vapor barriers. Condition of surfaces shall be inspected and approved prior to the start of building insulation work.

Construction shall be supplemented with nailers, furring strips, or other supporting members to support the insulation in its proper location.

3.4 PERIMETER INSULATION SYSTEM

Perimeter insulation applied to foundation walls shall be installed before the start of drainage-fill placing operations. Cellular plastic boards shall be applied to the interior side of outside foundation walls where indicated and shall extend the indicated dimension from the top of the foundation wall. Cellular plastic boards shall be secured to the foundation wall surface by means of spot-applied bonding adhesive for cellular plastic boards; the bonding adhesive shall be applied in accordance with the adhesive manufacturer's printed directions. Cellular plastic boards shall be applied in a horizontal position with ends and sides closely butted together and with vertical joints broken.

Perimeter insulation applied on horizontal surfaces shall be installed after the completion of drainage fill-placing operations. Cellular plastic boards shall be applied horizontally under concrete slabs on the ground where indicated and shall extend the indicated dimension in from the exterior wall. Cellular plastic boards shall be installed with ends and

sides closely butted together and the surface leveled to finish flush with the drainage-fill surface. Cellular plastic boards shall be protected by covering horizontal surfaces with water-vapor barrier subgrade covers. Subgrade cover sheets shall be laid with not less than 6-inch laps at edges and ends. Lapped joints shall be sealed with adhesive.

3.5 WALL AND CEILING INSULATION SYSTEM

Glass-fiber insulation batts and rolls shall be placed between wall and ceiling framing members, fitting snugly against framing members. Insulation shall be cut to required length for each space to be insulated.

Batts having membrane facing or enveloping membranes shall be installed with the affixed flanged membrane facing toward the winter-heated side of the construction. Additional end flanges shall be formed of the vapor-barrier membrane facing at the ends of batts by cutting or pushing away the insulation material, leaving the facing for attachment to the framing. Flanges shall be nailed or stapled to framing members not more than 6 inches on center. Joints at perimeter of cutouts, end joints between batts in ceiling construction, and tears or ruptures in the membrane facing shall be sealed with vapor-barrier tape.

Batts without membrane facing shall be secured in place between framing members by means of wood nailing strips or an approved adhesive, standard with the insulation materials manufacturer.

Vapor barriers shall be installed after batts have been placed and shall be applied to the winter-heated side of the construction. Vapor-barrier edges shall occur over framing members. Vapor barriers shall be secured by nails or staples. Vapor barrier shall be cut and fit to accommodate piping, conduits, outlet boxes, and other construction penetrating the vapor barrier. Joints at the perimeter of cutouts and tears or ruptures in the vapor-barrier shall be sealed with vapor-barrier tape.

3.6 FLOOR INSULATION SYSTEM

Water-vapor subgrade covers shall be installed over the ground surface under enclosed insulated-floor construction. Ground surface shall be level and free of debris, sharp objects, standing water, and other deleterious substances before the subgrade cover is applied. Subgrade-cover sheets shall be laid over the ground surface with not less than a 6-inch lap at edges and ends; lapped joints shall be sealed with adhesive. Tears, breaks, or ruptures in the subgrade cover which might interfere with effectiveness of the vapor barrier shall be sealed with adhesive and not less than 2-inch wide strips of subgrade cover material. A layer of sand not less than 1 inch thick shall be applied over the subgrade cover.

3.7 WALL AND CEILING INSULATION SYSTEM: METAL STUD

Insulation shall be wired or taped to metal studs as recommended by the metal-stud manufacturer.

3.8 INSPECTION AND ACCEPTANCE PROVISIONS

3.8.1 Finished-Building Insulation Requirements

Building insulation work will be rejected for, but not limited to, any of the following deficiencies:

Thermal insulation material not conforming to the type and nominal thickness indicated for the kind of construction

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

3.8.2 Repair of Defective Work

Defective work shall be removed and replaced, at no expense to the Government, with building insulation materials that meet the requirements of this section.

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SECTION 07220

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03/97

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SECTION 07220

ROOF AND DECK INSULATION
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1013	(1994) Membrane-Faced Rigid Cellular Polyurethane Roof Insulation
ASTM C 1050	(1991) Rigid Cellular Polystyrene - Cellulosic Fiber Composite Roof Insulation
ASTM C 1289	(1995) Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM C 150	(2000) Standard Specification for Portland Cement
ASTM C 208	(1995) Standard Specification for Insulation Boards (Cellulosic Fiber) Structural and Decorative
ASTM C 317	(1993; Rev A) Gypsum Concrete
ASTM C 332	(1987; R 1991) Lightweight Aggregates for Insulating Concrete
ASTM C 552	(2000) Standard Specification for Cellular Glass Thermal Insulation
ASTM C 726	(1993) Mineral Fiber Roof Insulation Board
ASTM C 728	(1991) Standard Specification for Perlite Thermal Insulation Board
ASTM D 1190	(1997) Standard Specification for Concrete Joint Sealer, Hot-Poured Elastic Type
ASTM D 1227	(1987) Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing
ASTM D 1751	(1999) Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

ASTM D 1752	(1984; R 1996) Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1850	(1974; R 1979) Concrete Joint Sealer, Cold-Application Type
ASTM D 2178	(1989) Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D 226	(1994) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 227	(1994) Standard Specification for Coal-Tar-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 2626	(1994) Asphalt-Saturated and Coated Organic Felt Base Sheet Used in Roofing
ASTM D 2822	(1991) Standard Specification for Asphalt Roof Cement
ASTM D 312	(1995) Specification for Asphalt Used in Roofing
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 450	(1991) Coal-Tar Pitch used in Roofing, Dampproofing, and Waterproofing
ASTM E 96	(1995) Standard Test Methods for Water Vapor Transmission of Materials

FEDERAL SPECIFICATIONS (FS)

FS SS-S-200	(Rev E; Am 1) Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold-Applied, for Portland Cement Concrete Pavement

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Thermal Insulation Materials
Sheathing Paper
Vapor Barriers*
Fastening Materials

Bituminous Plastic Cement
Asphalt-Base Emulsion

SD-04 Samples

Contractor shall submit the following samples:

Three of each type of Fastener.

Three pieces, full thickness by 12 inches by the width of roll of Vapor Barrier and Insulation (or underlayment).

After approval, full-sized samples may be used in the construction, provided each sample is clearly identified and its location recorded.

SD-06 Test Reports

Test Reports for water resistance and permeance shall be submitted for Vapor Barriers.

SD-07 Certificates

Certificates of Compliance for the following items shall exactly identify each item by the designation that will appear on the packaging for that item. Certificates shall be submitted for all materials that are identified by a referenced specification.

Fiberboard Rigid Roof Insulation
Fibrous-Glass Roof Insulation
Expanded-Perlite Roof Insulation
Cellular Polyurethane Roof Insulation
Polyisocyanurate Roof Insulation
Expansion Joint Filler Strips
Polyvinylchloride Sheet Vapor Barrier

SD-08 Manufacturer's Instructions

Manufacturer's Instructions for the following items shall indicate fastener and adhesive instructions for each type of installation.

Vapor Barrier
Roof Insulation

1.3 QUALIFICATIONS FOR ROOF AND DECK INSULATION WORK

Work shall be performed by contractor personnel certified by the manufacturer for roof insulation (rigid board or poured) applications and installations.

Insulating concrete contractor shall be certified by the aggregate manufacturer to be approved for application of the materials.

1.4 DELIVERY AND STORAGE OF MATERIALS

Materials shall be delivered to the project site in their original, unopened packages or containers bearing labels identifying the manufacturer's name, brand name, material, and other information.

Materials shall be stored in their original, unbroken packages or containers in a weathertight and dry area and protected from damage until needed for use.

PART 2 PRODUCTS

2.1 THERMAL INSULATION (OR UNDERLAYMENT) MATERIALS

2.1.1 Rigid Board

Polyisocyanurate roof insulation shall conform to ASTM C 1289, with a maximum thermal conductance of R-20.

2.2 SHEATHING PAPER

Sheathing paper shall be unsaturated felt weighing approximately 7-1/2 pounds per 100 square feet.

2.3 VAPOR BARRIER

2.3.1 Polyvinylchloride Sheet

Polyvinylchloride sheet vapor barriers shall be unplasticized virgin polyvinylchloride and shall be not less than 0.004 inch thick, with water vapor permeance of not more than 0.10 on a spot-by-spot basis, not as an average. Permeance shall be measured in accordance with ASTM E 96, Water Method.

2.4 FASTENING MATERIALS

2.4.1 Adhesives

2.4.1.1 Insulation or Underlayment

Adhesive for application of insulation or underlayment to steel decks shall be nonflammable and shall meet the requirements of the Underwriters Laboratories, Inc., for a metal roof-deck construction assembly; the Contractor shall submit proof of such conformance. Label of the Underwriters Laboratories, Inc., will be acceptable evidence. In lieu of the label, the Contractor may submit a written certificate from any approved nationally recognized testing organization adequately equipped and competent to perform such services, stating that the adhesive conforms to the requirements, including methods of testing, of the Underwriters Laboratories, Inc.

2.4.1.2 Polyvinyl-Sheet

Adhesive for application of film polyvinyl-sheet vapor barriers shall be rubber-base water-resistant material with a nontoxic vehicle especially prepared for application of polyvinyl-sheet membrane to roof decks. Holding power of the adhesive shall be not less than 100 psi. Adhesive shall be certified by the manufacturer on the basis of tests by an independent testing laboratory to have a tunnel flame spread of not more than 10 when applied to a noncombustible surface.

2.4.1.3 Felt or Base Sheet

Asphalt primer shall conform to ASTM D 41.

2.5 BITUMINOUS PLASTIC CEMENT

Plastic cement shall conform to ASTM D 2822 Type I for asphalt-saturated felts and Type II for coal-tar-saturated felts.

2.6 ASPHALT-BASE EMULSION

Asphalt-base emulsion shall conform to ASTM D 1227, Type I.

2.7 POLYMER-BASE SOLUTION

When indicated on drawings use a polymer base adhesive as Insta-Stik manufactured by Flexible Products Company or approved equal to atach insulation board to deck.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Roof insulation shall be installed in accordance with approved descriptive data and as specified in Section 07550, "Modified Bitumen Membrane Roofing."

Contractor shall verify that all work that penetrates roof decks or that requires men and equipment to traverse a roof deck has been completed prior to underlayment or roof insulation installation.

Contractor shall examine deck surfaces for inadequate anchorage, foreign material, moisture, and unevenness, any condition which would prevent the execution and quality of application of underlayment or roof insulation system as specified shall be corrected before beginning work. Work shall not proceed with underlayment or insulation application until defects are corrected.

Insulation shall be installed only after building construction has progressed to the point that inclement weather will not damage or wet the insulation material.

Starting work designates acceptance of the surfaces by the Contractor.

Underlayment or insulation material shall be cut and fit as necessary to fully insulate small areas and to accommodate piping, scuttles, skylights, vents, and other construction penetrating the insulation material.

Vapor barriers shall be installed to provide a continuous vapor-barrier seal. Tears, breaks, or ruptures that might interfere with effectiveness of the vapor barrier shall be repaired.

3.2 PREPARATION

3.2.1 Protection of Property

Flame-heated equipment shall be located and used so it will not endanger the structure or other materials on the site or adjacent property. Fire extinguishers of an appropriate approved type shall be provided and maintained by the Contractor.

Flame-heated equipment shall not be placed on the roof of any structure.

Before starting work, paving and faces of building walls adjacent to hoist

and kettles shall be protected and this protection maintained for duration of work.

3.2.2 Preparation of Surfaces

Surfaces on which thermal insulation materials are to be applied shall be clean, smooth, dry, and free from projections which might puncture the vapor barriers. Condition of surfaces shall be inspected and approved by the Government prior to the start of roof insulation work.

3.3 APPLICATION

3.3.1 General Procedures

Underlayment or insulation installation shall be continuous, with all operations proceeding together.

Before cessation of work on each working day or when work is interrupted due to rainfall or other causes, the roof shall be sealed against intrusion of water. Insulation or underlayment shall not be left exposed during rainfall or overnight.

Traffic over partially or completely finished underlayment or insulation shall be only on planks, or on plywood not less than 5/8-inch thick and 2-feet wide.

Materials temporarily stored on the roof shall be distributed to stay within the live-load limits of the roof. Ample bases shall be provided under equipment to distribute the weight to conform to the live-load limits.

3.3.2 Heating Bitumens

Asphalt shall be heated and applied at its respective Equiviscous Temperature (EVT) plus or minus 25 degrees F.

Contractor shall provide thermostatic controls and visible thermometer on the kettle and shall maintain them in working order and keep them calibrated.

Foreman shall carry immersion thermometers accurate within plus or minus 2 degrees F and shall frequently check temperatures. If the temperature of the bitumens in the applicators is below specified amounts, removal and replacement of the effected roofing may be required.

3.3.3 Vapor-Barrier Application

Polyvinylchloride sheet vapor barriers shall be applied as follows:

Vapor barriers shall be applied to the deck by adhesive applied in ribbons at a minimum rate of 0.4 gallon per 100 square feet in accordance with the printed instructions of the manufacturer.

Vapor-barrier installation shall proceed progressively directly ahead of the advancing insulation installation. Work shall be organized to eliminate walking over the vapor barrier; traffic over the installed vapor barrier shall be confined to areas where plywood sheets have been laid to protect the vapor barrier.

Felt-type vapor barriers shall be as follows:

Vapor barrier shall be one layer of base sheet. Lap plies shall be 4 inches at edges and 6 inches at ends. Base sheet and lapped edges and ends shall be embedded in full hot application of steep asphalt.

On concrete: Where asphalt-saturated felts are used over poured-in-place concrete, the first ply shall be channel- or spot-mopped in place over asphalt primer. Where coal-tar-saturated felts are used, the first ply shall be channel- or felt-mopped directly over the concrete deck. Channel mopping shall be done in one direction with approximately 6-inch spacing between strips and with ends left open. Spots in spot-mopping shall be spaced uniformly, without closed pockets between spots.

On decks composed of precast units: Hot bitumen shall be channel-mopped to not less than 3 inches and not more than 4 inches away from joints in the deck. Plies shall be lapped 19 inches and solid-mopped between plies.

3.3.4 Insulation Application

Insulation shall be installed in accordance with the manufacturer's requirements and as specified below. Method of holddown used by the manufacturer in areas subject to hurricane velocity winds shall be subject to approval prior to installation.

Total nominal thickness shall be installed in layers. Care shall be taken not to rupture the vapor barrier during installation of insulation. No more insulation shall be installed at one time than can be protected from wetting or other damage by installation of roofing membranes on the same day or prior to rain or dew.

Layer to receive the roofing membrane shall be installed with longitudinal joints parallel to the short dimension of the roof. Joints shall be staggered in each layer. First layer and between layers shall be solid-mopped. Membrane shall be laid with edges in moderate contact, but not forced into place. End joints shall be staggered.

Vapor-barrier felts shall be laid perpendicular to the roof slope.

Joints of insulation board shall be taped, if required by manufacturers of insulation and roofing.

Temporary water cutoffs shall be installed at the completion of each day's work and removed upon resumption of work.

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SECTION 07400

SIDING PANELS
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ALUMINUM ASSOCIATION (AA)

AA 1	(1993; 11th Ed) Aluminum Standards and Data
AA 2	(1986) Aluminum Standards and Data Metric SI

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S335	(1989) Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-671	(1986; Addendum 1989) Specification for the Design of Cold-Formed Steel Structural Members

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 36/A 36M	(2000; Rev A) Standard Specification for Carbon Structural Steel
ASTM A 366/A 366M	(1996) Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 424	(2000) Standard Specification for Steel Sheet for Porcelain Enameling
ASTM A 446/A 446M	(1993) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
ASTM A 463/A 463M	(1999; Rev A) Standard Specification for Steel Sheet, Cold-Rolled, Aluminum-Coated, Type 1 and Type 2
ASTM A 525	(1993) Standard Specification for General

	Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 525M	(1991; Rev A) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process (Metric)
ASTM A 606	(1998) Standard Specification for Steel, Sheet and Strip, High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A 780	(2001) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM B 209	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 749	(1997) Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products
ASTM C 286	(1983; Rev A) Standard Definitions of Terms Relative to Porcelain Enamel and Ceramic Metal Systems
ASTM C 553	(1999) Standard Specification for Mineral Fiber Blanket and Felt Insulation (Industrial Type)
ASTM C 920	(1998) Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	(2000) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM E 621	(1994; R 1999) Standard Practice for Use of Metric (SI) Units in Building Design and Construction

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1	(1991) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1	(2000) Structural Welding Code - Steel

FEDERAL SPECIFICATIONS (FS)

FS SS-L-30	(Rev D; Int Am 3) Lath and Board Products, Gypsum

MILITARY SPECIFICATIONS (MS)

MS MIL-P-28578	(Rev B) Paint, Water-Borne, Acrylic or Modified Acrylic, Semi-Gloss, for Metal Surfaces

PORCELAIN ENAMEL INSTITUTE (PEI)

PEI S-100	(1965) Architectural Porcelain Enamel on Steel for Exterior Use

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 12	(1982) Paint Specification No. 12 Cold-Applied Asphalt Mastic (Extra Thick Film)

UNDERWRITERS LABORATORIES (UL)

UL-02	(2000) Building Materials Directory

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Properties of Sections

Properties of steel siding sections shall be in accordance with AISI SG-671.

Section properties, including yield point, section modulus, and moment of inertia per foot of width, shall equal or exceed the required values of section properties.

1.2.2 Allowable Design Stress, Deflection, and Loads

Allowable design stress, deflection, and loads for the metal siding shall be as follows:

Deflection of metal siding shall not exceed 1/180 under the indicated total dead and live load.

Resistance to wind pressure loading shall be as indicated on the drawings, but in no case shall it be less than 73 psf for exterior metal siding.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication and Installation Drawings for the following items shall indicate completely dimensioned structural frame and erection layouts, openings in roof and walls, special framing details, construction details at corners, ridges, eaves, building intersections, curbs and flashing, location and type of mastic and metal filler strips, location and erection of subgirts, sandwich walls, and fire-rated walls.

Metal Siding Units
Flashing and Accessories

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Aluminum Materials
Steel Sheet Materials
Subgirts and Formed Shapes
Closure Materials
Paint Materials

SD-04 Samples

Contractor shall submit three pieces each of the following samples:

Metal Siding, 8 by 11 inches

Color Panels, approximately 4 by 4 inches, for color range each type

Fastener

Metal Closure Strips, 10 inches long of each type

Sandwich Wall, 8 by 11 inches

SD-06 Test Reports

Test Reports shall be submitted for the following items:

Coatings and Base Metals of metal siding type of test as specified.

Chemical Composition, Mechanical Usability and Soundness Tests, in accordance with AWS A5.1, for Welding Electrodes.

Leakage Tests

SD-07 Certificates

Certificates of Compliance shall be submitted for the following items showing conformance with referenced standards contained in this section.

Fasteners
Galvanizing Repair Paint
Enamel Repair Paint
Aluminum Steel Repair Paint

1.4 QUALIFICATIONS FOR WELDING WORK

Welding procedures shall be in accordance with AWS D1.1.

Operators shall be permitted to make only those types of weldments for which each is specifically qualified.

1.5 DELIVERY, HANDLING, AND STORAGE

Metal siding shall be carefully handled at all times to prevent damage to the surfaces, edges, and ends. Contractor shall be responsible for arrangement with the manufacturer for adequate packaging and protection during shipment and offsite storage. Upon arrival at the job site, the sheets shall be checked for damage, dampness, and wet storage stain.

Moisture shall be removed from dampened or wetted sheets. Sheets not immediately used in the work shall be stored and protected in a covered, dry location that provides good air circulation free from effects of moisture and other corrosive environments. Sheets found with damage or stain shall not be used in the work.

1.6 FIELD MEASUREMENTS

Field measurements shall be taken prior to preparation of drawings and fabrication. Field measurements for wall panels shall take into consideration roof sag across the face of a given elevation.

PART 2 PRODUCTS

2.1 ALUMINUM MATERIALS

2.1.1 Aluminum Siding Sheets and Panels

Aluminum siding sheets and panels shall be continuous, roll-formed sheets, Alclad 3004-H36 alloy, with a minimum ultimate tensile strength of 34,000 pounds per square inch (psi) and a minimum yield strength of 30,000 psi, and shall conform to ASTM B 209and AA 1.

Finish of sheets shall be low specular gloss finish.

2.1.2 Exterior Sheets

Sheets shall be vertical, ribbed or fluted architectural pattern.

2.1.3 Interior Sheets

Interior sheets shall be vertical, ribbed or fluted architectural pattern aluminum sheets.

2.1.4 Insulated Panel Construction

Insulated panel construction shall be composed of the specified exterior and interior aluminum sheet erected in accordance with manufacturer's printed instructions. Insulation shall be of thickness and density required.

2.1.5 Flashing and Accessories

Field-formed flashing, corners, closers, fillers, and aluminum expansion joints shall be flat aluminum sheet, 0.040 inch thick, same finish and alloy as specified for siding, except that temper may be Alclad 3004-0 annealed temper.

Preformed aluminum sheet flashing for corrugated sheet and plain-ridge rolls shall be 0.032-inch thick Alclad 3004-0, same finish as the specified siding.

2.2 STEEL SHEET MATERIALS

2.2.1 Siding Sheets and Panels

Siding sheets and panels shall be roll formed to the specified profile, thickness and depth as indicated. Material shall be plumb and true, and within the tolerances listed in ASTM A 525.

Flashings, dormers, closers, fillers, metal expansion joints, ridge rolls, and other sheet metal accessories shall be factory-formed material of the same type and quality finish as specified for siding sheets, and shall be not less than 0.0239 inch thick.

Siding material, before coating, shall be not less than 0.0239 inch thick.

2.2.2 Profile of Sheet

Profile shall be vertical, ribbed or fluted architectural pattern.

2.2.3 Side Laps

Side joint laps shall be manufacturer's standard lapped joint for the specified corrugation profile, sealed, and then fastened with sheet metal screws.

2.2.4 Insulated Panel Construction

Panel shall consist of an exterior and interior sheet of profile and coating specified with insulation of thickness indicated. Panels shall be secured in accordance with manufacturer's instructions.

2.2.5 Baked-Enamel-Coated Steel

Sheets shall be enamel-coated, hot-dip galvanized steel conforming to ASTM A 446/A 446M, Grade A. Corrugation dimensions and profile shall be as specified. Sheets shall have a coating in accordance with ASTM A 525, G90.

Pretreated steel shall be given a two-coat, baked-on, thermo-setting acrylic enamel, alkyd melamine, or vinyl-solution finish with a minimum dry-film thickness of 1 mil.

Siding sheets exposed on one side only, shall have finish coat one side and standard wash coat on the reverse side. Siding sheets exposed on two sides shall be finish coated on both sides. Color of sheets shall be as selected from manufacturer's standard colors.

2.3 SUBGIRTS AND FORMED SHAPES

Panel subgirts, T-bars, Z-bars, and angle closers shall be die-formed shapes fabricated from steel conforming to ASTM A 36/A 36M, hot-dip galvanized in accordance with ASTM A 525, G90.

Die-formed subgirts shall have a minimum uncoated thickness of 0.0478 inch (No. 18 U.S. standard gage) and bar shapes shall be at least 1/4 by 1 inch. T-bars shall have a minimum uncoated thickness of 0.0299 inch (No. 22 U.S. standard gage) and Z-bars shall have a minimum uncoated thickness of 0.0747 inch (No. 14 U.S. standard gage).

Concealed clips shall be fabricated from hot-dip-galvanized steel conforming to ASTM A 366/A 366M, coating designation ASTM A 525, G90.

2.3.1 Galvanized Steel Angles

Galvanized steel angles shall be hot-rolled carbon steel conforming to ASTM A 36/A 36M, and hot-dip galvanized in accordance with ASTM A 123.

2.3.2 Electrodes for Manual, Shielded Metal Arc Welding

Electrodes for manual, shielded metal arc welding shall meet the requirements of AWS D1.1, and shall be covered, mild-steel electrodes conforming to AWS A5.1.

2.4 FASTENERS

Exposed fasteners for securing sheets to structural steel framing or to subgirts shall be No. 14 self-tapping, Type B, recessed hexagon-head, Type 305 corrosion-resistant steel screws with cadmium-plate finish; length as required for the application. Fastener assembly shall include a corrosion-resistant steel washer and a neoprene washer, or an integral corrosion-resistant steel and neoprene washer. Exposed head of fastener shall match color of siding sheets by means of plastic caps or factory-coated heads.

Exposed fasteners for securing overlap-type side laps of corrugated profile steel materials, and for securing accessory steel flashing, shall be No. 14 by 3/4-inch long Type B recessed hexagon-head, Type 305 corrosion-resistant, chromium-nickel-steel screws with corrosion-resistant steel and neoprene washers. Screw head caps shall match color of sheets.

Exposed fasteners for securing sidelaps of aluminum sheets and for securing aluminum flashing to siding sheets, shall be No. 12 by 3/4-inch long, slotted pan-head Type A aluminum, sheet metal screws with aluminum and neoprene washers.

2.5 CLOSURE MATERIALS

2.5.1 Mastic Closure Strips

Mastic closure strips shall be closed-cell, expanded cellular rubber conforming to ASTM D 1056, Type S, Class SCE-41 CMP. Closure strips shall be cut or premolded to the exact configuration of the specified siding material.

Closure strips shall be uniform in appearance, free of weak sections, bubbles, cracks, and defects.

2.5.2 Adhesives for Closure Strips

Adhesive for use with closure strips shall be the type recommended and furnished by the closure strip manufacturer.

2.5.3 Metal Closure Strips

Metal closure strips shall be factory fabricated accessories matching the type, thickness, and corrugation profile of the specified siding. Aluminum closure strips shall be mill-finish aluminum, Alclad 3004-H36, not less than 0.032 inch thick. Steel closure strips shall be the same thickness and

finish as the exterior siding panels.

2.5.4 Joint Sealants

2.5.4.1 Sealants

Sealants shall be an approved gunnable type for use in hand- or air-pressure calking guns at temperatures above 40 degrees F (or frost-free application at temperatures above 10 degrees F). They shall be used around doors, windows, masonry, and other construction material. Solids content shall be a minimum of 85 percent of the total volume. Sealant shall dry with a tough, durable surface skin which permits it to remain soft and pliable underneath, providing a weathertight joint. No migratory staining shall be permitted on painted or unpainted metal, stone, glass, vinyl, or wood.

Joints shall be primed with a compatible one-component or two-component primer as recommended by the sealant manufacturer.

2.5.4.2 Shop Applied

Sealant for shop-applied calking shall be an approved gun grade, nonsag one-component polysulfide or silicone conforming to ASTM C 920, Type II, and with a curing time to ensure the sealant's plasticity at the time of field erection.

2.5.4.3 Field Applied

Sealant for field-applied calking shall be an approved gun grade, nonsag one-component polysulfide or two-component polyurethane with an initial maximum Shore A durometer hardness of 25, and shall conform to ASTM C 920, Type II. Color shall match panel colors.

2.6 INSULATION

Insulation shall be glass-fiber insulation board as specified in Section 07210, "Building Insulation".

2.7 FIRE-RATED WALLS

2.7.1 Fire-Rating

Fire-retardant partition shall be a UL design of the rating indicated, constructed in accordance with the indicated details and the siding manufacturer's instructions.

2.8 FABRICATION OF METAL PANELS

Manufacturer's standard product fabrication and details shall be provided. Flat and curved panels shall be provided as required.

System components shall be factory fabricated ready for field installation.

2.9 REPAIR OF FINISH-PROTECTED MATERIALS

2.9.1 Enamel Repair Paint

Repair paint for color finish enameled siding shall be compatible paint of the same formula and color as the specified finish furnished by the siding

manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

Siding shall be erected in accordance with the approved erection drawings, the printed instructions and safety precautions of the manufacturer.

Sheets shall not be subjected to overloading, abuse, or undue impact. Bent, chipped, or defective sheets shall not be applied.

Sheets shall be erected true and plumb and in exact alignment with the horizontal and vertical edges of the building, securely anchored, and with the indicated rake, eave, and curb overhang.

Work shall be installed to allow for thermal movement of the siding, movement of the building structure, and to provide permanent freedom from noise due to wind pressure.

Exterior panels of insulated walls shall be installed to provide ventilation of the space between the exterior panel and the insulation.

Weld burns and abrasions due to assembly shall be touched up with the proper finish repair material.

Uncovered edge of the top sheet at sidelaps shall turn in for siding and doors.

Siding sheets shall be installed with corrugations vertical.

Separate aluminum from contacting dissimilar metals, except zinc and cadmium coatings, with heavy-bodied bituminous coating or resilient gasket.

End laps of exterior siding sheets shall be not less than 6 inches; the side laps of external siding sheets shall be not less than two full corrugations for standard corrugated sheets and not less than one and one-half corrugations for V-beam and ribbed corrugated sheets.

3.2 ALIGNMENT OF STRUCTURAL FRAME

Erected structural-steel frame shall be inspected for plumb and true surfaces. Misalignment of framing and erection not in accordance with AISC S335 shall be corrected before commencing installation of siding.

3.3 WELDING

Procedures for manual, shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work shall be in accordance with AWS D1.1.

3.4 FASTENING SYSTEM

Fastening system shall consist of concealed clips and fasteners installed in accordance with the manufacturer's printed instructions.

3.4.1 Single Sheet, Uninsulated Metal Siding

Siding shall be attached with fasteners of a length to penetrate the

support member and extend at least 1/4 inch on the inside of the member.

Interlocking side laps shall be fastened by die-clinching at approximately 24 inches on center.

3.4.2 Sandwich Wall Construction

Temporary self-tapping screws for interior sandwich wall panels shall be spaced in sufficient number to securely hold the sheet until the insulation and exterior sheets are installed.

End laps of interior siding sheets shall be not less than 4 inches. Side laps shall be in accordance with the manufacturer's written instructions for the type and profile of the specified sheet.

Interlocking side joints shall be factory calked. Overlap joints shall be sealed with a continuous bead of the specified joint sealant.

Subgirts shall be installed at indicated spacing but not more than 48 inches on center and secured to the interlocking edge of the interior sheets with self-tapping screw fasteners, fillet welding, or clips, spaced at not more than 12 inches on center.

Insulation shall be placed between subgirts and interior sheets in accordance with manufacturer's printed instructions, butting each board tightly together, and immobilized by impaling spikes or bolts.

Exterior sheets shall be fastened to subgirts with concealed clips and fasteners spaced in accordance with the manufacturer's printed instructions for siding installed in a hurricane velocity wind area.

3.4.3 Metal and Insulation-Faced Construction

Metal and insulation-faced construction shall consist of the specified exterior metal siding and rigid insulation board. Insulation shall be installed at right angles to the structural supports and screw-fastened through metal, insulation, and into the support. Fastener spacing shall be as noted.

Metal and insulation-faced construction shall consist of the specified exterior metal siding and rigid insulation board, installed on T-bars and in accordance with the manufacturer's instructions.

3.5 DISSIMILAR METALS

Dissimilar metals, except corrosion-resistant steel and zinc, shall be insulated from each other by painting, or other approved system, as recommended by the roofing and siding manufacturer.

Aluminum shall be insulated from other metals by painting the other metal with one coat of bituminous paint conforming to SSPC Paint 12cold-applied asphalt mastic to a thickness of at least 1/16 inch.

Aluminum surface shall be backpainted where it is impractical to paint the other material.

Aluminum surfaces in contact with lime mortar, concrete, or other masonry materials shall be backpainted with a 1/16-inchthick coat of No. 12 asphalt mastic.

3.6 JOINT SEALANTS

Joints shall be made weathertight. End joints of metal siding, flashing at corners and openings in walls shall be sealed with the specified joint sealant.

Sealing beads shall be continuous, not less than 1/2 inch in diameter, and applied to ensure a weathertight joint.

3.7 FLASHING AND CLOSURE INSTALLATION

3.7.1 Metal Flashing

Concealed metal flashing shall be installed at heads and sills of openings as indicated, and formed to the proper profile and thickness.

Exposed metal flashing shall be installed at building corners, jambs and sills, junctions between metal siding and roofing, and building expansion joints. Flashing shall be of thickness and profile shown.

Exposed metal flashing shall be the same material, color, and finish as the specified metal siding.

Flashing shall be fastened at not more than 12 inches on center for walls, except where flashings are held in place by the same screws that secure covering sheets.

Flashing shall be furnished in at least 8-foot lengths. Exposed flashing shall have 1-inch locked and blind-soldered end joints, and expansion joints at intervals of not more than 16 feet.

Expansion joints shall be formed to the profile indicated with end joints flat-seamed, locked, and soldered, and with free-sliding, sleeve type slip joints at 16-foot intervals, designed to allow expansion and contraction and remain weathertight.
Exposed flashing and flashing subject to rain penetration shall be bedded in the specified joint sealant.

Flashing in contact with dissimilar metal shall be insulated by means of the specified asphalt mastic material to prevent electrolytic deterioration.

3.7.2 Closures

Mastic closure strips shall be installed at intersection of ridge roll with metal roofing; top and bottom of metal siding; heads of wall openings; and in other required locations.

3.8 ACCEPTANCE PROVISIONS

3.8.1 Erection Tolerances

Metal siding shall be erected straight and true with plumb vertical lines correctly lapped and secured in accordance with the manufacturer's written instructions. Horizontal lines shall not vary more than 1/8 inch in 40 feet.

3.8.2 Leakage Tests

Finished application of metal siding shall be subject to inspection and test for leakage by the Contracting Officer.

Inspection and testing will be made promptly after erection to permit correction of defects and the removal and replacement of defective materials.

3.8.3 Repairs to Finish

Scratches, abrasions, and minor surface defects of finish may be repaired with the specified repair materials. Finished repaired surfaces shall be uniform and free from variations of color and surface texture.

Repaired metal surfaces that are not acceptable to the Contracting Officer shall be immediately removed and replaced with new material.

3.8.4 Paint-Finish Metal Siding

Paint-finish metal siding will be tested for color stability by the Contracting Officer during the manufacturer's specified guarantee period. Tests will be performed by means of groups of 2-inch metal disks, fastened in exposed areas on all elevations of the building.

Panels that indicate color changes, fading, or surface degradation, determined by visual examination of the test areas after removal of the disks, shall be removed and replaced with new panels at no expense to the Government.

New panels will be subject to the specified tests for an additional year from the date of their installation.

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SECTION 07550

MODIFIED BITUMINOUS MEMBRANE ROOFING
01/97

PART 1 GENERAL

1.1 SUMMARY (Not Applicable)

1.2 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 518	(1991) Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 728	(1991) Standard Specification for Perlite Thermal Insulation Board
ASTM D 2170	(1992) Kinematic Viscosity of Asphalts (Bitumens)
ASTM D 2178	(1989) Specification for Asphalt Glass Felt Used in Roofing and Waterproofing
ASTM D 226	(1994) Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 2824	(1985) Specification for Aluminum Asphalt Roof Coatings
ASTM D 312	(1995) Specification for Asphalt Used in Roofing
ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 4402	(1987; R 1995) Viscosity Determinations of Unfilled Asphalts Using the Brookfield Thermosel Apparatus
ASTM D 4586	(1993) Standard Specification for Asphalt Roof Cement, Asbestos Free
ASTM D 4601	(1991) Specification for Asphalt Coated Glass Fiber Base Sheet Used in Roofing
ASTM D 4897	(1989) Specification for Asphalt-Coated Glass Fiber Venting Base Sheet Used in

	Roofing
ASTM E 108	(1991; Rev. A) Fire Tests of Roof Coverings

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM-01	(1993) Approval Guide and Loss Prevention Data Sheets 1-28 and 29
FM P7825	(2001) Approval Guide
FM A/S4470	(1993) Class I Roof Covers

UNDERWRITERS LABORATORIES (UL)

UL-01	(1997) Roofing Materials and Systems Directory
UL-790	(1997) Fire Resistance of Roof Covering Materials
UL-01	(1997) Roofing Materials and Systems Directory
UL RMSD	(1997) Roofing Materials and Systems Directory

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specifications:

SD-03 Product Data

Manufacturer's Catalog Data
Modified bitumen sheet
Asphalt
Felts
Primer
Asphalt roof cement
Fasteners
Coating

SD-07 Certificates

Qualification of Manufacturer
Qualification of Applicator
Bill of Lading

Certify that the manufacturer of the modified bitumen membrane meets requirements specified under paragraph entitled "Qualification of Manufacturer." Show evidence that products used within this specification are manufactured in the United States. Certify that the applicator meets requirements specified under paragraph entitled "Qualification of Applicator." Submit bill of lading when labels of asphalt containers do not bear the flash point (FP), finished blowing temperature (FBT), and equiviscous

temperature (EVT).

SD-08 Manufacturer's Instructions

Modified bitumen sheet
Asphalt
Felts
Primer
Asphalt roof cement
Fasteners
Coating

Include detailed application instructions and standard drawings altered as required by these specifications. Explicitly identify in writing, differences between manufacturer's instructions and the specified requirements.

SD-10 Operation and Maintenance Data

Written Instructions to Government Personnel

Submit instructions meeting the requirements of paragraph entitled "Instructions to Government Personnel" and include copies of Material Safety Data Sheets for maintenance/repair materials.

1.4 QUALITY ASSURANCE

1.4.1 Qualification of Manufacturer

Modified bitumen sheet roofing system manufacturer shall have a minimum of 5 years experience in manufacturing modified bitumen roofing products in the United States. Show evidence that specified products and materials are manufactured in the United States.

1.4.2 Qualification of Applicator

Roofing system applicator shall be approved in writing by the modified bitumen sheet roofing system manufacturer and shall have a minimum of three years experience as an approved applicator with that manufacturer. The applicator shall supply the names and locations of 5 projects of similar size and scope that he has constructed within the previous three years.

1.4.3 Fire Safety

Complete roof covering assembly shall:

a. Have ASTM E 108 Class 1A or UL-790, Class A classification; and

b. Be listed as part of Fire-Classified roof deck construction in UL RMSD, or Class I roof deck construction in FM P7825.

UL approved components of the roof covering assembly shall bear the UL label.

1.4.4 Wind Uplift

Complete roof covering assembly shall be rated Class I-90 in accordance with FM P7825 capable of withstanding an uplift pressure of 90 pounds per

per square foot.

1.4.5 Preroofing Conference

After approval of submittals and before performing roofing and insulation work, including associated work, the Contracting Officer will hold a preroofing conference to review the following:

a. Drawings and specifications;

b. Procedure for onsite inspection and acceptance of the roofing substrate and pertinent structural details relating to the roofing system;

c. 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

d. Safety requirements.

Preroofing conference shall be attended by the Contractor and personnel directly responsible for the installation of roofing and insulation, flashing and sheet metal work, mechanical and electrical work, and representative of the roofing materials manufacturer. Before beginning roofing work, confirm in writing the resolution of conflicts among those attending the preroofing conference.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

Deliver materials in manufacturers' original unopened containers and rolls with labels intact and legible. Mark and remove wet materials from the site. Where materials are covered by a referenced specification, the container shall bear the specification number, type, and class, as applicable. Labels or bill of lading for roofing asphalt shall indicate asphalt type, FP, FBT, and EVT, that is, the temperature at which the viscosity is either 125 centistokes when tested in accordance with ASTM D 2170 or 75 centipoise when tested in accordance with ASTM D 4402. Deliver materials in sufficient quantity to allow work to proceed without interruption.

1.5.2 Storage

Protect materials against moisture absorption. Store roll materials on end on clean raised platforms or pallets one level high in dry locations with adequate ventilation, such as an enclosed building or closed trailer. Do not store roll materials in buildings under construction until concrete, mortar, and plaster work is finished and dry. Maintain roll materials at temperatures above 50 degrees F for 24 hours immediately before application. Do not store materials outdoors unless approved by the Contracting Officer. 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. Do not store more materials on roof than can be installed the same day and remove unused materials at end of each days work. Distribute materials temporarily stored on roof to stay within live load limits of the roof construction.

1.5.3 Handling

Select and operate material handling equipment so as not to damage applied roofing. Prevent damage to edges and ends of roll materials.

1.6 PROJECT CONDITIONS

Proceed with roofing work only when existing and forecasted weather conditions will permit unit of work to be installed in accordance with manufacturer's recommendations and warranty requirements.

When adverse job or weather conditions prevent permanent roofing system from being installed in accordance with requirements, install temporary roofing. Do not apply roofing membrane to damp or frozen deck surfaces.

When the existing facility is occupied and will remain occupied during the roof work. Take necessary precautions to prevent damage to the building interior and undue hardship to the occupants. Contractor shall be responsible for the prevention of water, dirt, debris, dust or any other material from entering the building.

Maintain roof in a watertight condition throughout the Contract period. Make all work watertight at the end of each work day and prior to exposure to inclement weather. If water leaks into the building, immediately repair leak and repair damage to the building and building contents caused by the leak.

1.7 SEQUENCING AND SCHEDULING

Sequence installation of modified bituminous sheet roofing with related work to ensure that roof assemblies, including roof insulation, accessories, flashing, trim, and joint sealers are protected against damage from effects of weather, corrosion, and adjacent construction activity.

Coordinate roofing installation so that insulation and roofing plies are not exposed overnight. Provide temporary cut offs at the end of each day's work to cover exposed ply sheets and insulation.

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 flashing and counter flashing are installed as the work progresses.

1.8 WARRANTY

Furnish the modified bitumen sheet roofing system manufacturer's premium warranty for the roofing system, including insulation, flashing, and accessories. The warranty shall run directly to the Government. In no event shall the warranty period be less than 10 years from the date of the Government's acceptance of the work, notwithstanding roofing applicator's or manufacturer's unpaid invoices for installation, supplies, or service. The warranty shall state that:

a. When within the warranty period the roofing system becomes nonwatertight, splits, tears, or separates at the seams because of defective materials and workmanship, the repair or replacement of defective materials and correction of defective workmanship shall be the responsibility of the manufacturer;

b. When the manufacturer or the manufacturer's approved applicator fail to perform repairs within 72 hours of notification, emergency repairs performed by others will not void the warranty; and

c. Damage to the roofing system caused by sustained winds having a velocity of 55 miles per hour or less is covered by the warranty.

PART 2 PRODUCTS

2.1 DESCRIPTION OF ROOFING SYSTEM

2.1.1 SBS Modified Bitumen Sheet on Nailable Substrate

Substrate: Metal Deck

Components:	Quantity:
Insulation	See subpara. "a" below
Type III or IV Asphalt	See subpara. "b" below
Base Sheet (GB)	1 ply
Mechanical Fasteners	1 per 2 square feet
Type III or IV Asphalt	25 lbs/100 square feet
SBS Modified Base Sheet (MB)	1 ply
Type III or IV Asphalt	25 lbs/100 square feet
SBS Modified Bitumen Cap Sheet (RSS)	1 ply

a. Roof insulation shall conform to the requirements specified in Section 07220, "Roof and Deck Insulation."

b. Quantity of asphalt shall be in accordance with modified bitumen sheet manufacturer's requirements.

2.2 MATERIALS

2.2.1 Asphalt

ASTM D 312, Type III or IV.

2.2.2 Modified Bitumen Sheet, Felts

Designation	Use	Felt	Impregnant	Coating	Specification
GB	Base Sheet	Glass	Asphalt	Asphalt	ASTM D 4601, Type II, without perforations
MB	SBS Modified Base Sheet	Fiber-glass and/or Poly-ester	SBS Modified Bitumen	SBS Modified Bitumen	See subpara. "a" below
RSS	SBS Bitumen Cap	Fiber-glass	SBS Modified	SBS Bitumen/	See subpara. "b" below

Designation	Use	Felt	Impregnant	Coating	Specification
	Sheet Roofing	and/or Poly-ester	Bitumen	Granules	

a. Modified bitumen base sheet shall be a prefabricated styrene butadiene styrene (SBS) modified bitumen sheet, 75 mil thick minimum, weighing 50 pounds per 100 square feet minimum, with a layer of fiberglass and/or polyester sheet reinforcement, and fire rated.

b. Modified bitumen shall be a prefabricated styrene butadiene styrene(SBS) modified bitumen sheet, 112.5 mil thick minimum, weighing 100 pounds per 100 square feet minimum, with a layer of fiberglass and/or polyester sheet reinforcement, and fire rated.

2.2.3 Top Surfacing

Protect modified bitumen roofing system from direct exposure to the weather with one of the following surfacings as recommended by the modified bitumen roofing system manufacturer.

2.2.3.1 Mineral Roofing Granules

Factory applied, requiring no further coating.

2.2.4 Primer

ASTM D 41.

2.2.5 Asphalt Roof Cement

ASTM D 4586, Type II for vertical surfaces, Type I for horizontal surfaces.

2.2.6 Fasteners

Provide noncorrosive fasteners as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM A/S4470. For felts, provide fasteners driven through metal discs, or one-piece composite fasteners with heads not less than one inch in diameter or one inch square with rounded or 5-degree tapered corners.

2.2.6.1 Masonry Walls and Vertical Surfaces

Provide hardened steel nails with flat heads, diamond shaped points, and mechanically deformed shanks not less than one inch long for securing felts, modified bitumen sheets, and metal Items to masonry walls and vertical surfaces. Use power-driven fasteners only when approved in writing.

2.2.7 Metal Discs (Tin Caps)

Flat noncorrosive fasteners as recommended by the modified bitumen sheet manufacturer's printed instructions and meeting the requirements of FM A/S4470; not less than 3 inches in diameter, when using screw type fasteners. Discs shall be formed to prevent dishing or cupping.

2.2.8 Walkway Protection Boards

Mineral surfaced bituminous composition boards, approximately 1/2 inch thick, manufactured specifically for application on modified bituminous sheet roofing as a protection course for foot traffic. Provide where indicated in manufacturer's standard sizes, with minimum walkway width of 36 inches.

2.2.9 Roof Insulation Below Modified Bitumen Membrane System

Insulation shall be compatible with the membrane as recommended in modified bitumen manufacturer's printed instructions and as specified in Section 07220, "Roof and Deck Insulation".

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

Ensure that the following conditions exist prior to application of the roofing materials:

a. Drains, curbs, cants, control joints, expansion joints, perimeter walls, roof penetrating components, and equipment supports are in place.

b. Surfaces are rigid, dry, smooth, and free from cracks, holes, and sharp changes in elevation. Joints in the substrate are sealed to prevent dripping of bitumen into building or down exterior walls.

c. The plane of the substrate does not vary more than 1/4 inch within an area 10 feet by 10 feet when checked with a 10-foot straight edge placed anywhere on the substrate.

d. Substrate is sloped as indicated to provide positive drainage.

e. Walls and vertical surfaces are constructed to receive counter flashing, and will permit nailing of the base flashing materials.

f. Treated wood nailers are fastened in place at eaves, gable ends, openings, and intersections with vertical surfaces for securing of felts, edging strips, gravel stops, and roof fixtures. Surface-applied nailers are the same thickness as the roof insulation.

g. Cants are securely fastened in place in the angles formed by walls and other vertical surfaces. The angle of the cant is 45 degrees and the height of the vertical leg is not less than nominal 4 inches. Cants are constructed of wood fiberboard roof insulation.

h. Insulation boards are installed smoothly and evenly, and are not broken, cracked, or curled. Insulation is being roofed over on the same day the insulation is installed.

3.2 PREPARATION

3.2.1 Protection of Property

3.2.1.1 Protective Coverings

Install protective coverings at paving and building walls adjacent to hoist and kettles prior to starting the work. Lap protective coverings not less than six inches, 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 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.

3.2.1.3 Electric-Heated Equipment

Provide adequate electrical service as required by manufacturer of electrical equipment to ensure against damage to equipment and property and to ensure proper application of roofing materials.

3.2.2 Priming of Surfaces

Prime surfaces at the rate of 0.75 gallon per 100 square feet or as recommended by modified bitumen sheet manufacturer's printed instructions and allow to dry.

3.2.2.1 Priming of Masonry Surfaces

After surface dryness requirements have been met, coat concrete and masonry surfaces which are to receive base sheet and roofing materials uniformly with asphalt primer. Allow primer to dry prior to application of base sheet, roofing, and flashing.

3.2.2.2 Priming of Metal Surfaces

Prime flanges of metal edging strips, prior to stripping into roofing system in accordance with modified bitumen manufacturer's printed instructions and allow to dry.

3.2.3 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. Kettles shall have visible thermometer and thermostatic controls set to the temperature limits specified herein. 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 maximums specified, remove asphalt from the site. Do no permit cutting back, adulterating, or fluxing of asphalt.

3.3 APPLICATION

Apply roofing materials as specified herein unless specified or recommended otherwise by manufacturer's printed application instructions. Keep roofing materials dry before and during application. Do not permit phased

construction. 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 temperatures for asphalt. Provide temporary roofing and flashing as specified herein prior to application of permanent roofing system.

3.3.1 Temporary Roofing and Flashing

Provide temporary roofing and flashing where considerable work by other trades, such as installing antennas, pipes, ducts, is to be performed on the roof or where construction scheduling or weather conditions require protection of the building's 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.

3.3.1.1 Temporary Roofing Membrane

Install 2 plies of ply felt in accordance with the application procedures specified; except spot mop the first ply on cast-in-place concrete decks by brooming felts into 12-inch-diameter spots of asphalt spaced 18 inches on centers.

3.3.1.2 Temporary Flashing

Install temporary flashing consisting of one ply of ply felt. Place ply felt in a trowel coat of asphalt roof cement and cover with a trowel coat of asphalt roof cement.

3.3.1.3 Removal

Completely remove temporary roofing and flashing before continuing with application of the permanent roofing system.

3.3.2 Bitumen Stops

Provide bitumen stops at roof edges, openings, and vertical projections before hot mopped application of the roofing membrane (base sheet and modified bitumen). Do not provide sheet metal bitumen stops. Form bitumen stops of two 18-inch wide strips of organic felt conforming to ASTM D 226. ply felts. Attach nine inches of the width to the roof surface and extend 9 inches beyond the edge. Apply first strip in a 9-inch wide layer of asphalt roof cement and, where nailers are provided, nail on 6-inch spacing 1/2 inch from the edge. Apply second strip in a 9-inch wide mopping of asphalt. Protect the free portion of each strip from damage throughout the roofing period. After the roofing plies are in place, fold the free portion of each strip over the roofing membrane and embed in a continuous coating of asphalt roof cement and secure with fasteners 3 inches on centers.

3.3.3 Base Sheet

Apply base sheets in shingle fashion. On nailable substrates, mechanically fasten base sheet in conformance with FM requirements and membrane manufacturer's printed instructions. 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 in accordance with the materials manufacturer's printed instructions. Provide end laps of not less than 6 inches and staggered a minimum of 36 inches900 millimeters.

Apply sheets atright angles to the roof slope so that the direction of water flow is over and not against the laps. Extend sheets approximately 2 inches above the
top of cant strips at vertical surfaces and to the top of cant strips elsewhere. Trim felt to a neat fit around vent pipes, roof drains, and other projections through the roof.

3.3.4 Hot-Mopping of Base Sheets

Provide hot asphalt for embedding of base sheets, including modified bitumen base sheet, to the insulation. Apply base sheets immediately following application of hot asphalt. Do not work ahead with asphalt. Asphalt shall be completely fluid, with mop temperatures within the specified EVT range, at the instant base sheets come into contact with asphalt. Application of bitumen between plies shall be such as to provide void-free coverage and complete penetration of asphalt into the sheet above and below. Embed sheets in asphalt. As sheets are being rolled into hot asphalt, immediately and thoroughly squeegee, roll, or broom down to eliminate trapped air and to provide tight, smooth laminations without wrinkles, buckles, kinks, and fish mouths. Completed system shall be free of air pockets and blisters.

3.3.4.1 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 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 base 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.

3.3.5 Modified Bitumen Sheets

Sheets shall be watertight and visually free of pinholes, particles of foreign matter, undispersed raw material, or other manufacturing defects that might affect serviceability. Edges of seams shall be straight and flat so that they may be seamed to one another without forming fish mouths or wrinkles.

3.3.5.1 SBS Modified Bitumen Sheets

Solid mop top surface of base sheet with hot asphalt at the rate of 25 pounds per 100 square feet and embed one layer of roofing membrane into hotasphalt. Roll modified bitumen roofing membrane into place with a flow of hot asphalt out of side and end laps. Side laps shall be 4 inches and end laps shall be 6 inches. Stagger end laps a minimum of 36 inches. Back mop end laps. Apply roofing in a continuous application. Start installation at the low point of the roof and progress to the high point.

3.3.6 Flashing

Apply modified bitumen sheet flashing in the angles formed where the roof deck abuts walls, curbs, ventilators, pipes, and other vertical surfaces, in accordance with membrane manufacturer's printed application instructions

and where necessary to make the work watertight. Metal flashing collars and cap flashings are specified under Section 07600, "Flashing and Sheet Metal." Do not set metal flashing in hot asphalt.

3.3.6.1 Flashing at Roof Drain

Roof drains are specified under Section 15410, "Plumbing Fixtures." Flashing for roof drains, are specified under Section 07600, "Flashing and Sheet Metal." Extend base sheet and modified bitumen sheets to edge of drain opening at the roof drain deck flange in accordance with membrane manufacturer's printed application instructions. Securely clamp base sheet, modified bitumen sheet, and metal roof drain flashing in the flashing clamping ring. Secure clamps so that sheets and metal flashing are free from wrinkles and folds.

3.3.7 Clean Up

Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.

3.3.8 Protection of Applied Roofing Against Moisture Absorption

At the end of the day's work and when precipitation is imminent, protect applied modified bitumen roofing system as follows.

3.3.8.1 Water Cutoffs

Straighten insulation line using loose-laid cut insulation sheets and seal the terminated edge of modified bitumen roofing system with two full width strips of roofing felt set in and coated with asphalt roof cement. One-half width of the strips shall extend up and over the finished roofing and the other half-width extended out onto the bare deck unless recommended otherwise in membrane manufacturer's printed application instructions. Seal off flutes in metal decking along the cutoff edge. Pull membrane free or cut to expose the insulation when resuming work, and remove the insulation sheets used for fill-in.

3.3.8.2 Temporary Flashing for Permanent Roofing

Provide temporary flashing at drains curbs, walls and other penetrations and terminations of roofing felts until roofing membrane application is complete, and permanent flashings are applied. Temporary flashings shall consist of one ply of ply felt applied in a trowel coat of asphalt roof cement applied to a primed surface, and finished with a surface coat of asphalt roof cement. Remove temporary flashing before applying permanent flashing.

3.3.8.3 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 or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to indicated live load limits of roof construction. Use rubber-tired equipment for roofing work.

3.4 FIELD QUALITY CONTROL

Perform field tests in the presence of the Contracting Officer. Notify

the Contracting Officer one day before performing tests.

3.4.1 Test for Surface Dryness

Before application of base sheets 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 felts are to be applied, one pint of asphalt when heated in the range of 350 to 400 degrees F, shall not foam upon contact.

b. Strippability: 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.

3.4.2 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 24 hours. To ensure some drainage from roof, do not test all drains at same time. Measure water at beginning and end of the 24-hour 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. Repeat test until there is no water leakage.

3.4.3 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 modified bitumen 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.

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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07600

FLASHING AND SHEETMETAL

03/98

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SECTION 07600

FLASHING AND SHEETMETAL
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 526/A 526M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM B 209	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 224	(1992) Standard Classification of Coppers
ASTM B 32	(1996) Standard Specification for Solder Metal
ASTM B 370	(1998) Standard Specifications for Copper Sheet and Strip for Building Construction
ASTM B 749	(1997) Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products
ASTM C 920	(1998) Standard Specification for Elastomeric Joint Sealants
ASTM D 4586	(1993) Standard Specification for Asphalt Roof Cement, Asbestos Free

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA-02	(1993) Architectural Sheet Metal Manual
SMACNA-02A	(1980; 5th Ed) Architectural Sheet Metal Specifications

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Installation Drawings shall include material, description, and thickness,and indicate location, dimensions, configuration, construction details, type of seams and fastening method for the following items:

Flashing
Sheet Metal
Accessories

SD-07 Certificates

Certificates of Compliance for the following items shall be submitted showing conformance with referenced standards contained in this section.

Aluminum Sheetmetal
Copper Sheetmetal
Fasteners
Solder Materials
Cements
Sealing Compounds

PART 2 PRODUCTS

2.1 SHEETMETAL MATERIALS

2.1.1 Aluminum

Sheet and strip aluminum shall be Alclad 3003, 3004, or 3005 conforming to, embossed finish, clad one side and specified temper. Minimum tensile strength shall be 23,000 psi.

2.1.2 Copper

Copper shall be standard electrolytic tough-pitch copper, Type ETP or fire-refined tough-pitch copper, Type FRTP as classified in ASTM B 224 and conforming to ASTM B 370, light cold-rolled temper.

2.1.3 Minimum Dimensions and Thicknesses

Materials shall be in accordance with SMACNA-02 and shall be not less than the following minimum thicknesses and weights.

ITEM	COPPER, OUNCES PER SQ FT	ALUMINUM, THICKNESS INCH
Building expansion joints, cap	16	0.032
Bellows or flanges, U-type	16	---
Flashings		
Base	20	0.032
Cap, roof penetration cap flashing, equipment and structural supports, pitch pans	16	0.03
Through-wall, above roof line, including coping and parapet	16	---
Cleats, 2 inches by 3 inches	16	0.032
Edge strips, 1-1/4 inches wide	24	0.050
Reglets	10	---
Cap flashing receivers	16	---
Gravel stop fascias:		
Corrugated sheets	16	0.032
Smooth sheets to 3-1/2 inches	16	0.032
Smooth sheets over 3-1/2 inches	20	0.050
Gutters and downspouts:		
Gutter sections, end caps	16	0.032
Continuous cleats, cover plates	16	0.032
Downspouts, con-	16	0.024

ITEM	COPPER, OUNCES PER SQ FT	ALUMINUM, THICKNESS INCH
ductor heads		
Scupper linings	20	0.032
Strainer wire gage/diameter	No. 9	0.144 dia.
Downspout hangers, 2 inch	1/8 inch	0.125
Gutter hangers, 1 inch wide	1/8 inch	0.125
Splash pans	16	0.040

2.2 CEMENTS AND SEALING COMPOUNDS

2.2.1 Bituminous Plastic Cement

Bituminous plastic cement shall be an asphaltic-base material conforming to ASTM D 4586, compatible with the roofing asphalts and asphalt primer.

2.2.2 Sealing Compound

Sealing compound shall be gun grade, one- or two-component, nonsag, elastomeric, conforming to ASTM C 920. Base material shall be polysulfide, resistant to 50-percent joint movement.

Aluminum-seam sealant shall be as recommended by the aluminum manufacturer.

2.3 SOLDER MATERIALS

Solder and flux shall meet the requirements of ASTM B 32. Solder shall be SN50.

2.4 FASTENERS

Fasteners shall be the same metal or a metal compatible with the material joined.

2.5 MISCELLANEOUS COMPONENTS

Metal splash pans conforming to SMACNA-02, Figure 1-36, Alternate Section 2, shall be provided. Material shall be the same for downspouts.

PART 3 EXECUTION

3.1 GENERAL

Sheetmetal work shall conform to drawing details and to the applicable plate number and design and installation recommendations of SMACNA-02. Finished sheetmetal installation shall be free from water leakage.

Surfaces to receive sheetmetal work shall be clean, smooth, dry, and free from defects and projections which might affect the work. Surfaces shall be plumb and true to a tolerance of not more than 1/2 inch in 40 feet, with no dips, waves, or uneven surfaces exceeding 1/8 inch in 10 feet in any direction. Lines, arises, and angles shall be sharp and uniform. Exposed edges of sheetmetal shall be folded back to form a 1/2-inch wide hem on the concealed side.

3.1.1 Fastening Methods

Fasteners shall be concealed. Only one edge shall be nailed to permit freedom of expansion perpendicular to the line of nailing. Nails shall be spaced at not more than 3 inches on center. Nails shall penetrate backing by not less than 1 inch.

Cleats shall be used for securing edges of sheetmetal members over 12-inches wide and at other designated locations. Cleats shall be fastened with two nails and the end folded over the nails. Other end of the cleat shall be locked into the seam or the folded edge of member being fastened. Cleats shall be spaced at not more than 12 inches on center.

Screws shall be fitted with neoprene washers to protect surface of metal sheet and provide a watertight connection.

3.1.2 Seams

Seams and lock joint construction shall conform to SMACNA-02, Figure 3-2 and 3-3.

Seams shall be straight and uniform in height, width, and finish as follows:

Flat-lock seams shall be not less than 3/4-inch wide.

Lap seams, when soldered, shall finish not less than 1-inch wide.

Lap seams, not soldered, shall overlap not less than 3 inches.

Joints, seams, and connections of copper shall be soldered except where other methods of joining are indicated.

Joints, seams, and connections of aluminum shall be welded except where a screw or riveted and hard-setting sealant connection is indicated.

Loose-lock expansion seams shall be not less than 3-inches wide and shall provide for not less than a 1-inch movement within the joint. Joint shall be completely filled with the specified sealant applied at not less than 1/8-inch bed thickness.

Flat seams shall be made in the direction of flow. Seams not soldered shall be completely filled with plastic cement.

Surfaces to be joined by soldering shall be cleaned, pretinned, heated, fluxed, and sweat-soldered through the full contact area in accordance with the best standards of practice in modern sheet metal shops. Flux residue and foreign matter shall be removed after soldering. Soldered surfaces shall be rinsed with water and wiped clean.

Procedures for manual shielded metal-arc welding, the appearance and quality of welds made, and the methods used in correcting welding work

shall conform to AWS D1.1.

3.1.3 Provisions for Expansion and Contraction

Expansion-joint configuration shall conform to the drawing details and to SMACNA-02, Figures 5-4 through 5-7.

Expansion joints in concrete walls shall conform to SMACNA-02, Figure 5-7B Detail 4.. Each member shall not exceed 10 feet in length and shall run continuously from the top of the footing to the top of the wall.

Floor slab expansion joints shall conform to SMACNA-02, Figure 5-8A. Joints shall be lapped 3/4 inch and soldered prior to installation in the concrete floor slab.

3.1.4 Dissimilar Metals

Dissimilar metals shall be isolated from each other by painting with bituminous paint.

3.2 FLASHING

3.2.1 Reglets and Flashing Receivers

Reglets and flashing receivers shall conform to SMACNA-02, Figure 4-3C. Masonry joints or concrete shall be cut to form a saw-cut reglet. Slots shall be cut to a depth not less than 1-1/2 inches and approximately 3/16-inch thick.

3.2.2 Base Flashing

Metal base flashing shall be installed where the roof abuts vertical surfaces, in valleys, at ridges, and where the roof slope changes. Configuration shall conform to SMACNA-02, Figure 4-7B.

Flashing shall extend not less than 8 inches up vertical surfaces.

3.2.3 Cap and Counter Flashing

Metal cap or counter flashing shall be installed 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 shall conform to SMACNA-02, Figure 3-6A or 3-8A.

Flashing shall be formed in 10-foot lengths, except where shorter pieces are required; end joints shall be lapped not less than 3 inches Joints shall not be soldered.

3.2.4 Edge Strips

Edge trim strips shall have a formed drip edge.

3.2.5 Flashing at Roof Penetrations and Equipment Supports

Metal flashing conforming to SMACNA-02, Figure 4-15D, shall be installed where piping, conduit, or equipment supports penetrate roof surfaces.

Single-pipe vents shall be flashed with a two-piece formed-metal housing of

the specified sheetmetal, installed as indicated in SMACNA-02, Figure 4-14B.

3.3 GRAVEL-STOP FASCIAS

Gravel-stop fascias shall be installed at exposed edges of built-up roofs. Configuration shall conform to SMACNA-02, Figure 2-1B. Lower edge of each gravel-stop fascia section shall be secured in place by hooking over a continuous edge strip or cleat. Flanges of each section shall extend out on the top of roofing felts not less than 3-1/2 inches.

A 1/4-inch open joint shall be provided between each gravel-stop fascia section, with a 12-inch wide plate centered on the joint. System shall be installed in accordance with SMACNA-02, Figure 2-5C.

3.4 MISCELLANEOUS DRAINAGE ITEMS

3.4.1 Scupper Lining

Linings shall be projected beyond walls or fascias and terminated in conductor heads, spouts, or overflow openings. Surfaces to receive linings shall be coated with bituminous cement.

3.5 CLEANING

Exposed sheetmetal work shall be cleaned of all surface contaminants and imperfections at completion of installation.

-- End of Section --

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SECTION 07710

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02/96

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SECTION 07710

MANUFACTURED ROOF SPECIALTIES
02/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 525	(1993) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 526	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM B 209M	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221	(1995; Rev A) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM B 32	(1996) Standard Specification for Solder Metal
ASTM B 370	(1998) Standard Specifications for Copper Sheet and Strip for Building Construction
ASTM C 920	(1998) Standard Specification for Elastomeric Joint Sealants
ASTM D 2822	(1991) Standard Specification for Asphalt Roof Cement

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA-02	(1993) Architectural Sheet Metal Manual

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the

specification:

SD-02 Shop Drawings

Submit Installation Drawings indicating location, dimensions, configuration, construction details, type of seams and fastening method for the following items:

Manufactured roof specialties
Accessories

SD-03 Product Data

Submit Manufacturer's Catalog Data on shape of components, materials, and finishes, installation instructions, and data substantiating that materials and performance comply with requirements.

Manufactured roof specialties
Accessories

SD-04 Samples

Submit two samples, in 8 inch long sections, which indicate and two copies of Manufacturer's Color Selection Sample finishes showing full range of colors and textures available for items with factory-applied color.

1.3 QUALITY ASSURANCE

Perform work in accordance with application requirements of SMACNA-02 "Architectural Sheet Metal Manual", unless indicated otherwise.

1.4 COORDINATION

Coordinate work of this section with adjoining work for proper sequencing of each installation to ensure best possible weather resistance and protection of materials and finishes against damage.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum Extrusions

Manufacturer's recommended alloy and temper for intended use and as required for indicated application, but not less than the strength and durability properties indicated for 6063-T5 in ASTM B 221.

2.1.2 Aluminum Sheet

Manufacturer's recommended alloy and temper for intended use and as required for indicated application, but not less than the strength and durability properties indicated for 3003-H14 in ASTM B 209M.

2.1.3 Galvanized Steel

Commercial quality zinc-coated steel, complying with ASTM A 526, hot-dipped galvanized in accordance with ASTM A 525 G90, mill phosphatized.

2.1.4 Stainless Steel

Corrosion-resistant steel conforming to ASTM A 167, Type 302/304, No. 2D annealed finish, soft temper unless harder temper is required for forming or performance.

2.1.5 Copper

Rolled copper sheets or strips conforming to ASTM B 370, Temper Designation H00 (cold-rolled) except where Temper Designation 060 (soft) is required for forming.

2.2 COMPONENTS

2.2.1 Counterflashing System

Provide manufacturer's standard two-piece cap flashing system, consisting of surface-mounted reglet with sealant flange or masonry reglet section or concrete reglet section, as indicated, and cap flashing insert section, formed in sizes indicated, and designed to provide a tight fit against roof base flashing.

Material and Thickness: Aluminum, 0.050 inches.

2.2.2 Gravel Stops/Fascia Systems

Provide manufacturer's standard extruded aluminum gravel stop and fascia system, formed in shapes and sizes indicated, with shop-welded mitered corners and concealed splice plates of matching color and finish, in manufacturer's standard lengths. Provide continuous edge cleats of same material of equal or greater thickness than the fascia metal.

Minimum Thickness: Aluminum, 0.050 inches.

2.2.3 Copings

Provide manufacturer's standard aluminum sheet coping system, formed in shapes and sizes indicated, with shop-welded mitered corners and concealed splice plates of matching color and finish, in manufacturer's standard lengths. Provide continuous edge cleats of same material of equal or greater thickness than coping material.

Material and Thickness: Aluminum, 0.050 inches.

2.2.4 Roof Expansion Joint Covers

Provide manufacturer's standard metal-flanged elastic expansion joint cover system, fabricated specifically for required roof-to-roof and roof-to-wall applications. Units shall consist of exposed elastic sheet over foam bellows, securely anchored at both edges to minimum 3-inch metal nailing flanges, plain or angle-formed to fit curbs. Bellows shall be insulated from below with adhesively-applied flexible plastic or rubber insulation not less than 5/16 inchesthick. Provide prefabricated corner units, joint intersection units, splicing units, adhesives, coatings, and other components as recommended by manufacturer for a complete installation.

Elastic Sheet: Neoprene or EPDM, 60 mil.

Metal Flanges: Aluminum, minimum 0.032 inch thickness.

2.2.5 Roof Drain Flashing

Provide sheet lead flashing, minimum 4 lbs/sq ft (0.0625 inches) thick.

2.2.6 Gutters and Downspouts

Aluminum sheet, minimum 0.032 inch thickness; shop pre-coated with baked-on acrylic finish in color as selected. Form gutters to SMACNA rectangular or semi-circular style profile to match existing. form downspouts to SMACNA rectangular or round profile to match existing.

2.3 ACCESSORIES

2.3.1 Cement

Provide asphalt roof cement, complying with ASTM D 2822, and compatible with roofing products.

2.3.2 Sealant

Provide single component polyurethane sealant, non-staining, non-skinning, non-shrinking, and non-sagging, ultra-violet and ozone resistant, complying with ASTM C 920, Type S, Grade NS, Class 25, color as selected.

2.3.3 Solder

For use with steel or copper, provide 50-50 tin/lead solder, complying with ASTM B 32, with rosin flux.

For use with stainless steel, provide 60-40 tin/lead solder, complying with ASTM B 32, with acid-chloride type flux, except use rosin flux over tinned surfaces.

2.3.4 Fasteners

Provide fasteners of same material and finish as flashing material, or other non-corrosive metal, as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.

2.3.5 Bituminous Coating

Provide solvent type bituminous mastic, free of sulfur, compounded for 15-mil dry film thickness per coat.

2.3.6 Gutter and Downspout Anchorage Devices

Type of anchorage devices as recommended by fabricator and conforming to SMACNA requirements.

2.3.7 Pipe Seals

Provide pre-formed caps or covers, designed to fit around and over pitch pockets or other roof penetrations. Caps or covers shall be metal, molded EPDM or neoprene rubber, weather resistant, and mechanically fastened to pipe with a stainless steel clamping collar.

2.4 FABRICATED UNITS

Form sections true to shape, accurate in size, square, and free from distortion or defects. Hem exposed edges on underside 1/2 inch; miter and seam corners. Form pieces in longest possible lengths. Form work to fit substrates. Comply with material manufacturer's instructions for forming material. Shop-fabricate work when possible. Fabricate for waterproof and weather-resistance performance, with provisions for expansion.

2.5 FINISHES

Finish shall be manufacturer's standard mill finish, unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

Verify that roof substrate, curbs, roofing membrane, base flashings and other items affecting the work of this section are in place and positioned correctly. Note any damaged areas and equipment on SD-18, Record of Existing Conditions. See section 01730, "Demolition and Existing Conditions to Remain".

3.2 INSTALLATION

Securely anchor components in accordance with manufacturer's installation instructions and in conformance with standards of SMACNA-02. Coordinate installation of components with installation of insulation, roof membrane, and base flashings. Coordinate installation of sealants and roofing cement with work of this section to ensure water tightness.

Where metal surfaces of components are installed in contact with dissimilar metals or corrosive substrates, apply bituminous coating on concealed metal surfaces.

3.3 CLEANING

Clean exposed metal surfaces of components in accordance with manufacturer's instructions. Touch up damaged metal coatings.

-- End of Section --

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SECTION 07840

FIRESTOPPING AND SMOKESTOPPING

06/98

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SECTION 07840

FIRESTOPPING AND SMOKESTOPPING
06/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 119	(2008; Rev A) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 814	(2008; Rev B) Fire Tests of Through-Penetration Fire Stops
ASTM E 84	(2009) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 101	(2000) Safety to Life from Fire in Buildings and Structures

UNDERWRITERS LABORATORIES (UL)

UL 1479	(2003; Rev thru Dec 2008) Fire Tests of Through-Penetration Firestops
UL 723	(2008) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
UL-FRD	(2009) Fire Resistance Directory

1.2 PERFORMANCE REQUIREMENTS

Provide firestop and smokestop systems which consist of a material or a combination of materials to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire rated walls, partitions, floors, and ceiling-floor assemblies.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330 "Submittals", in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Submit detailed drawings, indicating materials, installation methods, and relationships to adjoining construction for each system, and each kind of construction condition penetrated and kind of penetrating item. Include design documentation with illustrations as listed in UL-FRD or other nationally recognized testing agency showing compliance with requirements for each condition indicated. For non-standard applications, provide qualified engineering judgements and drawings from manufacturer or manufacturer's representative.

SD-03 Product Data

Submit Manufacturer's Catalog Data, including detailed specifications, technical data, installation instructions, and fire-test data for each type of application for the following items:

Firestop systems
Smokestop systems

SD-07 Certificates

Submit certificates signed by manufacturers of firestopping or smokestopping products attesting that systems comply with the specified requirements.

Submit manufacturer's certification stating that each installer is qualified and trained to install the specified firestop systems.

1.4 QUALITY ASSURANCE

Installer's qualifications: Firm experienced in installation and application of firestop and smokestop systems similar in complexity to those required for the project, and certified by manufacturer as qualified and trained to install the specified system material.

1.5 DELIVERY, STORAGE AND HANDLING

Deliver materials in the original unopened packages or containers showing product and manufacturer identification. Store materials in a clean, dry, and ventilated location. Protect from soiling, abuse, moisture and freezing. Follow manufacturer's instructions for handling. Remove damaged or deteriorated materials from the site.

PART 2 PRODUCTS

2.1 FIRESTOPPING AND SMOKESTOPPING MATERIALS

Provide materials which are compatible with each other and with the substrates forming openings. Materials shall be non-combustible and nontoxic during installation and during fire conditions.

Provide systems or devices listed in UL-FRD, or other nationally recognized testing authority, which conform to construction type, penetration type, annular space requirements, and fire rating required at each separate penetration and construction joint or gap.

Provide materials with a flame spread value of 25 or less, and a smoke

developed value of 50 or less, when tested in accordance with ASTM E 84 or UL 723.

Provide asbestos-free firestopping material capable of maintaining an effective barrier against flame, gases, and temperature. Provide noncombustible firestopping that is nontoxic to humans during installation or during fire conditions. Devices and equipment for firestopping service shall be UL FRD listed for use with appplicable construction, and penetrating items including openings with penetrants subject to movement without reduction or loss of functionality. Materials and system designs shall not require ampacity derating in power cable installations.

Contractor shall provide re-usable heat expanding pillows or bags to seal cable tray penetrations through rated floors or walls. Installation of pillow bags shall be in strict compliance with manufacturer's instructions.

2.1.1 Through-Penetration Firestopping

Provide systems for through-penetrations of fire-rated construction with required F and T Ratings in accordance with ASTM E 814 or UL 1479, except that T Ratings are not required for penetrations smaller than or equal to a 4-inchnominal pipe or 16 square inches in overall cross sectional area. Provide F and T Ratings as follows:

Penetrations of Fire Resistance Rated Walls and Partitions: F and T Ratings shall not be less than the required fire resistance rating of the assembly being penetrated.

Penetrations of Floors and Ceiling-Floor Assemblies: F and T Ratings shall not be less than 2 hours for any floor or ceiling-floor assembly. For fire resistance rated floors or ceiling-floor assemblies, F and T Ratings also shall not be less than the required fire resistance rating of the assembly being penetrated.

For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

2.1.2 Construction Joints and Gaps

Provide systems with required fire resistance ratings at construction joints and gaps. Fire resistance ratings of systems shall be not less than the fire rating of the construction in which they occur.

Construction gaps occur between floor slabs or roof decks and curtain walls, between tops of partitions and underside of structural systems, and between tops of partitions and underside of ceiling or ceiling assemblies.

Construction joints consist of control joints in fire-rated masonry partitions, and building expansion joints.

2.1.3 Fire-Resistive Joint Sealants

Provide joint sealants with fire-resistance ratings, as determined by ASTM E 119, not less than that equaling or exceeding the fire-resistance rating of the construction in which the joint occurs.

2.2 ACCESSORIES

Provide components for each system as required to install fill materials and to comply with system performance requirements. Use only components specified by the materials manufacturer and listed by UL-FRD, or other nationally recognized testing agency, for the designated firestop or smokestop systems. Accessories shall include but not be limited to permanent and temporary forming materials, damming and backing materials, substrate primers, collars, and steel sleeves.

PART 3 EXECUTION

3.1 PREPARATION

Clean surfaces to be in contact with penetration seal materials of dirt, grease, oil, loose materials, rust, or other substances that may affect proper fitting, adhesion, or required fire resistance of firestopping or smokestopping materials. Prepare surfaces in accordance with manufacturer's installation instructions.

3.2 INSTALLATION

Install forming and damming materials and other accessories of types required to support fill materials during application and in position required to support shapes and depths of fill materials to achieve fire ratings designated.

Install fill materials for firestop systems in accordance with manufacturer's installation instructions and UL-FRD. Completely fill voids and cavities formed by openings, forming materials, accessories, and penetrating items. Apply materials to adhere to substrates formed by openings and penetrating items. For fill materials which will remain exposed to view, finish to provide smooth and uniform surfaces which are flush with adjoining finishes.

Install smokestop materials in accordance with manufacturer instructions and NFPA 101. Install smokestop from an outside wall to an outside wall from a floor to a floor, from a smoke barrier to a smoke barrier, or a combination thereof; this includes continuity through all concealed spaces, completly fill voids and cavities formed by openings, forming materials, accessories, and penetrating items. Seal completly all openings where the smoke barrier abuts other smoke barriers, fire barriers, exterior walls, the floor bellow, and the floor or ceiling above. For fill materials wich will remain exposed to view, finish to provide smooth and uniform surfaces wich are flush with adjoining finishes.

Provide cased openings for penetration of cable trays. Size opening 152mm larger than cable tray, all around.

Provide firestopping where indicated and in the following locations:

Penetrations of duct, piping, tubing, cable trays, electrical conduit and cable through floors and through indicated fire-resistance rated walls, partitions, and ceiling-floor assemblies.

Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.

Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.

Gaps at perimeter of indicated fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.

Construction joints in floors and in indicated fire rated walls and partitions.

Other locations where required to maintain indicated fire resistance rating of the construction.

Firestopping or smokestpping 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 or smokestopped area.

Firestopping or smokestopping of electrical cables and conduits shall also comply with NFPA 70 and NFPA 101.

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. Thermal insulation shall be replaced with a material having equal thermal insulating and firestopping characteristics.

3.3 FIELD QUALITY CONTROL

Examine penetration seal areas to ensure proper installation before concealing or enclosing area. Keep firestopped or smokestopped areas of work accessible until inspected and approved by the Contracting Officer.

Where deficiencies are found, repair or replace firestopping or smokestopping to comply with requirements.

3.4 CLEANING

Clean off excess fill materials and sealants on adjacent areas as work progresses.

3.5 PROTECTION

Protect system during and after curing period from contact with contaminating substances and from damage resulting from other work. Immediately remove damaged or deteriorated material and install new material which complies with specified requirements.

-- End of Section --

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DIVISION 07 - THERMAL AND MOISTURE PROTECTION

SECTION 07920

JOINT SEALANTS

08/98

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SECTION 07920

JOINT SEALANTS
08/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1193	(1991) Guide for Use of Joint Sealants
ASTM C 834	(1991) Standard Specification for Latex Sealing Compounds
ASTM C 920	(1998) Standard Specification for Elastomeric Joint Sealants

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Submit Manufacturer's Catalog Data, including installation instructions, for the following items:

Joint sealants
Joint backing
Miscellaneous materials

SD-04 Samples

Submit the following product samples:

Submit three Manufacturer's Standard Color Charts illustrating full range of colors available for Joint sealants.

Three cured color bead samples of each color and type of Joint sealants to be used in the work, approximately 1/4-inch wide by 6-inch long.

Three samples of Joint backing material to be used in the work, full size by 12-inches long.

SD-07 Certificates

Submit Certificates of Compliance from joint sealant manufacturers certifying that products comply with specifications.

1.3 QUALITY ASSURANCE

1.3.1 Applicator Qualifications

Sealant applicator shall be a company specializing in applying the work of this section with minimum three years documented experience.

1.3.2 Mock-Up

Prior to installation of joint sealants, apply a 6 foot section of elastomeric sealant with backup material in an exterior joint to verify selections made under submittals and to demonstrate aesthetic effects and qualities of materials and workmanship. Do not proceed with joint sealant installation until mock-up is approved by the Contracting Officer. Accepted mock-up may remain as part of the Work.

1.4 DELIVERY, HANDLING, AND STORAGE

Deliver materials in unopened containers that identify product, manufacturer, color, directions for use, shelf life, curing time, and mixing instructions for multicomponent materials. Store and protect materials from deterioration or damage due to moisture, high temperatures, and freezing.

1.5 PROJECT CONDITIONS

Do not proceed with installation of joint sealants when ambient and substrate temperatures are below 40 degrees, or below temperature limit permitted by joint sealant manufacturer.

PART 2 PRODUCTS

2.1 JOINT SEALANTS

Provide joint sealants, fillers, and related materials which are compatible with one another and with joint substrates.

Provide sealant colors selected by the Government from manufacturer's full range of standard colors for sealant types specified, and provide custom sealant colors to match samples provided by the Government when scheduled.

2.1.1 Elastomeric Joint Sealant

For joints in vertical surfaces, provide non-sag urethane or low modulus silicone joint sealant, conforming to ASTM C 920, Type S or M, Grade NS, Class 25, Use NT, M, A, and O.

For joints in horizontal and floor surfaces, provide pourable urethane or low modulus silicone joint sealant, conforming to ASTM C 920, Type S or M, Grade P, Class 25, Use T, M, A, and O.

2.1.2 Latex Joint Sealant

For joints in vertical surfaces, provide acrylic emulsion or silicone emulsion latex joint sealant, single component, nonsag type, mildew-resistant, paintable, complying with ASTM C 834, with an elongation capability of 2 to 5 percent.

2.1.3 Mildew-Resistant Sealant

For interior joints requiring resistance to mildew and fungus, provide single component acid-curing mildew-resistant silicone sealant, conforming to ASTM C 920, Type S, Grade NS, Class 25, Use NT, formulated with fungicide.

2.2 JOINT BACKING

Provide joint backings of material and type which are compatible with joint substrates, sealants, and primers, and approved for applications indicated by sealant manufacturer.

2.2.1 Plastic Foam Joint Backing

Provide open-cell polyurethane foam or closed-cell polyethylene foam that is non-absorbant to liquid and gas and non-outgassing in unruptured state. Other types of joint backing may be used if approved by the Contracting Officer. Joint backing shall consist of strips of flexible plastic foam which are preformed, compressible, resilient, non-staining, non-waxing, and non-extruding, and of size and density to control depth of sealant.

2.2.2 Bond-Breaker Tape

Provide polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid and inflexible joint filler materials, or from adhering to surfaces at back of joint where adhesion would result in sealant failure.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Primer

Provide primer where required for proper adhesion of sealant to joint substrates. Primer shall be non-staining and type recommended by sealant manufacturer to suit application.

2.3.2 Cleaners

Provide chemical cleaning agents for non-porous surfaces where required to promote optimum adhesion of sealant to joint substrates. Cleaners shall be non-staining and acceptable to joint sealant and backing manufacturers.

2.3.3 Masking Tape

Provide non-staining and non-absorbent tape material which is compatible with joint sealants and adjacent surfaces to joints.

PART 3 EXECUTION

3.1 EXAMINATION

Examine joints to receive sealant materials for compliance with requirements for joint size and configuration, installation tolerances, and conditions which may affect joint sealant performance. Do not proceed with joint sealant installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

Clean out joints prior to installing joint sealants. Remove foreign material from joint substrates which could interfere with sealant adhesion, including dirt, old sealants, and waterproofing. Clean concrete, masonry, unglazed surfaces of ceramic tile, and similar joint substrate surfaces by brushing, grinding, or blast cleaning to produce a clean substrate capable of providing optimum bond with joint sealants.

Prime joint substrates to comply with joint sealant manufacturer's recommendations and in accordance with manufacturer's installation instructions. Confine primers to areas of joint sealant bond, and protect adjacent exposed surfaces.

Apply masking tape as required to prevent contact of sealant or cleaning materials with adjoining surfaces. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

Install backup material to provide support of sealants during application and as required to produce optimum shapes and depths of sealants relative to joint widths. Do not leave gaps between ends of joints fillers. Do not stretch, twist, puncture or tear joint fillers. Replace joint fillers that have become wet prior to sealant application with dry material. Backup material shall be minimum 33 percent oversized for closed cell material and 50 percent oversized for open cell material, unless indicated otherwise.

Install bond breaker tape between sealants and joint fillers when backer rods are not used, and at back surface of joints to avoid three-sided adhesion.

Install joint sealants in accordance with manufacturer's installation instructions and in compliance with recommendations of ASTM C 1193. Provide uniform cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Completely fill recesses provided for each joint and install sealants at the same time sealant backing is installed.

Immediately after sealant application, tool sealants to form smooth and uniform sealant beads without air pockets. Ensure contact and adhesion of sealant with sides of joint. Provide concave joint configuration in accordance with Figure 5 of ASTM C 1193.

3.4 CLEANING

Clean off excess sealant and sealant smears on materials adjacent to joints as work progresses. Clean with methods and materials approved by manufacturers of joint sealants and of adjacent materials.

3.5 PROTECTION

Protect joint sealants during and after curing period from damage and from contaminating substances. If joint sealants are damaged or deteriorated, cut out and remove damaged or deteriorated joint sealants, and install new sealants to match original work exactly.

3.6 SCHEDULE

Location	Type	Color
Window, door and louver perimeters in exterior walls	Elastomeric	As selected
Masonry expansion and control joints in exterior walls	Elastomeric	Match mortar
Exterior metal joints	Elastomeric	Match metal
Voids where items pass through exterior walls	Elastomeric	As selected
Interior window and door frame perimeters	Latex	As selected
Interior wall and partition joints	Latex	As selected
Plumbing fixture perimeters	Mildew-Resistant Silicone	White
Ceramic Wall Tile	Mildew-Resistant Silicone	Match grout
Control and expansion joints in floors, slabs, tile, and walkways	Elastomeric	As selected
Under exterior door thresholds	Elastomeric	Gray

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DIVISION 08 - DOORS AND WINDOWS

SECTION 08100

METAL DOORS AND FRAMES

11/94

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SECTION 08100

METAL DOORS AND FRAMES
11/94

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A115	Specifications for Steel Door and Frame Preparation for Hardware.
ANSI A224.1	(1990) Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames
ANSI/SDI-100	(1991) Recommended Specifications for Standard Steel Doors and Frames

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 525	(1993) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 525M	(1991; Rev A) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process (Metric)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1992) Fire Doors and Windows

STEEL DOOR INSTITUTE (SDOI)

SDOI SDI-105	(1992) Recommended Erection Instructions for Steel Frames
SDOI SDI-111-C	Recommended Louver Details for Standard Steel Doors
SDOI SDI-113	(1979) Test Procedure and Acceptance Criteria for Apparent Thermal Performance of Steel Door and Frame Assemblies
SDOI SDI-117	(1988) Manufacturing Tolerances for Standard Steel Doors and Frames

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330,

"Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Submit Fabrication drawings and Installation drawings for steel doors and frames. Include details of each frame type, elevations of each door design type, details of construction, location and installation requirements of hardware and reinforcements, and details of opening connections.

SD-03 Product Data

Submit Manufacturer's Catalog Data for each type of door and frame specified, including data on door construction, materials, reference compliance, hardware preparation, core, fire rating compliance, sound ratings, profiles, and finishes.

SD-07 Certificates

Submit manufacturer's Door Label Certification indicating that each door and frame assembly required to be fire-rated has been constructed to conform to design, materials and construction required for labeled construction.

1.3 QUALITY ASSURANCE

Provide doors and frames complying with ANSI/SDI-100 and as specified.

Provide fire-rated door assemblies complying with NFPA 80 and identical to door and frame assemblies listed and labeled by UL, Factory Mutual, Warnock Hersey, or other testing and inspecting organization acceptable to the Contracting Officer.

1.4 DELIVERY, HANDLING, AND STORAGE

Protect doors, frames, and accessories from damage during handling, transportation, and at the job site.

PART 2 PRODUCTS

2.1 METAL DOORS

2.1.1 Exterior Doors

Exterior metal doors shall comply with ANSI/SDI-100, Grade II Heavy Duty, seamless construction, with minimum 18 gagecold-rolled hot-dip galvanized steel sheet faces conforming to coating designation.

Provide exterior metal doors with insulating core, complying with SDOI SDI-113, and providing a minimum R-value of 7.7.

2.1.2 Interior Doors

Interior metal door shall comply with ANSI/SDI-100, Grade II Heavy Duty, full flush construction, with minimum 18 gagecold rolled steel sheet faces.

Provide interior metal doors with Kraft honeycomb core.

2.2 METAL FRAMES

2.2.1 Exterior Frames

Exterior frames shall be 16-gage cold rolled hot-dipped galvanized steel conforming to coating designation, full welded-unit type.

2.2.2 Interior Frames

Interior frames shall be 16-gage cold rolled steel, full welded-unit or knocked down, field assembled type, as indicated. Drill stops to receive 3 silencers on strike jamb of single interior door frames and two silencers on heads of double interior door frames.

2.3 FABRICATION

Fabricate steel door and frame units in compliance with ANSI/SDI-100 requirements. When possible, fit and assemble units at manufacturer's plant.

Prepare doors and frames to receive hardware in accordance with the Door Hardware Schedule and templates provided by the hardware supplier. Comply with applicable requirements of ANSI A115 Series Specifications for door and frame preparation for hardware.

Comply with ANSI/SDI-100 for hardware locations, except when template dimensions and multiple item installations require an alternative locations.

Reinforce doors and frames to receive surface-applied hardware, including closers and exit devices when applicable, in accordance with ANSI/SDI-100.

Provide non-removable glazing stops on outside of exterior doors and on secure side of interior doors. Provide screw applied removable beads on inside of glass in doors. Glazing stops shall be minimum 20 gage thick steel or aluminum.

Fabricate doors and frames with tolerances in compliance with SDOI SDI-117.

2.4 LOUVERS

Provide inserted sightproof louvers for interior doors in compliance with SDOI SDI-111-C where indicated. Louvers shall be constructed of inverted V-shaped blades formed of minimum 24 gage cold-rolled steel and set into minimum 20 gage steel frame.

2.5 SHOP PRIMING

Clean metal surfaces of mill scale, rust, oil, grease, dirt, and other foreign materials, and phosphatize metal surfaces. Apply one shop coat of baked-on rust-inhibiting prime paint, complying with ANSI A224.1.

PART 3 EXECUTION

3.1 INSTALLATION

Install steel doors and frames in accordance with Drawings, manufacturer's installation instructions, and SDOI SDI-105. Install fire-rated doors and frames in accordance with NFPA 80.

In new construction, place frames prior to installing the enclosing walls. Set frames in position, plumb, aligned, and temporarily braced until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders with frames undamaged.

Provide at least three wall anchors on each jamb, located adjacent to hinge locations on hinge side and at corresponding heights on strike side jamb. Acceptable anchors for masonry construction shall include masonry wire anchors and masonry T-anchors.

Fit metal doors accurately in frames within clearances specified in ANSI/SDI-100.

Immediately after erection, sand smooth rusted or damaged areas of prime paint and apply touch-up primer.

3.2 ERECTION TOLERANCES

Install doors and frames within the following tolerances:

Deviation in location from that indicated on the drawings:

Plus or minus 1/4 inch.

Deviation from plumb or horizontal:

Not more than 1/16 inch. in 8 feet

3.3 ADJUSTING

Before final acceptance, check and readjust finish hardware items to ensure complete and proper operation, and smooth door movement.

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DIVISION 08 - DOORS AND WINDOWS

SECTION 08120

ALUMINUM DOORS AND FRAMES

03/98

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SECTION 08120

ALUMINUM DOORS AND FRAMES
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ALUMINUM ASSOCIATION (AA)

AA 45	(1980) Designation System for Aluminum Finishes
AA SAS-30	(1986) Specifications for Aluminum Structures Construction Manual Series Section 1

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S328	(1986) Specification for Structural Steel Buildings Load and Resistance Factor Design

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-671	(1986; Addendum 1989) Specification for the Design of Cold-Formed Steel Structural Members

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.22	(1981) Plain Washers
ASME B18.22M	(1981; Rev 1990) Metric Plain Washers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2001) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 27/A 27M	(1995; R 2000) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 283/A 283M	(1993; Rev A) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 307	(2000) Standard Specification for Carbon

	Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 36/A 36M	(2000; Rev A) Standard Specification for Carbon Structural Steel
ASTM A 47	(1990) Standard Specification for Ferritic Malleable Iron Castings
ASTM A 47M	(1990) Standard Specification for Ferritic Malleable Iron Castings (Metric)
ASTM A 501	(2001) Standard Specification for Hot-Formed Welded and Seamless Carbon-Steel Structural Tubing
ASTM A 563	(2000) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2000) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A 570/A 570M	(1996) Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM B 136	(1984; R 1993) Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum
ASTM B 137	(1989) Standard Test Method for Measurement of Mass of Coating on Anodically Coated Aluminum
ASTM B 209	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 211	(1995) Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire
ASTM B 211M	(1995) Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire (Metric)
ASTM B 221	(1995; Rev A) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM B 221M	(1996) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes (Metric)
ASTM B 244	(1979; R 1993) Standard Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic

	Basis Metals with Eddy-Current Instruments
ASTM B 316/B 316M	(1995) Standard Specification for Aluminum and Aluminum-Alloy Rivet and Cold Heading Wire and Rods
ASTM C 509	(1994) Standard Specification for Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM D 1730	(1967; R 1993) Standard Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting
ASTM F 568	(1995) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS A5.1	(1991) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1	(2000) Structural Welding Code - Steel

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1	(2000) Butts and Hinges
BHMA A156.16	(1989) Auxiliary Hardware
BHMA A156.18	(2000) Materials and Finishes
BHMA A156.21	(1989) Thresholds
BHMA A156.4	(2000) Door Controls - Closers
BHMA A156.5	(1992) Auxiliary Locks and Associated Products
BHMA A156.6	(2001) Architectural Door Trim

COUNCIL OF AMERICAN BUILDING OFFICIALS (CABO)

CABO A117.1	(1992) American National Standards for Buildings and Facilities Providing Accessibility and Usability for Physically Handicapped People

FEDERAL SPECIFICATIONS (FS)

FS FF-B-588	(Rev D) Bolt, Toggle; and Expansion Sleeve, Screw
FS FF-S-325	(Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices,

	Anchoring, Masonry)
FS FF-W-84	(Rev A; Am 3) Washers, Lock (Spring)
FS TT-C-490	(Rev C; Am 2) Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings
FS TT-C-494	(Rev B; Notice 1) Coating Compound, Bituminous, Solvent Type, Acid Resistant

UNDERWRITERS LABORATORIES (UL)

UL-02	(2000) Building Materials Directory

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Allowable Design Stresses

Aluminum-alloy framing member allowable design stresses shall be in accordance with AA SAS-30 for the specified aluminum alloy.

Hot-rolled structural steel member allowable design stresses and design rules shall be in accordance with AISC S328 for the specified structural steel.

Cold-formed light-gage steel structural member allowable design stresses and design rules shall be in accordance with AISI SG-671, for the specified structural-steel sheet or strip.

1.2.2 Design Wind Load

Design wind load shall be 35 pounds per square foot.

1.2.3 Structural Requirements

Doors and frames shall be designed to withstand the specified design wind load acting normal to the plane of the entrance wall either inward or outward.

Deflection of any metal framing member in a direction normal to the plane of the entrance wall, when the glazed entrance is subjected to the specified wind pressure, shall not exceed 1/175 of the clear span of the member or 3/4 inch, whichever value is the lesser.

Deflection of any metal member in a direction parallel to the plane of the entrance wall, when the metal member is carrying its full design load, shall not exceed 75 percent of the design clearance dimension between that member and the glass, sash, panel, or other part immediately below it.

1.2.4 Provisions for Thermal Movement

Doors and frames shall be designed to provide for expansion and contraction of the component parts caused by an ambient temperature range of 0 to 100 degrees F without causing buckling, opening of joints, overstressing of fasteners, or other harmful effects.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings for the following items shall be in accordance with the paragraph entitled, "Fabrication," of this section.

Finish Hardware
Doors and Frames

Installation Drawings shall include the following information:

Door and frame locations in the building, layout and elevations, dimensions, shapes and sizes of members, thicknesses of metals, types and locations of shop and field connections, details of anchorage to other construction, method of glazing, and other pertinent construction and erection details.

Location and details of materials that are to be embedded in cast-in-place concrete and masonry construction.

A finish hardware schedule indicating type, quantity, manufacturer's name, catalog number, location, and finish.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Aluminum Doors
Paint Materials
Glazing Materials
Finish Hardware
Installation Materials
Thresholds
Frames
Weatherstripping

SD-04 Samples

Contractor shall submit the following samples:

An Aluminum Finish for exposed-to-view surfaces, approximately 3-inches wide by 6-inches long, to illustrate the aluminum producer's standard color and appearance range.

Preformed Glazing Gasket, full size by 12 inches long.

Anchorage Devices and Fasteners, one full size of each type to be used in the work.

Lock Cylinder, one full size.

After approval, full size samples may be used in the construction,

provided each is clearly identified and its location is recorded.

SD-05 Design Data

Design Analysis and Calculations for the following items shall indicate the allowable design loads as specified in the paragraph entitled, "Performance Requirements," of this section.

Aluminum Doors
Frames
Aluminum Alloys
Structural Steel
Sheet and Strip

SD-06 Test Reports

Test Reports shall be in accordance with the paragraph entitled, "Finishes, Except Hardware," of this section, for Anodic Coating Tests.

SD-07 Certificates

Certificates of Compliance shall be submitted for the following items showing conformance with referenced standards contained in this section.

Metals for Fabrication
Paint Materials
Glazing Materials
Finish Hardware
Installation Materials

SD-08 Manufacturer's Instructions

Preventive Maintenance and Inspection for the aluminum manufacturer's recommended Cleaning Materials and Application Methods shall be submitted, including detrimental effects to the aluminum finish when improperly applied.

1.4 DELIVERY, HANDLING, AND STORAGE

Doors, frames, and accessories shall be protected from damage during handling, transportation, and at the job site. Materials shall be stored at the site in their original, unopened packages under cover on wood blocking or on suitable floors.

1.5 FIELD MEASUREMENTS

Field measurements shall be taken prior to the preparation of drawings and fabrication.

PART 2 PRODUCTS

2.1 METALS FOR FABRICATION

2.1.1 Aluminum-Alloy Extrusions

Extrusions shall conform to

Alloy and temper shall be 6063-T5.

2.1.2 Metals for Fasteners

Metals for fasteners shall be a type recommended by the door manufacturer.

2.2 PAINT MATERIAL

Shop paint for aluminum shall conform to FS TT-C-494, Type II, bituminous solvent type.

2.3 GLAZING MATERIALS

Preformed glazing gaskets shall be elastomeric compression type, extruded to shape with factory-made tight fitting corners to suit the type of flush glazing and glass size.

Glazing shall be in accordance with Sectioin 08805 "GLASS AND GLAZING"..

2.4 FINISH HARDWARE

2.4.1 Checking Floor Hinges

Floor hinges shall be jamb mounted, single-acting, offset-pivot operation with top pivots, of a size and hand best suited for the door weight and opening, conforming to BHMA A156.4, type as indicated in the hardware schedule in Section 08710, "Finish Hardware".

2.4.2 Overhead Concealed Door Closers

When indicated on drawings concealed door closers shall be liquid-controlled with back-check, double-acting, center-pivot operation, having the closer mechanism concealed in the overhead frame, without holdopen, with bottom pivot, of the size best suited for the door weight and opening, conforming to BHMA A156.4, Type C05062. Closers shall be the product of one manufacturer.

2.4.3 Overhead Surface-Mounted Door Closers

When indicated on drawings surface-mounted door closers shall be liquid-controlled, rack-and-pinion construction, of a size best suited for the door weight and opening, conforming to BHMA A156.4, Type C02021. Closers shall be the product of one manufacturer.

Closer arms and mounting brackets shall be provided as required. Drop plates shall be provided, sized for the door stile dimension.

2.4.4 Butt Hinges

Hinges shall be the full-mortise, template, extra-heavy, ball bearing, five-knuckle type with button tips, conforming to BHMA A156.1. Hinges for exterior out-swinging doors shall have pins that cannot be removed when the door is in the closed position. Hinges shall be the product of one manufacturer.

2.4.5 Pivot Hinges

Pivots shall be full-mortised, template, ball bearing, vertical-adjustment

type of cast or forged high-strength bronze conforming to BHMA A156.1. Pivots shall be the product of one manufacturer.

2.4.6 Door Pulls

Door pulls shall be extruded aluminum and of the door manufacturer's standard push-pull plate type.

2.4.7 Pushbars

Pushbars shall be extruded aluminum and of the door manufacturer's standard single bar type.

Pushbars shall be extruded aluminum and of the door manufacturer's standard single bar type, with attached pushplate having design matching the door pull used.

2.4.8 Deadlocks

Deadlocks shall be mortised, one-point maximum-security type. Backset dimensions, front shape, and hand shall be suitable for the door stile. Deadlock shall receive the lock cylinder specified, in accordance with Section 08710 "FINISH HARDWARE", without modification.

2.4.9 Lock Cylinders

Cylinders shall be in accordance with Section 08710 "Finish Hardware".

2.4.10 Flush Bolts

Flush bolts shall be the concealed-lever extension type with a cast-aluminum front plate, conforming to BHMA A156.16, Type L04082. Soffit and sill strikes shall be provided.

2.4.11 Pull Handles

Handles shall be extruded aluminum, door manufacturer's standard panic device pull handle.

2.4.12 Panic Exit Devices

Exit devices shall be in accordance with Section 08710, "Finish Hardware".

2.4.13 Thresholds

Thresholds shall be extruded aluminum conforming to BHMA A156.21, and in accordance with Section 08710 "Finish Hardware".

2.4.14 Hardware Finishes

Finish designations are Builders' Hardware Manufacturer Association (BHMA) code numbers, and conform to BHMA A156.18.

Door closing devices, exposed cover plates, arms, and pivots shall be BHMA Code 689.

Butt or pivot hinges shall be BHMA Code 63. Finish of the cover enclosing the closer case shall be BHMA Code 689. Finish of closer arms, mounting brackets, and drop plates shall be BHMA Code 689.

Finish of door pulls, pushbars, deadlocks, lock cylinders, and flush bolts shall be the same as that specified for doors and frames.

Finish of door handles and lock cylinders shall be the same as that specified for doors and frames.

Panic exit devices shall be BHMA Code 689.

2.4.15 Hardware Sets

Hardware sets shall be as indicated on the drawings and as follows:

Set A:

1 Checking floor hinge with top and intermediate pivot, each leaf

1 Door pull, each leaf

1 Pushbar, each leaf

1 Deadlock, each active leaf

2 Lock cylinders, each active leaf

2 Flush bolts, each inactive leaf

1 Threshold, each door opening

Set B:

1 Overhead concealed door closer with a bottom pivot and door stop applied to the frame, each leaf

1 Door pull, each leaf

1 Pushbar, each leaf

1 Deadlock, each active leaf

2 Lock cylinders, each active leaf

2 Flush bolts, each inactive leaf

1 Threshold, each door opening

Set C:

1 Set of pivot hinges (top and bottom), each leaf

1 Intermediate pivot

1 Overhead surface-mounted door closer, each leaf

1 Door pull, each leaf

1 Pushbar, each leaf

1 Deadlock, each inactive leaf

2 Lock cylinders, each active leaf

2 Flush bolts, each inactive leaf

1 Threshold, each door opening

Set D:

1 Overhead concealed door closer with bottom pivot and door stop applied to the frame, each leaf

1 Pull handle, each leaf

1 Panic exit device for exit and entrance operation, each active leaf

2 Lock cylinders, each active leaf

1 Panic exit device for exit only, each inactive leaf

1 Threshold, each door opening

Set E:

1 Set of offset pivots (top and bottom), each leaf

1 Intermediate offset pivot, each leaf

1 Overhead surface-mounted door closer, each leaf

1 Pull handle, each leaf

1 Panic exit device for exit and entrance operation, each active leaf

2 Lock cylinders, each active leaf

1 Panic exit device for exit only, each inactive leaf

1 Threshold, each door opening

2.5 FABRICATION

2.5.1 Workmanship

Metal parts shall be accurately formed. Joints, except those designed to accommodate movement, shall be accurately fitted and rigidly assembled.

Welding shall be in accordance with AWS D1.1 and shall be done with filler metals and by methods recommended by the producer of the metal being welded. Welds behind finished surfaces shall cause no distortion or discoloration on the exposed side. Welded joints shall be cleaned of all welding flux and dressed on all exposed and contact surfaces.

Insofar as practical, fitting and assembly of the work shall be done in the manufacturer's plant. Work that cannot be permanently factory assembled shall be marked before shipment for proper assembly at the site.

2.5.2 Preparation for Finish Hardware

Preparations for mortised and concealed hardware shall be done at the factory and shall include cutouts, recesses, mortises, reinforcing, drilling, and tapping to receive the specified hardware sets. Preparations for hardware shall be made to the template of the manufacturer of each hardware item. Where concealed closers and other mechanisms are required, the necessary space, cutouts, reinforcement, and provisions for secure fastening shall be made. Where butt or pivot hinges are required, doors and frames shall be reinforced with backing plates to ensure adequate strength of the fastening.

2.5.3 Protection of Aluminum from Dissimilar Materials

Surfaces that will come in contact with dissimilar metals, masonry, concrete, or wood shall be shop primed.

Surfaces shall be prepared in conformance with ASTM D 1730, Type B, Method 3.

Surfaces shall be given one shop coat of paint which shall be applied to dry, clean surfaces to provide a continuous minimum dry-film thickness of 1.5 mils (0.0015 inch).

2.5.4 Doors

Doors shall be swing type, full glazed, stile-and-rail construction with medium stile, of the size indicated.

Stiles and rails shall be fabricated of aluminum-alloy tubular extrusions having a wall thickness not less than 0.125 inch.Corners shall be joined by both concealed welding and mechanical fastening. Corner connections shall be accurately milled to a hairline watertight joint.

Single swing doors shall have not more than 3/32-inch clearance at jambs and heads, 3/16-inchclearance at meeting edges of pairs of doors, and 1/2-inch clearance at the bottom. Dimensions are nominal and subject to the manufacturer's tolerances. Lock edges of doors shall provide the proper operating clearance.

Glazing moldings shall be fabricated of aluminum-alloy extrusions with wall thicknesses not less than 0.050 inch. Moldings shall be the snap-in flush glazing type with preformed glazing gasket, sized to receive the type and thickness of the glass. Moldings on the exterior face of doors shall be the nonremovable type without exposed screws. Moldings shall be carefully fitted and joined at corners.

2.5.5 Finishes, Except Hardware

Exposed aluminum surfaces of the doors and frames shall be factory finished polished frosted finish with Class II clear anodic coating. Finish shall be a smooth specular buffed mechanical finish followed by a medium matte chemical-etch finish and Architectural Class II (0.4- to 0.7-mil thickness) anodic coating. The finish color shall be as scheduled and approved

Finish color and appearance shall match that of the sample approved for use in the project within the aluminum producer's standard color range.

2.5.6 Hardware Locations

Hardware locations shall be as follows:

HARDWARE ITEM	LOCATION
Door handles	Centerline of grip 42 inches above the floor
Door pulls	Top fastening 45 inches above the floor
Pushbars, single	Centerline 45 inches above the floor
Deadlocks	Centerline of strike 48 inches above the floor
Panic exit devices	Centerline of strike 40-5/16 inches above the floor
Top flush bolt	Centerline of front plate 72 inches above the floor
Bottom flush bolt	Centerline of front plate 12 inches above the floor
Top butt hinges	11-3/4 inches from the rabbet section of the head of the frame to the centerline of the hinge
Bottom butt hinges	13 inches from the finished floor to the centerline of the hinge
Intermediate butt hinges	Equally spaced between the top and bottom butt hinges
Pivot hinges (top, bottom, and intermediate)	In accordance with the pivot manufacturer's printed instructions

2.5.7 Weatherstripping

Exterior doors shall be provided with weatherstripping at heads, jambs, and meeting stiles.

Weatherstripping shall be silicone treated wool pile inserted in a corrosion-resistant steel or extruded aluminum-alloy housing. Weatherstripping at meeting stiles of pairs of doors shall be adjustable. Weatherstripping shall be mortised into the door edges, or frame, or both, as required to suit the conditions. Weatherstripping shall be designed for easy removal and replacement.

2.6 INSTALLATION MATERIALS

2.6.1 Threaded-Type Concrete Inserts

Inserts shall be galvanized ferrous castings having enlarged bases with not less than two nailing lugs, length not more than the thickness of the concrete less 3/4 inch, and internally threaded to receive 3/4-inch diameter machine bolts. Castings shall conform to. Inserts shall be

galvanized in accordance with ASTM A 153/A 153M after fabrication.

Inserts shall not be removable when embedded in 3,000-pound per square inch (psi) concrete and subjected to a 10,000-pound tension load test in an axial direction, nor shall the concrete show any evidence of failure attributable to installation of the anchorage device itself.

2.6.2 Wedge Concrete Inserts

Inserts shall be galvanized box-type ferrous castings with an integral loop at the back of the box and designed to accept 3/4-inch diameter bolts having special wedge-shaped heads. Castings shall conform to Grade 32510 or 35018, or ASTM A 27/A 27M, Grade U-60-30. Inserts shall be galvanized after fabrication in accordance with ASTM A 153/A 153M.

Inserts shall not be removable when embedded in 3,000-psi concrete and subjected to a 16,000-poundtension load test in an axial direction, nor shall the concrete show any evidence of failure attributable to installation of the anchoring device itself.

Carbon-steel bolts having special wedge shape heads, nuts, washers, and shims, galvanized in accordance with ASTM A 153/A 153M, shall be provided.

2.6.3 Slotted Concrete Inserts

Inserts shall be the galvanized, pressed-steel plate, welded construction, box type, with slots designed to receive 3/4-inchdiameter square-head bolts and to provide lateral adjustment of the bolt. Length of the insert body less the anchorage lugs shall be not less than 4-1/2 inches. Inserts shall be provided with knockout covers. Steel plate shall be not less than 1/8 inch thick, conforming to ASTM A 283/A 283M, Grade C. Inserts shall be galvanized in accordance with ASTM A 123 after fabrication.

Inserts shall not be removable when embedded in 3,000-psi concrete and subjected to a 6,000-poundtension load test in an axial direction, nor shall the concrete show any evidence of failure attributable to installation of the anchoring device itself.

2.6.4 Masonry-Anchorage Devices

Devices shall be expansion shields conforming to FS FF-S-325, group, type, and class as follows:

Shields for machine screws 1/4-inch and smaller shall be lead group, head-out embedded nut type, single unit class, conforming to Group I, Type 1, Class 1.

Shields for standard steel bolts and machine screws larger than 1/4-inch shall be lead group, head-out embedded nut type, multiple unit class, conforming to Group I, Type 1, Class 2.

2.6.5 Toggle Bolts

Toggle bolts shall be tumble-wing type, class and style best suited for the work, conforming to FS FF-B-588, Type II.

2.6.6 Standard Threaded Fasteners

Standard threaded fasteners shall be as follows:

Standard steel bolts: Regular hexagon head, low-carbon steel, coarse-thread series, conforming to ASTM A 307.

Nuts: Plain hexagon, regular style, carbon steel, conforming to ASTM A 563.

Plain washers: Round, general assembly purpose grade, carbon steel, conforming to

Lockwashers: Helical-spring, carbon steel, of the style best suited for the work, conforming to FS FF-W-84, Class A.

2.6.7 Electrodes for Welding Steel

Electrodes for welding steel by the manual shielded metal-arc welding process shall meet the requirements of AWS D1.1 and shall be covered mild-steel electrodes conforming to AWS A5.1, E60 series.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Doors, Frames and Accessories

Doors, frames, and accessories shall be installed in accordance with the approved shop drawings and descriptive data.

3.1.2 Materials Embedded in Other Construction

Materials such as cement boxes for checking floor hinges, concrete inserts, and anchor bolts, which are to be embedded in cast-in-place concrete and masonry construction, shall be delivered to the project site in time to be installed before the start of the other construction. Setting drawings, templates, instructions, and directions shall be provided for the installation of the embedded materials.

3.1.3 Fastening to Construction-in-Place

Anchorage devices and fasteners shall be provided where necessary for fastening the specified work to construction in place and shall include threaded fasteners for concrete inserts embedded in cast-in-place concrete, masonry anchorage devices and threaded fasteners for solid masonry and concrete in place, toggle bolts for hollow masonry and stud partitions, and connections for structural steel. Fastening shall be provided as specified. Fastening to wood plugs in masonry or concrete in place is not permitted.

3.1.4 Setting Masonry Anchorage Devices

Devices shall be set in masonry or concrete in place in accordance with the manufacturer's printed instructions. Holes shall be the recommended depth and diameter and shall be drilled using the drill recommended by the manufacturer of the particular anchorage device used. Drilled holes shall be left rough, not reamed, and free from drill dust.

3.1.5 Field Welding Steel, Touchup Painting

Procedures of manual shielded metal-arc welding, the appearance and quality

of welds made, and the methods used in correcting welding work shall conform to AWS D1.1.

After completion of welding, field welds and scarred surfaces on steel work and on adjacent ferrous-metal surfaces shall be touchup painted. Before start of touchup painting, weld scars, bruises, abrasions, and rust spots shall be wire brushed and solvent cleaned. Paint used for touchup painting shall be the same as that used for shop painting steel.

3.1.6 Installation Tolerances

Doors and frames shall be installed in a manner not to exceed the following limits of tolerance:

Deviation in location from that indicated on the drawings	Plus or minus 1/4 inch
Deviation from the plumb or horizontal:	
In 12 feet	Not more than 1/8 inch
In 24 or more feet	Not more than 1/4 inch
Offset from true alignment at joints between members in line end-to-end	Not more than 1/16 inch

3.1.7 Placing Frames

Supporting members, including materials embedded in other construction, shall be completely in place before placing frames. Framing members shall be installed plumb, level, and in alignment within the limits of the installation tolerances specified. Temporary supports and bracing shall be provided as required to maintain the position, stability, and alignment of the framing members while they are being permanently connected.

3.1.8 Door Installation

Doors shall fit accurately in frames within the specified door clearances.

3.1.9 Finish Hardware Installation

Contractor shall drill and tap as required for the application of surface-mounted finish hardware. True position shall be located by template to ensure accurate placement. Hardware items shall be installed in accordance with the manufacturer's printed instructions.

Thresholds shall be bedded in mastic and secured with corrosion-resistant steel flathead machine screws and lead expansion shields.

After installation is completed, hardware shall be adjusted and lubricated to ensure proper performance.

3.2 CLEANING

Upon completion of the installation, work shall be cleaned to remove all mastic smears and other foreign materials.

Before final acceptance, exposed-to-view aluminum surfaces shall be

thoroughly washed with clean water and soap and rinsed with clean water. Acid solutions, steel wool, or other harsh abrasives shall not be used. Stains that remain after washing shall be removed or the finish restored in accordance with the aluminum producer's recommendations.

3.3 FINAL ADJUSTMENT

Before final acceptance, finish hardware shall be checked and readjusted as required to ensure proper operation.

3.4 ACCEPTANCE PROVISIONS

Doors and frames will be rejected for, but not limited to, any of the following deficiencies:

Exposed-to-view aluminum surfaces having color and appearance that are outside the color and appearance range of the approved samples for aluminum finish

Doors and frames not conforming to the requirements for installation tolerances and door clearances specified

Hardware that is not complete and operating properly

Doors and frames having stained, discolored, abraded, or otherwise damaged exposed-to-view aluminum surfaces that cannot be restored by cleaning or repairing

3.5 REPAIR OF DEFECTIVE WORK

Defective work shall be removed and replaced with new at no additional cost to the Government.

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SECTION 08210

FLUSH WOOD DOORS

08/98

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SECTION 08210

FLUSH WOOD DOORS
08/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 152 (1981a) Standard Methods of Fire Tests of Door Assemblies

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Section 1500 (1993) Architectural Quality Standards for Factory Finishing.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1992) Fire Doors and Windows

NATIONAL WOOD WINDOW AND DOOR ASSOCIATION (NWWDA)

NWWDA I.S. 1-A (1993) Architectural Wood Flush Doors

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Submit Fabrication drawings indicating locations and dimensions fire ratings, acoustic ratings, and location and details of cutouts for glazing for the following items:

Solid Core Doors
Fire-Rated Labeled Doors

SD-03 Product Data

Submit Manufacturer's Catalog Data for Solid core doors and Fire-rated labeled doors including data for door construction, core, veneers, and finishes.

SD-04 Samples

Submit three samples for selection in the form of color charts consisting of actual materials and finishes for the following:

Faces of factory finished doors

SD-07 Certificates

Certificates shall be submitted for the following items showing conformance with the referenced standars contained in this section.

Solid Core Doors
Fire-Rated Labeled Doors

1.3 DELIVERY, STORAGE, AND HANDLING

Protect doors during transit, storage, and handling to prevent damage, soiling and deterioration.

PART 2 PRODUCTS

2.1 INTERIOR FLUSH WOOD DOORS

2.1.1 Solid Core Flush Wood Doors

Interior solid core flush wood doors shall be 1-3/4 inch thick, complying with NWWDA I.S. 1-A, with particleboard core.

2.1.2 Door Faces for Opaque Finish

Provide doors with 1/8-inch veneer faces for paint finish, consisting of overlayed medium-density hardwood face veneers, complying with NWWDA I.S. 1-A Sound Grade.

2.1.3 Door Faces for Transparent Finish

Provide doors with 1/8-inch 3-ply wood veneer faces for transparent finish, consisting of white birch or white oak wood species, plain sliced, conforming to NWWDA I.S. 1-A Sound Grade.

2.1.4 Fire-Rated Wood Doors

Fire-rated wood doors shall comply with NFPA 80 and be identical in materials and construction to units tested in door and frame assemblies in accordance with ASTM E 152. Fire-rated doors shall be labeled and listed by UL, Warnock Hersey, or other testing and inspection agency acceptable to the Contracting Officer.

Provide door faces and grades to match non-fire-rated doors in building unless otherwise indicated. Provide manufacturer's standard core construction as required to provide fire-resistance rating indicated.

2.2 FABRICATION

Fabricate doors in accordance with NWWDA I.S. 1-A industry standards.

Provide wood blocking for hardware reinforcement as follows:

5 x 18 inch lock blocks at lock edge.

5 inch wide top rail for door closer.

Bond stiles and rails to core, and plane entire door unit prior to application of veneers.

Vertical exposed edges of stiles shall be of same species as veneer facing.

2.3 LIGHT FRAMES

Metal frames for light openings in fire-rated doors shall be manufacturer's standard frame formed of 18 gage thick cold-rolled steel sheet, factory primed, and approved for use in doors of fire-rating indicated.

Wood frames for light openings in non-fire-rated doors shall be mnufacturer's standard which matches door face veneer.

2.4 DOOR FINISH

Doors to receive a job-site-applied finish shall be clean and sanded smooth to remove handling and storage marks, raised train, minor surface marks, and abrasions, and shall be left ready for finishing as specified in Section 09900, "Painting."

PART 3 EXECUTION

3.1 EXAMINATION

Verify that frames have been installed plumb and level, and comply with indicated requirements for type, size, location, and swing characteristics. Do not proceed with installation of doors until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

Install wood doors to comply with manufacturer's installation instructions and reference standards indicated. Install fire-rated doors in accordance with requirements of NFPA 80.

Align and fit doors in frames with uniform clearances and bevels. Do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.

For non-rated doors, provide fitting clearances of 1/8 inch at jambs and heads, 1/16 inch per leaf at meeting stiles for pairs of doors, and 3/4 inch from bottom of doors to top of floor finish covering. Bevel non-rated doors 1/8 inch in 2 inches at lock and hinge edges.

For fire-rated doors, provide fitting clearances in compliance with NFPA 80. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge, and trim stiles and rails only to extent permitted for fire rating requirements.

3.3 TOLERANCES

Maximum diagonal distortion (warp) of doors shall not exceed 1/8 inch measured with straight edge or taught string, corner to corner.

3.4 ADJUSTING

Adjust doors for smooth and balanced door movement. Rehang or replace doors that do not swing or operate properly.

-- End of Section --

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SECTION 08331

OVERHEAD COILING DOORS

09/96

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SECTION 08331

OVERHEAD COILING DOORS
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 153/A 153M	(2001) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 27/A 27M	(1995; R 2000) Standard Specification for Steel Castings, Carbon, for General Application
ASTM A 307	(2000) Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 36/A 36M	(2000; Rev A) Standard Specification for Carbon Structural Steel
ASTM A 446/A 446M	(1993) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
ASTM A 48	(1994; Rev E1) Standard Specification for Gray Iron Castings
ASTM A 48M	(1994; Rev A) Standard Specification for Gray Iron Castings (Metric)
ASTM A 525	(1993) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 525M	(1991; Rev A) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process (Metric)
ASTM A 526/A 526M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM A 53	(1999; rev B) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

ASTM D 2000	(1999) Standard Classification System for Rubber Products in Automotive Applications
ASTM A 780	(2001) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM E 152	(1981a) Standard Methods of Fire Tests of Door Assemblies
ASTM F 568	(1995) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B29.11M	(1984) Combination Chains, Attachments and Sprocket Teeth
ASME B29.1M	(1993) Precision Power Transmission Roller Chains, Attachments and Sprockets

AMERICAN WOOD PRESERVERS BUREAU (AWPB)

AWPB LP 2	(1988) Softwood Lumber, Timber and Plywood Pressure Treated with Water-Borne Preservatives for Aboveground Use

FEDERAL SPECIFICATIONS (FS)

FS FF-B-171	(Rev A; Am 1) Bearings, Ball, Annular (General Purpose)
FS TT-C-490	(Rev C; Am 2) Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings
FS TT-W-571	(Rev J) Wood Preservation: Treating Practices

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA MG 1	(1998; Rev. 1) Motors and Generators
NEMA ST 1	(1988) Specialty Transformers (Except General Purpose Type)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1992) Fire Doors and Windows

UNDERWRITERS LABORATORIES (UL)

UL 674	(1994; 3rd Ed) Electric Motors and Generators for Use in Hazardous (Classified) Locations

UL-02 (2000) Building Materials Directory

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Wind Loading

Doors shall be designed and reinforced to withstand a wind loading pressure of at least pounds per square foot with a maximum deflection of 1/120 of the opening width.

1.2.2 Fire Doors, Frames, and Hardware

Fire doors, frames, and hardware shall be types that have been fire tested, rated, and labeled in accordance with ASTM E 152. They shall bear metal UL labels as evidence of the rating. Labels shall indicate the rating in hours of duration of exposure to fire, with a letter following the hourly rating to designate the location for which the assembly is designed and the temperature rise on the unexposed face of the door at the end of 30 minutes of fire exposure.

Door frames shall bear the UL label: "Listed Fire Door Frame." Special frames constructed of materials other than steel and intended for use with doors rated at less than 3 hours shall bear a UL label indicating the hourly rating.

Metal UL labels shall be attached to each item of hardware in accordance with requirements specified in the UL-02.

1.2.3 Oversized Rolling Fire Doors

Where fire doors and frames exceed the size for which testing and labeling services are offered, certificates of inspection from the UL shall be furnished. Certificates shall state that except for size, doors, frames, and hardware are identical in design, materials, and construction to a door that has been tested and rated by the UL.

1.2.4 Water Leakage Requirements

The Contractor shall perform the following testing in the presence of the Contracting Officer.

Doors shall show no water leakage at heads, jambs, sills, and through each section when subjected to a 15-minute water hose spray test. The hose shall be held at a distance of not more than 4572 millimeter and shall produce a circle of impact of not less than 1524 nor more than 2134 millimeter in diameter at a water pressure of approximately 345 kilopascal and a flow rate of not less than 31.5 cubic meters per second.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication and Installation Drawings for Overhead Coiling Door shall show complete assembly with hardware and and framing details

for the following items:

Overhead Coiling Door
Counterbalancing Mechanism
Manual Door Operators
Electric Door Operators

SD-03 Product Data

Manufacturer's Catalog Data including Equipment and Performance Data for the following items shall be submitted listing all accessories including supports, locks and latches, and weatherstripping.

Overhead Coiling Doors
Hardware
Counterbalancing Mechanism
Manual Door Operators
Electric Door Operators
Fire-Rated Doors

SD-10 Operation and Maintenance Data

Contractor shall submit 4 copies of the Operation and Maintenance Manuals 30 days prior to testing the Overhead Door Assemblies. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

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.

1.4 FIELD MEASUREMENTS

Field measurements shall be taken prior to preparation of drawings and fabrication.

1.5 WARRANTY

Contractor shall furnish a written guarantee that the helical spring and counterbalance mechanism are free from defects in material and workmanship and that they will remain so for not less than 2 years after completion and acceptance of the project.

Contractor shall warrant that upon notification by the Government, he will immediately make good any defects in material, workmanship, and door operation within the same time period covered by the guarantee, at no cost to the Government.

1.6 OVERHEAD COILING DOOR ASSEMBLIES

Installation Drawings for overhad coiling door assemblies shall show rough frame opening dimensions, hardware and anchor locations, and counterbalancing mechanism and door operator destails.

PART 2 PRODUCTS

2.1 DOORS

2.1.1 Curtain Construction

Curtains shall be fabricated from steel sheets conforming to ASTM A 446/A 446M, Grade A, or to ASTM A 526/A 526M, with the additional requirement of a minimum yield point of 33,000 psi.Sheets shall be galvanized in accordance with ASTM A 525, G90.

Doors shall be fabricated from interlocking cold-rolled slats, with section profiles as specified, designed to withstand the specified wind loading. Slats shall be continuous without splices for the width of the door. Exterior slats shall have a foamed-in-place polyurethane insulation core between the outer and inner steel sheets, providing an R value of 6.25 For doors not exceeding 14 feet in width, slats shall be flat-profile design, with a depth not less than 0.625 inch, a center-to-center width not more than 2.75 inches, and not less than a 0.0478-inch uncoated thickness.

For doors not exceeding 18 feet in width, slats shall be flat-profile design, with a depth not less than 0.75 inch, a center-to-center width not more than 2.75 inches, and not less than a 0.0478-inch uncoated thickness.

For doors not exceeding 25 feet in width, slats shall be flat-profile design, with a depth not less than 0.75 inch, a center-to-center width not more than 2.75 inches, and not less than a 0.0598-inch uncoated thickness.

For doors exceeding 25 feet in width, the door manufacturer's literature should be consulted.

2.1.2 Curtain Bottom Bar

Curtain bottom bars shall be pairs of angles not less than 2.0 by 2.0 inches by 0.188 inch. Angles shall be steel conforming to ASTM A 36/A 36M. Angles and fasteners shall be galvanized in accordance with ASTM A 525, G90. Welds and abrasions shall be coated with paint conforming to ASTM A 780.

2.1.3 Wind Locks

Wind locks shall be cast steel conforming to ASTM A 27/A 27M, Grade B. Locks shall be galvanized in accordance with ASTM A 525, G90, and secured to the curtain slats. A wind lock shall be provided on every other curtain slat.

2.1.4 Weatherstripping

Weatherstripping for door heads shall be 1/8-inchthick sheet natural rubber or neoprene rubber air baffles secured to the insides of hoods with galvanized-steel fasteners through continuous galvanized-steel pressure bars at least 5/8-inchwide and 1/8-inch thick.

Weatherstripping for door-jamb guides shall be 1/8-inch thick strip natural rubber or neoprene rubber secured to the exterior sides of jamb guides with galvanized-steel fasteners through continuous galvanized-steel pressure bars at least 5/8-inch wide and 1/8-inch thick.

Bottom astragals shall be 1/8-inch thick sheet natural rubber or neoprene

rubber secured to the bottom bars.

Weatherstripping and astragals shall be natural rubber or neoprene rubber conforming to ASTM D 2000.

2.2 HARDWARE

2.2.1 Curtain Jamb Guides

Curtain jamb guides shall be fabricated from a combination of steel angles of sufficient size to retain the curtain against the specified wind loadings. Guides shall be fabricated from rolled structural-quality carbon-steel angles conforming to ASTM A 36/A 36M. Guide assembly shall be galvanized in accordance with ASTM A 525, G90. Bolt holes shall be slotted for track adjustment. Welds and abrasions shall be coated with paint conforming to ASTM A 780.

2.2.2 Equipment Supports

Door-operating equipment supports shall be fabricated from steel shapes and plates conforming to ASTM A 36/A 36M, galvanized in accordance with ASTM A 525, G90. Shapes and plates shall be sized in accordance with the manufacturer's standard practices for the size, weight, and type of door installation.

2.2.3 Threaded Fasteners

Threaded fasteners shall consist of unfinished low-carbon steel bolts and nuts conforming to ASTM A 307, Grade A,galvanized per ASTM A 153/A 153M, Table 1.

2.2.4 Locks and Latches

Doors shall have seven-pin tumbler locks with temporary construction cores in accordance with Section 08710 "FINNISH HARDWARE". Construction coresshall be removed when directed by the Contracting Officer. Security cores will be installed by the Government prior to acceptance of the work.

2.3 COUNTERBALANCING MECHANISM

Doors shall be counterbalanced by an adjustable, steel, helical torsion spring mounted around a steel shaft in a spring barrel and connected to the door curtain with the required barrel rings.

2.3.1 Brackets

Mounting brackets shall be the manufacturer's standard with one located at each end of the counterbalance barrel. Brackets shall be gray cast iron conforming to ASTM A 48.

2.3.2 Hoods

Hoods shall be fabricated from steel sheets conforming to ASTM A 446/A 446M, Grade A, or to ASTM A 526/A 526M, with the additional requirement of a minimum yield strength of 33,000 psi. Sheets shall be galvanized in accordance with ASTM A 525, G90. Material shall have an uncoated thickness of not less than 0.0299 inch. Hoods shall be reinforced to prevent hood deflection.

2.3.3 Counterbalance Barrels

Counterbalance-barrel components shall be as follows:

Spring barrels shall be hot-formed structural-quality carbon-steel, welded or seamless pipe conforming to ASTM A 53, Type E or S, Grade A, with the steel yield point and design stresses conforming to ASTM A 36/A 36M. Pipe shall be of sufficient diameter and wall thickness to limit deflection to a maximum of 1/360 of the span. Barrels shall be hot-dip galvanized, inside and outside, in conformance with ASTM A 525, G90.

Counterbalance springs shall be oil-tempered helical steel springs designed with a safety factor of not less than 4. Springs shall be sized to counterbalance the weight of the curtain at any point of its travel, and shall be capable of being adjusted to counterbalance not less than 125 percent of the normal curtain load. Spring adjustment shall be arranged in such a way that the curtain need not be raised or lowered to secure the adjustment.

Counterbalance shafts shall be case-hardened steel of the proper size to hold the fixed ends of the spring and carry the torsional load of the spring.

Barrel plugs shall be fabricated from cast steel machined to fit the ends of the barrel. Plugs shall secure the ends of the spring to the barrel and the shaft. Plugs shall be galvanized in conformance with ASTM A 525, G90.

Barrel rings shall be fabricated from malleable iron of the proper involute shape to coil the curtain in a uniformly increasing diameter.

Shaft bearings shall be factory-sealed ball bearings conforming to FS FF-B-171 and of the proper size for load and shaft diameters.

2.4 MANUAL DOOR OPERATORS

2.4.1 Manual Push-Up Door Operators

Door operators shall consist of lifting handles, locks, and latches. Counterbalance mechanisms shall be adjusted so that the required lift or pull for operation does not exceed 25 pounds.Operating mechanisms shall be designed so that the curtain can be stopped at any point in its upward or downward travel and will remain in that position until pushed to the fully open or closed position.

2.4.2 Manual Chain-Hoist Door Operators

Door operators shall consist of an endless steel hand chain, chain-pocket wheel and guard, and a geared reduction unit of at least a 3 to 1 ratio. Required pull for operation shall not exceed 35 pounds.

Chain hoists shall have a self-locking mechanism allowing the curtain to be stopped at any point in its upward or downward travel and to remain in that position until moved to the fully open or closed position.

Hand chains shall be cadmium-plated alloy steel conforming to ASME B29.11M. Yield point of the chain shall be at least three times the required hand-chain pull.

Chain-sprocket wheels shall be cast iron conforming to ASTM A 48.

2.4.3 Manual Crank-Hoist Door Operators

Door operators shall consist of wall-mounted cranks and crank gear boxes, steel crank drive shaft, and a geared reduction unit of at least a 3 to 1 ratio. Required lift or pull for operation shall not exceed 35 pounds.

Crank hoists shall have a self-locking mechanism allowing the curtain to be stopped at any point in its upward or downward travel and remain in that position until moved to the fully open or closed position.

Driving gears shall be steel castings with machine-cut teeth and with keys and keyways for mounting on shafts.

Bearings shall be factory-sealed ball bearings conforming to FS FF-B-171 and of the proper size for load and shaft diameters.

Drive shafts shall be cold-rolled, polished steel.

Gear boxes shall be oiltight, fabricated from wrought iron, with a design suitable for mounting on wall or curtain track guides.

2.5 ELECTRIC DOOR OPERATORS

Electrical wiring shall conform to the applicable requirements of Section 16145, "Standard Wiring Systems."

Door operator controls shall conform to the applicable requirements of Section 16286, "Overcurrent Protective Devices."

Electric door-operator assemblies shall be the sizes and capacities recommended and provided by the door manufacturer for specified doors. Assemblies shall be complete with electric motors and factory-prewired motor controls, gear reduction units, solenoid-operated brakes, clutches, remote-control stations, manual or automatic control devices, and control of stations and accessories as required for proper operation of the doors.

Operators shall be so designed that motors may be removed without disturbing the limit-switch adjustment and without affecting the emergency auxiliary operators.

A manual operator of crank-gear or chain-gear mechanisms with a release clutch shall be provided to permit manual operation of doors in case of power failure. Emergency manual operator shall be so arranged that it may be put into and out of operation from floor level, and its use shall not affect the adjustment of the limit switches. An electrical or mechanical device shall be provided which will automatically disconnect the motor from the operating mechanism when the emergency manual operating mechanism is engaged.

2.5.1 Door-Operator Types

Door operators shall be wall or bracket mounted units consisting of an electric motor, a worm-gear drive from the motor to the reduction gear box, a chain or worm-gear drive from the reduction gear box to the gear wheel mounted on the counterbalance shaft, and a quick-clutch disconnect release for manual operation. Motor, clutch, and drive assembly shall be the horsepower rating and design determined by the door manufacturer for the

size of the door and as specified.

2.5.2 Motors

Motors shall be the high-starting-torque, reversible, constant-duty electrical type with overload protection. Motors shall be of sufficient torque and horsepower to move the door in either direction from any position and produce a door-travel speed of not less than 8 nor more than 12 inches per second without exceeding the horsepower rating.

Motors shall conform to NEMA MG 1 and to the requirements specified.

Coordinate wiring requirements and current characteristics of motor with building electrical system.

Motor frame sizes shall conform to NEMA MG 1.

Motor enclosures shall be open drip-proof and shall be certified for continuous operation at full nameplate power output in an ambient temperature of 104 degrees F.

2.5.3 Motor Bearings

Bearings shall be bronze-sleeve or heavy-duty ball or roller antifriction type with full provisions for the type of thrust imposed by the specific duty load.

Bearings in motors less than 1/2 horsepower shall be prelubricated and factory sealed.

Motors coupled to worm-gear reduction units shall be equipped with either ball or roller bearings.

Bearings in motors 1/2 horsepower or larger shall be equipped with lubrication service fittings. Lubrication fittings shall be fitted with color-coded plastic or metal dust caps.

In any motor, bearings that are lubricated at the factory for extended duty periods shall not need to be lubricated for a given number of operating hours. An appropriate tag or label on the motor shall display this information.

2.5.4 Motor Starters, Controls, and Enclosures

Each door motor shall have a factory-wired, unfused, disconnect switch; a reversing, across-the-line magnetic starter with thermal overload protection; 120-volt operating coils with a control transformer limit switch; and a safety interlock assembled in a NEMA ICS 6 type enclosure as specified herein.

Adjustable switches, electrically interlocked with the motor controls and set to stop the door automatically at the fully open and fully closed position, shall be provided.

2.5.5 Control Enclosures

Control enclosures shall conform to NEMA ICS 6 for general purpose NEMA Type 1.

2.5.6 Transformer

Starters with 230/460 to 115 volt control transformers with one secondary fuse shall be provided when it is required to reduce the voltage on control circuits to 120 volts or less. Transformers shall conform to NEMA ST 1.

2.5.7 Safety-Edge Device

Each door shall be provided with a pneumatic safety device extending the full width of the door and located within a U-section neoprene or rubber astragal mounted on the bottom rail of the bottom door section. Device shall immediately stop and reverse the door upon contact with an obstruction in the door opening during downward travel and shall cause the door to return to full-open position. Safety device shall not be a substitute for a limit switch.

Safety device shall be connected to the control circuit through a retracting safety cord and reel.

2.5.8 Remote-Control Stations

Interior remote-control stations shall be full-guarded, momentary-contact three-button, heavy-duty, surface-mounted NEMA ICS 6 type enclosures as specified. Buttons shall be marked "OPEN," "CLOSE," and "STOP." The "CLOSE" button shall be the type requiring a constant pressure to maintain the closing motion of the door. When the door is in motion and the "STOP" button is pressed, the door shall stop instantly and remain in the stopped position; from the stopped position, the door may then be operated in either direction.

Exterior control stations shall be full-guarded, momentary-contact three-button standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosures, key-operated, with the same operating functions as specified herein for interior remote-control stations.

2.5.9 Speed-Reduction Units

Speed-reduction units shall consist of hardened-steel worm and bronze worm gear assemblies running in oil or grease and encased in a sealed casing, coupled to the motor through a flexible coupling. Drive shafts shall rotate on ball- or roller-bearing assemblies that are integral with the unit.

Minimum ratings of speed reduction units shall be in accordance with AGMA provisions for class of service.

Worm gears shall be ground to provide accurate thread form; all other types of gearing shall have machined teeth. All gears shall be surface hardened.

Bearings shall be the antifriction type equipped with oil seals.

2.5.10 Chain Drives

Roller chains shall be power-transmission series steel roller type conforming to ASME B29.1M, with a minimum safety factor of 10 times the design load.

Roller-chain side bars, rollers, pins, and bushings shall be heat-treated or otherwise hardened.

Chain sprockets shall be high-carbon steel with machine-cut hardened teeth, finished bore and keyseat, and hollow-head setscrews.

2.5.11 Brakes

Brakes shall be internally expanding 360-degree shoe brakes or shoe and drum brakes, solenoid-operated and electrically interlocked to the control circuit to set automatically when power is interrupted.

2.5.12 Clutches

Clutches shall be the 4-inch diameter, multiple face, externally adjustable friction type or adjustable centrifugal type.

2.6 FIRE-RATED DOORS

Fire doors shall be the dimension, fire rating, and operating type indicated and shall consist of interlocking hot-dip galvanized steel slats, a bottom bar, wall guides, counterbalancing, and an automatic mechanism. Doors with electric operators shall be designed so that the electric assembly does not interfere with fire-release devices.

Door manufacturer's standard interconnecting fusible links shall be provided for doors on both sides of interior rated walls.

2.6.1 Fire Ratings

Doors shall meet the applicable requirements of ASTM E 152 for the indicated rating:

Doors Class A, 3-hour rated.

Doors Class B, 1-1/2-hour rated.

Doors Class C, 3/4-hour rated.

Doors Class D, 1-1/2-hour rated.

2.7 SURFACE FINISHING

Zinc-coated steel materials shall be chemically cleaned, rinsed, given a zinc-phosphate conversion coating, rinsed with cold water, and then sealed with a chromic-acid rinse in accordance with FS TT-C-490, Method III, Type I. Minimum weight of the pretreatment coating shall be not less than 150 milligrams per square foot.

Pretreated zinc-coated steel sheets shall be given the manufacturer's standard prime coat of paint applied to both faces of the door after forming.

PART 3 EXECUTION

3.1 GENERAL

Doors, tracks, and operating equipment shall be installed complete with specified preparatory framing, jamb and head mold stops, anchors, inserts, hangers, and equipment supports in accordance with approved drawings, manufacturer's printed instructions, and as specified.

Door guide-track assembly shall be fastened to steel framing with 1/2-inch galvanized machine bolts or lag screws, not more than 24 inches on center, and erected plumb and true to a vertical alignment with not more than 1/8 inch deviation in 20 feet.

Fire doors shall be installed in accordance with NFPA 80 and the manufacturer's standard procedure for the fire rating and type of door operation indicated.

3.2 STEEL FRAMING

Steel framing at jambs and heads of door openings shall be plumb, true, and securely anchored in place. Vertical members shall be plumb, with a deviation of not more than 1/16 inch in 20 feet. Inside faces of steel jambs shall extend to the ceiling or to the minimum headroom height of the door.

3.3 ACCEPTANCE PROVISIONS

After installation, doors, track, and operating equipment will be examined and tested by the Government for general operation, for operation against the specified wind pressure, and for resistance to weather.

Doors that fail the required tests shall be adjusted and retested. Doors that have been adjusted and which fail subsequent tests shall be removed and replaced with new doors. New doors shall be tested and adjusted at no additional cost to the Government.

3.3.1 Maintenance and Adjustment

Not more than 90 days after completion and acceptance of the project, the Contractor shall examine, lubricate, test, and re-adjust doors as required for proper operation.

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SECTION 08345

SOUND CONTROL DOORS

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SECTION 08345

SOUND CONTROL DOORS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 366/A 366M	(1996) Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 568/A 568M	(2000; Rev B) Standard Specifications for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM C 1036	(1991; R 1997) Standard Specification for Flat Glass
ASTM D 1056	(2000) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 2092	(1995) Standard Practice for Preparation of Zinc-Coated Galvanized Steel Surfaces for Painting
ASTM D 4689	(1990) Standard Specification for Adhesive, Casein Type
ASTM E 90	(1990) Standard Test Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI-01	(1986) Architectural Casework - General

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Installation Drawings for the following items shall include a finish hardware schedule for each door (coordinate with Section 08710, "Finish Hardware") and a hollow metal door frame schedule for each door indicating profile, dimensions, hardware

reinforcement, and frame anchorage.

Hollow-Metal Sound Retardant Doors

SD-03 Product Data

Manufacturer's Catalog Data shall include STC ratings, and UL fire rating, where applicable, for the following items:

Hollow-Metal Sound Retardant Doors
Door Frames
Vision Panels
Thresholds
Astragals

SD-06 Test Reports

Test Reports for the following items shall be provided by a nationally recognized, independent acoustical laboratory indicating that the sound transmission classification (STC) of the proposed door, based on tests at 16 third-octave band frequencies from 125 to 4,000 hertz, is no less than the specified STC when tested in accordance with ASTM E 90, and that the door tested is hung in substantially the type of wall and frame as indicated and is fully operable with hardware and perimeter seals installed.

SD-07 Certificates

Certificates of Compliance shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Hollow-Metal Sound Retardant Doors
Door Frames
Seals and Door Bottoms
Thresholds
Astragals
Accessories

1.3 GUARANTEE

Contractor shall guarantee that each door delivered to the project is equal in construction and sound transmission classification to that of the sample door tested and that each door assembly, when installed in accordance with the manufacturer's printed instructions, will have an inplace sound transmission classification within 3 decibels of the specimen tested.

1.4 DELIVERY, HANDLING, AND STORAGE

Doors shall be shipped in the manufacturer's undamaged individual cartons, securely bundled and wrapped with moisture-resistant covers and stored in accordance with the manufacturer's printed instructions in a dry, clean, and ventilated area.

Final adjustment of seals shall be made when temperatures and humidity conditions approximate the interior conditions that will exist when the building is occupied.

1.5 FIELD MEASUREMENTS

Measurements shall be taken prior to preparation of drawings and fabrication.

PART 2 PRODUCTS

2.1 GENERAL

Sound-retardant door assemblies shall include doors of the thickness, width, and height indicated, complete with perimeter seals, seal housings, automatic door bottoms, thresholds, door frames, and astragals as required to conform to the specified STC.

2.2 STC RATING

STC of each door shall be not less than that indicated on drawings.

2.3 HOLLOW-METAL SOUND-RETARDANT DOORS

Door construction shall consist of steel facing sheets conforming to ASTM A 366/A 366M; stretcher-level flatness conforming to ASTM A 568/A 568M; not less than 0.0598 inch thick; free from pitting, scale, and surface defects; separated by a core construction designed to meet the required STC; and tested and rated in accordance with ASTM E 90.

Doors shall have flush seamless face sheets and vertical edges. Joints shall be continuous welded and smooth. Edges shall be flush or rabbeted as required for perimeter seals.

Hardware reinforcement shall be steel drilled and tapped to template requirements and welded in place. Minimum thicknesses shall be as follows:

Butts, 0.1494 inch; locksets, 0.1196 inch 3.04 millimeter; surface-applied hardware, 0.0747 inch 1.90 millimeter

Door surfaces shall be visually flat and free from warp, waviness, and other surface irregularities and defects. Maximum allowable warp or twist shall not exceed 1/8 inch when measured with a 7-foot straightedge along the diagonal and shall not exceed 1/16 inch when measured with a 7-foot straightedge in the width or in any position along the length of the door.

Sound retardant doors, where indicated, shall bear the UL fire rating label and the specified STC label.

Concealed surfaces of exterior doors, except galvanized surfaces, shall be shop painted.

Surfaces shall be thoroughly cleaned of all mill scale, rust, oil, grease, dirt, and other foreign materials before the application of paint.

After cleaning, galvanized surfaces shall be free of paint in accordance with ASTM D 2092, Method A, B, C, or D.

Cleaned prepared surfaces shall be given one shop coat of rust-inhibitive metallic oxide or synthetic resin primer applied to dry surfaces by brush, dipping, or other approved method to provide a continuous minimum dry-film thickness of 0.9 mil (0.0009 inch).

2.4 DOOR FRAMES

Frames shall be fabricated from steel sheets conforming to ASTM A 366/A 366M, not less than 0.0747 inch thick, and free from pitting, scale, stretcher strains, fluting, and surface defects.

Frames shall have 2-inch faces, profiles and dimensions as indicated, with mitered reinforced corners, welded the full depth of frame and trim, with exposed surfaces ground smooth and flush. Contact edges shall be closed to hairline joints.

Hardware reinforcement shall be steel, drilled and tapped to template requirements, and welded in place. Galvanized dust covers shall be welded over reinforcements. Minimum thicknesses shall be as follows:

Butts, 3/16 inch; lock strike, 0.1196 inch; surface-applied hardware, 0.0747 inch

Frame anchors shall be located near the top and bottom of doors and at intermediate points not over 24 inches on center. Not less than three anchors shall be provided per jamb.

Floor-anchor clips shall be provided at each jamb with 2-inch vertical adjustments on increments not exceeding 1/16 inch.

A temporary angle spreader shall be welded to the bottom of each jamb and removed at the time of the frame installation.

Surfaces shall be thoroughly cleaned of all mill scale, rust, oil, grease, dirt, and other foreign materials before the application of paint.

Cleaned prepared surfaces shall be given one shop coat of rust-inhibitive metallic oxide or synthetic resin primer applied to dry surfaces by brush, dipping, or other approved method to provide a continuous minimum dry-film thickness of 0.9 mil (0.0009 inch).

2.5 PERIMETER SEALS AND DOOR BOTTOMS

Seal material for heads, jambs, and door bottoms shall be a closed-cell, expanded cellular rubber conforming to ASTM D 1056, Type S, Grade SBE-42 or SCE-42.

Seals shall be installed in formed steel or extruded aluminum shapes designed to receive and hold seals and to provide concealed adjustable attachment to door frames. Concealed adjustment screws not more than 12 inches on center shall provide at least 3/8-inch adjustment.

Door bottoms shall be assemblies of closed-cell neoprene seals, seal housings, and automatic operating devices, mounted on the doors as indicated. Devices shall be designed to seal the spaces between the doors and the finished floors or thresholds when closed and to retract immediately when doors are opened, with a sill clearance of approximately 1/4 inch.

2.6 THRESHOLDS

Metal thresholds shall be provided where indicated. Thresholds shall be extruded aluminum, 6063-T5 alloy, mill finish, not less than 1/8 inch

thick, with integral seal grooves formed to the indicated section.

2.7 ASTRAGALS

Steel astragals shall be provided for the inactive leaf of each pair of doors, as indicated, and shall be surface-mounted to the door by welded connections or by countersunk, flat-head screws and shall have an integral groove to receive perimeter seal material.

PART 3 EXECUTION

3.1 PREPARATION

Door frames shall be inspected and approved before commencing work.

Door frames shall be plumb and true with not more than 1/32-inch deviation in vertical alignment in 8 feet and shall be anchored to the wall in accordance with the printed instructions of the manufacturer. Frames shall be grouted solid with mortar in masonry, concrete, and plaster wall construction. Frames in dry-wall partitions shall be spot-grouted with mortar at the jamb anchor clips; the space between metal frame and stud partition shall be filled solidly with fiberglass or mineral-wool insulation. Spot-grout the frames at the floor level.

3.2 DOOR INSTALLATION

Doors, hardware, and seals shall be installed and adjusted in accordance with the approved drawings, hardware schedules, and the printed instructions of the door manufacturer.

Perimeter seals and automatic door-bottom seals shall be installed and adjusted to provide positive compression contact with the entire sealing surface with no gaps, openings, or breaks. Hinges or hardware shall not distort or pinch the perimeter seal during operation of the door.

Door-bottom devices shall seal the space between the door bottoms and the finished floor and the space between the seal and seal housing.

Perimeter seal housings shall be field-applied with mitered corners and with flush, aligned hairline joints.

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SECTION 08520

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SECTION 08520

ALUMINUM WINDOWS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ALUMINUM ASSOCIATION (AA)

AA 45	(1980) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101	(1993) Voluntary Guide Specifications for Aluminum and Polyvinylchloride (PVC) Prime Windows and Sliding Glass Doors
AAMA 701	(1992) Voluntary Specification for Pile Weather Strip
AAMA 902	(1992) Voluntary Specification for Sash Balances
AAMA WSG-1	(1988) Selection Guide for Architectural Aluminum Windows

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(2000; Rev A) Standard Specification for Carbon Structural Steel
ASTM A 501	(2001) Standard Specification for Hot-Formed Welded and Seamless Carbon-Steel Structural Tubing
ASTM A 570/A 570M	(1996) Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM B 117	(1997) Standard Test Method of Salt Spray (Fog) Testing
ASTM B 221	(1995; Rev A) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM B 221M	(1996) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes (Metric)
ASTM B 244	(1979; R 1993) Standard Method for

	Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments
ASTM B 584	(1998 Rev A) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM C 920	(1998) Standard Specification for Elastomeric Joint Sealants
ASTM D 1056	(2000) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1593	(1992) Standard Specification for Nonrigid Vinyl Chloride Plastic Sheeting
ASTM E 437	(1992) Standard Specification for Cloth and Screen, Industrial Wire (Square Opening Series)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A39.1	(1987; Special Notice August 1987; Addenda A 1988) Safety Requirements for Window Cleaning
ASME B29.11M	(1984) Combination Chains, Attachments and Sprocket Teeth

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.16	(1989) Auxiliary Hardware

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AMS 3110G	(1992) Primer, Zinc Chromate

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 101	(1991) Aluminum Alkyd Paint Leafing (Type I) and Non-Leafing (Type II)
SSPC Paint 12	(1982) Paint Specification No. 12 Cold-Applied Asphalt Mastic (Extra Thick Film)

STEEL WINDOW INSTITUTE (SWI)

SWI-01	(1989) The Specifier's Guide to Steel Windows

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings shall show complete window assembly including hardware, weatherstripping, and subframe assembly details. Window elevatons, sectons thickness and gages of metal, anchoring,details of construction and installation and other relarlted items for Aluminum Window Units.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items, including operating hardware, locking assemblies and strikes, and weatherstripping.

Casement Windows
Fixed Windows

SD-04 Samples

The following samples shall be full-sized as used in construction, and may be used in the work when approved, and the location shall be recorded.

Casement Windows
Fixed Windows

1.3 DELIVERY, HANDLING, AND STORAGE

Windows, mullions, accessories, and trim shall be delivered in the manufacturer's unbroken containers and shall be handled carefully at all times to prevent damage.

Windows shall be stored on edge above ground and protected from the weather in accordance with the manufacturer's directions.

1.4 FIELD MEASUREMENTS

Field measurements shall be taken prior to preparation of the drawings and fabrication.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Wind Loading Design Pressure

Window components, including mullions, hardware, and anchors, shall be designed to withstand a wind-loading design pressure of at least or as noted on structural drawings.

1.5.2 Tests

Windows proposed for use shall be tested in accordance with AAMA 101 for the particular type and quality window specified.

Tests shall be performed by a nationally recognized independent testing laboratory equipped and capable of performing the required tests. Results of the tests shall be submitted as certified laboratory reports required herein.

Minimum design load for a uniform-load structural test shall be as noted on structural drawings.

Windows shall be tested in accordance with the applicable portions of the AAMA WSG-1 for air infiltration, water resistance, condensation resistance, uniform-load deflection, and uniform-load structural test.

PART 2 PRODUCTS

2.1 WINDOWS

Windows shall be high-performance classification casement aluminum sash complete with fins, closures, accessories, fittings, and trim, meeting or exceeding AAMA 101 for Type P-A2-HP and the requirements specified.

Windows, mullions, hardware, and anchors shall be designed to withstand the wind loading specified.

2.1.1 Materials

Frames, ventilators, mullions, mullion covers, glazing beads, and fittings shall be extruded aluminum shapes fabricated from aluminum conforming to ASTM B 221, 6063-T5 alloy, AAMA 101. Aluminum sheet and plate shall be 5005 alloy, temper as required.

Joint sealing compound shall be a gun grade, nonsag, single-component butyl or acrylic sealant conforming to ASTM C 920.

Weatherstripping shall be extruded flexible polyvinylchloride, weatherstripping grade, conforming to ASTM D 1593, Type I, with a tensile strength of at least 2,200 pounds per square inch (psi) and a tear strength of not less than 275 pounds per inch.

2.1.2 Steel Subframes

Subframe members shall be the size and weight indicated, formed from steel sheets conforming to ASTM A 570/A 570M, steel shapes conforming to ASTM A 36/A 36M, or steel tubing conforming to ASTM A 501. Members shall be coated as specified under "Dissimilar Materials" herein.

2.1.3 Construction

Windows shall be unequal-leg type, double-contact weathering, with 5/8-inch anchorage and a combined depth of frame and ventilator of not less than 1-3/4 inches. Frame shall be not less than 1-1/2 inches deep, and the ventilator shall be not less than 1-5/8 inches deep. Minimum web thickness for solid sections shall be 1/8 inch, and the minimum web thickness for solid-ventilator hardware rails shall be at least 3/16 inchTubular sections shall have a minimum web thickness of 3/32 inchand flanges shall be not less than 1/8 inch thick.

Allowance for expansion between component parts shall be provided for window assemblies.

Integral drip holes or weepholes shall be provided for exterior in-sill sections at not more than 2 feet on center.

Tubular sections shall be used in horizontal meeting rails longer than 48-7/8 inches.

Corners of window frame assemblies shall be coped, double mortised-and-tenoned, and riveted, or shall be mitered and welded.

Corners of ventilator frames shall be mitered and welded; mortise and tenon construction is not permitted.

Welds shall be continuous across the web member and up the abutting flanges on the unexposed surface. Welds shall be dressed smooth and flush on exposed and contact surfaces and shall exhibit no discoloration, pitting, or surface defects.

Corner joints shall be accurately fitted, flush, watertight hairline joints not exceeding 1/64 inch in width. Joint-sealing compound shall be applied to the unexposed surface of all mortise and tenon joints.

Ventilators shall be handle operated. Provide ventilators over high with two separate locking devices or a two-point locking device operated by rods from a single lever handle Conceal rods where possible. Provide casement windows in combination with curtain wall specified in Section 08900, "Glazed Curtain Walls."

Ventilator hardware and balance-arm assembly shall be attached to ventilator and frame members with corrosion-resistant steel screws threaded into serrated corrosion-resistant steel grommet inserts.

2.1.4 Hardware

Operating hardware shall be nickel-silver castings conforming to ASTM B 584, Alloy C97600, or AISI Series 18-8 corrosion-resistant steel. Hardware shall be a modern design, smoothly finished, free of defects, and suitable for the intended purpose.

Cam-action locking handles and strikes shall be provided for projected-out vents; cam-action locks and keepers shall be provided for projected-in vents.

Strikes and contact surfaces for lock fasteners shall be corrosion-resistant steel, nickel silver, or a similar abrasion-resistant metal.

2.1.5 Glazing Provisions

Windows shall be designed for outside glazing, using glazing clips and glazing compound as specified in Section 08805, "Glass and Glazing".

2.1.6 Weatherstripping

Windows shall have single continuous extruded weatherstripping set in integrally formed pockets in the sash.

2.1.7 Aluminum Sills

Sills shall be the profiles and dimensions indicated, the same alloy and finish as windows, at least 1/8 inch thick, and furnished the full width of the window opening.

Sills shall be securely anchored in place with concealed anchors not more than 18 inches on center.

2.2 FINISH

Aluminum windows, mullions, glazing beads, trim, and accessory fittings shall be cleaned, and receive an Architectural Class II natural anodic coating (designation AA-M-12C22A31) in accordance with AA 45. Anodic coating shall be not less than 0.4 mil. The finish color shall be as scheduled and approved.

Thickness of the anodic coating shall be tested in accordance with ASTM B 244.

PART 3 EXECUTION

3.1 INSTALLATION

Windows shall be set plumb, level to a tolerance of not more than 1/16 inch in 10 feet and in alignment without frame distortion and securely anchored in place as indicated, in accordance with the manufacturer's printed instructions and the approved drawings.

Fasteners shall be concealed except for specifically indicated mullion covers, window-operating hardware, screen attachment hardware, and similar surface-applied trim.

Ventilators and operating parts shall be protected against cement, lime, plaster, adhesives, and other building material after installation and until completion.

Steel work shall be drilled and tapped for the attaching window units, trim, and accessories. Where window units are set in prepared masonry openings, anchorage items shall be placed during wall construction. Anchors and fasteners shall be welded or bolted securely to the frame and shall be built-in, anchored, or bolted to the building construction with sufficient anchors to hold each window unit firmly in place. Anchors shall be not more than 18 inches on center at heads, jambs, and sills.

Fasteners, clips, fittings, aluminum trim, closures, and shapes shall be provided as indicated and as required to provide a complete installation.

Joints shall be sealed between sash units, aluminum sills, mullions, and covers and similar metal-to-metal contact surfaces with sealant or tape as recommended and furnished by the window manufacturer. Installations shall be weathertight.

Joint sealing and calking between metal and masonry is specified in Section 07920, "Joint Sealants ."

3.2 DISSIMILAR MATERIALS

Aluminum shall be kept from direct contact with steel or other dissimilar materials by painting, nonabsorptive tape, gasket, or other approved system as recommended by the manufacturer and as specified.

Aluminum surfaces in contact with steel shall be given one coat of zinc-chromate primer conforming to SAE AMS 3110G, applied to a dry-film thickness of not less than 1.5 mils, or one coat of a suitable nonhardening joint compound capable of excluding moisture from the joint during prolonged service.

Steel surfaces in contact with aluminum shall be given one coat of zinc-chromate paint conforming to SAE AMS 3110G, applied to a dry-coat thickness of 1.5 mils, and two or more coats of aluminum paint conforming to SSPC Paint 101, aluminum alkyd, Type II, applied to a dry-film thickness of 1.5 mils for each coat and a total dry-film thickness of 3.0 mils.

Corrosion-resistant, aluminized, or hot-dip galvanized steel placed in contact with aluminum need not be painted.

Aluminum surfaces placed in contact with wood, concrete, or masonry construction shall be given one coat of bituminous paint conforming to SSPC Paint 12, applied to a thickness of at least 1/16 inch.

3.3 ADJUSTMENT AFTER INSTALLATION

After the sash is erected and glazed, ventilators shall be lubricated and adjusted for smooth weathertight operation. Guides shall be waxed or lubricated and balances shall be adjusted for the proper tension.

Weatherstripping shall make weathertight contact around the entire weatherstripped area when ventilators are closed and locked. Weatherstripping shall not cause the sash to bind or prevent closing and locking the ventilator.

3.4 CLEANING AFTER INSTALLATION

Interior and exterior metal surfaces of windows shall be cleaned of mortar, plaster, paint spattering or spots, and other foreign matter, and washed with soap and water, brushed with a fiber brush, and thoroughly rinsed with clear water. Acid solutions, steel wool, or other harsh abrasives shall not be used.

Stained or discolored windows shall be cleaned in accordance with the window manufacturer's recommendations. Windows that cannot be satisfactorily cleaned and windows with abraded, stained, or defective surface finish that cannot be satisfactorily repaired shall be replaced.

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SECTION 08710

FINISH HARDWARE

05/96

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SECTION 08710

FINISH HARDWARE
05/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ALUMINUM ASSOCIATION (AA)

AA 45	(1980) Designation System for Aluminum Finishes

STEEL DOOR INSTITUTE (SDOI)

SDI-100	(1991) Recommended Specifications for Standard Steel Doors and Frames

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1	(2000) Butts and Hinges
BHMA A156.15	(1995) Closer Holder Release Devices
BHMA A156.2	(1996) Bored and Preassembled Locks and Latches
BHMA A156.3	(2001) Exit Devices
BHMA A156.4	(2000) Door Controls - Closers
BHMA A156.5	(1992) Auxiliary Locks and Associated Products
BHMA A156.6	(2001) Architectural Door Trim
BHMA A156.8	(2000) Door Controls - Overhead Holders
BHMA A156.13	(1994) Mortise Locks & Latches
BHMA A156.16	(1989) Auxiliary Hardware
BHMA A156.18	(2000) Materials and Finishes
BHMA A156.21	(1989) Thresholds

FEDERAL STANDARDS (FED-STD)

FED-STD-795	(1988) Uniform Federal Accessibility Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1992) Fire Doors and Windows

UNDERWRITERS LABORATORIES (UL)

UL-02 (2000) Building Materials Directory

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Submit installation drawings for finish hardware, including hardware schedule indicating door and frame locations, type, size, swing, bevel, material, hardware type by Builders' Hardware Manufacturer's Association (BHMA) numbers, and the respective manufacturer's type, name, number, finish, and design.

SD-03 Product Data

Submit material, equipment and fixture lists for finish hardware prior to the submission of installation drawings, including manufacturer's catalog data for each type of finish hardware consisting of a list of the proposed finish hardware by manufacturer, type, name, series, material, finish, installation instructions, maintenence of operating parts and other information necessary to show compliance with requirements.

SD-04 Samples

The Contractor shall provide a sample of each finish hardware item, including lock cylinder and construction core properly marked and tagged for identification. Samples that are on file shall be identified with an "F" on the sample tag. Samples that are not on file shall be identified with and "NF" on the sample tag.

SD-10 Operation and Maintenance Data

The Contractor shall submit 4 copies of Operation and Maintenance Manuals for finish hardware. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

Operation and maintenance manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions.

1.3 HARDWARE SCHEDULE

Provide hardware schedule for each door to comply with hardware set numbers indicated in Door Schedule and in the following schedule of hardware sets. Hardware sets indicate items, quantities, BHMA or manufacturer's product designations, sizes, and finishes as applicable.

1.3 SUPPLIER QUALIFICATIONS

Supplier of finish hardware shall be a firm specializing in supplying commercial door hardware with minimum five years documented experience. Supplier shall employ an experienced architectural hardware consultant (AHC) to assist in the work of this section.

1.4 REGULATORY REQUIREMENTS

Finish hardware used in fire rated door assemblies shall comply with NFPA 80 and be listed by UL-02, or other nationally recognized testing and inspection agency, for the specific application.

Finish hardware shall comply with FED-STD-795 for handicapped accessibility requirements.

1.5 DELIVERY, STORAGE AND HANDLING

Deliver hardware wrapped and sealed in the manufacturer's original cartons complete with the correct fastenings. Label and identify each hardware item for room and location, and identified with the proper door frame and hardware schedule number.

1.6 WARRANTY

Provide a written extended warranty from the hardware manufacturer indicating that locks and latches are free from defects in material, workmanship for a period of five years after acceptance of the Project.

The warranty shall indicate that upon notification by the Government, the Contractor shall immediately correct defects in material, workmanship, and hardware operation during the warranty period at no cost to the Government.

Inability of the Government to properly install, operate and maintain permanent lock cores after acceptance shall be considered a defect and shall require that the hardware be replaced with new hardware in which permanent lock cores can be installed and operated properly.

1.7 MAINTENANCE

Submit to the Contracting Officer at the completion of the Project, a complete set of specialized tools and maintenance instructions for continual hardware adjustment, maintenance, removal, and replacement by the Government. Tools shall include adjustment wrenches for locksets and control valve keys for door closers.

PART 2 PRODUCTS

2.1 SCHEDULED HARDWARE

Refer to hardware schedule of this section for type, grade, function, finish, size, and other requirements for each finish hardware item.

Builders Hardware Manufacturing Association, Inc. (BHMA) designations are used in the hardware schedule and elsewhere in this section to define quality and function of finish hardware items. Provide products complying with BHMA Standards.

2.2 BUTTS AND HINGES

Butts and hinges shall conform to BHMA A156.1. Provide type, grade, and finish indicated in hardware schedule. Except for hinges and pivots to be installed on to wood doors and frames, provide only templated units. Hinges for exterior doors shall be bronze or corrosion-resistant steel unless indicated otherwise.

Provide non-removable pins at out-swing exterior doors and out-swing corridor doors with locksets. Provide non-rising pins at interior doors. Provide two hinges for doors 5 feet and less in height, and one additional hinge for each additional 30 inches in height or fraction thereof.

Doors 36 inches wide and wider shall have hinges with ball bearings or oil-impregnated bearings.

Doors hung on offset floor hinges shall have an intermediate pivot.

Provide hinges with leaves of sufficient width to clear the trim but not less than the following sizes:

DOOR THICKNESS	HINGE SIZE
1-3/8 inches	3-1/2 x 3-1/2 inches
1-3/4 inches	4-1/2 x 4-1/2 inches
2-1/4 inches	5 x 5 inches

Doors wider than 40 inches shall have hinges 5 x 4-1/2 inches or larger, suitable to door thickness.

2.3 LOCKS AND LATCHES

2.3.1 General Requirement

Latchsets shall have standardized fronts, cases, and strikes so that varying functions are interchangeable and 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.

2.3.2 Cylindrical Locks and Latches

Cylindrical locks and latches shall be bored and preassembled and conform to BHMA A156.2, Series 4000, Grade 1. Provide type, function, and finish indicated.

Lever style for cylindrical locks and latches shall match "Style 14" (curved return) manufactured by the Best Lock Corporation. Rose style shall match "Style C" (3-inch convex) manufactured by the Best Lock Corporation.

2.3.3 Mortise Locks and Latches

Mortise locks and latches shall conform to BHMA A156.13, Series 1000, Grade 1. Provide type, function, and finish indicated.

Lever style for mortise locks and latches shall match "Style 14" (curved return) manufactured by the Best Lock Corporation. Trim style shall match "Style J" (wrought brass or bonze, 2-1/4 x 7-1/2 inches) manufactured by the Best Lock Corporation.

2.4 LOCK CYLINDERS

Provide locks with cylinders that accept government furnished interchangeable 7-pin tumbler core inserts manufactured by the Best Lock Corporation. Core insert face shall fit flush with front of lock housing and be of same finish as lockset finish.

Provide and maintain temporary brass core inserts during the construction period. If temporary construction core inserts cannot be operated by core keys manufactured by the Best Lock Corporation, provide twelve keys which will operate the temporary construction core inserts for emergency access by the GSFC Security Office during the construction period.

Temporary construction core inserts manufactured by Best Lock Corporation shall become the property of the Government at completion of the Project. The GSFC Security Office will replace the temporary inserts with permanent core inserts manufactured by the Best Lock Corporation and return the temporary inserts directly to the Best Lock Corporation. Temporary construction cores and keys manufactured by other manufacturers will be returned to the Contractor after permanent cores manufactured by the Best Lock Corporation are installed by the GSFC Security Office.

2.5 PANIC EXIT DEVICES

Exit devices shall conform to BHMA A156.3 and shall be the type, function, and finish specified in the hardware schedule. Exit devices shall be listed by Underwriters Laboratories, Inc. (UL), bear the UL label and be ADA compliant.

2.6 FLUSH BOLTS

Flush bolts shall be the concealed-lever extension type with a cast-aluminum front plate, conforming to BHMA A156.16 Type L04261 or L04251 for fire rated door.

2.7 DEADLOCKS

Deadlocks shall be mortised, one-point maximum security type. Basket dimensions, front shape, and hand shall be suitable for the door stile. Dead locks shall receive the lock cylinder in with paragraph entitled, "LOCK CYLINDERS" of this section, without modification.

2.8 PUSH/PULL UNITS

Push and pull units shall conform to BHMA A156.6. Provide types and finishes indicated in hardware schedule. Provide manufacturer's standard exposed fasteners for installation, through bolted for matched pairs but not for single units. Push plates and plates with door pulls shall be not less than 6 x 16 inches x 0.050 inch thick.

2.9 CLOSERS AND DOOR CONTROL DEVICES

Closers and door control devices shall conform to BHMA A156.4, Grade 1, medium duty. Provide type, size and finish as indicated in hardware schedule.

Closers shall feature full rack and pinion operation, adjustable backcheck, and separate valves to regulate door and latching speed. Provide hold-open devices on closers except those installed on labeled and exterior doors. Provide parallel-arm closers for outswinging exterior doors, doors less than 7 feet in height, and special conditions require parallel-arm operation. Provide brackets, reinforcing plates, and accessory fittings shall be as required for proper installation.

Provide combination door closers and holders which are designed to hold door in open position under normal usage and to release and close door under fire conditions. Incorporate an integral electro magnetic holder mechanism designed for use with UL listed fire detectors and normally closed switching contacts.

Closers shall be provided on emergency fire exits, UL labeled, exterior, rest rooms, and general office doors and where specified in the hardware schedule.

Electro-magnetic door holders specified herein shall be provided under Section 13851, "Fire Alarm Systems". Devices shall conform to requirements of BHMA A156.15.

2.10 COORDINATING DEVICE

Coordinating devices shall conform to BHMA A156.3. Provide finish to match the locksets.

2.11 AUXILIARY HARDWARE

Auxiliary hardware shall conform to BHMA A156.16, except as noted, and shall match or have the same finish as lockset finish, except when indicated otherwise.

Provide door silencers conforming to BHMA A156.16, except where specifically indicated otherwise. Provide Type L03011 for metal frames and Type L03021 for wood frames. Provide three silencers for single doors and four for dutch doors. Provide two silencers for each leaf of pairs of doors for installation in the head rail of door frame.

2.11.1 Door Stops and Roller Bumpers

Door stops or bumpers conforming to BHMA A156.16 shall be provided to protect the hardware and prevent doors from striking walls and fixtures.

Wall-mounted door stops Type L02061 or L02101 shall be provided where practical. Where impossible to install wall-mounted stops, floor-mounted stops Type L12141 or L12161 shall be provided.

A roller bumper Type L02191, L02201, or L02211, shall be provided where two swinging doors interfere with each other.

2.12 PROTECTION PLATES

Door protection plates shall conform to BHMA A156.6. Metal protection plates shall be corrosion-resistant steel with minimum thickness of 0.050 inches. Width of kick, mop, and armor plates shall be 2 inches less than the width of door. Height of plates shall be as indicated.

2.13 ASTRAGALS

Astragals for both wood and metal doors shall be primed steel, 1/8 inches thick x 2 inches wide , with rounded corners and edges.

2.14 WEATHERSTRIPPING AND SEALS

Provide continuous weatherstripping on exterior doors, and on smoke, light, or sound seals on interior doors as indicated. Provide only those units in which the seal strip is easily replaceable and readily available from manufacturer.

Weatherstripping at door heads and jambs shall consist of expanded or solid neoprene strip, contained in an extruded aluminum housing, 0.062-inch minimum thickness, with clear anodized finish.

Weatherstripping at meeting styles for pairs of single-acting exterior doors shall consist of feather-edged neoprene strips, housed in extruded aluminum Z-shaped strips, 0.062-inch minimum thickness, with clear anodized finish. Provide one strip on each door leaf, overlapping, and full height of door.

Door rain drips shall be approximately1-1/2 inches high with5/8 inch projection, and length equal to overall width of door. Overhead rain drips shall be approximately 1-1/2 inches high with 2-1/2 inchprojection, and length equal to overall width of door frame.

Automatic door bottoms shall be an automatically operating assembly composed of a rubber seal, a metal seal housing, and an automatic operating device mounted on the bottom of the door as indicated. The device shall be designed to seal the space between the bottom of the door and the finished floor when closed and to retract immediately when the door is opened to provide a sill clearance of approximately 1/4 inch. Provide type and size indicated with an STC rating of 48.

2.15 THRESHOLDS

Provide standard metal thresholds complying with BHMA A156.21, of type, size, and profile indicated. Provide thresholds not less than 4 inches wide, formed to accommodate changes in floor elevation, and fabricated to accommodated door hardware and frames.

Thresholds shall be extruded aluminum, mill finished.

2.16 FASTENERS

Provide fasteners of the proper type, size, quantity, and finish for each finish hardware item. Machine screws and expansion shields shall be used for attaching hardware to concrete , stone, or masonry. Visible fasteners shall be phillips-head, bronze or corrosion-resistant steel, and finished to match specified hardware.

2.17 FINISHES

Hardware finishes shall conform to BHMA A156.18.

Provide finish hardware with BHMA 626 (satin chromium plated with brass or bronze base material) finish, unless indicated otherwise.

Provide steel hinges with BHMA 652 (satin chromium plated) finish. Hinges for exterior doors shall be stainless steel with BHMA 630 (satin stainless steel) finish, or brass or bronze with BHMA 626 (satin chromium plated) finish.

PART 3 EXECUTION

3.1 INSTALLATION

Install each hardware unit in accordance with the manufacturer's instructions. Set units level and plumb, and in proper location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

Drill and countersink units which are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

Set thresholds for exterior doors in full bead of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Section 07920, " Joint Sealants ".

3.2 HARDWARE LOCATION

Install hardware in accordance with SDI-100, FED-STD-795, and as follows, except when template dimensions and multiple-item installations require alternative locations:

HARDWARE ITEM	LOCATION
Top hinge	Center of hinge not more than 11 inches below top of door.
Bottom hinge	Center of hinge not more than 13 inches above finished floor line.
Intermediate hinge	Equal distance between top and bottom hinges or pivots
Latch and lock sets	40-5/16 inches above finished floor to latch center of strike
Deadlock strikes	48 inches above finished floor to center of lock strike
Exit devices	40-5/16 inches above finished floor to center of strike
Door pulls	42 inches above finished floor to center of pull
Push plates and bars	42 inches above finished floor to center of plate or bar
Door closer	Install and adjust in accordance with template dimensions. Except where impractical, closer shall be mounted on room side of doors opening into corridors, halls, and reception areas.

HARDWARE ITEM	LOCATION
Kick plates	Install on push side of single-acting doors and on both sides of double-acting doors

3.3 ADJUSTING

Adjust and check each operating item of finish hardware and each door to ensure proper and smooth operation. Replace units which cannot be adjusted to operate properly.

3.4 CLEANING

Clean hardware and adjacent surfaces soiled by hardware installation. After cleaning, protect hardware against damage.

3.5 DEMONSTRATION

Instruct Government personnel in the proper adjustment and maintenance of door hardware and hardware finishes.

-- End of Section --

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SECTION 08805

GLASS AND GLAZING

03/97

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SECTION 08805

GLASS AND GLAZING
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 800	(1992) Voluntary Specifications and Test Methods for Sealants

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(1984; R 1994) American National Standards for Safety Glazing Material Used in Buildings - Safety Performance Specifications and Methods of Test

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036	(1991; R 1997) Standard Specification for Flat Glass
ASTM C 669	(2000) Standard Specification for Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C 920	(1998) Standard Specification for Elastomeric Joint Sealants

CODE OF FEDERAL REGULATIONS (CFR)

16 CFR 1201	Safety Standard for Architectural Glazing Materials

FEDERAL SPECIFICATIONS (FS)

FS TT-P-00791	(Rev B; Am 2) Putty; Linseed-Oil Type, (For Wood-Sash-Glazing)

FLAT GLASS MARKETING ASSOCIATION (FGMA)

FGMA-01	(1990) Glazing Manual

UNDERWRITERS LABORATORIES (UL)

UL-02	(2000) Building Materials Directory

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-04 Samples

Contractor shall submit the following samples:

Not less than 2 different samples 10 by 12 inches of each glass of the specified type, class, thickness, and finish shall be provided for inspection and approval by the Contracting Officer prior to delivery of material to site.

Color samples of each color and type of glazing and sealing compound to be used in the work, beads approximately 1/4-inch wide by 1 inch long, to illustrate the glazing or sealing compound manufacturer's standard color range after setting or curing.

Clear Glass
Heat Absorbing Glass
Tinted Glass
Safety Rated Tempered Glass
Double Glassing Units
Fire-Rated Wired Glass
Glazing Compound
Elastomeric Sealing Compound

SD-07 Certificates

Certificates of Compliance shall be submitted for the following items showing conformance with the referenced standards and tests contained in this section.

Glass Materials
Glazing Materials
Tempered Glass
Fire Rated Glass

1.3 DELIVERY, STORAGE AND HANDLING

Manufactured glass units shall be delivered and stored until installation in the manufacturer's container's and shall be clearly marked on the exterior as to type, and quantity of units.

When special moisture protection is required, glass shall be stored in accordance with the manufacturer's recommendations.

PART 2 PRODUCTS

2.1 GLASS

Glass in doors and sidelights shall be safety glazing material conforming to 16 CFR 1201.

2.1.1 Clear Glass

Glass shall be float type conforming to ASTM C 1036, Type I, Class 1,

Quality q3.

Clear sheet glass shall conform to ASTM C 1036, Type II, Class 1.

Maximum allowable areas of glass subject to wind pressure shall conform to the glass manufacturer's recommendations.

2.1.2 Heat-Absorbing Glass

Glass shall be float type conforming to ASTM C 1036, Type I, Class 2, Quality q3. Edges shall be factory shop clean-cut.

Tint shall be light green.

Maximum allowable areas of glass subject to wind pressure shall conform to the glass manufacturer's recommendations.

2.1.3 Tinted Glass

Glass shall be float type conforming to ASTM C 1036, Type I, Class 3, Quality q3. Edges shall be factory or shop clean-cut.

Tinted sheet glass shall conform to ASTM C 1036, Type II, Class 3.

Tint shall be light green.

Maximum allowable areas of glass subject to wind pressure shall conform to the glass manufacturer's recommendations.

2.1.4 Safety-Rated Tempered Glass

Glass for entrance doors and sidelights shall conform to ANSI Z97.1 and shall bear the ANSI safety glass marking.

Glass before tempering shall be the float type conforming to ASTM C 1036, Type I, Class 1, Quality q3.

Glass shall be factory-cut to suit each opening. Edges shall be clean cut.

2.1.5 Fire-Rated Wired Glass

Glass shall be UL approved for fire windows and doors, shall be listed in the UL-02, Guide Designation KCMZ, and shall bear the UL listing and marking.

Polished wire glass shall conform to ASTM C 1036, Type II, Class 1, Form 1, Mesh m1.

2.1.6 Double-Glazing Units

Units shall be factory fabricated, shall be two panels of flat glass separated by a hermetically sealed, dehydrated air space.

Maximum allowable areas of glass subject to wind pressure shall conform to the glass manufacturer's recommendations.

Clear double-glazing units shall be as follows:

OUTER PANE GLASS, THICKNESS	INNER PANE GLASS, THICKNESS	AIR SPACE WIDTH	EDGE SEAL
Clear float 1/4 inch thick	Same as outer pane outer pane	1/2 inch	Metal

Tinted double-glazing units shall be as follows:

	OUTER PANE GLASS, THICKNESS	INNER PANE GLASS, THICKNESS	AIR SPACE WIDTH	EDGE SEAL
Type 1.	Tinted plate, green tint with Low-E coating	Clear plate or float 1/4" thick	1/2 inch	Metal
Type 2.	Tinted plate, green tint with Low-E coating	Clear plate or float 1/4" thick	1/2 inch	Metal
Type 3.	Tinted plate, green tint with Low-E coating	Clear plate or float 1/4" thick	1/2 inch	Metal
Type 6.	Clear tempered 1/4" thick Low-E coating	Clear tempered 1/4" thick	1/2 inch	Metal
Type 7.	Tinted tempered green tint, same as Type 2 1/4" thick	Clear tempered 1/4" thick	1/2 inch	Metal
Type 8.	Tinted plate, green tint, same as type 3 1/4" thick	Clear tempered 1/4" thick thick	1/2 inch	Metal

Units shall comply with the following minimum Performance Data:

Window
U-Factor .40 or less
Solar Heat Gain Coefficient (SHGC) .40 or less
Visible Transmitance (VT) .6 or higher

Skylights
U-Factor .45 or less
Solar Heat Gain Coefficient (SHGC) .55 or less
Visible Transmitance (VT) .6 or higher

2.1.7 Low Emissivity Glass

Insulating glass units (IGU) shall have a thin metallic high-transmittance coating applied to the number 2 surface of the unit. The U-value for the IGU shall be no greater than specified.

2.2 GLAZING MATERIALS

2.2.1 Elastic Glazing Compound

Elastic glazing compound shall conform to ASTM C 669.

Color of the sealing compound shall match the color of the metal sash as closely as possible.

2.2.2 Thermoplastic Sealing Compound

Compound shall be one-component acrylic terpolymer base conforming to ASTM C 920. Compound shall match the color of the metal sash as closely as possible.

2.2.3 Glazing Tape

Tape shall be nonskinning, nonoily, reinforced class, butyl- or polyisobutylene-base resilient preformed compound conforming to AAMA 800.

2.2.4 Elastomeric Sealing Compound

Compound shall be the two-component, nonsag type, resistant to 50 percent total joint movement, conforming to ASTM C 920, Type S, Grade NS, Class 25.

Compound shall match the color of the metal sash as closely as possible.

Primer for the compound shall be as recommended by the elastomeric sealing compound manufacturer.

2.2.5 Solvents and Cleaning Agents

Solvents, cleaning agents, and other cleaning materials shall be as recommended by the glazing-material manufacturer.

2.2.6 Glazing Clips

Clips shall be zinc-coated or copper-clad spring-steel wire or nonferrous metal and shall be the type, sizes, and shapes suitable for the intended use.

2.2.7 Resilient Setting Blocks and Spacers

Blocks shall be solid chloroprene elastomeric extrusions having a Shore A durometer hardness between 70 and 90. Thickness shall be approximately the same as the glass-edge clearance dimension; the length shall be 4 inches, minimum.

Spacers shall be solid chloroprene elastomeric extrusions having a Shore A durometer hardness between 40 and 50. Spacers shall be 2- to 3-inches long with thickness and height to suit the application.

PART 3 EXECUTION

3.1 GENERAL

Glass shall be installed in accordance with the manufacturer's printed instructions.

Field cutting, or nipping or grinding the edges of glass will not be permitted.

Sheet glass shall be installed with the wave horizontal.

Operable sash shall move freely and properly in the frame of the unit prior to the start of glazing. Movable items shall be securely fixed or in a closed and locked position until the glazing material has set.

Sizes of glass shown on drawings are approximate. Sizes and proper edge clearances shall be determined by measuring the actual unit to receive glass. Except where specified otherwise, each piece of glass shall bear the manufacturer's label to identify its type as well as thickness and quality. Labels shall not be removed until final approval is obtained.

3.2 TEMPERATURE AND ATMOSPHERIC CONDITIONS

Glazing materials shall not be installed when the ambient temperature is below 40 or above 100 degrees F.

Exterior glazing shall not be performed in damp or rainy weather.

3.3 GLAZED OPENINGS PREPARATION

Surface of rabbets shall be clean and dry prior to the start of glazing.

Surfaces in contact with glazing materials shall be clean and free of loose particles, surface dust, and other foreign matter.

When elastomeric sealing compound is used, the surfaces shall be cleaned with a solvent that leaves no residue. Surfaces shall be wiped dry before the solvent has air dried.

3.4 CLEARANCES AND POSITIONING GLASS

Face and edge clearances and positioning glass with setting blocks and spacers shall be as recommended in the FGMA-01.

3.5 APPLICATION OF GLAZING COMPOUNDS

Glazing compounds shall be installed in accordance with the manufacturer's printed instructions.

3.6 SINGLE GLASS IN METAL SASH WITH FACE GLAZING

Single-glass lights up to 50 united inchesin size, with the greatest dimension not exceeding 30 inches, shall be set in metal sash with elastic glazing-compound back bed, heel bead, and front putty.

Single-glass lights between 50 and 100 united inches in size, with the greatest dimension between 30 and 50 inches,, shall be set in metal sash with a glazing-tape back bed, an elastic-glazing compound heel bead, and front putty.

Glass lights shall be secured with glazing clips placed at sill, head, and jambs 18 inches on center, minimum. Each ventilator shall be provided with a minimum of four glazing clips.

Front of each glass light edge in the sash rabbet shall be face-puttied with elastic glazing compound to form a triangular fillet, stopping 1/16 inch short of the sight line. Corners shall be mitered finish and excess compound shall be removed. Surplus back-bed material shall be stripped at an angle without undercutting.

3.7 SINGLE GLASS IN METAL SASH WITH CHANNEL GLAZING

Single-glass lights up to 100 united inchesin size shall be set in metal sash with thermoplastic sealing-compound back bed, heel bead, and bedding of stop.

Single-glass lights shall be set in metal sash with glazing-tape back bed, elastomeric sealing-compound heel bead, glazing-tape bedding of stop, and elastomeric sealing-compound topping bead on both sides of the glass light. Glazing tape shall be kept down at least 1/8-inchbelow the sight line.

Clear-glass lights between 100 and 150 united inches in size shall be set with glazing-tape back bed, thermoplastic sealing-compound heel bead, glazing-tape bedding of stop, and thermoplastic sealing-compound topping bead on both sides of the glass light. Glazing tape shall be kept down at least 1/8-inch below the sight line.

Single-glass lights over 100 united inchessize shall be set with glazing tape-back bed, elastomeric sealing-compound heel bead, glazing-tape bedding of stop, and elastomeric sealing-compound topping bead on both sides of the glass light. Glazing tape shall be kept down at least 1/8-inch below the sight line.

Heat-absorbing glass lights over 100 united inches in size shall be set with glazing-tape back bed, elastomeric sealing-compound heel bead, glazing-tape bedding of stop, and elastomeric sealing-compound topping bead on both sides of the glass light. Glazing tape shall be kept down at least 1/8-inch below the sight line.

Tinted-glass lights over 100 united inches in size shall be set with glazing-tape back bed, elastomeric sealing-compound heel bead, glazing-tape bedding of stop, and elastomeric sealing-compound topping bead on both sides of the glass light. Glazing tape shall be kept down at least 1/8-inch below the sight line.

A void shall be provided at the head and jambs for clear-glass, wired-glass, and figured-glass lights over 100 united inches in size and for all heat-absorbing glass and tinted-glass lights.

Excess sealing compound on the sash shall be removed with a glazing knife at a slight angle over the sight line.

3.8 DOUBLE UNITS IN METAL SASH WITH CHANNEL GLAZING

Double-glazing units shall be set in metal sash with channel glazing in accordance with the recommendations of the FGMA-01.

A void shall be provided at the head and jambs. Excess elastomeric glazing compound on the sash shall be removed with a glazing knife at a slight angle over the sight line.

3.9 SINGLE GLASS IN ALUMINUM DOORS WITH FLUSH GLAZING

Single-glass lights shall be secured in aluminum doors with the door and frame manufacturer's preformed glazing gaskets and installed in accordance with the manufacturer's printed instructions. Lights shall be positioned with resilient setting blocks as specified.

3.10 GLASS PROTECTION

Glazed openings shall be identified during the construction period by tapes or flags that are not in contact with the glass.

Temporary labels shall be removed immediately after the glass and glazing work has been approved.

3.11 CLEANING

Upon completion of work, glass surfaces shall be cleaned and shall be free of glazing- or sealing-compound, smears, and other defacement.

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DIVISION 08 - DOORS AND WINDOWS

SECTION 08900

GLAZED CURTAIN WALLS

03/98

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SECTION 08900

GLAZED CURTAIN WALLS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ALUMINUM ASSOCIATION (AA)

AA 45	(1980) Designation System for Aluminum Finishes
AA SAS-30	(1986) Specifications for Aluminum Structures Construction Manual Series Section 1

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101	(1993) Voluntary Guide Specifications for Aluminum and Polyvinylchloride (PVC) Prime Windows and Sliding Glass Doors
AAMA 800	(1992) Voluntary Specifications and Test Methods for Sealants
AAMA WSG-1	(1988) Selection Guide for Architectural Aluminum Windows

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC M017	(1992) Manual of Steel Construction, Volume II, Connections

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-671	(1986; Addendum 1989) Specification for the Design of Cold-Formed Steel Structural Members

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2001) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 27/A 27M	(1995; R 2000) Standard Specification for Steel Castings, Carbon, for General Application

ASTM A 283/A 283M	(1993; Rev A) Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A 36/A 36M	(2000; Rev A) Standard Specification for Carbon Structural Steel
ASTM A 424	(2000) Standard Specification for Steel Sheet for Porcelain Enameling
ASTM A 47	(1990) Standard Specification for Ferritic Malleable Iron Castings
ASTM A 47M	(1990) Standard Specification for Ferritic Malleable Iron Castings (Metric)
ASTM A 501	(2001) Standard Specification for Hot-Formed Welded and Seamless Carbon-Steel Structural Tubing
ASTM A 526/A 526M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM A 570/A 570M	(1996) Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
ASTM B 136	(1984; R 1993) Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum
ASTM B 137	(1989) Standard Test Method for Measurement of Mass of Coating on Anodically Coated Aluminum
ASTM B 209	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 211	(1995) Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire
ASTM B 211M	(1995) Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod, and Wire (Metric)
ASTM B 221	(1995; Rev A) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM B 221M	(1996) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes (Metric)
ASTM B 244	(1979; R 1993) Standard Method for

	Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments
ASTM B 316/B 316M	(1995) Standard Specification for Aluminum and Aluminum-Alloy Rivet and Cold Heading Wire and Rods
ASTM C 220	(1991) Flat Asbestos-Cement Sheets
ASTM C 236	(1989; R 1993) Steady-State Thermal Performance of Building Assemblies by Means of a Guarded Hot Box
ASTM C 481	(1994) Laboratory Aging of Sandwich Constructions
ASTM C 552	(2000) Standard Specification for Cellular Glass Thermal Insulation
ASTM C 578	(1995) Standard Specification for Preformed, Cellular Polystyrene Thermal Insulation
ASTM C 591	(2000) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation
ASTM C 610	(1995) Standard Specification for Expanded Perlite Block and Pipe Thermal Insulation
ASTM D 1730	(1967; R 1993) Standard Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting

AMERICAN WELDING SOCIETY (AWS)

AWS A5.1	(1991) Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS D1.1	(2000) Structural Welding Code - Steel

FEDERAL SPECIFICATIONS (FS)

FS A-A-344	(Rev A) Lacquer (Clear Gloss)
FS HH-I-558	(Rev C) Insulation, Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Mineral Fiber, Industrial Type)
FS TT-C-494	(Rev B; Notice 1) Coating Compound, Bituminous, Solvent Type, Acid Resistant
FS TT-P-645	(Rev B) Primer, Paint, Zinc-Molybdate, Alkyd Type

PORCELAIN ENAMEL INSTITUTE (PEI)

PEI CG-3	(1985) Color Guide for Architectural Porcelain Enamel
PEI S-100	(1965) Architectural Porcelain Enamel on Steel for Exterior Use

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 1	(1994) Surface Preparation Specification No. 1, Solvent Cleaning
SSPC SP 3	(1995) Surface Preparation Specification No. 3, Power Tool Cleaning
SSPC SP 7	(1991) Brush-Off Blast Cleaning

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings for the following items shall be in accordance with the paragraph entitled, "Fabrication," of this section.

Shop Painting
Finish
Metal Accessories

Installation Drawings shall include the following information for Curtain Wall Assemblies.

Curtain-wall system, accessories, and locations in building, layout and elevations, dimensions, shapes and sizes of members, thickness of metals, types and locations of shop and field connections, details of anchorage to building construction, glazing provisions, and other pertinent construction and erection details.

Location and details of anchorage devices that are to be cast-in-place in concrete and masonry construction.

Panel dimensions, thicknesses and kinds of materials, edge details, details of installation in curtain-wall framing, and other pertinent construction and erection details.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Metals for Fabrication
Paint Materials

Glazing Materials
Nonskinning Sealing Compound
Curtain Wall System
Aluminum Windows
Aluminum Doors and Frames
Metal Accessories
Panels
Thermal Insulation Materials
Glass and Glazing
Sealants and Calking
Curtain-Wall Installation Materials

SD-04 Samples

Contractor shall provide the following samples:

Three 3- by 6-inch samples of Exposed-to-View Aluminum Finish.

Three samples of each type of Anchorage Device.

Three 3- by 6-inch samples of Porcelain-Enamel Finish.

SD-05 Design Data

Submit design calculations prior to the manufacture of any units for this project. Calculations shall address all structural aspects of the system. These aspects include, but are not limited to, seismic, wind and thermal forces, and erection loads. All calculations shall be stamped by a registered professional engineer. The structural calculations shall be indexed and cross referenced to details in the shop drawings.

SD-07 Certificates

Certificates of Compliance shall be submitted for the following items showing conformance with the referenced standards contained in this section, and showing porcelain-enamel-faced panels provided under this contract shall not develop crazing, cracking, or color fading for 10 years from the date of acceptance.

Metals for Fabrication
Paint Materials
Glazing Materials
Nonskinning Sealing Compound
Curtain Wall Frames
Aluminum Windows
Aluminum Doors and Frames
Metal Accessories
Panels
Thermal Insulation Materials
Glass and Glazing
Sealants and Calking
Curtain-Wall Installation Materials

SD-08 Manufacturer's Instructions

Preventive Maintenance and Inspection shall consist of the aluminum manufacturer's recommended Cleaning Materials and Application Methods, including detrimental effects to the aluminum

finish when improperly applied.

1.3 INTERPRETATION OF AWS CODE

AWS code, when referred to herein, shall mean AWS D1.1, "Structural Welding Code - Steel" with the following modification:

Revise AWS code Section 1, "General Provisions," Paragraph 1.1 as follows: References to the need for approval shall mean "Approval by the Contracting Officer" and references to the "Building Commissioner" shall mean the "Contracting Officer."

1.4 QUALIFICATIONS FOR THE CURTAIN-WALL INSTALLER

A written description of the proposed curtain-wall system installer shall be submitted giving the name of the curtain-wall manufacturer, qualifications of personnel, years of concurrent contracting experience, lists of projects similar in scope to the specified work, and other information as may be required by the Contracting Officer.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Allowable Design Stresses

Aluminum-alloy framing member allowable design stresses shall be in accordance with the requirements of AA SAS-30 pertaining to building type structures made of the specified aluminum alloy.

Hot-rolled structural-steel member allowable design stresses and design rules shall be in accordance with the requirements of AISC M017 pertaining to the specified structural steel.

Cold-formed light-gage steel structural member allowable design stresses and design rules shall be in accordance with the requirements of AISI SG-671 SG570 pertaining to structural members formed from the specified structural-steel sheet or strip.

1.5.2 Design Wind Load

Design windload shall be as stipulated in the structural documents.

1.5.3 Structural Capacity

Curtain-wall system, including framing members, windows, doors and frames, metal accessories, panels, and glazing shall be designed to withstand the specified design windload acting normal to the plane of the curtain wall and acting either inward or outward.

Deflection of any metal framing member in a direction normal to the plane of the curtain wall, when subjected to the test of structural performance, using the specified windload in accordance with AAMA 101, shall not exceed 1/175 of the clear span of the member or 3/4 inch, whichever value is less.

Deflection of any metal member in a direction parallel to the plane of the curtain wall, when the metal member is carrying its full design load, shall not exceed 75 percent of the design clearance dimension between that member and the glass, sash, panels, or other part immediately below it.

1.5.4 Provisions for Thermal Movement

Curtain-wall systems, including framing members, windows, doors and frames, metal accessories, and other components incorporated into the curtain wall, shall be designed to allow for expansion and contraction of the component parts at an ambient temperature of 100 degrees F without causing buckling, opening of joints, overstressing of fasteners, or other harmful effects.

1.5.5 Water Penetration

No water penetration shall occur when the curtain-wall system is tested for water penetration under static pressure in accordance with AAMA WSG-1.

1.5.6 Air Infiltration

Air infiltration through the curtain-wall system except curtain-wall areas containing louvers, when tested for air infiltration in accordance with AAMA WSG-1, shall not exceed 0.06 cubic foot per hour per square foot of fixed curtain-wall area plus the air infiltration for operable windows within the test area herein specified.

PART 2 PRODUCTS

2.1 METALS FOR FABRICATION

2.1.1 Aluminum-Alloy Extrusions

Extrusions shall conform to ASTM B 221.

Extrusions to receive an integral-color anodic coating shall be the alloy and temper recommended by the aluminum producer for the specified finish with integral-color anodic coating and shall have mechanical properties equal to or exceeding those of 6063-T5.

2.1.2 Aluminum-Alloy Sheets and Plates

Unless otherwise specified, sheets and plates shall conform to ASTM B 209, Alloy 3003-H16.

Sheets and plates to receive a clear anodic coating shall conform to ASTM B 209, Alloy 5005-H16.

Sheets and plates to receive an integral-color anodic coating shall be the alloy and temper recommended by the aluminum producer for the specified coating and shall have mechanical properties equal to or exceeding those of 5005-H16.

2.1.3 Structural Steel

Hot-rolled shapes, plates, and bars shall conform to ASTM A 36/A 36M.

Hot-formed tubing shall conform to ASTM A 501.

Sheet and strip for cold-formed, light-gage, structural members shall conform to ASTM A 570/A 570M.

2.1.4 Metals for Fasteners

Aluminum-alloy bolts and screws shall be made from rod conforming to

ASTM B 211, Alloy 2024-T351.

Aluminum-alloy nuts shall be made from rod conforming to ASTM B 211, Alloy 6061-T6.

Aluminum-alloy washers shall be made from sheet conforming to ASTM B 209, Alloy 2024-T4.

Aluminum-alloy rivets shall be made from rod or wire conforming to ASTM B 316/B 316M, Alloy 6053-T61.

Steel fasteners shall be made from corrosion-resistant chromium-nickel Type 302, 303, 304, 305, or 316 with the form and condition best suited for the work.

2.2 PAINT MATERIALS

Shop paint for aluminum shall conform to FS TT-P-645 or FS TT-C-494, Type II.

Shop paint for steel shall conform to FS TT-P-645.

2.3 NONSKINNING SEALING COMPOUND

Sealing compound shall be nonskinning, gun-grade type conforming to AAMA 800.

2.4 FABRICATION

2.4.1 Workmanship

Metal parts shall be accurately formed; joints, except those designed to accommodate movement, shall be accurately fitted and rigidly assembled.

Insofar as practical, fitting and assembly of the work shall be done in the manufacturer's plant. Work that cannot be permanently factory-assembled shall be marked before shipment to ensure proper assembly at the site.

2.4.2 Shop-Painting Aluminum

Aluminum surfaces that will come in contact with dissimilar metals, masonry, concrete, or wood shall be shop primed.

Aluminum surfaces shall be prepared for painting in accordance with ASTM D 1730, Type B, Method 2 or 3.

Aluminum surfaces shall be given one shop coat of paint applied to dry, clean, surfaces to provide a continuous minimum dry-film thickness of 1.5 mils.

2.4.3 Shop-Painting Steel

Surfaces of concealed steel shall be shop primed.

Scale, rust, and other deleterious materials shall be removed. Heavy rust and loose mill scale shall be removed in accordance with SSPC SP 3 or SSPC SP 7. Oil, grease, and similar contaminants shall be removed in accordance with SSPC SP 1.

Steel surfaces shall be given two coats of paint; the second coat shall

have a color different from the first coat. Paint shall be applied to dry, clean, surfaces to provide a continuous minimum dry-film thickness of 1.5 mils for the first coat and 1 mil for the second coat.

2.4.4 Depth of Glazing Rabbets

Depth of glazing rabbets for openings to receive glass materials or panels shall be as follows:

MATERIAL	NOMINAL THICKNESS	MAXIMUM SIZE	MINIMUM RABBET DEPTH
Double-glazing units	All thicknesses	Up to 24 square feet	5/8 inch
	All thicknesses	24 to 70 square feet	3/4 inch
Panels	Up to 1 inch	All sizes	5/8 inch
	1 to 1-1/2 inches	All sizes	3/4 inch

2.4.5 Finish

Finish of exposed-to-view aluminum surfaces shall be:

Polished frosted finish with integral-color anodic coating: Smooth specular buffed mechanical, followed by nonetching inhibitive alkaline cleaning, medium-matte chemical etch, and Architectural Class I (0.7-mil and greater thickness) anodic coating producing an integral-color finish. Color shall beas indicated on drawings.:

Aluminum-finish color and appearance shall match that of the sample approved for use in the project within the aluminum producer's standard color range.
The anodic coating on aluminum shall be tested for thickness in accordance with ASTM B 244.

Anodically coated aluminum shall be tested for the weight of the coating in accordance with ASTM B 137.

The resistance of anodically coated aluminum to staining by dyes shall be tested in accordance with ASTM B 136.

2.5 CURTAIN-WALL FRAMING MEMBERS

2.5.1 General

Framing members shall be the section dimensions and arrangement indicated and shall be designed to accommodate windows, panels, and other materials to be incorporated into the curtain-wall system.

Curtain-wall framing shall be the vertical mullion type with the vertical mullions extending the indicated distance beyond the exterior face of the curtain wall.

2.5.2 Construction

Framing members shall be aluminum-alloy extrusions with a wall thickness

not less than 0.125 inch. Glazing rabbet legs shall be an integral part of the frame with the leg depth not less than the minimum depth specified for the thickness and size of the glass material or panel to be installed in the curtain-wall frame. Frames shall be designed and constructed to receive window sash and louvers of the type specified when required.

Vertical mullions shall be prepared for anchorage to the building construction at the bottom, at each intermediate floor elevation, and at the top.

Corners of frames shall be mortise-and-tenon construction except that the corners of the vertical and horizontal mullions in grid frames shall be coped-and-welded construction. Welds shall be on the unexposed surfaces. Corner joints shall be accurately fitted and flush, with watertight hairline joints not exceeding 1/64 inch in width. Nonskinning sealing compound shall be applied to the unexposed surfaces of all mortise-and-tenon joints.

Corners of frames shall be coped and welded construction. Welds shall be on the unexposed surfaces. Corner joints shall be accurately fitted and flush, with watertight hairline joints not exceeding 1/64 inch in width.

2.5.3 Glazing Provisions

System shall be designed for outside glazing using glazing clips and compounds.

2.6 ALUMINUM WINDOWS

Aluminum windows are specified in Section 08520, "Aluminum Windows."

2.7 ALUMINUM DOORS AND FRAMES

Aluminum doors and frames are specified in Section 08120, "Aluminum Doors and Frames."

2.8 METAL ACCESSORIES

2.8.1 Sills

Sills shall be the shapes and dimensions indicated and fabricated of aluminum-alloy extrusions having a wall thickness not less than 0.125 inch.

2.8.2 Coping

Coping shall be the shapes and dimensions indicated and shall be welded mitered inside and outside corner sections, concealed cover plates, and other components as required for the installation.

Coping-system components shall be aluminum-alloy extrusions with wall thicknesses of 0.05 inch, minimum.

2.8.3 Exterior Architectural Louvers

Exterior architectural louvers are specified in Section 05700, "Ornamental Metal."

2.9 PANELS

2.9.1 Panel Type

Panels shall be metal-faced laminated both sides, consisting of exterior metal facing, facing backing, insulating core, facing backing, and interior metal facing. Facing-panel dimensions shall be as indicated.

2.9.2 Exterior Finish

Finish of the panels on exposed-to-view surfaces shall match the color of the approved samples.

Gloss of exposed-to-view surfaces shall be low reflectivity.

2.9.3 Interior Metal Facing

Facing shall be 24-gage galvanized-steel sheets conforming to ASTM A 526/A 526M, coating G90.

2.9.4 Panel Fabrication

Panel materials shall be securely bonded together to form a stable and durable composite unit. Panels with core insulation of absorptive material shall have edges sealed and shall provide venting to the outside air. Panels shall conform to the following:

Flatness: Exterior surfaces shall be of such flatness that, when measured at room temperature, the maximum slope of the surface at any point, measured from the nominal plane of the surface, shall not exceed 1.5 percent for surfaces having a finish of low reflectivity.

Structural requirements: Panels of the maximum size required by the work, when supported in the manner intended, shall withstand the windload specified without permanent deformation or damage.

Accelerated aging: Panels shall show no evidence of delamination, warpage, or other deterioration or damage after completion of six accelerated aging cycles in accordance with ASTM C 481, Cycle A.

2.10 THERMAL INSULATION MATERIALS

Thermal insulation materials are specified in Section 07210, "Building Insulation."

2.11 GLASS AND GLAZING

Glass and glazing are specified in Section 08805, "Glass and Glazing."

2.12 SEALANTS AND CALKINGS

Sealants and calkings are specified in Section 07920, "Sealants and Calkings."

2.13 CURTAIN-WALL INSTALLATION MATERIALS

2.13.1 Threaded Concrete Inserts

Galvanized ferrous castings with enlarged bases with not less than two

nailing lugs, length as indicated, internally threaded 3/4-inch diameter machine bolt shall conform to or ASTM A 27/A 27M, Grade U-60-30, and shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

2.13.2 Wedge Concrete Inserts

Galvanized, box-type, ferrous castings with an integral loop at the back of the box and designed for 3/4-inch diameter bolts with wedge-shaped heads shall conform to or ASTM A 27/A 27M, Grade U-60-30, and shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

Carbon steel bolts with wedge-shaped heads, nuts, washers, and shims shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

2.13.3 Slotted Concrete Inserts

Galvanized pressed-steel plate, welded construction, box type with a slot designed for 3/4-inch diameter square-head bolts to provide lateral adjustment shall be 1/8-inch minimum thickness, conforming to ASTM A 283/A 283M, Grade C, hot-dip galvanized in accordance with ASTM A 123. Length of the insert body less anchorage lugs shall be 4-1/2 inches minimum and shall be provided with a knockout cover.

2.13.4 Masonry Anchorage Devices

2.13.5 Toggle Bolts

Toggle bolts shall be the tumble-wing type.

2.13.6 Steel Bolts, Nuts, and Washers

Bolts shall be regular hexagon head, low-carbon steel.

Nuts shall be hexagon, regular style, carbon steel.

Plain washers shall be round, general-assembly purpose, carbon steel.

Lockwashers shall be helical spring, carbon steel.

2.13.7 Machine Screws

Screws for concealed work shall be corrosion-resistant steel, slotted or cross-recessed type, roundhead.

Screws for exposed-to-view work shall be corrosion-resistant steel, cross-recessed, flathead.

2.13.8 Electrodes for Welding Steel

Electrodes for welding steel by the manual shielded metal arc welding process shall meet the requirements of AWS D1.1 and shall be covered mild-steel electrodes conforming to AWS A5.1, E60 series.

PART 3 EXECUTION

3.1 GENERAL

Curtain walls and accessories shall be installed in accordance with the approved drawings and as specified.

3.2 MATERIALS EMBEDDED IN OTHER CONSTRUCTION

Materials to be embedded in cast-in-place concrete and masonry shall be installed prior to the installation of the curtain wall. Setting drawings, templates, and instructions for installation shall be provided.

3.3 FASTENING TO CONSTRUCTION-IN-PLACE

Anchorage devices and fasteners shall be provided for fastening work to construction-in-place. Fasteners shall be provided as specified.

3.4 SETTING MASONRY ANCHORAGE DEVICES

Devices shall be set in masonry or concrete-in-place construction in accordance with the manufacturer's printed instructions. Drilled holes shall be left rough and free of drill dust.

3.5 FIELD-WELDING STEEL AND TOUCHUP PAINTING

Procedures of manual shielded metal arc welding, the appearance and quality of the welds made, and the methods used in correcting welding work shall conform to AWS D1.1.

After completion of welding, field welds and scarred surfaces on steel work and on adjacent ferrous-metal surfaces shall be cleaned and painted. Paint shall be the same as that used for shop painting.

3.6 INSTALLATION TOLERANCES

Curtain walls shall be installed within the following tolerances:

Deviation in location from that indicated on the drawings	Plus or minus 1/4 inch
Deviation from the plumb or horizontal	
In 12 feet of length	Not more than 1/8 inch
In any total length	Not more than 1/2 inch
Offset from true alignment at joints between abutting members in line	Not more than 1/16 inch

3.7 PLACING CURTAIN-WALL FRAMING MEMBERS

Members shall be installed plumb, level, and within the limits of the installation tolerances specified.

Members shall be connected to building framing. Supporting brackets shall provide adjustments for the accurate location of curtain-wall components. Adjustable connections shall be rigidly fixed after members have been positioned.

3.8 PANEL INSTALLATION

Panels shall be set with a glazing-tape back bed, two-component elastomeric

sealing-compound heel bead, glazing-tape bedding of the stop, and two-component elastomeric sealing-compound topping bead on both sides of the panel. Face and edge clearances shall be not less than 1/8 inch. Excess sealing compound on both sides of the curtain wall opening shall be removed with a glazing knife at a slight angle over the rabbet leg or applied stop. Applied stops shall be installed on the exterior side of the curtain wall and shall be secured with screws.

3.9 CLEANING

3.9.1 General

At the completion of the installation, the work shall be cleaned to remove mastic smears and other foreign materials.

3.9.2 Aluminum Surfaces

Before final acceptance, exposed-to-view aluminum surfaces shall be washed with clean water and soap and rinsed with clean water. Acid solutions, steel wool, or other harsh abrasives shall not be used. Stains that remain after washing shall be removed or the finish shall be restored in accordance with the aluminum producer's recommendations.

3.9.3 Porcelain-Enamel Surfaces

Surfaces shall be washed with clean water and soap and rinsed with clean water. Acid solutions, steel wool, or other harsh abrasives shall not be used.

3.10 INSPECTION AND ACCEPTANCE PROVISIONS

3.10.1 Finished Curtain-Wall System Requirements

Curtain-wall work will be rejected for any of the following deficiencies:

Finish of exposed-to-view aluminum having color and appearance that are outside the color and appearance range of the approved samples.

Installed curtain-wall components having stained, discolored, abraded, or otherwise damaged exposed-to-view surfaces that cannot be cleaned or repaired.

Aluminum surfaces in contact with dissimilar materials that are not protected as specified.

3.10.2 Repair of Defective Work

Defective work shall be removed and replaced with curtain-wall materials that meet the specifications at no expense to the Government.

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SECTION 09212

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09/94

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SECTION 09212

FIREPROOFING PLASTER
09/94

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 119	(2000; Rev A) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 84	(2001) Standard Test Method for Surface Burning Characteristics of Building Materials

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO-01	(1997) Uniform Building Code

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Installation Drawings shall be submitted for Fireproof Plaster in accordance with the paragraph entitled, "Application," of this section.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for Fireproof Plaster showing flame spread classification, fuel contribution, and smoke developed.

SD-04 Samples

Not less than 1/2 pound of Fireproofing Plaster Mix

SD-07 Certificates

Certificates of Compliance shall be submitted for Fireproof Plaster showing conformance with the ICBO-01, "Uniform Building Code," Volume I, "Requirements for Four-Hour Construction."

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted for Fireproof

Plaster including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered in original unopened packages bearing the name of the product, manufacturer's name, and the Underwriters Laboratories, Inc. label.

Materials shall be stored off the ground, under cover, and away from damp surfaces and shall be kept dry until ready to use. Materials that have been exposed to water before use shall be discarded.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Fireproof Plaster

Fireproof plaster shall be gypsum-vermiculite mix. Consisting of one part gypsum to two parts vermiculite. Plaster shall comply with ICBO-01, "Uniform Building Code," Volume I, "Requirements for 4-Hour Construction."

Cohesion of the dry set material shall be such that the fireproofing coat will not crack or delaminate when the structural steel element is subjected to a downward deflection of 1/120 of the span.

Compressive strength shall be not less than 70 pounds per square inch.

When tested in accordance with ASTM E 84, the set and dry material shall show the following characteristics:

Flame spread	10
Fuel contributed	5
Smoke developed	0

2.1.2 Water

Water shall be potable.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General Requirements

Fireproofing plaster shall be applied as specified to those areas indicated. Details shall be as indicated.

3.1.2 Application

Application of fireproofing plaster shall be pneumatic or trowelled in accordance with material manufacturer's written recommendations. Thickness of application shall be as indicated and in compliance with the applicable codes to provide rated fireproofing when tested in accordance with ASTM E 119.

Framing and furring shall be as recommended by manufacturer for the

installation of the fireproofing plaster thickness required or as indicated.

3.2 ACCEPTANCE PROVISIONS

After completion of fireproofing work, application equipment shall be removed. Areas of ceilings, walls, and floors, adjacent or exposed to the operations of application of the fireproofing material, and other surfaces and finishes that may have been soiled shall be cleaned of fireproofing materials.

Damaged or unacceptable portions of the fireproofing plaster shall be removed and replaced with new work at no additional cost to the Government.

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SECTION 09260

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09/96

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SECTION 09260

GYPSUM BOARD ASSEMBLIES
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 111	(1990) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel, Products

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 569/A 569M	(1991; Rev A) Standard Specification for Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality
ASTM A 641	(1991) Standard Specification for Zinc Coated (Galvanized) Carbon Steel Wire
ASTM A 641M	(1991) Standard Specification for Zinc Coated (Galvanized) Carbon Steel Wire (Metric)
ASTM C 36	(1995) Gypsum Wallboard
ASTM C 442	(1995) Gypsum Backing Board and Coreboard
ASTM C 473	(1995) Physical Testing of Gypsum Board Products and Gypsum Lath
ASTM C 475	(1994) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 514	(1994) Standard Specification for Nails for the Application of Gypsumboard
ASTM C 515	(1986; R 1992) Chemical-Resistant Ceramic Tower Packings
ASTM C 553	(1999) Standard Specification for Mineral Fiber Blanket and Felt Insulation (Industrial Type)
ASTM C 557	(1993; Rev A) Adhesives for Fastening Gypsum Wallboard to Wood Framing
ASTM C 630	(1993) Water-Resistant Gypsum Backing Board

ASTM C 645	(1995) Non-Load (Axial) Bearing Steel Studs, Runners (Track) and Rigid Furring Channels for Screw Applications of Gypsum Board
ASTM D 2103	(1997) Standard Specification for Polyethylene Film and Sheeting
ASTM E 119	(2000; Rev A) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 84	(2001) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 90	(1990) Standard Test Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.2.1	(1981; R 1992) Square and Hex Bolts and Screws, Including Hex Cap and Lag Screws (Inch Series)
ASME B18.2.2	(1987; R 1999) Square and Hex Nuts (Inch Series)
ASME B18.2.3.7M	(1979) Metric Heavy Hex Screws
ASME B18.2.4M	(1979; Rev 1989) Metric Hex Nuts

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Safety to Life from Fire in Buildings and Structures

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA-02	(1993) Architectural Sheet Metal Manual
SMACNA-02A	(1980; 5th Ed) Architectural Sheet Metal Specifications

1.2 SYSTEM DESCRIPTION

1.2.1 Partition Configurations

1.2.1.1 Single-Layer Partitions

Single-layer drywall partitions shall be fire-retardant when so indicated, gypsum wallboard, thickness as indicated.

Furred drywall on exterior masonry walls shall be insulated fire retardant when so indicated, gypsum wallboard, thickness as indicated.

1.2.1.2 Double-Layer Partitions

Double-layer drywall partitions shall consist of two layers of fire-retardant gypsum wallboard, thickness as indicated.

1.2.2 Performance Requirements

1.2.2.1 Fire Retardant Requirements

Type X gypsum wallboard shall provide at least 1 hour fire-retardant rating for 5/8-inch thick material or 3/4-hour fire-retardant rating for 1/2-inch material when applied in single-layer, nailed on each face of load-bearing, wood framing members, and when tested in accordance with ASTM E 119.

When tested in accordance with ASTM E 84, gypsum wallboard shall have a maximum flame-spread rating of 15, fuel contributed 15, and smoke developed 15.

1.2.2.2 Ceiling Assembly Fire Ratings

Gypsum drywall ceiling, floor, and roof assemblies shall have a fire rating of 1, 2, or 3 hours as indicated on drawings. Drywall construction shall be as specified in the UL fire classification design number(s) approved for the work.

1.2.2.3 Permeance Requirements

Back gypsum wallboard shall meet the permeance requirements specified in ASTM C 36.

1.2.2.4 Sound Transmission Classifications

Sound transmission classification (STC) shall be as published by the gypsum wallboard manufacturer. Classifications shall be established in accordance with ASTM E 90 and shall reflect acoustical performance values obtained in laboratory tests by a recognized independent acoustical laboratory.

Gypsum drywall ceiling shall have an STC of 40 to 45.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings shall be submitted for the following items consisting of fabrication and assembly details to be performed in the factory.

Hangers and Inserts
Suspension, Furring, and Channels
Resilient Channels
Steel Stud Framing
Metal Accessories and Trim

Installation Drawings shall be submitted for Gypsum Wallboard Systems in accordance with the paragraph entitled, "Erection,

Installation, and Application."

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items including fire ratings, sound transmission classification, and permeance requirements where applicable.

Gypsum Wallboard
Ceiling and Wall Framing
Furring
Special Framed Openings
Rated Wallboard Assemblies
Joint Tapes
Compounds
Steel Stud Framing
Metal Ceiling Materials
Fasteners
Adhesives

SD-04 Samples

The following samples shall be submitted:

Gypsum Wallboard: Three 12 inch by 12 inch samples of each type.

Steel Stud Framing and Trim: Three samples each, 12-inches long.

Fasteners: Three 12-inch square samples of each type of gypsum wallboard

SD-07 Certificates

Certificates of Compliance shall be submitted for Gypsum Wallboard Systems indicating that the proposed materials meet or exceed the project specifications and the listed reference specifications.

Certification for Fire-Rated Gypsum Wallboard shall indicate the flame spread, fuel contributed, and smoke developed, together with the UL test number and the testing agency by which certification is made.

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be protected from weather, soil, and damage during delivery, while stored, and during construction.

Materials shall be delivered in the manufacturer's original packages; containers or bundles shall bear the brand name and the name of the manufacturer.

Materials shall be stored in dry, weathertight, and properly ventilated areas.

Gypsum wallboard shall be neatly stacked flat, with care taken to avoid sagging or damage to edges, ends, and surfaces.

Wallboard delivered to the building shall be kept protected and banded with midpoint slat spaces of 2 by 1/2-inch material extended full width between

each layer of gypsum wallboard.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Environmental Requirements

1.5.1.1 Temperature

A temperature of not less than 55 degrees F shall be provided in areas of work during the application of the materials and shall be maintained until the joint treatment compounds are dry.

1.5.1.2 Ventilation

Ventilation shall be provided to eliminate moisture within the building.

1.5.1.3 Moisture Control

Gypsum wallboard installation and joint treatment shall be accomplished in a uniform temperature with sufficient ventilation to ensure that throughout the application period the wallboard moisture does not exceed 8 percent.

Wallboard that has a moisture content in excess of 8 percent shall not be installed.

1.5.2 Field Measurements

Field measurements shall be taken before installation of materials to verify the indicated dimensions and to ensure proper fit of the work.

PART 2 PRODUCTS

2.1 WALLBOARD MATERIALS

2.1.1 General Requirements for Wallboard

Gypsum wallboard shall conform to ASTM C 36 of grade and form as specified for each type of board. Wallboard shall be 48-inches wide, shall have thickness as indicated, and a maximum practical length for end use.

2.1.2 Ceiling

Board for drywall ceilings shall be 5/8-inch thick, regular gypsum wallboard, unless noted otherwise.

Board for drywall ceilings shall be 5/8-inch thick, moisture-resistant backing board, unless noted otherwise.

2.1.3 Regular Gypsum Wallboard

Regular gypsum wallboard shall be Grade R, Form a, thickness as specified or otherwise indicated..

Regular gypsum wallboard shall conform to ASTM C 36, 48-inches wide and at least 1/2 inch thick, or 5/8 inch thick when so indicated on the drawings, and shall have tapered edges.

2.1.4 Foil Back Gypsum Wallboard

Foil back gypsum wallboard shall be Grade R, Form c, insulated with bright, finished aluminum foil on back surface and shall be at least 1/2 inch thick, or 5/8 inch thick when so indicated on the drawings.

2.1.5 Fire-Retardant Gypsum Wallboard

Fire-retardant gypsum wallboard shall be Grade X, Form a, at least 1/2 inch thick, or 5/8 inch thick when so indicated on the drawings.

2.1.6 Fire-Retardant Foil Back Gypsum Wallboard

Fire-retardant foil back gypsum wallboard shall be Grade X, Form c, insulated with bright, finished aluminum foil on back surface and shall be at least 1/2 inch thick 5/8 inch thick when so indicated on the drawings.

2.1.7 Gypsum Backing Board

Gypsum backing board shall conform to ASTM C 442 and shall be at least 1/2-inch thick when used as the first ply of a two-ply application, 48-inches wide, and in maximum practical length for end use.

2.1.8 Moisture-Resistant Backing Board

Moisture-resistant gypsum backing board shall conform to ASTM C 630 water-repellent-treated core with Class 2 water-repellent surface, Form a, tapered edge, at least 1/2-inch thick.

2.1.9 Water-Resistant Backing Board

Backing board for use with ceramic tile or other nonabsorbent wall tiles shall be moisture-resistant and thickness as indicated and shall meet the requirements of water resistance of ASTM C 630 when tested in accordance with ASTM C 473.

2.1.10 Joint Materials

2.1.10.1 Joint Tapes

Joint tape shall be plain or perforated material conforming to ASTM C 475, Type II, Styles 1 and 2.

2.1.10.2 Compounds and Adhesives

Joint compound shall be an adhesive conforming to ASTM C 475, Type I, Style 1.

Laminating adhesive shall be joint compound of the type used for embedding tape or a material recommended by the manufacturer of the gypsum board. Ready-mixed joint compound (Style 3) shall not be used as laminating adhesive.

2.1.11 Metal Fasteners

Screws shall be steel, self-tapping drywall type, bugle head, self-drilling point; the length shall be as recommended by the drywall manufacturer for the type of system being installed.

Screws for anchorage of runner channels to studs and securing gypsum backing board to metal studs and furring channels shall be 1 inch long. Screws for temporary support of gypsum wallboard face ply shall be 1-5/8-inches long of the same type.

Bolts shall be steel and conform to ASME B18.2.1. Type II, regular hexagon bolts.

Nuts shall be steel, plain, hexagon, Type II, and shall conform to ASME B18.2.2.

Expansion shields shall conform to ASTM C 514, Group, Type, and Class as required.

Staples shall conform to ASTM C 514, galvanized steel, Table IV-A, size as required.

Wire for tying insulation shall be galvanized soft steel wire conforming to ASTM A 641, steel number 1010, Class 1 light zinc coating.

2.1.12 Metal Framing Materials

2.1.12.1 Hangers and Inserts

Wire hangers for main runner channels shall be galvanized soft steel wire not less than 28-gage, conforming to ASTM A 641, steel number 1010, Class 2 zinc coating.

Hot-dip galvanized flat steel hangers 1 by 3/16 inch; galvanized concrete insert-type rod hangers may be substituted for wire hangers.

Tie wires for splicing furring channels or for securing furring channels to main running channels shall be galvanized soft steel wire not less than 16-gage with Class 2 zinc coating.

Clips used in lieu of tie wire shall be galvanized steel equivalent in holding power to that provided by the tie wires and of a type recommended by the gypsum board manufacturer.

2.1.12.2 Suspension, Furring, and Channels

Channels shall be formed from galvanized steel sheets conforming to SMACNA-02 SMACNA-02A AASHTO M 111, Type I, Class d, ordinary zinc coated (commercial).

Main runner channels shall be 1-1/2-inch, hot- or cold-rolled, galvanized steel. Hot-rolled channels shall weigh not less than 1.12 pounds per linear foot. Cold-rolled channels shall be not less than 16-gageuncoated steel with flanges at least 19/32-inchwide.

Furring channels shall be roll-formed, galvanized steel not less than 0.021 inch thick before galvanizing, with steel face width of 1-3/8 inches and a depth of 7/8 inch, and shall have reinforced, folded edges.

Furring channels for miscellaneous framing shall be 3/4-inch wide, cold-rolled galvanized steel not less than 16-gage before galvanizing, and shall weigh not less than 0.33 pounds per linear feet.

Nailing channels 3/4 by 7/8 inch shall be cold-rolled, electrogalvanized

steel not less than 25-gage before galvanizing, and shall be formed with a continuous lip to retain ratchet nail fasteners.

2.1.12.3 Resilient Channels

Resilient channels shall be formed from cold-rolled, electrogalvanized steel, shall have a minimum thickness of 26-gage in a modified hat section with a face width of 1-1/2 inches, and shall have a depth of 1/2 inch, with reinforced flange edge and prepunched holes in flange for screw fastening.

2.1.12.4 Steel Stud Framing

Steel studs, floor and ceiling runners, angle runners, and furring channels shall be electrogalvanized, cold-rolled steel conforming to ASTM C 645 ordinary zinc coated (commercial).

Metal studs shall be formed, zinc-coated sections of channel or Z-shape, of 26-gage minimum thickness, and of widths indicated on the drawings. Stud flanges that come in contact with gypsum wallboard shall be a minimum of 1-7/16 inches wide, with a stiffening lip with turned or folded edges. Holes shall be regularly punched in studs to facilitate installation of electrical wiring, conduit, or horizontal bracing.

Minimum thickness of 0.0179 inch (25 gage) shall be used for interior nonload-bearing studs without supporting attached loads. Minimum thickness of 0.0329 inch (20 gage) shall be used in laboratory.

Floor and ceiling runners shall be not less than 26-gage steel before galvanizing, with 1-1/4-inch flanges, sized to nest with steel stud.

Angle runners shall be 1-3/8 inches by 7/8 inchand not less than 22-gage.

2.1.13 Metal Accessories and Trim

2.1.13.1 Corner Beads and Trim

Corner beads shall be 30-gage minimum, hot-dip galvanized steel, with 1-1/4- by 1-1/4-inchflanges and a 1/8-inch beaded corner.

Corner beads shall be formed to an angle of 90 degrees and shall be zinc-coated steel not lighter than 30-gagebefore coating with wings not less than 7/8-inch wide and perforated for nails and cement treatment, or shall be for,ed of zinc-coated steel or protected aluminum with legs approximately 3/4-inch wide and cemented under pressure with a rubber-base adhesive to tough-paper jointing-tape wings not less than 1-inch wide. Zinc-coated steel shall conform to SMACNA-02, SMACNA-02A, and AASHTO M 111, Type I, Class C.

Casing trim shall be 28-gage nominal thickness, hot-dip galvanized steel channel, depth as required for wallboard, with attached tape flange.

2.1.13.2 Metal Base

Metal base shall be fabricated from hot-rolled strip steel, commercial quality, in accordance with ASTM A 569/A 569M and shall be 2-1/2-inches wide, (18-gage), flush face or reveal face as indicated, factory primed with manufacturer's standard rust-inhibiting primer, with welded exterior corners, splice, and attachment plates.

2.1.14 Control Joint Material

Control joint material shall be one piece, 29-gage, roll-formed zinc, formed 7/16-inch deep by 1/4-inch wide with a perforated flange 7/8-inch wide on each side of the joint opening, with a protective plastic strip.

2.1.15 Calking

Control joint calking shall be as recommended by the drywall manufacturer and shall be the same type used for partition and ceiling assemblies when the fire rating and STC were established.

2.1.16 Dust Membrane

Dust membrane shall be clear, 4-mil polyethylene film, conforming to ASTM D 2103, Type 13000.

2.1.17 Fire-Insulation Blankets

Insulation shall be semirigid, paperless, spun mineral-fiber mat, thickness and width as indicated, and shall conform to ASTM C 553. Material shall be UL listed with a Class A fire-hazard classification as defined in NFPA 101; flame spread shall not exceed 25, fuel distributed 20, smoke developed 0 when tested in accordance with the tunnel test of ASTM E 84.

2.2 SOURCE QUALITY CONTROL

Gypsum wallboard shall be tested at the manufacturing plant in accordance with ASTM C 473 for flexural strength, thickness and weight of paper, and thickness of edge of recessed or tapered-edge gypsum wallboard.

PART 3 EXECUTION

3.1 PREPARATION

Defective wall and ceiling surfaces shall be corrected prior to application of drywall materials.

3.2 ERECTION, INSTALLATION, AND APPLICATION

3.2.1 Framing

Framing members to receive gypsum wallboard shall be straight, plumb, and true and spaced not to exceed the maximum spacings for the board thickness.

3.2.2 Board Length

Boards of maximum practical length shall be used to minimize the number of end joints. Edges of boards shall be butted together but shall not be forced.

3.2.3 Staggering Boards

Joints shall be staggered and shall not be aligned with the edge of an opening nor positioned so that the corners of four boards will meet at a common point.

3.2.4 Joints

All abutting ends or edge joints shall occur over solid bearing, (wood joists, wood furring, or over the web surface of furring channels) and shall be fitted neatly and accurately, with all end joints staggered. Wallboard shall be supported as recommended by the manufacturer, with additional framing at all cutouts and openings.

3.2.5 Ceiling Abuts Dissimilar Wall

Perimeter of ceilings shall be finished with an edge bead trim where ceiling abuts dissimilar wall materials.

3.2.6 Wall Trim

Trim shall be applied to wall and accurately aligned with the finished ceiling. Ceiling board edges that adjoin walls shall be laid on the horizontal leg of the trim strip, and the space behind the junction shall be closed with a dust membrane. Membrane shall be applied in advance of the wallboard application.

3.2.7 Corners and Edges

Exposed corners and edges and the perimeter of door, window, and borrowed-light frames shall be finished with the specified metal trim.

3.2.8 Tolerance and Alignment

Finished wallboard application shall be plumb and true, with all joints aligned to within a 1/16-inch tolerance and with all surfaces shimmed and aligned to a plane and even surface having a maximum variation of 1/8 inch in 8 feet.

3.2.9 Midheight Horizontal Bracing

Midheight horizontal bracing shall be continuous in partitions for all heights above 8 feet 6 inches. Bracing shall be standard runner channel for stud size specified. Channel shall be secured rigidly in place at each stud.

3.2.10 Partition Bracing

Where gypsum wallboard partitions do not extend to the underside of construction above, they shall be braced at the top channel with a V-frame perpendicular to the line of the partition located 18 feet 8 inches maximum on center where partitioning is not intersected or otherwise braced. V-braces shall be composed of two 2-by 2-by 1/8-inch angles attached to metal clips. When brace is in final position, it shall be welded, or holes shall be drilled and the brace bolted in permanent position. Partitions shall not exceed 16 feet in height.

3.2.11 Ply

Wallboard shall be applied to ceilings in single-ply, with the long dimension of the wallboard at right angle to the furring members as specified herein and in accordance with the drywall manufacturer's instructions for the type and classification of wall assembly indicated.

Wallboard shall be applied to walls in single-ply, horizontal and vertical

application, and in two-ply as specified herein and in accordance with the drywall manufacturer's instructions for the type and classification of wall assembly indicated.

Gypsum wallboard face layers shall be cut to full floor-to-ceiling height for vertical installation. Ends of the face ply shall fit over the runner flanges. Vertical joints shall occur over studs and shall be staggered on opposite sides of the partition.

3.2.12 Fastening

Board shall be fastened with power-driven, phillips-head screws at a maximum spacing of 12 inches on center in the field of the board and at 8 inches on center at edges and along abutting ends.

Screws shall be placed not closer than 3/8 inch to ends or edges of boards.

3.2.13 Installation of Control Joints

Control joints shall be provided where indicated and shall be screwed in place.

3.2.13.1 Ceiling

Ceiling control joints fastened securely in place shall be provided at spacing not to exceed 50 feet in each direction.

3.2.13.2 Vertical

Vertical control joints in long runs of drywall partitions shall be provided at spacing not to exceed 30 feet on center; at partition intersections with structural floors and columns; and at walls of dissimilar materials.

3.2.13.3 Abutting Concrete Slabs

Where tops of drywall partitions abut concrete slab floors, a 1/2 inch gap for deflection shall be provided between the top of stud and bottom of floor slab. A double slip track consisting of an inside and outside deep leg track shall be provided with studs screwed to the inside track. Runner tracks shall be embedded in calking or in an adhesive recommended by the drywall manufacturer, then stub-nailed in place.

3.2.14 Acoustical Sound Barrier

Glass-fiber or mineral-wool insulation shall be provided as required for an acoustical sound barrier. Where drywall partitions abut structural columns or dissimilar wall materials, 1/2-inch of insulation shall be provided between web of stud and column or wall.

3.2.15 Trim

Edges of exposed drywall shall be trimmed with the specified metal bead.

3.2.16 Framed Openings

Support members shall be provided at ceiling openings as required for access panels, recessed lighting fixtures, and heating and ventilating ducts.

Support members shall be not less than 1-1/2-inch main runner channels located where required and shall be provided in sufficient number to support furring and wallboard attachment.

3.2.17 Joint Finishing

Joints between wallboard panels and joints at metal trim shall be reinforced with joint tape and embedding-type joint compound and concealed with at least two applications of finishing compound in accordance with the printed instructions of the manufacturer of the gypsum wallboard. Screw depressions shall be filled with at least three coats of joint compound. Flanges at corner beads, edge trim, and control joints shall be concealed with at least two applications of joint compound, feathered and when deemed necessary sanded smooth.

Joint and screw-depression treatment shall be accomplished after wallboard is in place. The manufacturer recommended drying time shall be allowed between the application of each coat of joint compound. Where necessary, the last coating shall be sanded lightly with 2/0 sandpaper to leave a smooth finish flush with the paper face of the wallboard.

Control joints shall be concealed with three coats of joint cement. After the second coating has dried, a third coating shall be applied very thin to a smooth surface and feathered out 12 to 16 inches on both sides of the joint. If necessary, the joints, when dry, shall be sanded lightly with 2/0 sandpaper to leave a smooth, flush surface. Care shall be taken not to scuff the paper surface of the wallboard when sandpapering the cement. Water content of the finish bedding cement coat shall be in strict accordance with the manufacturer's specifications.

3.2.18 Moisture Proofing

Edges of gypsum wallboard adjoining tile bases and cut edges in areas of high humidity shall be sealed before erection with a waterproofing agent, plastic tape, joint compound, or material approved by the manufacturer of the wallboard.

3.2.19 Installation of Gypsum Drywall Ceilings

3.2.19.1 Metal-Framed Drywall Ceilings

Metal-framed drywall ceilings shall be installed and finished as specified and in accordance with the drywall manufacturer's written instructions for drywall ceilings installed over suspended or furred metal grilles and as required for the indicated fire rating and STC.

3.2.19.2 Metal Suspension Grilles

Main runner channels suspended or furred from the bottom chord of steel joists shall have the wire hanger looped around the runner channel and twisted a minimum of three times around itself. Hangers shall be plumb and spaced at not more than 4 feet on center.

Main runner channels suspended from concrete slab construction shall have hanger wires embedded in concrete construction by an approved method before concrete is placed, or they shall have hanger wires attached to approved inserts. Hanger straps shall be hung plumb and connected with 3/8-inch galvanized bolts and nuts to anchors made of hanger strap and set in the

concrete. Hangers shall be spaced at not more than 4 feet on center. Runner channels shall be braced in position true and rigid and as required to prevent distortion. At least 1-inch clear space shall be maintained between channel and wall or other building elements.

Main runner channels shall be spliced with 12-inchnested laps and tied securely near each end of the splice with two loops of 8-gage hanger wire. Splices shall be staggered.

Furring channels or resilient channels shall be installed at right angles to main runner channels or structural supporting members, and shall be fastened with clips or tie wires at a maximum spacing of 48 inches on center. Resilient channels shall be screw fastened to wood members. Furring channels or resilient channels shall be spaced at 24 inches on center. Channels shall be extended to within 2 inches of perimeter walls and abutting elements. Channels shall not be anchored or buried in the wall.

Furring shall be spliced with 8-inch nested laps and tied securely near each of the splice with two loops of 16-gage tie wire. Splices shall be staggered.

Suspension grilles shall be reinforced with 3/4-inch, cold-rolled channels or with furring channels at light troffers or any openings that interrupt the main runner or furring channels. Reinforcing channels shall be wire tied to and parallel to the main runner channels.

3.2.20 Steel Stud Framing

Floor and ceiling runner tracks shall be accurately aligned and securely attached to floors, structural ceilings, finished ceilings, or roof deck. Track shall be attached to concrete slabs with concrete stud nails at 24 inches on center; track shall be attached to metal ceiling grilles with a double strand of 18-gage tie wire spaced at no more than 16 inches on center; to steel framing or steel joists with machine bolts at 24 inches on center, and to suspended finish ceiling with toggle bolts, at 24 inches on center.

Runners shall extend beyond open-end partitions for at least 12 inches. Upon installation of end studs, runner extensions shall be bent and nested with the stud and attached with at least two sheet metal screws.

Runners shall be furnished in longest practical lengths with butt joints.

Steel studs shall be size indicated, spaced at 24 inches on center. A maximum height span of 12 feet shall be used for 2-1/2-inch studs. Maximum height span for 3-5/8-inch studs shall be 16 feet.

Studs for pipe chases, ventilating shaft framing, and steel column or beam fireproofing shall be the size indicated, spaced 16 inches on center.

Studs shall be positioned plumb in ceiling and floor runners and attached with at least one self-tapping screw on each side of the stud ends. Studs shall be installed in continuous lengths with no splicing.

Stud shall be placed no more than 1/2 inch from door frames, framed openings, abutting partitions, and partition corners. Studs shall be securely anchored direct or with spacers to door and borrowed-light frames by screw attachment.

Top-runner channels of intersecting partitions shall have the web extended across the intersected channel. Extended web shall be fastened with two screws. Flanges of the intersecting channel shall be cut, bent, and fastened to the flanges of the continuously intersected channel with two screws in each flange.

Partition reinforcement shall be provided over door and borrowed-light frame openings and, where required, for support of plumbing fixtures, accessories, and electrical and mechanical equipment. Reinforcement shall consist of cut-to-length sections of runner track or cold-rolled channels extending at least 2 feet on each side of the opening and braced and fastened to studs in accordance with the manufacturer's directions.

Head and jamb framing at door openings shall consist of a tube made up of one runner channel and one stud. Tubes at door jambs shall extend the full height of the partition and shall be fastened together with screws at a minimum of 24 inches center-to-center each flange. Tube over the door head shall be fastened together with a minimum of three screws each flange. Runner channel section of the header tube shall be cut 12-inches longer than the span between the two jamb studs. A web bend shall be made with 6 inches extended in a vertical direction on each jamb tube and fastened with a minimum of two screws. Flanges shall be extended horizontally and fastened to the flanges of the vertical stud. Cut-to-length studs shall then be positioned at not more than 16-inch spacing over the door opening and secured to the tube with a web flange bend with a minimum of two screws. Runner channel sections of tubes shall be secured to the door frame head and jamb with two 1/4-inch machine bolts, nuts, and washers.

3.2.21 Fixture Attachment

Wood or metal mounting strips shall be provided for cabinets and shelving as indicated. Mounting strip shall be braced and secured between studs; attachment bolts that extend through bracing, studs, and drywall shall be provided.

3.2.22 Double Partition Steel Stud Framing

Double partition stud framing shall consist of two completely separate steel stud partitions with stud width and spacing as indicated. Stud partition shall be constructed as specified herein and in accordance with gypsum wallboard manufacturer's written instructions.

Insulation shall be of thickness indicated and fastened securely to stud framing line as indicated, and shall be fastened securely to each stud.

3.2.23 Steel Framed Drywall Partitions

3.2.23.1 Single-Layer Partition Over Steel Framing

Gypsum wallboard shall be applied and finished as specified and in accordance with the drywall manufacturer's written instructions for a UL-approved, 1-hour fire-rated, single-layer, screw-stud drywall partition, with an STC of at least 41. All perimeter joints shall be calked.

Gypsum wallboard shall be applied and finished as specified and in accordance with the drywall manufacturer's written instructions for a non fire-rated, single-layer, screw-stud drywall partition and with a nonrated STC of at least 40.

3.2.23.2 Multiple-Layer Partition Over Steel Framing

Gypsum wallboard shall be applied and finished as specified and in accordance with the drywall manufacturer's written instructions for a UL-approved, 2-hour fire-rated, two-layer, screw-stud drywall partition, with joints staggered, mineral wool, sound attenuation blankets, perimeter calked, and with an STC of at least 50.

3.2.23.3 Metal Furring

Furring to receive gypsum wallboard shall be the specified galvanized-steel furring channels of the type and spacing as indicated. Clips and fasteners shall be provided as required for type of installation and in accordance with the wallboard manufacturer's written instructions. Furring members shall be installed plumb and true, shimmed to a plane surface, and spaced as indicated. Plane surface shall vary less than 1/8 inch in 8 feet.

Metal wall furring channels shall be installed vertically with horizontal spacing of not over 24 inches on center and shall be securely anchored to walls with suitable fasteners spaced 24 inches on center. Fasteners shall penetrate alternate wing flanges (staggered) of the furring channel. Metal wall furring channels shall also be placed horizontally at floors and ceilings; at heads of door frames; over and under wall louvers, access panels, and other opening in the walls, and shall be securely anchored as specified above.

3.2.24 Wallboard on Masonry

Gypsum wallboard shall be applied and finished as specified and in accordance with the drywall manufacturer's written instructions for a single-layer application to masonry walls.

3.2.25 Structural Frame Fireproofing

3.2.25.1 Column Fireproofing

Steel columns shall be fireproofed with 5/8-inch thick, Grade X, fire-retardant, gypsum wallboard, laminated and wired to column and furring as indicated and in accordance with the gypsum wallboard manufacturer's written instructions for the UL-approved, fire-rated construction. Wallboard shall be attached to 1-5/8-inch steel studs located at each corner of the columns. Joints shall be finished. Exposed corners and edges shall be finished with metal corner beads as specified.

3.2.25.2 Beams, Girders, and Trusses

Beams, girders, and trusses shall be fireproofed with 5/8-inch thick, Grade X, fire-retardant, gypsum wallboard, as indicated, and in accordance with the gypsum wallboard manufacturer's written instructions for a UL-approved, fire-rated construction. Joints shall be finished. Exposed corners and edges shall be finished with metal corner beads as specified.

3.2.26 Surface Finishing

Surface defects and damage shall be corrected to leave wallboard smooth, uniform in appearance, and ready to receive finish as specified in other sections of these specifications.

All control joints shall be properly and completely filled with the specified sealant.

Each application of joint compound if deemed necessary shall be sanded when dry . Final finish shall be uniformly smooth and flush with the paper face of the wallboard.

Surfaces of the work, and adjacent surfaces soiled as a result of this work shall be cleaned.

3.3 MARKING LOCATION OF MECHANICAL AND ELECTRICAL EQUIPMENT

Where either new or existing equipment is concealed above new ceilings, access doors or panels at equipment location shall be marked in accordance with Section 01600, "MATERIAL AND EQUIPMENT". Marking shall consist of GOMAR Ceiling Markers for GOMAR tagged equipment, and additional tags when required by Code.

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DIVISION 09 - FINISHES

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07/00

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SECTION 09310

CERAMIC, QUARRY, AND PAVER TILE
07/00

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108	(1992) Installation of Ceramic Tile
ANSI A118.3	(1992) Chemical Resistant Water Cleanable Tile-Setting and Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive
ANSI A118.4	(1992) Latex-Portland Cement Mortar
ANSI A118.6	(1992) Ceramic Tile Grouts
ANSI A118.9	(1992) Cementitious Backer Units
ANSI A137.1	(1988) Ceramic Tile

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 503	(1989) Standard Specification for Marble Dimension Stone (Exterior)
ASTM C 920	(1998) Standard Specification for Elastomeric Joint Sealants

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Submit Manufacturer's Catalog Data for the following items:

Wall tile
Floor tile
Trim units
Marble thresholds
Setting materials
Waterproofing materials
Elastomeric sealant
Cementitious backing units

SD-04 Samples

Submit three full-size samples of each type, color and pattern of the following items:

Wall tile
Floor tile
Grout (6 inch strip)
Marble thresholds (6 inch length)

SD-04 Samples

Submit three Manufacturer's Standard Color Charts illustrating range of colors available for the following items:

Wall tile
Floor tile
Grout

1.3 QUALITY ASSURANCE

Obtain tile materials from a single manufacturer who specializes in manufacturing products specified in this section. Obtain setting and grouting materials from a single manufacturer for each cementitious and admixture component.

Installer shall be a company specializing in performing the work of this section, and who has successfully completed tile installations similar in material and design to that indicated for this Project.

Finished tile installation shall display no uneven surfaces or high or low spots in excess of 1/8 inch in 8 feet when measured with and 8-foot straightedge in any direction. Tile floors pitched to a floor drain shall be measured at any point along an 8-foot radius from the floor drain.

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.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements of ANSI A137.1 for labeling sealed tile packages. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

1.5 ENVIRONMENTAL CONDITIONS

Maintain minimum temperature of 50 degrees F in areas of tile installation during installation and for 7 days after completion unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

PART 2 PRODUCTS

2.1 WALL TILE MATERIALS

2.1.1 Glazed Wall Tile

Provide standard grade matte, bright, or glazed tile, as indicated,

conforming to ANSI A137.1, and complying with the following requirements:

Nominal Thickness: 5/16 inch.

Nominal Face Size: 4-1/4 x 4-1/4 inches

Face: Plain with modified square edge or cushion edge.

Color: As selected from manufacturer's full range of standard colors.

2.1.2 Ceramic Mosaic Tile

Provide standard grade unglazed, bright glazed, or matte glazed, as indicated on the drawings factory-mounted ceramic mosaic tile assemblies, conforming to ANSI A137.1, and complying with the following requirements:

Composition: Porcelain.

Nominal Thickness: 1/4 inch.

Nominal Face Size: 1 x 1 inches or
2 x 2 inches.

Face: Plain with cushion edge.

Color: As selected from manufacturer's full range of standard colors.

2.2 FLOOR TILE MATERIALS

2.2.1 Ceramic Mosaic Tile

Provide standard grade, factory-mounted, unglazed mosaic tile, conforming to ANSI A137.1, and complying with the following requirements:

Composition: Porcelain with abrasive admixture.

Nominal Thickness: 1/4 inch.

Nominal Face Size: 1 x 1 inches or
2 x 2 inches.

Face: Plain with cushion edge.

Color: As selected from manufacturer's full range of standard colors.

2.2.2 Paver Floor Tile

Provide standard grade unglazed flat tile, conforming to ANSI A137.1, and complying with the following requirements:

Composition: Porcelain or natural clay, as indicated on the drawings.

Nominal Thickness: 5/16 inch.

Nominal Face Size: 8 x 8 inches or 12 x 12 inches.

Face: Plain with square or cushioned edge.

Color: As selected from manufacturer's full range of standard colors.

2.2.3 Quarry Floor Tile

Provide standard grade unglazed flat quarry tile, conforming to ANSI A137.1, and complying with the following requirements:

Wearing Surface: Nonabrasive or abrasive aggregate embedded in surface.

Nominal Thickness: 1/2 inch.

Nominal Face Size: 6 x 6 inch or 8 x 8 inch, as indicated on the drawings.

Face: Plain or as indicated on the drawings.

Color: As selected from manufacturer's full range of standard colors.

2.3 TRIM UNITS

Provide manufacturer's standard trim shapes for thin-set mortar installations to match characteristics of adjoining flat tile, and complying with the following requirements:

Base: Cove.

Wainscot Cap: Surface bullnose.

External Corners: Cap shapes.

Internal Corners: Cap shapes of square corners. Combination angle and stretcher type..

2.4 MARBLE THRESHOLDS

Provide marble thresholds at door openings and where indicated, complying with ASTM C 503 requirements for exterior use and abrasion resistance, minimum 3/4-inch thick by full width of wall or frame opening, beveled both sides for handicapped accessibility, white color with honed finish.

2.5 SETTING MATERIALS

2.5.1 Latex-Portland Cement Mortar

Provide latex-portland cement mortar bond coat for setting tile, complying with ANSI A118.4, consisting of an acrylic resin latex additive, combined at the job site with a prepackaged dry mortar mix supplied by latex additive manufacturer.

2.5.2 Latex-Portland Cement Grout

Provide latex-portland cement grout, complying with ANSI A118.6, consisting of an acrylic resin latex additive, combined at the job site with a prepackaged dry grout mix supplied by latex additive manufacturer. Provide color as selected from manufacturer's full range of standard colors.

2.5.3 Epoxy Grout

Provide chemical-resistant, water-cleanable epoxy resin tile grout, complying with ANSI A118.3. Provide color as selected from manufacturer's

full range of standard colors.

2.6 GROUT SEALER

Provide "Grout Sealer" manufactured by CeramaSeal from Bostick, or an approved equal water-based grout sealer for wall tile joints.

Provide "Silox 8" manufactured by CeramaSeal from Bostick, or an approved equal sub-surface stain repellent for porcelain floor tile joints.

2.7 WATERPROOFING MEMBRANE MATERIALS

Provide one of the following waterproofing systems for thinset tile installations:

Polyethylene sheet waterproofing, consisting of composite sheets, minimum 0.030 inch thickness, composed of an inner layer of chlorinated polyethylene sheet faced on both sides with laminated high-strength nonwoven polyester, designed for embedding in latex-portland cement mortar, and as substrate for latex-portland cement mortar setting bed.

Trowel-applied waterproofing system, consisting of a two-part liquid latex rubber and powder or two-part synthetic polymer formulation, factory-prepackaged and job mixed for trowel application with glass fiber reinforcing, or a one-part liquid urethane and tile-setting adhesive for trowel application.

2.8 ELASTOMERIC SEALANT

At interior joints in vertical surfaces of ceramic tile, provide mildew-resistant silicone sealant, single component, conforming to ASTM C 920, Type S, Grade NS, Class 25, Uses NT, G, A, and O, formulated with fungicide. Match color of grout unless indicated otherwise.

At interior joints in horizontal surfaces of ceramic tile, provide single component pourable urethane sealant, conforming to ASTM C 920, Type S, Grade P, Class 25, Uses T, M, A, and O. Match color of grout unless indicated otherwise.

2.9 CEMENTITIOUS BACKING UNITS

Provide cementitious backing units, complying with ANSI A118.9, and conforming to the following requirements:

Thickness: Not less than 7/16 inches.

Width: Not less than 32 inches.

Length: Maximum lengths available.

PART 3 EXECUTION

3.1 EXAMINATION

Verify that substrates for setting tile are firm and clean. Do not proceed with tile installation until unsatisfactory conditions are corrected.

3.2 PREPARATION

Verify that tile is factory blended within the color ranges selected during sample submittals. If tiles are not factory blended, return to manufacturer or blend tiles at Project site before installing.

Before commencing work, field pattern and border line locations shall be established and the work shall be contered symmetrically so that no tile need be cut to less than half size. Joints in wall tile shall be aligned vertically and horizontally. Staggered joints will not be accepted.

3.3 WATERPROOFING INSTALLATION

Install waterproofing in accordance with manufacturer's instructions to produce a waterproof membrane of uniform thickness bonded to substrate. Do not install tile until waterproofing has cured and has been tested for watertightness.

3.4 TILE INSTALLATION

Install tile in accordance with manufacturer's instructions, and ANSI A108 tile installation standards which apply to the type of setting and grouting materials and methods indicated.

Lay tile in grid pattern unless indicated otherwise. Provide uniform joint widths and align floor, base and wall joints when possible. Center tile in both directions in each space or on each wall area.

Cut and fit tile tight to penetrations through tile. Form corners and bases neatly. Make joints watertight without voids, cracks, excess mortar, or excess grout. Perform cutting and drilling of tile without marring visible surfaces.

For tile mounted on sheets, make joints between tile sheets same width as joints within tile sheets.

Install marble thresholds at locations indicated. Set in same type of setting bed as abutting field tile unless otherwise indicated.

3.5 CLEANING

Clean tile surfaces and adjacent surfaces soiled as result of tile work. Remove grout residue from tile as soon as possible after installation.

Clean unglazed tile with acid solutions if necessary, and when permitted by tile and grout manufacturer's printed instructions, and not earlier than 14 days after installation. Protect adjacent surfaces and fixtures from effects of acid cleaning.

3.6 PROTECTION

Seal grout surfaces with specified sealer in accordance with manufacturer's instructions.

Protect completed tile work from staining and damage with Kraft paper or other covering during the construction period. Prohibit foot and wheel traffic on tile floors for at least 7 days after grouting is completed.

-- End of Section --

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SECTION 09514

ACOUSTIC CEILINGS, EXPOSED GRID
06/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 366/A 366M	(1996) Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 489	(1993) Standard Specification for Carbon Steel Eyebolts
ASTM A 591/A 591M	(1989; R 1994) Standard Specification for Steel Sheet, Cold-Rolled, Electrolytic Zinc-Coated for Light Coating Mass Applications
ASTM B 221	(1995; Rev A) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM B 221M	(1996) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes (Metric)
ASTM B 633	(1985; R 1994) Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C 423	(1990; Rev A) Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C 635	(1994) Standard Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636	(1992) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM D 1593	(1992) Standard Specification for Nonrigid Vinyl Chloride Plastic Sheeting
ASTM D 1730	(1967; R 1993) Standard Practices for Preparation of Aluminum and Aluminum-Alloy

	Surfaces for Painting
ASTM D 2103	(1997) Standard Specification for Polyethylene Film and Sheeting
ASTM E 119	(2000; Rev A) Standard Test Methods for Fire Tests of Building Construction and Materials
ASTM E 1264	(1990) Standard Classification for Acoustical Ceiling Products
ASTM E 413	(1987; R 1994) Standard Classification for Rating Sound Insulation
ASTM E 90	(1990) Standard Test Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions
ASTM F 541	(1990) Standard Specification for Alloy Steel Eyebolts

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.15	(1985) Forged Eyebolts
ASME B18.6.1	(1981; R 1991) Wood Screws (Inch Series)
ASME B18.6.3	(1972; R 1991) Machine Screws and Machine Screw Nuts
ASME B18.6.4	(1981; R 1991) Thread Forming and Thread Cutting, Tapping Screws and Metallic Drive Screws
ASME B18.6.5M	(1986; R 1993) Metric Thread Forming and Thread Cutting Tapping Screws
ASME B18.6.7M	(1985; R 1993) Metric Machine Screws

INDUSTRIAL FASTENER INSTITUTE (IFI)

IFI 502	(1982) Metric Tapping Screws

UNDERWRITERS LABORATORIES (UL)

UL-02	(2000) Building Materials Directory

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Noise Reduction Coefficient Grade

Noise reduction coefficient (NRC) grade of acoustic ceilings shall be tested or certified by an approved testing laboratory in accordance with ASTM C 423, and shall be mounting type No. 7, NRC grade 0.50 to 0.60.

1.2.2 Ceiling Sound-Transmission Classification

Sound Transmission Classification (STC) of the indicated acoustic ceilings

shall be an 11-frequency test method conforming to ASTM E 90, and shall have an STC rating of 35 to 39 for both continuous and interrupted partition conditions.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Installation Drawings shall be submitted for Acoustic Ceilings showing intermediate framing of hanger supports that fall between framing members; fastening of suspension system to top plate of nonbearing partitions; hanger fastenings at roof framing members and at main runners; acoustic unit support at ceiling fixtures; the splicing method for main and cross runners; positioning of splines; and the suspension system structural classification in accordance with ASTM C 635.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items showing UL classification of fire-rated ceilings giving materials, construction details, and UL design number and fire protection time rating for each acoustic ceiling assembly, and showing conformance to the referenced standards.

Fire-Rated Ceiling Systems
Acoustic Materials
Suspension System Materials

SD-04 Samples

The following samples shall be submitted:

Acoustic Units: Three 6-inch by 6-inch samples of each type and pattern to illustrate the manufacturer's standard color and appearance range.

Suspension System Members: Three 1-foot samples of each type.

Anchorage Devices and Fasteners: Three full-size samples of each type.

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted showing printed instructions covering installation of Acoustic Materials and Suspension Systems.

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered and stored in their original, unopened packages bearing labels clearly identifying manufacturer's name, brand name, material, type or class, UL listing when applicable, and other pertinent data.

Acoustic materials shall be stored in a weathertight and dry place, having a temperature not less than 65 degrees F and relative humidity not more than 70 percent, and for at least 24 hours prior to installation.

1.5 FIELD MEASUREMENTS

Field measurements shall be taken prior to preparation of drawings and fabrication, to ensure proper fitting of the work.

1.6 MAINTENANCE INSTRUCTIONS

The Contractor shall follow the acoustic material manufacturer's recommended cleaning and application methods, including precautions in the use of cleaning materials that may be detrimental to acoustic surfaces and the finish of exposed metal components.

PART 2 PRODUCTS

2.1 FIRE-RATED CEILING SYSTEMS

Materials and methods used for fire-rated ceiling systems shall meet the minimum requirements of ASTM E 1264, ASTM C 635, ASTM C 636, and ASTM E 119.

2.2 ACOUSTIC MATERIALS

2.2.1 Mineral Fiber Acoustic Units

Units shall be prefabricated, mineral-composition type, not more than 25 flame spread index class and 0.75 or more light reflectance coefficient grade, conforming to ASTM E 1264.

Finish of exposed-to-view surfaces of the units shall be a factory-applied, washable, white paint, or scuff-resistant and washable white finish, as indicated on drawings, consisting of two paint coats and one vinyl coat.

2.2.2 Plastic Membrane-Faced Units

Units shall be mineral-composition type, not more than 25 flame spread index class and not less than 0.75 light coefficient grade, conforming to ASTM E 1264. Plastic membrane shall be factory-applied, white, polyester-film material, not less than 0.0015 inch thick, conforming to ASTM D 2103 or white, embossed-polyvinylchloride film material conforming to ASTM D 1593. Thickness tolerance shall be plus 0.0007 inch or minus 0.0003 inch.

2.2.3 Acoustic Panels

Panels shall be mineral-fiber plastic membrane-faced units, nominal 24 by 48 inches or 24 by 24 inchesby not less than 5/8 inch thick, with square trimmed and butt edges.

Pattern D (fissured) in accordance with ASTM E 1264.

2.3 SUSPENSION SYSTEM MATERIALS

2.3.1 Carrying Channels

Channels shall be 1-1/2-inch by not less than 19/32 inch, cold-formed, U-shape sections, fabricated from zinc-coated, cold-rolled steel sheets,

not less than 0.0598-inch thick.

Channels for fire-rated acoustic ceilings shall be in accordance with the specified Underwriters Laboratory (UL) fire classification design numbers approved for the work.

2.3.2 Exposed, Direct Hung, Main Runners

Main runners shall be cold-formed bulb-tee sections, single- or double-web type, fabricated from specified steel sheets. Web height shall be not less than 1-1/2 inches, and the bottom flange width not less than 15/16 inch. Webs shall be drilled or grooved to receive cross runner end tabs and main runner splices.

The structural classification shall be intermediate duty in accordance with ASTM C 635.

Finish of the exposed-to-view surfaces shall be baked-on white enamel. Finish shall pass the high humidity test specified in ASTM C 635.

2.3.3 Cross Runners and Accessories

Cross runners shall be designed for use with the type and structural classification of the main runners used, in accordance with ASTM C 635. The bottom flange shall be suitable for the tile joint used.

Finish of the exposed-to-view surfaces shall be the same as the main runners.

Antibreather splines, hold-down clips, main runner connectors, and other accessories required to complete the ceiling installation shall be provided. Such accessories shall be designed for use with the type of main runner used.

2.3.4 Fire-Rating and Finish

Fire-rated exposed runners for fire-rated acoustic ceilings shall be as specified in the UL fire classification design number(s) approved for the work. Cartons shall bear UL listing.

Finish of the exposed-to-view surface of main runners shall be baked-on white enamel, and shall pass the high humidity test specified in ASTM C 635.

2.3.5 Wall Moldings

Moldings shall be cold-formed sections, fabricated from steel sheets.

Height of moldings shall be as required to accommodate the type of runners used. Where exposed main runners are used, the exposed leg width of moldings shall be the same as the flange width of the runners. Where bullnose masonry units are used for wall and partition construction, inside-and outside-corner caps shall be provided. Corner caps shall be one-piece, shop-fabricated units having a radius conforming to the bullnose and exposed face width the same as the exposed width of the adjoining wall molding. Corner caps shall extend at least 12 inches on each side of the corner, and shall be butt-joined to the adjacent wall molding with concealed fastenings.

Finish of exposed-to-view surfaces of moldings and corner caps shall be the

same as the runners.

Moldings for fire-rated ceilings shall be approved for use in the UL fire classification design number(s) approved for the work.

2.4 SUSPENSION MATERIALS

2.4.1 Hanger Inserts

Inserts shall consist of a wire loop and steel shell embedded in concrete and designed to provide a single wire loop exposed flush with the concrete surface.

Inserts shall not be removable when embedded in concrete and subjected to a 300-pound tension load test in an axial direction; nor shall the concrete show evidence of failure attributed to the hanger insert.

2.4.2 Hanger Wire

Hangar wire shall be 12-gage galvanized, mild steel wire in accordance with ASTM C 636.

PART 3 EXECUTION

3.1 ACOUSTIC MATERIAL

Acoustic material shall be installed in accordance with the manufacturer's recommendations and ASTM C 636.

3.2 CONDITIONS AT BUILDING

Work above the ceiling line shall be completed, and approved, prior to the start of acoustic work.

3.3 ITEMS EMBEDDED IN OTHER CONSTRUCTION

Placement locations and installation instructions shall be provided for items embedded in other construction.

3.4 ARRANGEMENT OF ACOUSTIC CEILINGS

Acoustic units shall be so arranged that units less than one-half width do not occur unless otherwise required to suit conditions.

Ceilings shall be so arranged that either the tile joint or the tile centerline centers on ceiling fixtures.

3.5 PLACING SUSPENSION SYSTEM MEMBERS

Hanger wires shall be vertical and suspended from structural supporting members as follows:

Wires shall be secured to the bottom chord of joists or structural members by wire-tying or by metal clips especially designed for the purpose.

3.6 SETTING MASONRY ANCHORAGE DEVICES

Masonry anchorage devices shall be set in masonry or concrete in accordance

with the anchorage device manufacturer's printed instructions. Drilled holes shall be left rough, not reamed, and free from drill dust.

3.7 FRAMING OPENINGS FOR CEILING FIXTURES

Support members shall be provided at openings for ceiling fixtures or as indicated. Support members shall be of the size required to support the load without permitting deflection of the ceiling in excess of the performance requirements for the suspension system structural classification specified. Intermediate supports and separate hangers shall be provided if required.

Moldings shall be installed at walls and other vertical surfaces, except where movable metal partitions having caps designed to receive suspension system members are indicated.

Lay-in panels shall be installed with edges resting on the flanges of the suspension system members and held in place with approved hold-down clips.

3.8 FIRE-RATED ACOUSTIC CEILINGS

The fire-rated ceiling assembly shall be as specified in the UL fire classification design number(s) approved for the work..

Light-fixture protection shall be provided for all recessed-lighting fixtures in fire-resistive acoustic ceilings. Light-fixture protection shall be as specified in the approved UL fire-resistance classification design number approved for the work.

Ceiling openings for lighting and air distribution shall be as specified in the UL fire classification design number(s) approved for the work..

3.9 MARKING LOCATION OF MECHANICAL AND ELECTRICAL EQUIPMENT

Where either new or existing equipment is concealed above new ceilings, ceiling grid at equipment location shall be marked in accordance with Section 01600, "MATERIAL AND EQUIPMENT". Marking shall consist of GOMAR Ceiling Markers for GOMAR tagged equipment, and additional tags when required by Code.

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SECTION 09650

RESILIENT FLOORING
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 221	(1995; Rev A) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM B 221M	(1996) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes (Metric)
ASTM F 1066	(1995; Rev A) Standard Specification for Vinyl Composition Floor Tile
ASTM F 1303	(1995) Sheet Vinyl Floor Covering with Backing
ASTM F 1344	(1993) Standard Specification for Rubber Floor Tile

FEDERAL SPECIFICATIONS (FS)

FS RR-T-650	(Rev D) Treads, Metallic and Non-Metallic, Skid Resistant
FS SS-T-312	(Rev B; Notice 1) Tile, Floor; Asphalt, Rubber, Vinyl, Vinyl-Asbestos
FS SS-W-40	(Rev A; Int Am 1, Notice 1) Wall Base: Rubber, and Vinyl Plastic
FS ZZ-T-001237	Tread, Stair, Flexible and Semi-Rigid Type Rubber and Vinyl

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Vinyl Composite Tile
Sheet-Vinyl Flooring
Rubber Tile
Base
Vinyl Reducer Strips
Vinyl Feature Strips
Substrate Primer/Sealer
Adhesives
Edge Strips
Stair Treads
Risers

SD-04 Samples

Manufacturer's Standard Color Charts shall be submitted for Resilient Flooring showing NASA GSFC's recommended color and finish selections.

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted showing printed instructions covering installation of Resilient Flooring Systems.

SD-10 Operation and Maintenance Data

Preventive Maintenance and Inspection shall be submitted showing the resilient flooring material manufacturer's recommended cleaning and application methods.

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered to the project site in their original packages or containers bearing labels clearly identifying the manufacturer, brand name, and quality or grade.

Materials shall be stored in their original unbroken packages or containers in the area in which they will be installed.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 General Requirements

Resilient flooring, base, and edging strips shall be from the NASA GSFC standard color range.

2.1.2 Vinyl Composition Tile

Tile shall conform to ASTM F 1066, Composition I, 12 by 12 inches square, Class 2. Thickness shall be 1/8 inch.

2.1.3 Sheet-Vinyl Flooring

Sheet-vinyl flooring shall conform to ASTM F 1303, Type II, Grade A.

Minimum overall thickness shall be 0.090-inch.Flooring shall be suitable for above-grade, on-grade, and below-grade applications.

2.1.4 Rubber Tile

Rubber tile shall conform to ASTM F 1344, 12 by 12 inches square. Thickness shall be 1/8 inch.

2.1.5 Base

Base shall be vinyl composition and the selected style conforming to FS SS-W-40.

Base, exclusive of corners, shall be furnished in rolls not less than 50 feet long. Each wing of corners shall be not less than 2 inches long. Wall base shall be 4 inches in height, shall have toe, and shall match the NASA GSFC wall base standard colors.

2.1.6 Vinyl Reducer Strips

Vinyl reducer strips shall conform to FS SS-T-312.

Strips shall be 1-inch wide, in the lengths required to minimize joints, and 1/8-inch thick. Vinyl reducer strip shall match flooring field color.

2.1.7 Vinyl Feature Strips

Vinyl feature strips shall conform to FS SS-T-312 and shall be 1/8-inch thick.

2.1.8 Substrate Primer/Sealer

Substrate primer sealer shall comply with the resilient flooring manufacturer's recommendations for the type and location of substrate and the end use of the area to be covered. Primer/sealer shall be nonstaining to the resilient flooring.

2.1.9 Adhesive

Emulsion adhesive shall be used with emulsion primer. Cutback adhesive shall be used with cutback primer. Adhesive shall be nonstaining to the resilient flooring. Adhesive for stair treads shall be the type recommended by the manufacturer.

2.1.10 Edge Strips

Edge strips shall be extruded-aluminum alloy conforming to ASTM B 221, Temper F, 1/8-inch thick and 3/4-inch wide, butt type, and rounded on the exposed edge. Strips shall be installed in accordance with the manufacturer's recommendation.

2.1.11 Rubber Stair Treads and Landing Tile

Stair treads shall conform to FS RR-T-650, composition A, with curve nosing. Minimum tread thickness shall be 1/4 inch at front edge, a full 3/16 inch molded pettern low-profile raised disc desigh through the design, then down to 1/8-inch at the back edge. Treads and till shall contain 90 percent recycled rubber.

2.1.12 Risers

Risers shall conform to FS ZZ-T-001237, Style A. Thickness shall match

tile thickness.

PART 3 EXECUTION

3.1 CONDITIONS AT BUILDING

Surfaces to receive stair-tread materials shall be maintained at an ambient temperature of at least 70 degrees F for at least 48 hours prior to, during, and for 48 hours after completion of the stair-tread installation.

Specified materials shall be installed only when normal temperature and humidity conditions approximate the interior conditions of the building that will exist when occupied.

Installation of the resilient flooring shall be deferred until other work that might cause damage to flooring has been completed.

3.2 PREPARATION OF SUBSTRATE SURFACES

Surfaces to receive specified materials shall be clean, smooth, cured, and free from materials detrimental to achieving the required bond.

Concrete substrate surfaces shall be coated completely with a primer/sealer in accordance with the resilient-material manufacturer's recommendations.

Cracks, rough areas, joints, and other surface defects in the concrete shall be filled with a material recommended by the stair-tread manufacturer. Ridges, trowel marks, and other surface projections shall be ground smooth.

Before the start of stair-tread application, substrate surfaces shall be tested for moisture content to ensure against a moisture invasion of the adhesive.

Moisture test for concrete stairs to which stair treads are to be applied shall be performed as follows:

After the concrete has been cleaned, small patches of the adhesive to be used shall be spread evenly and allowed to dry or set overnight. When set adhesive can be peeled easily from the concrete, the test shall be repeated at intervals until the adhesive adheres tightly. Stair treads shall not be installed until the adhesive adheres tightly to the concrete.

3.3 APPLICATION OF FLOORING AND BASE

Application of flooring shall be in accordance with the flooring manufacturer's recommendations.

3.4 APPLICATION OF VINYL STRIPS

Vinyl reducer strips shall be applied in conjunction with the specified flooring materials where required. Reducer strips shall be tightly butted to the resilient flooring with the fewest possible seams, in accordance with the manufacturer's instructions.

Vinyl feature strips shall be applied in conjunction with the flooring materials and patterns. Feature strips shall be tightly butted to the resilient flooring with the fewest possible seams, as approved by the

manufacturer.

3.5 APPLICATION OF EDGE STRIPS

Edge strips shall be installed at exposed edges of resilient flooring and where thresholds are not required. Top surface shall be flush with resilient flooring. Strips shall be secured to the subfloor as recommended by the manufacturer.

3.6 CLEANING AND PREPARATION

Following application of flooring, the Contractor shall thoroughly clean and prepare the floor.

Stair-tread surfaces shall be cleaned of foreign substances in accordance with the stair tread manufacturer's cleaning instructions.

3.7 APPLICATION OF STAIR TREADS

Application of the adhesive and stair treads shall be in accordance with the manufacturer's recommendations.

3.8 ACCEPTANCE PROVISIONS

3.8.1 Rejection

Floor surfaces will be rejected when colors or patterns do not match the color or pattern of approved samples, and when chipped, cracked, stained, or mismatched stair treads occur.

3.8.2 Repairing

Damaged and unacceptable portions of the completed work shall be removed and replaced with new work to match adjacent surfaces at no additional cost to the Government.

3.8.3 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.

3.9 EXTRA MATERIAL

Upon completion of the vinyl composition tile flooring installation, spare tiles of each type, color, and pattern from the same lot as those installed shall be furnished at the rate of five tiles for each 1,000 tiles or fraction thereof installed.

Upon completion of the sheet vinyl flooring installation, extra material of each type, color, and pattern from the same lot as installed shall be furnished at the rate of 1.0 percent of the area installed.

Upon completion of the stair-tread installation, spare treads of each type, color, and pattern from the same lot as those installed shall be furnished at the rate of 1 tread for each 50 treads installed.

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HEAVY DUTY EPOXY FLOORING

09/96

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SECTION 09675

HEAVY DUTY EPOXY FLOORING
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 883	(1989) Standard Test Method for Effective Shrinkage of Epoxy-Resin Systems Used with Concrete
ASTM D 1475	(1990) Standard Test Method for Density of Paint, Varnish, Lacquer, and Related Products
ASTM D 1544	(1980; R 1989) Standard Test Method for Color of Transparent Liquids (Gardner Color Scale)
ASTM D 1652	(1990) Standard Test Method for Epoxy Content of Epoxy Resins
ASTM D 2240	(1991) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D 2471	(1994) Standard Test Method for Gel Time and Peak Exothermic Temperature of Reacting Thermosetting Resins
ASTM D 2566	(1986) Standard Test Method for Linear Shrinkage of Cured Thermosetting Casting Resins During Cure
ASTM D 445	(1994) Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
ASTM D 523	(1989; R 1994) Standard Test Method for Specular Gloss
ASTM D 570	(1995) Standard Test Method for Water Absorption of Plastics
ASTM D 638	(1999) Standard Test Method for Tensile Properties of Plastics
ASTM D 638M	(1994; Rev B) Standard Test Method for Tensile Properties of Plastics (Metric)

ASTM D 696	(1991) Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 degrees C and 30 Degrees C
ASTM D 756	(1993) Standard Practice for Determination of Weight and Shape Changes of Plastics Under Accelerated Service Conditions

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 6	(1991) Surface Preparation Specification No. 6 - Commercial Blast Cleaning

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Installation Drawings shall be submitted for Heavy Duty Epoxy Flooring Systems in accordance with the paragraph entitled, "Installation of Floor Topping," of this section.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Epoxy-Resin Binder/Matrix
Cured Epoxy Binder
Walnut Shell Aggregate
Surface Sealing Coat

SD-04 Samples

Three samples of Hardboard or Transite Panels not less than 12-inches square for each required color.

Panels shall show nominal thickness of finished toppings and color and texture of finished surfaces. Finished floor toppings shall match the approved samples in color and texture.

SD-07 Certificates

Certificates of Compliance shall be submitted for following showing conformance with the referenced standards contained in this section.

Epoxy-Resin Binder/Matrix
Cured Epoxy Binder
Walnut Shell Aggregate
Surface Sealing Coat

SD-07 Certificates

A copy of the records of inspections, as well as the records of

corrective action taken shall be submitted.

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be protected from weather, soil, and damage during delivery, storage, and construction.

Materials shall be delivered in original packages, containers, or bundles bearing brand name and name of material.

Materials used in the installation of floor topping shall be maintained at a temperature between 65 and 85 degrees F.

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Applicators installing the floor topping shall have had experience in the application of troweled walnut-shell aggregate thin-set floor topping.

PART 2 PRODUCTS

2.1 MIXES

2.1.1 Epoxy-Resin Binder/Matrix

Epoxy-resin binder shall be a clear two-component compatible system consisting of: (1) a liquid blend of a biphenol-based epoxy resin and an aliphatic polyglyceridyl ether, and (2) a liquid blend of two modified amine curing agents, which will individually cure the epoxy resin at room temperature to a glossy smooth film. Two components and the cured epoxy binder shall have the following physical properties:

PROPERTY	TEST METHOD	REQUIREMENT
	COMPONENT A (EPOXY RESIN)	
Viscosity (kinematic), at 77 degrees F, centipoises	ASTM D 445	3000 to 5000
Weight per epoxide, grams	ASTM D 1652	205 to 225
Color (Gardner Color Scale), maximum	ASTM D 1544	5
Weight per gallon, pounds	ASTM D 1475	9.46 - 9.56
	COMPONENT B (CURING AGENT)	
Viscosity (kinematic), at 77 degrees F, centistokes	ASTM D 445	75 to 125
Weight per gallon, pounds	ASTM D 1475	7.50 to 7.60
Color (Gardner Color Scale), maximum	ASTM D 1544	8

2.1.2 Cured-Epoxy Binder

Components A and B shall be combined in the proportions specified by the manufacturer to form a clear compatible system immediately on mixing. Combined components shall cure to a clear film possessing a glossy, nongreasy surface at relative humidities less than 80 percent, and have the following properties after curing 24 hours at 77 degrees F, followed by 24 hours at 125 degrees F:

PROPERTY	TEST METHOD	REQUIREMENT
Tensile strength, psi* at test temperature: 77 degrees F	ASTM D 638	4500 to 6500
Tensile elongation, percent* at test temperature: 77 degrees F	ASTM D 638	20 to 40
Weight loss, percent** 24 hours at 300 degrees F	ASTM D 756	6.0
Water absorption, percent 24 hours at 77 degrees F, maximum	ASTM D 570	0.40
Hardness, Shore D	ASTM D 2240	74 to 82
Linear shrinkage, inch/inch maximum	ASTM D 2566	0.006
Shrinkage, glass bow, inches divergence, maximum	ASTM C 883	0.016
Coefficient of linear thermal expansion, inch/inch/degree C, maximum	ASTM D 696 0 degrees C to 40 degrees C	200 X 10-6
Gel time/peak exotherm at 77 degrees F, 100 gm mass in 4-ounce metal container	ASTM D 2471	20 to 40 minutes at 300 degrees F, maximum

*1/8 inch thick castings

**1/8 by 1 by 3 inch castings, aged in forced draft oven

2.1.3 Walnut Shell Aggregate

Walnut shell aggregate shall be delivered to the site in three separate package gradations for blending. Gradations to be furnished shall be:

SIEVE SIZE	PERCENT MAXIMUM	PERCENT MINIMUM
GRADATION NO. 1		
Retained on No. 6	0.0	-
Passing No. 6, retained on No. 8	5.0	0.0

SIEVE SIZE	PERCENT MAXIMUM	PERCENT MINIMUM
Passing No. 8, retained on No. 12	100.0	74.0
Passing No. 20	1.0	-
GRADATION NO. 2		
Retained on No. 16	0.0	-
Passing No. 16, retained on No. 18	5.0	0.0
Passing No. 18, retained on No. 40	100.0	85.0
Passing No. 40, retained on No. 60	9.0	0.0
Passing No. 60	1.0	-
GRADATION NO. 3		
Retained on No. 20	0.0	-
Passing No. 20, retained on No. 35	5.0	0.0
Passing No. 35, retained on No. 60	100.0	80.0
Passing No. 60, retained on No. 100	13.0	0.0
Passing No. 100	2.0	-

2.1.4 Surface Sealing Coat

Surface sealer shall be nonambering aliphatic or aromatic moisture-curing polyurethane into which has been incorporated a suitable flatting agent. Flatting agent shall be added not more than 24 hours prior to actual application of the coating. Cured coating with flatting agent shall give 60-degree specular gloss of 10 to 20 when tested in accordance with ASTM D 523.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Safety Precautions

Prior to application in confined spaces of toppings and coatings containing flammable or toxic properties, forced ventilation shall be provided to ensure that vapor concentration is kept at acceptable limits recommended by the manufacturer of the product.

"NO SMOKING" signs shall be erected, and smoking or use of spark- or flame-producing devices shall be prohibited within 50 feet of any mixing or placing operation involving flammable materials.

Personnel required to handle, mix, or apply toppings containing toxic or flammable properties shall be provided with, and required to wear, such items of personal protective equipment and apparel for eye, skin, and

respiratory protection as are recommended by the manufacturer of the product.

Sand blasting shall be accomplished under approved controlled conditions with respect to sand and dust control to prevent damage to personnel and facility.

3.2 PREPARATION

3.2.1 Concrete Subfloor

Installation of floor topping shall not commence until concrete has cured a minimum of 28 days. Concrete shall have rough or broom type finish. Prior to applying the prime coat, concrete surface shall be cleaned by an approved method.

3.2.2 Mixing of Materials

Job mix proportions shall be based on the trial batch proportions used to prepare the floor topping samples submitted and approved. Binder aggregate ratio shall normally range from 1:2 to 1:2.3 (by weight), since mixtures providing satisfactory density, trowelability, and surface texture will be affected by variations in particle shapes, sizes, and size distribution. Three different walnut shell aggregate gradations shall be blended (by weight) as follows: 1 part No. 1; 1.15 parts No. 2; and 1.15 parts No. 3. Minor adjustments of the mix proportions of the approved floor topping samples will be permitted, subject to approval.

Mechanical equipment shall be used for mixing of materials. Rotating replaceable 5- to 16-gallon pail mixers shall be used for blending components A (epoxy resin) and B (curing agent) of epoxy binder.

Rotating paddle-type masonry mortar mixers shall be used for preblending the three sizes and color pigment, if any, of the walnut shell aggregate and addition of the mixed epoxy resin binder. Mixing times shall be as recommended by the materials supplier(s), provided mixing times result in homogeneous mixtures. In case the equipment used does not provide uniform mixtures in the times recommended, adjustment of the mixing times shall be subject to approval. Quantity of material mixed at one time shall be limited to that which can be applied and finished within the working life of the mixtures. Temperature of materials at the time of mixing shall be between 65 and 85 degrees F.

3.2.3 Protection

In addition to the protection of adjacent surfaces during installation, areas used to store and mix materials shall have a protective covering under the materials. After application of the sealer coats, finished flooring shall be protected during the remainder of the construction period. In areas of expected minimum or moderate traffic, floors shall be covered with 70-pound kraft paper, a 30-30-30 waterproof kraft paper, or an approved substitute, with strips taped together and edges secured to prevent roll-up. Vegetable fiberboard, plywood, or other suitable material that will not mar the flooring shall be placed over the paper to protect areas used as passages by workmen and areas subject to floor damage because of subsequent building operations. Upon completion of construction, the protection shall be removed, flooring cleaned and, where necessary, repaired, resealed, or both, at no additional cost to the Government.

3.3 APPLICATION OF FLOOR TOPPING

Anchor plates set with the top surface at or above the finished epoxy floor level shall not require coverage with this flooring material. Flooring shall extend under equipment, except when the equipment base is indicated to be flush against the structural floor. Surfaces not to receive the epoxy floor topping, such as equipment or cabinets installed prior to surface-preparation efforts and adjacent to the flooring installation, shall be covered, masked, or both.

Prepared subfloor surface shall be dry and at a temperature of not less than 60 degrees F when application of the floor topping is initiated. Immediately prior to application of the prime/scratch coat on the prepared surface, dust or other loose particles shall be removed by blowing with compressed air or vacuum cleaned. Air compressor used shall be equipped with an efficient oil-water trap to prevent oil contamination or wetting of surface.

A thin roller coat of the epoxy binder specified shall be applied to the prepared subfloor as a prime coat. As an aid to placing, compacting, and finishing the floor topping, the forming of a scratch coat by sprinkling a minimum quantity of the walnut shell aggregate on the prime coat surface immediately following the prime coat application may be employed by the Contractor. Prime coat application rate shall be approximately 150 square feet per gallon. Prior to application of the prime/scratch coat, cracks in the concrete shall be filled, and provisions shall be made to keep control or expansion joints open.

Placement of the floor topping shall be made prior to final gelling of the prime/scratch coat. Immediately after the materials are mixed as specified, the mixture shall be dumped in the placement area and spread to prolong troweling life. Placed materials shall be screeded or rough troweled to the specified thickness and then compacted by the use of a smooth roller prior to finish troweling to a nominal thickness of 3/16 inch plus or minus 1/16 inch. Finished surface shall be free of ridges, hollows (bird-baths), and trowel marks, and smoothness shall vary not more than 1/8 inch when tested with an 8-foot straightedge. Provisions shall be made to maintain the work areas in a relatively dust-free environment during curing of the topping.

After the floor topping has set firmly (approximately 6 to 16 hours depending on subfloor temperature) in a relatively dust-free environment, two thin coats of the sealer coat, shall be applied by means of brush, roller, squeegee, or notched trowel to provide a pore-free, easy-to-clean surface. At the time of sealer application, the surface shall be dust-free. Depending on relative humidity, the applied sealer shall cure to a tack-free condition in 2 to 4 hours. Second coat shall not be applied until after the initial coat has cured to a tack-free, hard film. Topping areas shall be maintained in a relatively dust-free environment during curing of the sealer coats.

3.4 FIELD QUALITY CONTROL

3.4.1 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.

3.5 CLEANING

Surfaces of the new 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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SECTION 09680

CARPET

09/94

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-- End of Section Table of Contents --

SECTION 09680

CARPET
09/94

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 648	(1994; Rev A) Standard Test Method Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source

CARPET AND RUG INSTITUTE (CRI)

CRI 104	(1991) Installation of Commercial Textile Floorcovering Materials

FEDERAL SPECIFICATIONS (FS)

FS SS-W-40	(Rev A; Int Am 1, Notice 1) Wall Base: Rubber, and Vinyl Plastic

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 253	(1990) Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source
NFPA 258	(1989) Standard Research Test Method for Determining Smoke Generation of Solid Materials

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Installation Drawings shall be submitted for the following items diagramming the location of seams, edge moldings, and carpet direction for approval prior to installation.

Carpet
Carpet Moldings
Base

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following

items:

Carpet
Carpet Moldings
Base

SD-04 Samples

The following samples shall be submitted:

Samples of Seam Tape, Edge Molding, and any other accessories to be used.

Three samples, each 4 inches square, of each type of Carpet to be used.

A sample of each Accessory.

SD-07 Certificates

Certificates of Compliance shall be submitted for following showing conformance with the referenced standards contained in this section.

Carpet
Carpet Moldings
Base

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted showing printed instructions covering installation of Carpet.

PART 2 PRODUCTS

2.1 CARPET TYPE AND CONSTRUCTION

The following specifies the construction for modular carpet.

Type shall be tufted carpet tile.

Size shall be 18 inches x 18 inches.

Pile fiber shall be textured loop or random tip shear, continuous filament nylon with soil hiding and static control, solution dyed.

Pile weight shall be approximately 22.4 ounces per square yard.

Backingmaterial shall be vinyl hardback, fiberglass reinforced.

Total weight shall be 142 ounces per square yard.

2.1.1 Flammability

Radiant panel test shall be Class I, 0.45 watt/cm2 or greater in accordance with NFPA 253.

Smoke density shall be 450 or less in accordance with NFPA 258.

2.1.2 Color and Pattern

Color and pattern shall be chosen from the NASA GSFC standard colors.

2.2 CARPET MOLDINGS

Carpet moldings, either vinyl or aluminum, shall be installed where floor covering material changes or carpet edge does not abut a vertical surface. Vinyl carpet molding shall match flooring field color.

2.3 BASE

Base shall be vinyl conforming to FS SS-W-40.

Minimum overall thickness of base shall be not less than 0.125 inch, color as selected from NASA GSFC standard colors. Wall base shall be toeless.

Base shall be furnished in rolls not less than 96 feet long. Corners shall be premolded with wings not less than 2 inches long.

PART 3 EXECUTION

3.1 INSTALLATION

Carpeting shall be installed in accordance with CRI 104 and the carpet manufacturer's instructions.

Type of installations required for this project are as follows:

Direct Glue Down
Carpet Modules

Contiguous carpeting shall be a product of the same dye lot.

Corrections in measurements made by the Contractor shall be at no additional cost to the Government.

Transportation of carpet within the jobsite shall be the responsibility of the Contractor.

Removal and replacement of furniture will be the responsibility of the Government.

3.2 PREPARATORY WORK

Contractor shall verify that surfaces to receive carpet are thoroughly clean, dry, dust-free, and in a satisfactory condition to be carpeted. Contractor shall notify the Government in writing of any conditions that will prevent the production of unsatisfactory work. Start of carpet installation shall be an indication of acceptance of the surfaces as being satisfactory for installing carpeting and he shall automatically assume the responsibility for any unacceptable finish work caused by floor conditions.

3.3 ACCEPTANCE PROVISIONS

Contractor shall be fully responsible for the installation upon completing of each area. Installation will be inspected and approved by the Contracting Officer prior to acceptance.

Damaged and unacceptable portions of completed work shall be removed and replaced with new carpeting.

3.4 CLEANING

Surfaces of new carpeting and adjacent surfaces soiled as a result of this work shall be cleaned thoroughly. Equipment, surplus materials, and rubbish from work shall be removed from the site.

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SECTION 09725

VINYL WALL COVERING

03/98

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3.2.3 Cleaning

-- End of Section Table of Contents --

SECTION 09725

VINYL WALL COVERING
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1308	(1987; R 1993) Effect of Household Chemicals on Clear and Pigmented Organic Finishes
ASTM D 751	(1995) Coated Fabrics

ALUMINUM ASSOCIATION (AA)

AA 45	(1980) Designation System for Aluminum Finishes

FEDERAL SPECIFICATIONS (FS)

FS CCC-W-408	(Rev C) Wallcovering, Vinyl Coated
FS MMM-A-130	(Rev B; Int Am 3) Adhesive, Contact

FEDERAL STANDARDS (FED-STD)

FED-STD 191	(Rev C) Textile Test Methods

UNDERWRITERS LABORATORIES (UL)

UL-02	(2000) Building Materials Directory

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings shall be submitted for Vinyl Wall Covering Systems consisting of fabrication and assembly details to be performed in the factory.

Installation Drawings shall be submitted for Vinyl Wall Covering in accordance with the paragraph entitled, "Installation," of this section.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items.

Vinyl Wall Covering
Adhesive, Primer, and Sealer
Contact Adhesive
Spare Parts

SD-04 Samples

Wall Covering: Three samples, 3 yards long by the width specified, of each color and grain to be installed in the work, as required to illustrate material weight, color, shade, decorative design, and embossing when required.

SD-07 Certificates

Certificates of Compliance shall be submitted for Vinyl Wall Covering including the following.

Certified laboratory test reports of the physical properties for vinyl wall covering, as specified

Certificates of Compliance for UL fire hazard classification listing, as specified

Certificates of Compliance for contact adhesive

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted for the following items showing printed instructions covering installation.

Wall Covering
Contact Adhesive

SD-10 Operation and Maintenance Data

Preventative Maintenance and Inspection shall be submitted for Vinyl Wall Covering showing the manufacturers recommended cleaning materials and application methods, including precautions in the use of cleaning materials that may be detrimental to the wall covering surface when improperly applied.

Records of vinyl wall covering manufacturer's name or trademark, wall covering brand name, color, and grain designation shall be submitted.

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered to the project site in their original packages or containers bearing labels clearly identifying the manufacturer, brand name, quality or grade, and UL fire-hazard classification when applicable.

Materials shall be stored in their original, unbroken packages or containers, in a weathertight and dry place having a temperature not less than 65 degrees F, for at least 24 hours before the start of wall covering installation.

PART 2 PRODUCTS

2.1 VINYL WALL COVERING

Vinyl wall covering shall be an integrally pigmented, opaque vinyl film, laminated to, or combined with, a fabric backing. Vinyl wall covering shall be class A fire rated.

Wall covering shall be medium-duty type, finish as specified, conforming to FS CCC-W-408, Type II, and the following modifications:

Supporting material for wall covering may be mildew-resistant treated at the option of the wall covering manufacturer.

Physical properties shall be as follows:

REQUIREMENT	TEST METHOD	VALUE
Coating weight, exclusive of fabric backing	FED-STD 191, Test 5041	Not less than 7 ounces per square yard
Adhesion of coating to fabric backing	ASTM D 751	Not less than 3 pounds pull per inch of width

Wallcovering fabric type and count shall be Osnaburg, 32x30. Manufacturer shall be "Stoneham", "Tribeca", or "Prefixx", manufactured by Genon Wall Coverings, or approved equal.

Color and grain of wall covering shall match that of the sample approved.

2.2 WALL COVERING ADHESIVE, PRIMER, AND SEALER

Wall covering adhesive, primer, and sealer shall comply with the vinyl wall covering manufacturer's recommendations. These materials shall be mildew-resistant and nonstaining to the wall covering coating.

2.3 UL FIRE HAZARD CLASSIFICATION LISTING AND LABEL

Vinyl wall covering and adhesive shall be listed in UL-02 and shall bear UL label and marking indicating the fire-hazard classification of the wall covering as applied to non-asbestos-cement board and using the adhesive recommended by the wall covering manufacturer, as follows:

Flame spread shall be not more than 25.

Fuel contributed shall be not more than 15.

Smoke developed shall be not more than 50.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Conditions at Building

Spaces to receive vinyl wall covering shall be maintained at a temperature of at least 70 degrees F at wall base level for at least 48 hours prior to, during, and for 48 hours after the completion of the wall covering installation.

Specified materials shall be installed only when ambient temperature and humidity conditions approximate the interior conditions that will exist when the building is occupied.

3.1.2 Preparation of Substrate Surfaces

Surfaces to receive specified materials shall be clean, smooth, thoroughly cured, and free from materials detrimental to achieving the required bond.

Before start of wall covering application, plaster surfaces shall be tested for moisture content with a moisture detector. Moisture content shall not exceed the percentage recommended by the wall covering manufacturer.

Substrates surfaces shall be primed or sealed in accordance with the wall covering manufacturer's recommendations for the type of substrate material.

3.1.3 Wall Covering Application

Application of adhesive and wall covering shall be in accordance with the wall covering manufacturer's approved descriptive data, and as specified. Wall covering seams shall be vertical and plumb, and at least 6 inches away from any corner; horizontal seams will not be permitted. Wall covering shall be continuous over internal and external corners. Switchplates, wallplates, and surface-mounted fixtures shall be removed and the wall covering shall be cut evenly to the edges of the outlet box or support. Selvages shall be trimmed in the field; trimming shall be sufficient to ensure color uniformity and matching of grain from one wall covering panel to the panel butted against it. Edges shall extend not less than 1/2 inch behind the applied base.

3.1.4 Cleaning

Wall covering surface shall be cleaned of excess adhesive and soil in accordance with the wall covering manufacturer's cleaning instructions.

3.1.5 Excess Materials

After completion of wall covering installation, usable remnants, as determined by the Contracting Officer, shall be separated by type, color, and pattern, and rolled and wrapped for protection from dirt, moisture, and infestation.

3.2 ACCEPTANCE PROVISIONS

3.2.1 Rejection

Vinyl wall covering work will be rejected for any of the following deficiencies:

Wall covering having colors and grains that do not match the color or grain of the approved sample

Finished wall covering having horizontal seams, out-of-plumb vertical seams, open seams, air pockets, buckles, wrinkles, loose edges, mismatched panels, or stains that cannot be removed by cleaning

3.2.2 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.

3.2.3 Cleaning

Surfaces of the new 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.

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SECTION 09915

PAINTING

07/96

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SECTION 09915

PAINTING
07/96

PART 1 GENERAL

1.1 REFERENCES

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Safety to Life from Fire in Buildings and Structures

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Submit manufacturer's catalog data for paint products scheduled, including fillers and primers. Include instructions for handling and storage, surface preparation procedures, priming requirements, application precautions, recommended coverages, and amount of volatile organic compounds contained in each paint product. Identify each material by manufacturer's catalog number and general classification.

SD-04 Samples

Submit three samples on primed cardboard, 127 x 178 millimeter in size, illustrating colors, texture, and sheen, for each color selected, including standard GSFC colors and custom colors selected.

1.3 QUALIFICATIONS

Manufacturer: Firm specializing in manufacturing the painting products specified in this section with minimum ten years documented experience.

Applicator: Firm specializing in performing the work of this section with minimum three years documented experience.

1.4 REGULATORY REQUIREMENTS

Conform to the requirements of a Class A Interior Wall and Ceiling Finish as defined in NFPA 101.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver products to project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label. Container labels shall include type of paint, description, manufacturer's stock number and date of manufacture, pigment and vehicle contents by volume,

coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

Store paint materials in a ventilated area and at a minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F , and as required by manufacturer's instructions. Protect products from freezing.

1.6 ENVIRONMENTAL REQUIREMENTS

Do not apply exterior paints in rain or snow, when the relative humidity exceeds 85 percent, or when surfaces are damp or wet.

Apply water-based paints when ambient temperatures are above50 degrees F , unless required otherwise by manufacturer's instructions. Apply solvent-thinned paints when ambient temperatures are above 65 degrees F, unless required otherwise by manufacturer's instructions.

Provide lighting level of approximately 80 foot candles measured mid-height at substrate surface.

1.7 EXTRA MATERIALS

When directed by the Government, provide 1 gallon of each paint type and custom color to the Contracting Officer. Label each color, type, texture, room locations, and product description in addition to the manufacturer's label. Provide the Government with the paint color formulaand availability information on custom color products.

PART 2 PRODUCTS

2.1 MANUFACTURERS

The paint products indicated in the painting schedule at the end of this section establish the quality of paint products desired, and are manufactured by the following:

Duron Paints and Wallcoverings
The Sherwin-Williams Company
Pittsburgh

Other manufacturer's products will be accepted, provided sufficient information is submitted to allow the Contracting Officer to determine that the products proposed are equivalent to those indicated.

2.2 MATERIALS

Provide coatings which are ready mixed and capable of being readily and uniformly applied as a homogeneous coating with good flow and brushing properties, and capable of drying or curing free of streaks and sags. Provide factory mixed colors which match Goddard Space Flight Center's standard colors and the Project's custom color samples exactly.

Use of latex paint with up to 50 percent of reprocessed content (paint that was never used) and matching Goddard Space Flight Center's standard colors and the project's custom color samples exactly will be allowed.

Use block fillers, primers, and sealers which are suitable for each surface to be covered and which are compatible with finish coats. Provide products of a single manufacturer for each coating system, unless indicated

otherwise.

Provide accessory materials, such as linseed oil, shellac, turpentine, paint thinners, patching materials, and other materials not specifically indicated but required to achieve the finishes specified.

2.3 STANDARD COLORS

Match the following Goddard Space Flight Center's standard paint colors as selected. The colors indicated are standard colors manufactured by Duron Paints & Wallcoverings and are subject to periodic changes in both the colors indicated and the number of colors.

Primary Colors	Accent Colors
White White, 5820W	Trail, 5342M
Cotton, 5630W	Cobblestone, 5292M
Saturn, 5411W	Breakwater, 5482M
Winter Mist, 5880W	Cambridge, 5522M
Moonlight, 5430W	Abstract, 5434D
Igloo, 5510W	Gray Kitten, 5412M

PART 3 EXECUTION

3.1 EXAMINATION

Examine surfaces scheduled to be finished prior to commencement of work. Report conditions that may potentially affect proper application. Do not proceed until unsatisfactory conditions are corrected.

Measure moisture content of surfaces using and electronic moisture meter. Do not apply finishes unless moisture content of surfaces is less than the following limitations:

Gypsum Wallboard and Plaster: 12 percent
Masonry and Concrete: 12 percent
Wood: 15 percent

3.2 PROTECTION AND PREPARATION

Protect adjacent surfaces and equipment against damage by use of suitable covering during the painting work. Repair damage to other surfaces caused by the work of this section.

Remove or protect hardware, plates, trim, fixtures, escutcheons, and fittings prior to preparing surfaces for finishing. Disconnect equipment located adjacent to walls where necessary, and move to permit painting of wall surfaces. Replace and reconnect equipment following completion of painting.

Surfaces shall be clean, dry, and free from contaminants and foreign matter. Remove mildew and chalking and thoroughly clean surfaces. Remove chipped, peeling, or blistered paint and spot prime surfaces. Roughen and dull hard glossy surfaces to ensure proper adhesion. Seal with shellac and spot prime surface marks which may bleed through surface finishes.

3.2.1 Metal

Remove oxide or corrosion by hand, power tool, or blast cleaning. Sand and scrape surfaces to remove loose primer and rust. Feather edges of repair

patches to provide smooth and flush appearances. Wash metal surfaces with a solvent and prime coat bare steel areas. Galvanized steel surfaces shall be cleaned of all contaminants using a solvent such as laquer thinner or xylol and etched with a phosporic acid pre-treatment solution.

"WET PAINT" signs shall be posted during painting operations and shall remain in place until newly painted surfaces have fully dried.

3.2.2 Wood

Seal knots, pitch streaks, and sappy sections on wood surfaces with sealer. Fill nail holes, cracks, and other defects with plastic wood or putty.

3.2.3 Concrete and Masonry

Clean concrete and masonry surfaces of dust, dirt, loose mortar, scale, efflorescence, and other contaminants. Large cracks, voids, and other major surface imperfections shall be cleared of loose material and filled with mortar. Verify that surfaces are dry before applying painting products.

3.2.4 Gypsum Board and Plaster

Fill minor surface defects in gypsum wallboard with joint finishing compound and sand smooth. Cut out cracks, holes, indentations, and other imperfections in plaster surfaces, and fill with patching plaster or spackling compound and sand smooth. Clean surfaces and joints of dust, dirt and other contaminants. Verify that surfaces are dry before applying paint.

3.3 APPLICATION

Surfaces and applied coatings shall be inspected prior to subsequent surface preparation or further coating application. Surface preparation and coating operations shall be sequenced so that freshly applied coatings will not be contaminated by dust or foreign matter.

Apply paint products in accordance with manufacturer's instructions. Do not apply coatings when moisture content of surfaces are more than the limitations indicated.

Prime concealed surfaces of interior wood trim with promer paint. Seal top and bottom edges of wood and metal doors with primer sealer.

Apply paint products in accordance with manufacturer's instructions. Do not apply coatings when moisture content of surfaces are more than the limitations indicated.

Apply coatings with brushes, rollers, or spray equipment suitable for finish required. Do not exceed the rate of application of coatings as recommended by paint manufacturer. Apply coatings to smooth uniform finish without brush marks, streaks, laps, and sags. Make edges of paint adjoining other materials and colors clean and sharp with no overlapping.

Prime concealed surfaces of interior wood trim with primer paint. Seal top and bottom edges of wood and metal doors with primer sealer.

Paints of different manufacturers shall not be mixed together. Primer and finish coats shall be the product of one manufacturer.

No exterior paint shall be applied in rainy weather or when rain is imminent or when the temperature or humidity is outside the limits recommended by the manufacturer.

3.4 FINISHING MECHANICAL AND ELECTRICAL EQUIPMENT

Factory-finished or shop-finished equipment shall not be painted in the field, unless otherwise indicated, except for touch-up of damaged finish with the approval of the government.

Unfinished, factory-primed and shop-primed equipment and system components shall be finished as described below. Type of paint and application shall be as specified elsewhere in this section for the applicable surfaces. Equipment and system components include, but are not limited to, the following:

Equipment
Piping (bare or insulated) and appurtenances
Ductwork (bare or insulated) hangers and appurtenances
Louvers and Grilles
Electrical conduits and boxes
Hangers and supports
Covers and Access Panels

Do not paint operating parts of mechanical and electrical equipment, or identification labels such as manufacturer's nameplates, safety or fire rating labels.

Painting shall be completed before installation of GOMAR tags on equipment, and before installation of pipe, duct or conduit labels.

3.4.1 Exposed-to-View Locations

Prime and paint in accordance with the schedule for interior surfaces. Color shall match surrounding surfaces, except where color-coding is required by Division 13, 15 or 16 sections, or otherwise indicated on drawings.

Prime and paint interior surfaces of air ducts that are visible through grilles and louvers, with one coat of flat black paint.

Prime and paint both sides and edges of plywood backboards for electrical and telephone equipment before equipment installation.

3.4.2 Concealed Locations (Accessible or Non-Accessible)

Painting is not required, unless otherwise indicated on drawings.

3.4.3 Weather or Moisture Exposed Locations

Prime and paint in accordance with the schedule for exterior surfaces. Color shall match surrounding surfaces, except where color-coding is required by Division 13, 15 or 16 sections, or otherwise indicated on drawings.

3.5 CLEANING

As work proceeds, remove paint where spilled, splashed or spattered.

Maintain premises free of unnecessary accumulation of tools, equipment, surplus materials, and debris. Remove empty paint containers from the project site. Collect waste material which may constitute a fire hazard and remove daily from the project site.

3.6 SCHEDULE - EXTERIOR SURFACES

3.6.1 Wood - Painted

One coat: Latex primer sealer
Duron: Bond-N-Seal Exterior Acrylic Primer, 08-124
S-W: A-100 Latex Exterior Wood Primer, B42
P: Speedhide Exterior Acrylic Latex Wood Primer, 6-609

Two coats: Latex enamel, semi-gloss
Duron: Weathershield Acrylic House Paint, 03-Series
S-W: A-100 Satin Latex House and Trim Paint, A82
P: Speedhide Exterior Acrylic Latex Paint, 6-900 Series

3.6.2 Wood - Stained

One coat: Latex wood primer
Duron: Bond-N-Seal Exterior Acrylic House Paint Primer, 08-124
S-W: A-100 Latex Exterior Wood Primer, B42
P: Speedhide Exterior Acrylic Latex Wood Primer, 6-609

Two coats: Latex wood stain
Duron: Perma-Stain Exterior 100% Acrylic Latex Flat Solid Hide, 28-3xx
S-W: Exterior Latex Solid Color Stain, B22
P: Rez Exterior Acrylic Latex Siding Stain, 77-445 Series

3.6.3 Concrete Block

One coat: Latex block filler
Duron: Block Kote Latex Block filler, 08-126
S-W: ProMar Interior/Exterior Block Filler, B25
P: Speedhide Acrylic Latex Masonry Block Filler, 6-7

Two coats: Latex, low-sheen
Duron: Weathershield Exterior Acrylic House Paint, 34 Series
S-W: A-100 Satin Latex House and Trim Paint, A82
P: Speedhide Exterior Acrylic Latex Satin Paint, 6-2000 Series

3.6.4 Concrete

One coat: Latex primer sealer
Duron: Bond-N-Seal Exterior Acrylic Primer, 08-124
S-W: Loxon Exterior Masonry Acrylic Primer, A24
P: Speedhide Acrylic Latex Alkali-Resistant Primer, 6-603

Two coats: Latex, low sheen
Duron: Weathershield Exterior Acrylic House Paint, 34 Series
S-W: A-100 Satin Latex House and Trim Paint, A82
P: Speedhide Exterior Acrylic Latex Satin Paint, 6-2000 Series

3.6.5 Ferrous Metal

One coat: Rust inhibitive metal primer (or touchup shop primed metal)
Duron: Dura Clad Red Oxide Metal Primer, 33-250
S-W: Kem Kromik Metal Primer, B50

Two coats: Latex enamel, semi-gloss
Duron: Dura Clad "Direct-To-Metal" (DTM) Acrylic, 95-06x
S-W: Metalatex Semi-Gloss Coating, B42
P: Speedhide Exterior Acrylic Latex Paint, 6-900 Series

3.6.6 Galvanized Metal

One coat: Galvanized metal primer
Duron: Dura Clad Acrylic Galvanized Metal Primer, white 33-100
S-W: Galvite, B50W3
P: Pitt-Tech Acrylic DTM Primer, 90-712

Two coats: Latex enamel, semi-gloss
Duron: Dura Clad "Direct-To-Metal" (DTM) Acrylic, 95-06x
S-W: A-100 Satin Latex house and Trim Paint, A82
P: Speedhide Exterior Acrylic Latex Paint, 6-900 Series

3.6.7 Aluminum

One coat: Latex enamel, semi-gloss
Duron: Dura Clad "Direct-To-Metal" (DTM) Acrylic
S-W: A-100 Satin Latex House and Trim Paint, A82
P: Speedhide Exterior Acrylic Latex Paint, 6-900 Series

3.7 SCHEDULE - INTERIOR SURFACES

3.7.1 Wood - Painted

One coat: Latex primer sealer
Duron: Acrylic Enamel Undercoater, 04-123
S-W: PrepRite Classic Latex Primer, B28
P: Speedhide Acrylic Latex Enamel Undercoater, 6-855

Two coats: Latex enamel, semi-gloss
Duron: Ultra Deluxe Interior Vinyl Acrylic Latex Enamel, 35 Series
S-W: ProMar 200 Latex Enamel, B4
P: Speedhide Acrylic Latex Enamel, 6-510 Series

3.7.2 Wood- Transparent

One coat: Oil stain (omit if clear finish indicated)
Duron: Interior Penetrating Oil Wood Stain, 28-100
S-W: Oil Stain, A48
P: Acrylic Semi-Transparent Stain, 77-460

One coat: Primer/Sealer
Duron: Interior Sanding Wood Sealer, Semi-Gloss Finish, 15-014
S-W: Oil Base Gloss Varnish, A66
P: Rez Acrylic Gloss Sanding Sealer, 77-45

Two coats: Varnish

Duron: Permathane Interior Polyurethane Satin Finish, 15-011
S-W: Oil Base Satin Varnish, A66
P: Rez Acrylic Satin Varnish, 77-49

3.7.3 Concrete Block

One coat: Latex block filler
Duron: Block Kote Latex Block Filler, 08-126
S-W: ProMar 200 Latex Wall Primer, B28
P: Speedhide Acrylic Latex Masonry Block Filler, 6-7

Two coats: Latex, low sheen (offices), semi-gloss (public areas)
Duron: Ultra Deluxe Interior Acrylic/Latex Enamel, 35 Series
S-W: ProMar 200 Latex Enamel, B31
P: Speedhide Acrylic Latex Enamel, 6-510 Series (semi-gloss)
P: Speddhide Acrylic Latex Enamel, 6-411 Series (low-sheen)

3.7.4 Concrete and Restored Masonry

One coat: Latex primer sealer
Duron: Acrylic Enamel Undercoater, 04-123
S-W: ProMar Latex Wall Primer, B28
P: Speedhide Acrylic Latex Alkali-Resistant Primer, 6-603

Two coats: Latex, low sheen (offices), semi-gloss (public areas)
Duron: Ultra Deluxe Interior Acrylic/Latex Enamel, 35 Series
S-W: ProMar 200 Latex Enamel, B31
P: Speedhide Acrylic Latex Enamel, 6-510 Series

3.7.5 Ferrous Metal

One coat: Rust Inhibitive metal primer (or touch up shop primed metal)
Duron: Dura Clad Red Oxide Metal Primer, 33-250
S-W: Kem Kromik Metal Primer, B50
P: Pitt-Tech Acrylic Rust Inhibitive Steel Primer, 90-708

Two coats: Latex enamel, semi-gloss
Duron: Ultra Deluxe Interior Acrylic Latex Enamel, 35 Series
S-W: ProMar 200 Latex Enamel, B31
P: Speedhide Acrylic Latex Enamel, 6-510 Series

3.7.6 Galvanized Metal

One coat: Galvanized metal primer
Duron: Dura Clad Acrylic Galvanized Metal Primer, 33-100
S-W: Galvite, B50W3
P: Pitt-Tech Acrylic "Direct-To-Metal" (DTM) Primer, 90-712

Two coats: Latex enamel, semi-gloss
Duron: Ultra Deluxe Interior Acrylic Latex Enamel, 35 Series
S-W: ProMar 200 Latex Enamel, B20
P: Speedhide Acrylic Latex Enamel, 6-510 Series

3.7.7 Gypsum Board and Plaster

One coat: Latex primer sealer
Duron: Ultra Deluxe Interior Drywall Vinyl Primer Sealer, 04-126
S-W: ProMar 200 Latex Wall Primer, B28

P: Speedhide Latex Wall Primer-Sealer, 6-2

Two coats: Latex enamel, low-sheen (offices), semi-gloss (public areas)
Duron: Ultra Deluxe Vinyl Acrylic Enamel, 35 Series
S-W: ProMar 200 Latex Enamel, B31
P: Speedhide Acrylic Latex Enamel, 6-510 Series

3.7.8 Concrete Floors - Clear Sealer

Two coats: Concrete floor sealer
Duron: Concrete Floor Sealer, Amber Clear, 93-011
P: Rez Alkyd Clear Primer, 77-1

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SECTION 10160

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05/95

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SECTION 10160

METAL TOILET COMPARTMENTS
05/95

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 591/A 591M	(1989; R 1994) Standard Specification for Steel Sheet, Cold-Rolled, Electrolytic Zinc-Coated for Light Coating Mass Applications

FEDERAL STANDARDS (FED-STD)

FED-STD-795	(1988) Uniform Federal Accessibility Standards

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Submit Installation drawings indicating types of partitions, locations, mounting heights, cutouts, and reinforcement required for toilet-room accessories.

SD-03 Product Data

Submit Manufacturer's Catalog Data for Toilet compartments, indicating materials, fabrication, finishes, installation instructions, and catalog cuts of anchors, hardware, fastenings, and accessories.

SD-04 Samples

Thre samples of a panel showing a finished edge on two adjacent sides and a core construction, each not less than square.

Three of each item of hardware, fittings, and fasteners

The approved hardware samples may be installed in the work if properly identified..

SD-07 Certificates

Certification 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 2 years after completion.

1.3 DELIVERY, STORAGE AND HANDLING

Deliver materials in original and unopened packages or containers which bear the brand name and name of material. Protect materials from weather, soil, and damage during delivery, storage, and construction.

1.4 REGULATORY REQUIREMENTS

Conform to FED-STD-795 for access requirements for people with disabilities.

1.5 FIELD MEASUREMENTS

Take field measurements prior to preparation of drawings and partition system fabrication to ensure proper fit of work.

1.6 COORDINATION

Provide inserts and anchorages to be built into other work for installation of toilet compartments and related items. Coordinate delivery with other work to avoid delay.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Galvanized Steel Sheets

Steel sheets for baked enamel finish shall be galvanized-bonderized steel sheet, conforming to ASTM A 591/A 591M, Class C. The minimum thickness of pilaster, panel, and screen face sheets shall be 0.0396 inch (20 gage), and door face sheets shall be 0.0336 inch (22 gage).

Steel sheets shall contain a minimum of 10 percent post-consumer recycled steel.

2.1.2 Core Material

Core material for metal partitions shall consist of manufacturer's standard sound-deadening honeycomb of impregnated Kraft paper in thickness to provide finished dimension of one inch minimum for doors, panels, and screens and 1-1/4 inch minimum for pilasters.

2.1.3 Pilaster Shoes and Caps

Provide formed stainless steel pilaster shoes and caps, conforming to ASTM A 167, Type 304, with No. 4 finish, not less than 3 inches high, 0.0396 inch (20 gage) thick.

2.1.4 Brackets

Provide manufacturer's standard stirrup brackets for attaching panels to walls and pilasters in stainless steel, conforming to ASTM A 167, Type 304,

with No. 4 finish, or anodized aluminum.

2.1.5 Anchorages and Fasteners

Provide exposed fasteners of stainless steel, with theft-resistant type heads and nuts. For concealed anchors, provide hot-dipped galvanized, cadmium-plated, or stainless steel.

2.1.6 HARDWARE AND ACCESSORIES

Provide manufacturer's standard design, heavy duty operating hardware and accessories of stainless steel, conforming to ASTM A 167, Type 304, with No. 4 finish. Provide the following hardware and accessories for each compartment.

a. Pivot hinges, self lubricating gravity type, adjustable to hold door open at any angle up to 90 degrees.

b. Latch and pull shall be designed for handicapped accessibility, with combination rubber-faced door strike and keeper equipped with emergency access.

c. Manufacturer's standard door pulls for out-swinging doors. Provide pulls on both faces of handicapped compartment doors.

d. Combination hook and rubber-tipped bumper type, sized to prevent door hitting mounted accessories.

2.2 FABRICATION

Fabricate partition panels, doors, screens, and pilasters from galvanized-steel face sheets with formed edges. Pressure laminate face sheets to core material with edges sealed with continuous locking strip and corners mitered and welded, ground 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.

2.2.1 Partition Doors and Panels

Provide 24 inch wide in-swinging doors for non-handicapped toilet compartments and minimum 32 inch clear opening out-swinging doors for stalls equipped for use by the handicapped. Door and panel height shall be 58 inches. Provide face sheets of sizes required to suit compartment width and spacing.

2.2.2 Floor-Supported Overhead-Braced Compartments

Provide galvanized steel supports and leveling bolts at pilasters as recommended by manufacturer to suit floor conditions. Provide shoe at each pilaster to conceal support and leveling mechanism. Make provisions for setting and securing continuous overhead bracing at top of each pilaster.

Provide overhead braces fabricated from continuous anodized aluminum tubing, minimum size of 1 x 1-1/2 inch x 0.125 inch wall thickness, inserted and securely fastened into top of pilasters.

2.2.3 Wall-Hung Screens

Wall-hung urinal screens shall be panel units, 42 inches high and 18 inches

wide, of same thickness, construction and finish as partition system panels. The supporting wall bracket shall consist of a continuous "Government type" mounting flange, integrally formed with screen, and fabricated to match screen material and finish.

2.3 FINISH

Chemically clean and phosphatize panel surfaces, and immediately follow with rust-resistant primer and two factory-applied finish coats of baked enamel, applied uniformly by electrostatic coating process.

Panel colors will be as selected by the Government from manufacturer's standard color charts.

PART 3 EXECUTION

3.1 INSTALLATION

Install partitions rigid, straight, plumb, and level, in accordance with manufacturer's instructions. Maintain clearances of not more than 1/2 inch 13 millimeter between walls and panels and between walls and pilasters. Secure panels to walls and pilasters with not less than two brackets attached near the top and bottom of panel. Locate wall brackets so that holes for wall anchorages occur in masonry or tile joints. Secure panels to pilasters with brackets which match wall brackets.

3.1.1 Floor-Supported Overhead-Braced Compartments

Pilasters shall be secured to the floor with the anchorage device specified. Leveling device shall be readily accessible for leveling, plumbing, and tightening the installation. Overhead brace shall be secured 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.

Tops of doors shall be parallel with the overhead brace when doors are in a closed position.

3.1.2 Screens

Attach screens with anchoring devices as recommended by manufacturer to suit supporting structure. Set units to provide support and to resist lateral impact.

3.2 ERECTION TOLERANCES

Erect partition system with maximum variation from true position of 1/4 inch, and maximum variation from plumb of 1/8 inch.

3.3 ADJUSTING

Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch. Adjust adjacent components for consistency of line or plane.

Set hinges on in-swinging doors to hold open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return to fully closed position.

3.4 CLEANING

Clean surfaces of partition system and adjacent surfaces soiled as a result of the work using materials and methods recommended by manufacturer.

3.5 PROTECTION

Provide protection of partition system to prevent damage during remainder of construction period. Replace damaged or scratched materials with new materials.

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SECTION 10201

METAL WALL LOUVERS

09/96

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SECTION 10201

METAL WALL LOUVERS
09/96

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 in the text by the basic designation only.

ALUMINUM ASSOCIATION (AA)

AA 45	(1980) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 603.8	(1992; Addendum 1993) Pigmented Organic Coatings on Extruded Aluminum

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 500	(1991) Louvers, Dampers and Shutters
AMCA 511	(1986) Certified Ratings Program for Air Control Devices

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 366/A 366M	(1996) Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 653/A 653M	(2001) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 209	(1996) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 221	(1995; Rev. A) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Fabrication and installation drawings shall show all information necessary for fabrication and installation of louvers. Indicate materials, sizes, thicknesses, fastenings, and profiles.

SD-04 Samples

Manufacturer's Standard Color Charts shall be submitted. Colors of finishes for wall louvers shall closely approximate colors indicated. Where color is not indicated, submit the anufacturer's standard colors to the Contracting Officer for selection.

1.3 DELIVERY, STORAGE, AND PROTECTION

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers shall be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Galvanized Steel Sheet

ASTM A 653/A 653M, coating designation G90.

2.1.2 Aluminum Sheet

ASTM B 209, alloy 3003 or 5005 with temper as required for forming.

2.1.3 Extruded Aluminum

ASTM B 221, alloy 6063-T5 or -T52.

2.1.4 Stainless Steel

ASTM A 167, Type 302 or 304, with 2B finish.

2.1.5 Cold Rolled Steel Sheet

ASTM A 366/A 366M, Class 1, with matte finish. Use for interior louvers only.

2.2 METAL WALL LOUVERS

Weather resistant type, with bird screens and made to withstand a wind load of not less than 30 pounds per square foot. Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500 and AMCA 511. The rating shall show a water penetration of 0.20 or less ounce per square foot of free area at a free velocity of 800 feet per minute.

2.2.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 0.081 inch.

2.2.2 Formed Metal Louvers

Formed of aluminum sheet not less than 0.08 inch thick.

2.2.3 Mullions and Mullion Covers

Same material and finish as louvers. Provide mullions for all louvers more than 5 feet in width at not more than 5 feet on centers. Provide mullions covers on both faces of joints between louvers.

2.2.4 Screens and Frames

For aluminum louvers, provide 1/2 inch square mesh, 14 or 16 gage aluminum or 1/4 inch square mesh, 16 gage aluminum bird screening. For steel louvers, provide 1/2 inch square mesh, 12 or 16 gage zinc-coated steel; 1/2 inch square mesh, 16 gage copper; or 1/4 inch square mesh, 16 gage zinc-coated steel or copper bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.3 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers and zinc-coated or stainless steel screws and fasteners for steel louvers. Provide other accessories as required for complete and proper installation.

2.4 FINISHES

2.4.1 Aluminum

Provide factory-applied anodic coating.

2.4.1.1 Anodic Coating

Clean exposed aluminum surfaces and apply an anodized finish conforming to AA 45 Designation System for Aluminum Finishes, clear (natural), M10C22A31, Architectural Class II.

2.4.2 Steel

Clean and phosphate treat exposed surfaces and apply rust-inhibitive primer and baked enamel finish coat, one mil minimum total dry film thickness.

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3.1 INSTALLATION

3.1.1 Wall Louvers

Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations.

3.1.2 Screens and Frames

Attach frames to louvers with screws or bolts.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Copper or Copper-Bearing Alloys

Paint copper or copper-bearing alloys in contact with dissimilar metal with heavy-bodied bituminous paint or separate with inert membrane.

3.2.2 Aluminum

Where aluminum contacts metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint.

3.2.3 Metal

Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.2.4 Wood

Paint wood or other absorptive materials that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

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SECTION 10260

WALL AND CORNER GUARDS
06/97

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.

ALUMINUM ASSOCIATION (AA)

AA 45	(1980) Designation System for Aluminum Finishes

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes
ASTM D 256	(1993; Rev. A) Determining the Pendulum Impact Resistance of Notched Specimens of Plastics
ASTM D 635	(1991) Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
ASTM E 84	(2001) Standard Test Method for Surface Burning Characteristics of Building Materials

ARCHITECTURAL & TRANSPORTATION BARRIERS COMPLIANCE BOARD (ATBCB)

ATBCB ADA TITLE III	(1990) Americans with Disabilities Act - Buildings and Facilities

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MFM	(1988) Metal Finishes Manual

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE J 1545	(1986) Instrumental Color Difference Measurement for Exterior Finishes, Textiles and Colored Trim

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures.

SD-03 Product Data

Submit Manufacturer's Catalog Data for the following items:

Wall guards (crash rails)
Corner Guards

SD-04 Samples

Submit color chart of factory color coatings when factory-finished color coating is to be provided.

SD-06 Test Reports

Submit test reports on fine rating and extinguishing tests on the following items:

Resilient material
Corner Guards

1.3 DELIVERY AND STORAGE

Deliver materials to the site in original sealed packages or containers marked with the name and brand, or trademark of the manufacturer. Protect from damage from handling and construction operations before, during, and after installation. Store materials for door and door frame protection in a dry environment of approximately 70 degrees F for at least 48 hours prior to installation.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Stainless Steel

ASTM A 167, Type 302 or 304, with No. 4 finish.

2.1.2 Aluminum Extruded

ASTM B 221, Alloy 6063, Temper T5 or T6.

2.1.3 Resilient Material

Extruded and injection molded acrylic vinyl or extruded polyvinyl chloride meeting following requirements.

2.1.3.1 Minimum Impact Resistance

ASTM D 256, 18 foot/pounds (Izod impact, foot/pounds per inch notch).

2.1.3.2 Class 1 Fire Rating

ASTM E 84, maximum flame spread rating of 25 and a smoke developed rating

of 450 or less.

2.1.3.3 Finish

Similar on all exposed surfaces.

2.2 CORNER GUARDS

2.2.1 Resilient, Shock-Absorbing Corner Guards

Surface mounted type of 1/4 inch corner formed to profile shown.

2.2.1.1 Assembly

Assembly shall consist of a snap-on corner guard formed from resilient material, minimum 0.078 inch thick, free floating on a continuous 0.063 inch thick extruded aluminum retainer. Provide appropriate mounting hardware, cushions and base plates as required.

2.2.1.2 End Closure Caps

Provide factory fabricated end closure caps at top and bottom of surface mounted corner guards.

2.2.1.3 Corner Guards

Flush mounted corner guards installed in any fire rated wall shall maintain the fire rating of the wall. Furnish fire test report of proposed corner guard system to verify compliance.

a. Where insulating materials are an integral part of the corner guard system, the manufacturer of the corner guard system shall provide the insulating materials.

b. Exposed metal in fire rated assemblies shall have a paintable finish.

2.2.2 Stainless Steel Corner Guards

Fabricate of 0.0625 inch thick stainless steel. Form guards of dimensions and to contour shown.

2.3 WALL GUARDS AND HANDRAILS

2.3.1 Resilient Wall Guards and Handrails

2.3.1.1 Wall Guards (Crash Rails)

Snap-on covers of resilient material, minimum 0.110 inch thick, shall be free-floated over 2 inch wide aluminum retainer clips, minimum 0.090 inch thick, anchored to wall at maximum 24 inches on center, supporting a continuous aluminum retainer, minimum 0.062 inch thick; or, shall be free-floated over a continuous extruded aluminum retainer, minimum 0.090 inch thick anchored to wall at maximum 24 inches on center.

2.3.1.2 Wall Guards (Crash Rails)

Provide wall guards (crash rails) with prefabricated end closure caps, inside and outside corners, concealed splices, cushions, mounting hardware

and other accessories as required. End caps and corners shall be field adjustable to assure close alignment with handrails and wall guards (crash rails).

2.3.2 Aluminum Wall Guards

Extruded aluminum, closed tubular bumper assembly mounted on wall brackets as shown.

2.3.2.1 Wall Bumper

Provide wall bumper with factory fabricated end closure caps, and inside and outside corner assemblies, concealed splice plates, and other accessories standard with the manufacturer.

2.3.2.2 Tubular Wall Guards

Fabricate tubular wall guards from material with a nominal wall thickness of 0.250 inch, form grooves for and provide two stripes of continuous polyvinyl chloride cushion bumper inserts.

2.3.2.3 Adjustable Wall Brackets

Fabricate adjustable wall brackets from aluminum having a nominal wall thickness of 0.20 inch.

2.3.3 Stainless Steel Wall Guards

Construct wall guard, including brackets, of minimum 0.1875 inch thick stainless steel to design shown.

2.4 FASTENERS AND ANCHORS

a. Provide fasteners and anchors as required for each specific type of installation.

2.5 FINISH

2.5.1 Aluminum

AA 45, finish numbers for aluminum.

2.5.1.1 Exposed Aluminum

AAC22A31 chemically etched medium matte, with clear anodic coating, Class II Architectural, 0.4 mil thick.

2.5.1.2 Concealed Aluminum

Mill finish as fabricated, uniform in natural color and free from surface blemishes.

2.5.2 Stainless Steel

NAAMM MFM, Mechanical finish number 4.

2.5.3 Resilient Material

Embossed texture and color in accordance with SAE J 1545 and as otherwise

specified.

PART 3 EXECUTION

3.1 RESILIENT CORNER GUARDS

Install resilient corner guards on walls in accordance with manufacturer's printed details and instructions.

3.2 STAINLESS STEEL CORNER GUARDS

Mount guards on external corners of interior walls, partitions and columns as shown.

Where corner guards are installed on walls, partitions or columns finished with plaster or ceramic tile, anchor corner guards as indicated by manufacturer.

Where corner guards are installed on gypsum board, clean surfaces and anchor guards with a neoprene solvent-type contact adhesive specifically manufactured for use on gypsum board construction. Remove excess adhesive from the guard edges and allow to cure undisturbed for 24 hours.

3.3 RESILIENT WALL GUARDS (CRASH RAILS)

Secure guards to the walls with brackets and fasteners in accordance with the manufacturer's details and instructions.

3.4 ALUMINUM WALL GUARDS

Secure brackets to walls with fasteners, spaced in accordance with the manufacturer's installation instructions.

3.5 STAINLESS STEEL WALL GUARDS

Space brackets at not more than 3 feet on centers and anchor to the wall in accordance with the manufacturer's installation instructions.

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SECTION 10275

ELEVATED FLOOR SYSTEM

03/97

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SECTION 10275

ELEVATED FLOOR SYSTEM
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A208.1	(1993) Wood Particleboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 526/A 526M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM B 85	(1994) Standard Specification for Aluminum-Alloy Die Casting
ASTM F 1066	(1995; Rev A) Standard Specification for Vinyl Composition Floor Tile

FEDERAL SPECIFICATIONS (FS)

FS A-A-8	(Base) Shellac Varnish
FS DDD-C-001799	(Base) Carpet, Squares, Pile Surface, Tile Type, With or Without Attached Cushion
FS L-F-475	(Rev A; Int Am 3) Floor Covering Vinyl, Surface (Tile and Roll), With Backing
FS TT-C-490	(Rev C; Am 2) Cleaning Methods for Ferrous Surfaces and Pretreatments for Organic Coatings

MILITARY SPECIFICATIONS (MS)

MS MIL-C-22750	(Rev F) Coating, Epoxy, High Solids
MS MIL-P-23377	(Rev G) Primer Coatings: Epoxy, High Solids

NATIONAL INSTITUTE FOR STANDARDS AND TECHNOLOGY (NIST)

NIST PS 1	(1983) Construction and Industrial Plywood

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the

specification:

SD-02 Shop Drawings

Fabrication Drawings shall be submitted for Elevated Floor Systems consisting of fabrication and assembly details to be performed in the factory.

Installation Drawings shall be submitted for Elevated Floor Systems in accordance with the paragraph entitled, "Installation," of this section.

Location Drawings shall show location of pedestals, ventilation openings, cable cutouts, and the panel installation pattern.

Detail Drawings shall show details of the pedestals, pedestal-floor interlocks, floor panels, panel edging, floor openings, floor opening edging, floor registers, floor grilles, cable cutout treatment, perimeter base, expansion joints, and peripheral support facilities.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Floor Panels
Die-Formed Steel Panels
Finish Flooring
Registers and Grills
Cutouts
Stringers
Edge Strips
Pedestals

SD-04 Samples

One Sectional Cut of Floor Panels.

One sample of the specified Finished Flooring.

One complete Pedestal-Stringer Assemblies

Full-sized samples may be installed in the work when they are properly identified and approved.

SD-07 Certificates

Certificates of Compliance shall be submitted for the following:

Load-bearing capabilities of pedestals, floor panels, and pedestal adhesive resisting force

Supporting independent laboratory test reports. For panel loads, test results shall include concentrated loads at center of panel, panel edge midpoint, and uniform loads.

Floor electrical characteristics.

Material requirements

Elevated floor system will be free of defects in materials, fabrication, finish, and installation and that it will remain so for a period of not less than 10 years after completion.

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be protected from weather, soil, and damage during delivery, storage, and construction.

Materials shall be delivered in the original unopened packages, containers, or bundles bearing the brand name and the name of the material.

1.4 FIELD MEASUREMENTS

Field measurements shall be taken prior to the preparation of shop drawings and fabrication to ensure proper fits.

1.5 SYSTEM DESIGN

Elevated floor system shall consist of structural panels mounted on a grid system with adjustable pedestals to provide an underfloor space for accommodating electrical wiring, mechanical service lines, and, when necessary, to serve as an air plenum.

Elevated floor system shall include a supporting grid in those areas shown to accommodate special equipment installation. Lateral bracing of grid areas and equipment supports shall be as necessary.

1.6 PERFORMANCE REQUIREMENTS

The Contractor warrants that, upon notification by the Government, they will immediately replace defective work with new work at no additional cost to the Government.

1.6.1 Elevated Floor Panels

Elevated floor panels shall be capable of supporting a uniform live load of a minimum 250 pounds per square foot with a deflection not to exceed 0.040 inch. Floor shall also be capable of supporting a minimum 1,000-pound load concentrated on 1 square inch at any point on the panel area without deflecting more than 0.080 inch with a safety factor of not less than 3 based on yield strength of the material being used. Floor system shall be laterally stable in all directions whether panels are in place or not. Finished assembly shall be rigid and free of vibration and rocking panels.

1.6.2 Pedestals

Each pedestal with components as assembled for the specified heights shall be capable of carrying a 5,000-pound axial load without permanent deformation.

1.6.3 Bonding Strength of Pedestal Adhesive

Adhesive for anchoring pedestal bases shall have a bonding strength capable of resisting an overturning moment of 1,000 inch-pounds when a force is applied to the top of the pedestal in any direction.

1.6.4 Stringers

Stringers shall provide seating for panels to preclude tilting, rocking, or vibrating when a live load is applied. Stringers shall be provided that can be added or removed after floor is in place. Each stringer shall support at least 650 pounds at mid-span without failure when tested. The yield strength of the material being used shall be at least 250 pounds at mid-span without failure when tested.

1.7 PEDESTAL LOAD TEST

A static axial load of 5,000 pounds shall be imposed on the pedestals. Should there be failure of any component of any pedestal, the remaining pedestals shall be so tested, and pedestals that have a component failure shall be replaced with pedestals that have withstood the 5,000-pound axial load test.

1.8 ELECTRICAL RESISTANCE

Electrical resistance between an individual stringer and pedestal shall be less than 100 microhms. Range of electrical resistance of the floor covering to ground shall be 0.5 to 20,000 megohms for humidity from 40 to 60 percent relative humidity. A signal reference grid shall be provided as an equipotential surface for high frequency, low digital signals.

PART 2 PRODUCTS

2.1 FLOOR SYSTEM

Design and workmanship shall be such that the floor, as installed, shall be completely planar within plus or minus 0.060 inch in 10 feet, 0.100 inch for the entire floor, and 0.030 inch across panel joints.

Floor-panel joint-width tolerances shall be 0.008 inch as measured with a feeler gage at any point in any joint when the panels are in the pressure contact required in final installation.

System assembly shall be based upon an interference fit of connections.

2.2 PANELS

Panel design shall provide for convenient panel removal for underfloor servicing and for openings for new equipment. Design shall also provide necessary panel support where required openings entail cutting panels.

Floor panels shall be machined square to within plus or minus 0.005 inch with edge straightness plus or minus 0.0025 inch. Tolerances shall apply to the panel before the plastic edging is applied.

2.2.1 Floor Panels

Floor panels shall be fabricated from plywood conforming to NIST PS 1 or particle board conforming to ANSI A208.1, structurally bonded to 24-gage (0.0276-inch) zinc-coated sheet steel on both top and bottom. Plywood or particle board shall be 1 inch thick and shall extend to the nominal panel dimension allowing a maximum void at panel edge of 0.125 inch. Sheet shall conform to the requirements of ASTM A 526/A 526M. Exposed edges of the panels shall be sealed with shellac conforming to FS A-A-8.

2.2.2 Die-Formed Steel Panels

Floor panels shall be constructed of die-formed steel of physical properties and thickness to satisfy the load-bearing requirements of these specifications. A flat upper sheet, a die-formed lower sheet, and any auxiliary reinforcing shall be spot-welded into a rigid composite which shall withstand specified tests without failure of any weld. When the panels are to be grid-supported, panels shall be further tested by supporting them at two opposite edges and applying a 500-pound load at the center of a panel selected; the panel shall be similarly tested while supported at the other two edges. There shall be no weld failure at any point under this loading. This additional test shall be applied to one panel 500 square feet of floor in the system, but in no case less than two panels. When any weld fails, that number of panels designated by the Contracting Officer shall be similarly tested, and those that have a weld failure shall be replaced at no cost to the Government.

Before fabrication, steel used in constructing floor panels shall have been cleaned in accordance with FS TT-C-490 and given a Type I pretreatment.

2.3 FINISH FLOORING

The floor covering type, pattern, and color shall conform to that specified and indicated. Floor covering shall be factory-attached to the floor by a noncreep conductive adhesive selected by the manufacturer.

Contractor shall provide two floor lifters, and wall hangers for them, per 600 square feet of flooring.

2.4 REGISTERS AND GRILLES

Registers and grilles and shall be furnished and installed where indicated and shall be of the dimensions and free-area sizes shown. Construction shall be extruded aluminum, in mill finish, to sustain point loads of 250 pounds per vane without failure or permanent deformation. No part of a grille or register shall project more than 1/8 inch above the floor.

2.5 CUTOUTS

Cutouts shall be finished with rigid polyvinylchloride or molded polypropylene edging to conform to the appearance level of the floor surface and to cover raw edges of the cutout panel. This extrusion shall be of a configuration to permit its effective and convenient use when new cable openings are required. At least 24 feet of additional extrusion shall be provided for future use.

Cutting of panels, including cutouts, shall be performed outside of the building.

When size of cutout reduces the performance requirement of panel, the Contractor shall provide intermediate stringers adjacent to cutouts.

2.6 STRINGERS

Stringers shall be galvanized steel channel sections having either conductive vinyl rib or a flat conductive vinyl gasket cemented on top surface of stringers to effect a complete air seal between the panels and the stringers and prevent slippage of floor panels horizontally.

Self-threading machine screws or clip nuts are not acceptable, only unistrut-type bolts and nuts shall be used for connection. Method of mechanical fastening of stringer to pedestal shall not cause buckling of the stringer cross section. Bolted connection shall attach the bottom of the stringer to the pedestal. Provisions shall be made to allow equipment located on the floor to be bonded to the stringer.

2.7 EDGE STRIPS

An extruded rigid polyvinylchloride or vinyl conductive edge strip less than 3 ohms shall be mechanically secured to the panel in a manner to preclude detachment under foot and wheel traffic after metal fabrication and machining have been completed. Top of the strip shall be flush with the top of the floor covering. Dimensional accuracy of the floor panel with the edge strip in place shall be such that, when installed, jointing shall be characterized by the interference fit of panel to panel.

2.8 PEDESTALS

Pedestals shall consist of a square steel base at least 4 by 4 inches that is designed to be attached to the subfloor with the manufacturer's recommended adhesive or by mechanical fasteners for the intended installation.

Vertical adjustment of pedestals shall be by threaded steel rod with a positively locking vibration proof elevating nut to control the height of the pedestal head.

Pedestal rods shall be cast-in with the base or welded to the base. Mechanical connections will not be permitted. All sliding surfaces in the elevating mechanism, such as threads, collars, sockets, and shafts, shall be machined to an interference fit. All welds shall be cleaned and a corrosion preventative coating applied.

Pedestal components, except rods and bearing pads, shall be diecast aluminum alloy or steel. Rods shall be rustproofed, after machining, by galvanizing in accordance with manufacturer's standards.

Pedestal cap shall be a flat steel bracket with suitable arrangements for fastening, floor stringers to pedestal cap, where the bolt and nut is installed from below the pedestal cap.

Pedestal design shall include devices for securely anchoring floor panels and supporting or stabilizing members of the system. Such devices shall be characterized by interference fits to preclude any metal-to-metal impact noises.

Any nonmetallic pads used on pedestal heads as bearing surfaces for floor panels shall be rigid conductive polyvinylchloride or vinyl.

Bolts, nuts, washers, and screws shall be cadmium-plated items.

At the periphery of the floor, full support shall be provided to the floor's extreme edge to ensure continuance of the specified strengths. Support system provided for this purpose shall not interfere with the free removal of affected panels.

2.9 ACCESSORIES

Ramps, steps, guardrails, perimeter fascia, plenum dividers, access grommets, underfloor service holes, core base and panel lifters shall be as shown. All accessories shall be provided by flooring manufacturer.

2.9.1 Ramp

Provide necessary brackets, clamps, shoe assembly, threshold, fascia, closure plates and supporting stringers for complete installation.

Closure plates shall be 1/16 inch aluminum plate. Nose pieces shall be extruded aluminum.

Structural characteristics shall be equal to those specified under "Performance Requirements." Maximum slope shall be one in 12. Anchor closures securely to floor slab and to access floor system.

Surface of ramps shall be non-slip rubber.

2.9.2 Edge Closure

Provide 1/16 inch aluminum closure plate and extruded aluminum nosing at exposed edge of floor. Back up the closure plates with aluminum or steel framing braced diagonally, or anchor at bottom to continuous angle.

2.9.3 Guard Railing

Railing shall be double-rail standard railing of access floor manufacturer, made of extruded architectural aluminum members, and approved as to design and installation by Contracting Officer.

Railing standards shall be spaced at not more than 4 feet on center, shall be firmly anchored to the concrete floor slab and penetrate the access floor. Provide escutcheons where standard penetrate floor surface.

Toprail shall be 42 inches above level of access floor surface.

PART 3 EXECUTION

3.1 INSTALLATION

Layout for the installation shall keep to a minimum the number of cut panels at the floor's periphery.

Panel assembly shall be scribed into place at the periphery so that no voids result between the floor panels and the contiguous vertical surface trim. Pedestal position shall be accurately located, and any necessary changes in subfloor surfaces shall be made before other installation work is started.

Pedestal heads and stringers must be cleaned before assembly to assure the proper electrical resistance between stringer and pedestals.

Before installation proceeds, the subfloor shall be cleared of dust and construction debris, including a final cleaning with high-suction industrial vacuum equipment. No cutting, trimming, or other debris-producing operation shall be conducted within the room where the floor is being installed. As the installation of floor panels proceeds,

the area under the installed floor shall be vacuum cleaned as each row of panels is completed. Cleaning shall extend at least 4 feet back from the completed edge where possible.

Pedestals shall be installed with an epoxy adhesive recommended by the elevated-floor manufacturer. Installation shall provide a full bearing of the pedestal base on the subfloor. Where the contour of the floor does not permit this, the floor and the base shall be primed with adhesive, a grout made by filling adhesive with clean sand shall be applied over the primed floor area, and the pedestal base shall be firmly seated in the grout.

Installation shall be such that a surveyor's level shall show the floor to be level within 0.10 inch.

After installation has been completed, the floor shall be vacuum cleaned and covered with a continuous sheet of paper or plastic of sufficient strength to withstand traffic which may be imposed upon the floor before the final acceptance. Should any break in this covering occur, the covering shall be immediately repaired or the entire covering shall be immediately replaced.

3.2 CLEANING

3.2.1 Surplus Material Removal

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.

3.2.2 Testing

Installed floor system shall be tested for required electrical resistance by the Contractor before acceptance by the Contracting Officer. Unacceptable and damaged portions of the elevated floor system shall be corrected, removed and replaced at no additional expense to the Government.

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06/96

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SECTION 10523

FIRE EXTINGUISHERS
06/96

PART 1 GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM C 1036	(1991; R 1997) Standard Specification for Flat Glass

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(1994) Standard for Portable Fire Extinguishers

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 1	(1994) Surface Preparation Specification No. 1, Solvent Cleaning
SSPC SP 5	(1994) Joint Surface Preparation Standard, White Metal Blast Cleaning (Nace No. 1)
SSPC SP 8	(1991) Pickling

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication and Installation Drawings shall be submitted for the following items consisting of fabrication and assembly details to be performed in the factory and installation details complying with the requirements of the paragraph entitled, "Installation," of this section.

Fire Extinguishers
Adjuncts
Cabinets
Wall Brackets

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following

items:

Fire Extinguishers
Adjuncts
Cabinets
Wall Brackets
Replacement Parts

SD-04 Samples

One full-sized sample of each type Cabinet to be installed

One sample of Wall Brackets and Accessories of each type to be used

Approved samples may be used for installation, with proper identification.

SD-07 Certificates

Certificates of Compliance shall be submitted showing the following:

Certification that fire extinguishers comply with local codes and regulations

Certification that fire extinguishers comply with OSHA requirements

Extinguishers will be free of defects in materials, fabrication, finish, and installation and that they will remain so for a period of not less than 2 years after completion.

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be protected from weather, soil, and damage during delivery, storage, and construction.

Materials shall be delivered in their original packages, containers, or bundles bearing the brand name and the name of the material.

PART 2 PRODUCTS

2.1 TYPES

Fire extinguishers shall conform to NFPA 10.

Fire extinguishers shall be multipurpose dry chemical type, 20A-120 B:C rated or carbon dioxide (CD) type, 10 B:C rated where indicated.

2.2 MATERIAL

Extinguisher shell shall be corrosion-resistant steel.

2.3 SIZE

Extinguishers shall be 20 pounds.

2.4 ADJUNCTS

Forged brass valve

Safety release

2.5 CABINETS

2.5.1 Material

Cabinets shall be corrosion-resistant steel.

2.5.2 Type

Cabinets shall be semirecessed.

Cabinet shall be fire rated when installed in fire rated walls.

2.5.3 Size

Dimensions of cabinets shall be as indicated and shall be of adequate size to accommodate the specified fire extinguishers or to accomodate a fire hose valve as well as one fire extinguisher of the capacity and type specified..

2.6 TRIM STYLE

Fabricate trim in one piece with corners mitered, welded, and ground smooth.

2.6.1 Exposed Trim

One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return.

Rolled edge 2-1/2 inch (semi-recessed)
Trim Metal: Stainless steel confirming to ASTM A 167, AISI Type 302/304 alloy.

2.6.2 Door Material and Construction

Manufacturer's standard door construction, of material indicated coordinated with cabinet types and trim styles selected.

2.6.2.1 Stainless Steel

Manufacturer's standard door construction, fabricated from austenitic stainless steel complying with ASTM A 167 for AISI Type 302/304 alloy.

2.6.2.2 Door Glazing

Clear float glass complying with ASTM C 1036, Type I, Class 1, quality q3.

2.6.3 Lettering

Identify fire extinguisher in cabinet with red lettering spelling "FIRE EXTINGUISHER" applied to door. Provide lettering as selected from manufacturer's standard arrangements.

2.6.4 Door Style

Manufacturer's standard design, vertical duo-panel, float glass, 1/8 inch thick.

2.6.5 Door Hardware

Provide manufacturer's standard door operating hardware of proper type for cabinet type, trim style, and door material and style indicated. Provide either lever handle with cam action latch or door pull, exposed or concealed, and friction latch. Finish shall match trim. Provide concealed or continuous-type hinge permitting door to open 180 degrees.

2.7 CABINET FINISHES

Protect mechanical finishes on exposed surfaces from damage by application of strippable, temporary protective covering prior to shipment.

2.7.1 Steel Cabinet Finishes

2.7.1.1 Surface Preparation

Solvent clean surfaces in compliance with SSPC SP 1 to remove dirt, oil, grease, and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel in compliance with SSPC SP 5 or SSPC SP 8

2.7.1.2 Baked Enamel Finish

Immediately after cleaning and pretreatment, apply manufacturer's standard 2-coat baked enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's instructions for application and baking to achieve a minimum dry film thickness of 2.0 mils.

2.7.1.3 Color and Gloss

As indicated by reference to manufacturer's standard color and gloss designations.

2.7.1.4 Stainless Steel

Grind and polish surfaces to produce uniform directional, textured polished finish, free of cross scratches. Run grain with long dimension of each piece.

2.7.1.5 Satin Finish

Satin, directional polish, AISI No. 6 finish. Passivate and rinse surfaces after poolishing. Removed embedded foreign matter and leave surfaces chemically clean.

2.8 WALL BRACKETS

Brackets designed to prevent accidentally dislodging extinguisher, of sizes required for type and capacity of extinguisher indicated, in plated finish. Provide brackets for extinguishers not located in cabinets..

Wall bracket and accessories shall be as approved.

PART 3 EXECUTION

3.1 INSTALLATION

Extinguishers shall be installed where indicated. Exact locations shall be verified prior to installation.

Installation of extinguishers shall comply with the manufacturer's recommendations.

Extinguishers shall be fully charged and ready for operation upon installation.

3.2 ACCEPTANCE PROVISIONS

3.2.1 Repairing

Damaged and unacceptable portions of completed work shall be removed and replaced with new work at no additional cost to the Government.

3.2.2 Cleaning

Surfaces of the work, and adjacent surfaces soiled as a result of the work, shall be cleaned in an approved manner. Equipment, surplus materials, and rubbish from the work shall be removed from the site.

-- End of Section --

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SECTION 10600

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03/98

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-- End of Section Table of Contents --

SECTION 10600

PARTITIONS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ALUMINUM ASSOCIATION (AA)

AA 45	(1980) Designation System for Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(1984; R 1994) American National Standards for Safety Glazing Material Used in Buildings - Safety Performance Specifications and Methods of Test

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 366/A 366M	(1996) Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 385	(1980; R 1991) Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A 423/A 423M	(1991) Seamless and Electric-Welded Low-Alloy Steel Tubes
ASTM A 525	(1993) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 525M	(1991; Rev A) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process (Metric)
ASTM A 526/A 526M	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM A 568/A 568M	(2000; Rev B) Standard Specifications for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled,

	General Requirements for
ASTM B 221	(1995; Rev A) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes
ASTM B 221M	(1996) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes and Tubes (Metric)
ASTM C 1036	(1991; R 1997) Standard Specification for Flat Glass
ASTM D 2287	(1992) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 84	(2001) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 90	(1990) Standard Test Method for Laboratory Measurement of Airborne-Sound Transmission Loss of Building Partitions

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1	(2000) Butts and Hinges
BHMA A156.17	(1993) American National Standard for Self Closing Hinges and Pivots
BHMA A156.18	(2000) Materials and Finishes
BHMA A156.2	(1996) Bored and Preassembled Locks and Latches

FEDERAL SPECIFICATIONS (FS)

FS AA-P-00615	(Rev B) Partitions, Office, Steel
FS CCC-C-700	(Rev J) Cloth, Coated, Vinyl Coated (Artificial Leather)

MILITARY SPECIFICATIONS (MS)

MS MIL-C-22750	(Rev F) Coating, Epoxy, High Solids
MS MIL-P-23377	(Rev G) Primer Coatings: Epoxy, High Solids

STEEL DOOR INSTITUTE (SDOI)

SDOI 100	(1991) Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES (UL)

UL 155	(1995; 7th Ed) UL Standard for Safety Tests for Fire Resistance of Vault and File Room Doors

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings shall be submitted for Partitionsconsisting of fabrication and assembly details to be performed in the factory.

Installation Drawings shall be submitted for the following items in accordance with paragraph entitled, "Installation," of this section.

Accordion-Folding Partitions
Folding Partitions
Mesh Partitions
Doors
Filler Panels
Posts
Glazing
Gates

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Accordion-Folding Partitions
Folding Partitions
Mesh Partitions
Hinged Doors
Hardware and Accessories
Miscellaneous

SD-04 Samples

Manufacturer's Standard Color Charts shall be submitted indicating the manufacturer's recommended color selections and finishes.

SD-07 Certificates

Certificates of Compliance shall be submitted for the following items, showing conformance with the referenced standards contained in this section.

Accordion-Folding Partitions
Folding Partitions
Mesh Partitions
Hinged Doors
Hardware and Accessories
Miscellaneous Items

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted for Partitions including special provisions required to install equipment

components and system packages. Special notices shall detail impedances, hazards and safety precautions.

1.3 FIELD MEASUREMENTS

Field measurements shall be taken prior to preparation of drawings and fabrication to ensure proper fits.

PART 2 PRODUCTS

2.1 ACCORDION-FOLDING PARTITION

2.1.1 Finish

Partition fabric shall weigh 3.0 pounds per square foot. Partition shall consist of liquid vinyl laminated to fabric backing.

Partition shall be vinyl laminate.

Partition width shall be 8 inches.

Weight, color, and texture of partitions shall conform to the approved sample.

Partitions shall have a Class A flame spread rating when tested in accordance with ASTM E 84.

Minimum STC classification rating shall be 35 in accordance with ASTM E 90 on large-scale test openings.

2.1.2 Interior Frame Work

Steel members shall be arranged to provide horizontal pantograph movement.

2.1.3 Suspension System

Suspension system shall consist of approved steel or aluminum track and trolleys designed to support the weight of the partition as recommended by the manufacturer.

Subchannel shall be approved, formed, cold-rolled steel or extruded aluminum compatible with the ceiling construction intended for the project.

Structural system shall be self-supporting.

2.1.4 Finish Hardware

Pull bar, closure device, screws, and installation hardware shall be the manufacturer's approved standard.

Finish of exposed hardware shall be as selected from the manufacturer's standard finish.

Additional approved hardware shall include keying mechanisms, masterkey assemblies, pendant pulls (for partitions over 8 feet high), tiebacks, and cremone-bolt or foot-bolt assemblies.

2.1.5 Sound Seals

Sound seals shall consist of vinyl or rubber gaskets, calking at jambs, and sweepstrips at top and bottom.

2.1.6 Ceiling Guards

Sound partitions shall be furnished with ceiling guards or integral track and ceiling guards.

2.1.7 Meeting Posts

Meeting posts shall be furnished for multiple-partition meeting points and for intermediate meeting points of two partitions.

2.1.8 Jamb Panels

For pocket-type applications, sliding jamb panels shall be furnished to match partitions.

2.1.9 Rolling Posts

Partitions shall be furnished with rolling posts.

2.1.10 Lead Post Air Holes

Lead post shall have air-release holes.

2.1.11 Pull-In Latch

Partitions shall be furnished with approved pull-in latches.

2.2 FOLDING PARTITION

2.2.1 Galvanized-Steel Sheet

Galvanized-steel used for fabrication of partition pantograph and metal sound insulation shall be hot-dipped, commercial-quality material conforming to ASTM A 526/A 526M with not less than 1.25 ounces of zinc coating conforming to ASTM A 525.

2.2.2 Fabric Covering

Fabric covering for partitions shall be polyvinylchloride polymer coating compound on a fiber based cloth conforming to FS CCC-C-700. Partition fabric weight shall be as indicated on drawings.

Fiber based cloth shall be mildew-resistant treated.

Fabric covering shall be tested for compliance with ASTM E 84; flame spread shall not exceed 25, fuel contributed shall not exceed 15, and smoke-developed shall not exceed 50.

2.2.3 Aluminum

Extruded aluminum materials shall be fabricated from 6063-T6 aluminum alloy in conformance with ASTM B 221. Surface finish shall be in conformance with C21A41, as specified in AA 45.

2.2.4 Galvanized Steel Anchoring Devices and Fasteners

Galvanized-steel anchoring devices and fasteners shall be hot-dip coated after fabrication in conformance with ASTM A 385 and ASTM A 123.

2.2.5 Partition Fabrication

2.2.5.1 Partition Support Frames

Partition support frames shall be fabricated of galvanized-steel components. Frames shall consist of horizontal or vertical type pantograph support hinges located at the top and bottom of the partition with intermediate pantographs located not more than 42 inches on center. Pantographs shall be supported and secured to each other with steel rods or plates. Partition support frame shall carry the partition weight without sag and shall allow balanced, smooth action in moving the partition from the closed or open position.

2.2.5.2 Partition Suspension System

For folding partitions less than 8 feet in height, suspension tracks shall be fabricated from not less than 0.0516-inch thick galvanized-steel sheet or not less then 0.080-inch thick extruded aluminum.

For folding partitions less then 14 feet in height, suspension tracks shall be fabricated from not less than 0.0635-inch thick galvanized-steel sheet or not less than 0.090-inch thick extruded aluminum.

For folding partitions exceeding 14 feet in height, suspension tracks shall be fabricated from not less than 0.1233-inch thick galvanized-steel sheet or not less then 0.125-inch thick extruded aluminum.

Tracks shall be sized to permit smooth, low-friction operation of partition trolleys.

For folding partitions less than 8 feet in height, partition support trolleys shall consist of noiseless nylon wheels secured to steel shafts.

For folding partitions exceeding 8 feet in height, partition support trolleys shall be noiseless nylon-tread ball-bearing wheels secured to steel shafts.

Lead trolley shall be 4-wheeled with the intermediate trolleys being 4-wheeled not more than 24 inches on center or 2-wheeled not more than 18 inches on center.

Ceiling contact guard for forming a pocket for recessed suspension track and hard-contact surface for perimeter seals shall be fabricated from not less than 0.0516-inch thick galvanized-steel sheet. Guard width shall not allow the sweep of the perimeter seals to make contact with the finished ceiling.

Subchannel used for forming a pocket for the recessed suspension tracks shall be fabricated from not less then 0.0516-inch thick galvanized-steel sheet.

2.2.5.3 Partition Covering

Fabric partitions shall be fabricated, installed, and tested in accordance

with ASTM E 90 to verify an STC of not less than 41.

Partition covering shall be a single-ply vinyl-coated fabric. Covering shall be secured to the partition support frame by a hidden system that will prevent sagging or separation of the covering while permitting on-site removal and repair of the fabric covering. Vertical seams in the covering shall be located in the valleys of the partition folds. Tops and bottoms of the covering shall be turned hems.

2.2.5.4 Fire Rating

Cores shall have the fire-resistant classification conforming to UL 155when tested in accordance with ASTM E 84 and shall bear the UL label.

2.2.6 Perimeter Seal

Perimeter seals shall be provided for each side, top, and bottom of the folding partition. Seals shall be durable and flexible and provide continuous contact with the head and sill surfaces for a positive light and sound seal.

Seals at lead and back jamb posts shall be the manufacturer's standard male and female light and sound seals.

2.2.7 Hardware

Manually operated folding fabric partitions shall have push-pull handles on each side of the partition and a cylinder locking device.

Locking assembly shall be made up of a keyed cylinder lock, pull-in or hook latch and operating handles standard with the manufacturer and capable of receiving the specified cylinder.

Pendant pulls for partitions exceeding 12 feet in height shall be provided on lead posts. Pulls shall be secured in a manner that will not interfere with light and sound seals.

Foot bolts shall be provided and secured to the lead posts in a manner that will not interfere with light and sound seals.

2.3 MESH PARTITION

2.3.1 General

Partition shall be a series of standard, modular, interchangeable units with captive hardware designed to permit interchange and rearrangement of panels, doors, gates, service windows, and corners. Components shall be readily disassembled, entirely or in part, for relocation.

Panel shall be steel-wire mesh or steel-wire mesh with base panel of nominal plan dimensions.

Filler panels shall be the manufacturer's standard sizes, matching the adjacent partition, where standard full-width panel cannot be used to fill out runs.

2.3.2 Free-Standing Partitions

Wire shall be 10-gage steel woven into a 1-1/2-inch diamond mesh, clinched

to frames.

Vertical frames shall be 1-1/4- by 5/8-inch steel C-channels with 1/4-inch bolt holes 12 inches on center.

Horizontal frames shall be 1- by 1/2-inch steel channels.

Joints shall be mortised and tenoned.

Center reinforcing bar shall be 1- by 1/2- by 1/8-inch steel channel tenoned to the side frames with wires passing through the center bar.

Top reinforcement or cap shall be a continuous 2-1/4- by 1-inch steel channel with holes for 1/4-inch U-bolts 2 feet 4 inches maximum on center.

Corner posts shall be 1-1/4 by 1-1/4-inch steel angles with 1/4-inch bolt holes to match partition.

Floor sockets shall be 2-1/2-inches high of high-grade cast iron with a setscrew adjustment.

2.3.3 Sheetmetal Base Partitions

Top of the lower panel of sheetmetal base partitions shall be approximately 3 feet 6 inches above the floor line and constructed of 16-gage formed steel sheet bolted to a frame.

2.3.4 Heavy Duty Partitions 7 to 20-FeetWide

Wire shall be 6-gage steel woven into 2-inch diamond mesh and clinched into frames.

Frames shall consist of 1-1/2- by 3/4-inchsteel channel. Vertical frames shall have 3/8-inchbolt holes 18 inches on center. Joints shall be mortised and tenoned.

Center reinforcing bar shall consist of 1-1/2- by 3/4-inch channel tenoned to side frames. Wires shall pass through the center bar.

Top reinforcement or cap shall be a continuous 3-inch steel channel with holes for 5/16-inch U-bolts 2 feet 4 inches on center, maximum.

Corner posts shall be 1-3/4- by 1-3/4-inch steel angles with 3/8-inch bolt holes to match the partition.

Floor sockets shall be 2-1/2-inches high and of high-grade cast iron with a setscrew adjustment.

2.3.5 Bracing

Bracing shall be designed and installed at intervals not exceeding 15 feet and where required to provide lateral stability.

Bracing shall be provided by extending the structural post or equivalent member and securing it to the overhead construction.

2.3.6 Sliding Doors

Sliding doors shall be the same construction as adjacent panels and as

follows:

Frames shall be 1-1/2- by 3/4-inch steel channel with 1-1/2- by 1/8-inch steel flat-bar cover all around.

Each door shall have two 4-wheel roller-bearing hangers.

Sliding doors shall have a steel box-trench and bottom-guide channel.

2.4 HINGED DOORS

Hinged doors shall be of same construction as adjacent panels and as follows:

Frames shall be 1-1/4- by 1/2-inch steel channel with 1-1/4- by 1/8-inch steel flat-bar cover on three sides and 1-3/8- by 3/4- by 1/8-inch steel angle riveted to the lock side.

Each door shall have 1-1/2 pairs of ball-bearing butt hinges riveted to both the door and the jamb.

2.5 HARDWARE

Hardware shall be the manufacturer's standard, as approved.

2.6 MISCELLANEOUS ITEMS

Shelves, dutch doors, counters and other required items shall be the manufacturer's standard.

2.7 FINISH

Finish shall be the manufacturer's standard shop coat.

PART 3 EXECUTION

3.1 INSTALLATION

Accordion-folding partition installation, operation, and hardware shall be checked for the following:

A positive seal for light and sound when partition is closed.

Partition does not drag or bind in its track or on the finished floor and the clearance meets manufacturer's recommendations.

Direction of travel during operation is as indicated on the drawings.

Fit is plumb and square within the opening.

Smooth operation; latch engages and holds the partition in an extended or closed position.

Effectiveness of security devices

Aligned track joints

Tracks shall be level and fastened securely to the header as recommended by the manufacturer.

Partitions shall be adjusted and left in smooth operating condition without binding.

3.1.1 Folding Partitions

Support frame, suspension system, partition covering perimeter seals, hardware and similar items shall be installed complete to the indicated support framing. Partitions shall be installed in accordance with approved drawings and the manufacturer's printed instructions.

Suspension system track shall be secured to the wood blocking with not less than No. 8 wood screws spaced not more than 18 inches on center.

Partition jambs shall be secured to supporting walls with anchors of the types required by the following substrate construction:

Jambs shall be secured to plaster on metal lath, plaster on gypsum lath, or gypsum-board walls with toggle bolts. Toggle bolts shall be designed for use with not less than 1/4-20 screws of the length required for the wall thickness. Toggle bolt spacing shall not exceed 24 inches on center. Load carrying strength shall be not less than 600 pounds per anchor.

Jambs shall be secured to solid masonry or concrete with lead or base expansion shields. Expansion shields shall be designed for use with not less than 1/4-20 screws having a shield length of not less than 1-1/2 inches. Load-carrying strength shall be not less than 500 pounds per anchor.

Folding fabric partitions shall be adjusted to be light-sealed; free of warp, twist and distortion. Partitions so adjusted shall be opened or closed from any position with a horizontal force not exceeding 30 pounds.

3.1.2 Doors

Doors shall fit accurately in their respective frames within the required clearances. Hardware shall be installed and adjusted in accordance with the manufacturer's printed directions.

3.1.3 Gates

Gates shall fit accurately in their respective frames within the required clearances. Tops of gates shall be level with tops of partitions when the gates are in the closed position.

3.1.4 Steel-Wire Mesh Partitions

Partitions shall be anchored, plumb, level, and true to line with hardware adjusted for proper operation. Installation shall be in accordance with the manufacturer's printed instructions.

3.2 FOLDING PARTITION TESTING

Folding partitions, suspension system, and perimeter seals shall be examined and tested for general operation, with the specified pulling or pushing force and given a visual test for light seal.

Partitions that fail to meet the required tests shall be adjusted and

retested until approved.

-- End of Section --

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DIVISION 10 - SPECIALTIES

SECTION 10800

TOILET AND BATH ACCESSORIES

09/93

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-- End of Section Table of Contents --

SECTION 10800

TOILET AND BATH ACCESSORIES
09/93

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A117.1	(1998) Accessible and Usable Buildings and Facilities

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 366	(1991) Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 385	(1980; R 1991) Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A 525	(1993) Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process
ASTM A 526	(1990) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality
ASTM A 568	(1991a) General Requirements for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled
ASTM B 456	(1991a) Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium
ASTM C 1036	(1991; R 1997) Standard Specification for Flat Glass
ASTM D 2092	(1995) Standard Practice for Preparation of Zinc-Coated Galvanized Steel Surfaces for

Painting

FEDERAL SPECIFICATIONS (FS)

FS WW-P-541 (Rev E; Am 1) Plumbing Fixtures

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Mirror Glass
Mounting Devices and Fasteners
Accessories
Paper Towel Dispenser-Waste Receptacle Units
Feminine Napkin Dispenser
Feminine Napkin Disposal
Toilet Tissue Dispenser
Liquid-Soap Dispenser
Shelf
Framed Mirror
Toilet-Seat-Cover Dispensers
Grab Bars
Towel Bars
Shower-Curtain Rod
Robe-Hook

SD-04 Samples

Samples of each Toilet and Bath Accessories to be used shall be submitted prior to installation. Approved full-size samples may be installed in the work provided they are properly identified.

1.3 DELIVERY, HANDLING, AND STORAGE

Materials shall be protected from weather, soil, and damage during delivery, storage, and construction.

Materials shall be delivered in their original packages, containers, or bundles bearing the brand name and the name of the material.

PART 2 PRODUCTS

2.1 MATERIALS

Corrosion-resistant steel shall conform to AISI, Type 304. The exposed surfaces shall have a No. 4 finish, unless otherwise specified.

Brass shall be cast, in accordance with FS WW-P-541.

Steel sheet shall conform to ASTM A 366 and ASTM A 568. Surface preparation and pretreatment shall be provided as required for the subsequent finish.

Galvanized-steel sheet shall be hot-dipped, minimum spangle, conforming to ASTM A 526, with a zinc coating in accordance with ASTM A 525. The surface preparation for painting shall conform to ASTM D 2092, Method A.

2.2 COATINGS

Chromium coating shall be nickel and chromium electrodeposited on brass, conforming to ASTM B 456, type and class as specified. The coating shall have a satin finish unless otherwise specified.

Enamel coating shall be factory applied, gloss white, baked acrylic. The coating shall be washable and suitable for the intended use.

2.3 MIRROR GLASS

Mirror glass shall be Type 1, Class 1, quality q1, 6 millimeter-thick float glass with silvering, copper backing, and protective coating, in accordance with ASTM C 1036.

2.4 MOUNTING DEVICES AND FASTENERS

Concealed mounting devices and fasteners for accessories shall be fabricated from the same materials as the accessories or from galvanized steel, conforming to ASTM A 385 and ASTM A 123. Exposed mounting devices and fasteners shall be finished to match the accessories. Fasteners shall be the theft-resistant type.

2.5 ACCESSORIES

2.5.1 GENERAL

All accessories shall be of the type and manufacturer indicated on the Standard Reference Document (SRD) or approved equal.

2.5.1 Multi-Purpose Units

2.5.1.1 Small Facilities

Paper towel dispenser/waste receptacle multipurpose units shall be recessed type. Dispensers shall be sized to dispense not less than 1100 singlefold paper towels with an interchangeable paper drop. The dispenser shall be fabricated to be recessed in a 203 millimeter nominal-depth wall opening. The cabinet and door shall be fabricated from not less than 0.79 millimeter-thick corrosion-resistant steel of all welded construction and no mitered corners. The door shall be hung with a full-length corrosion-resistant steel piano hinge and secured with a tumbler lock. Receptacles shall be not less than 0.79 millimeter-thick corrosion-resistant steel with joints continuously welded. The flange shall be fabricated from one piece seamless construction with no mitered corners. The door shall be hung with a full-length corrosion-resistant steel piano hinge and secured with a tumbler lock. The removable waste container shall be of the capacity indicated on drawings. All accessories shall be of the type and manufacturer indicated on drawings or approved equal.

2.5.2 Large Facilities

Paper towel dispenser/waste receptacle multipurpose units shell be recessed type. Dispensers shall be sized to dispense not less than 1100 singlefold paper towels with an interchangeable paper drop. The dispenser shall be fabricated to be recessed in a 203 millimeter nominal-depth wall opening. The cabinet and door shall be fabricated from not less than 0.79 millimeter-thick corrosion-resistant steel of all welded construction and no mitered corners. The door shall be hung with a full-length corrosion-resistant steel piano hinge and secured with a tumbler lock. Receptacles shall be not less than 0.79 millimeter-thick corrosion-resistant steel with joints continuously welded. The flange shall be fabricated from one piece seamless construction with no mitered corners. The door shall be hung with a full-length corrosion-resistant steel piano hinge and secured with a tumbler lock. The removable waste container shall be of the capacity indicated on drawings.All accessories shall be of the type and manufacturer indicated on drawings or approved equal.

2.5.3 Feminine Napkin Dispenser

2.5.3.1 Recessed Unit

Dispensers, of the type and manufacturer indicated on draswings or approved equal, shall be sized for 31 napkins/22 tampons. Recessed type dispensers shall be fabricated to be recessed in a wall opening not greater than 152 millimeter in depth. The dispenser door shall be fabricated from not less than 1.27 millimeter-thick corrosion-resistant steel with returned edges for rigidity. The door shall be hung with a full-length corrosion-resistant steel piano hinge and secured with a tumbler lock. The door shall be embossed with the word NAPKIN. The dispenser cabinet shall be fabricated from not less than 0.79 millimeter-thick corrosion-resistant steel with welded construction. The dispenser shall operate with double-coin mechanism. A separate lock shall be provided for the coin box.

2.5.3.2 Surface-Mounted Unit

Dispensers, of the type and manufacturer indicatted on drawings or approved equal, shall be sized for 31 napkins/22 tampons. The dispenser door shall be fabricated from not less than 1.27 millimeter-thick corrosion-resistant steel with returned edges for rigidity. The door shall be hung with a full-length corrosion-resistant steel piano hinge and secured with a tumbler lock. The door shall be embossed with the word NAPKIN. The dispenser cabinet shall be fabricated from not less than 0.79 millimeter-thick corrosion-resistant steel with welded construction. The dispenser shall operate with double-coin mechanism. A separate lock shall be provided for the coin box.

2.5.4 Feminine Napkin Disposal

2.5.4.1 Double Compartment Unit

Partition-mounted disposal shall be semirecessed for servicing two toilet compartments. The disposal shall be fabricated from not less than 0.79 millimeter-thick corrosion-resistant steel. The flange shall be 1-piece seamless construction with no mitered corners. Doors shall be self-closing and equipped with a full-length corrosion-resistant steel piano hinge. Doors shall be embossed with the words NAPKIN DISPOSAL and PUSH. The

cabinet and receptacle shall be corrosion-resistant steel with welded construction.

2.5.4.2 Single Compartment Unit

Recessed disposal shall be fabricated from not less than 0.79 millimeter-thick corrosion-resistant steel. The flange shall be 1-piece seamless construction with no mitered corners. Doors shall be self-closing and equipped with a full-length corrosion-resistant steel piano hinge. Doors shall be embossed with the words NAPKIN DISPOSAL and PUSH. The cabinet and receptacle shall be corrosion-resistant steel with welded construction. (Similar to Bobrick B-254.)

2.5.5 Toilet Tissue Dispenser

2.5.5.1 Recessed Unit

Multiroll dispensers shall be fabricated to accommodate and dispense not less than two 52 by 52 millimeter core tissue rolls. Recessed type dispenser shall be fabricated for wall openings not greater than 101.6 millimeter in depth. The dispenser shall be fabricated from not less than 0.79 millimeter-thick corrosion-resistant steel. The flange shall be fabricated from 1-piece seamless construction. The door shall be bottom hung with a continuous piano hinge and secured with a tumbler lock. The spare roll shall automatically drop into place when first roll is empty thereby eliminating a release bar. (Similar to Bobrick B-388.)

2.5.5.2 Partition-Mounted Unit

Multiroll dispensers shall be fabricated to accommodate and dispense not less than two 52 by 52 millimeter core tissue rolls. Partition-mounted type dispenser shall be fabricated to service two toilet compartments. The dispenser shall be fabricated from not less than 0.79 millimeter-thick corrosion-resistant steel. The flange shall be fabricated from 1-piece seamless construction. The door shall be bottom hung with a continuous piano hinge and secured with a tumbler lock. The spare rolls shall automatically drop into place when first rolls are empty thereby eliminating a release bar. (Similar to Bobrick B-386.)

2.5.5.3 Surface-Mounted Unit

Multiroll dispensers shall be fabricated to accommodate and dispense not less than two 52 by 52 millimeter core tissue rolls. The dispenser shall be fabricated from not less than 0.79 millimeter-thick corrosion-resistant steel. The door shall be bottom hung with a continuous piano hinge and secured with a tumbler lock. The spare roll shall automatically drop into place when first roll is empty thereby eliminating a release bar. (Similar to Bobrick B-288.)

2.5.6 Toilet-Seat-Cover Dispenser

Recessed Toilet-Seat-Cover Unit shall be fabricated to have a capacity of not less than 500 paper toilet-seat-covers. Unit shall be fabricated from not less than 0.79 millimeter-thick corrosion-resistant steel. The flange shall be 1-piece seamless construction with no mitered corners. Doors shall be equipped with a full-length corrosion-resistant steel piano hinge and tumbler lock. The cabinet and receptacle shall be corrosion-resistant steel with welded construction. (Similar to Bobrick B-301.)

2.5.7 Liquid-Soap Dispenser

The liquid-soap dispenser shall be stainless steel with refillable minimum capacity 800 mL soap container assembly. (Similar to Scott/Sani-Fresh No. 91125 "Reflections".)

2.5.8 Shelf

The shelf shall be fabricated from not less than 1.27 millimeter-thick corrosion-resistant steel, full length without seams, with not less than a 12.7 millimeter edge face and exposed edges rolled. Mounting brackets shall be fabricated from not less than 1.6 millimeter-thick corrosion-resistant steel welded to the bottom of the shelf. Provide two brackets for the first 600 millimeter of shelf and one additional bracket for each additional 300 millimeter of length. (Similar to Bobrick B-298.)

2.5.9 Mirrors

Framed mirrors shall be fabricated to the size indicated. The mirror frame shall be fabricated from not less than 0.79 millimeter-thick corrosion-resistant steel with corners mitered, welded, and ground smooth and a face width of not less than 16 millimeter. The backing sheet shall be fabricated from not less than 1 millimeter-thick galvanized steel secured to the frame with concealed screws. Edges and back of the mirror glass shall be protected with continuous wood fill strips and moisture-proof shock-absorbing back padding. Concealed galvanized-steel wall hanger of the size required for the mirror size shall be provided. The mirror shall be hung and locked in place with not less than two vandal-resistant locking screws per mirror. (Similar to Bobrick B-290.)

End shelf shall be fabricated from not less than 0.79 millimeter-thick corrosion-resistant steel not less than 127 millimeter wide with a 19 millimeter return edge. The shelf shall be secured to the mirror frame and reinforced with not less than 1.6 millimeter-thick corrosion-resistant steel concealed brackets. (Mirror with shelf, similar to Bobrick B-292.)

2.5.10 Grab Bars

Bars shall be fabricated from not less than 1.24 millimeter-thick 67 millimeter outside diameter seamless corrosion-resistant steel tubing. Wall flanges shall be fabricated for a concealed installation from not less than 2.39 millimeter-thick corrosion-resistant steel not less than 76.2 millimeter in diameter. Flanges shall be fully welded to the grab bar. A concealed mounting plate shall be fabricated from corrosion-resistant or galvanized steel. Secure flanges to the mounting plate with not less than four corrosion-resistant steel vandal-resistant setscrews. Exposed surfaces shall have a finish as specified unless the finish is indicated as nonslip. The nonslip finish shall have a peened or light knurled finish.

2.5.11 Towel Bar

Bar shall be fabricated from not less than 1.24 millimeter-thick, 19 millimeter outside diameter, seamless corrosion-resistant steel tubing. Support posts shall be fabricated for a concealed installation from satin-finish chromium-plated brass or corrosion-resistant steel. Concealed mounting brackets shall be fabricated from the same material as the support posts. Support posts shall be secured to the mounting brackets with a locking setscrew.

2.5.12 Shower-Curtain Rod

Rod shall be fabricated from not less than 0.89 millimeter-thick, 254 millimeter outside diameter, seamless corrosion-resistant steel tubing. Support flanges shall be fabricated from not less than 3.18 millimeter-thick corrosion-resistant steel not less than 76.2 millimeter in diameter.

2.5.13 Robe Hook

Hook shall be the double type fabricated from satin-finish chromium-plated brass. The projection from the back of the flange to the end of the hook shall be not less than 50.8 millimeter. The concealed mounting bracket shall be fabricated from solid brass. The hook shall be secured to the mounting bracket with a locking setscrew.

PART 3 EXECUTION

3.1 GENERAL

Field measurements shall be taken prior to the preparation of drawings and fabrication to ensure proper fits.

Accessories shall be secured to the supporting substrates with anchors of the types indicated by the following substrate construction.

3.2 TILE CEMENTED ON GYPSUM-BOARD WALL

Accessories shall be secured with toggle bolts using not less than No. 10-24 screws of the length required for the finish thickness.

3.3 GYPSUM BOARD

Accessories shall be secured with toggle bolts or expansion sleeve screws. Toggle bolts shall be not less than No. 10-24 screws of the length required for the finish thickness. Expansion-sleeve screws shall be not less than No. 6-32 screws or No. 10-24 screws of the lengths required for the finish thickness.

3.4 SOLID MASONRY, CONCRETE, OR TILE SET IN MORTAR

Accessories shall be secured with lead expansion shields or cast-in integral anchors. Lead expansion shields shall be not less than No. 8 wood screws with a shield length of not less than 25 millimeter. Integral anchors shall be deformed bars not less than 38 millimeterin length cast into a predrilled hole with quickset mortar or plaster of paris.

3.5 METAL PARTITIONS

Accessories shall be secured with T-nuts and through-bolts not less than No. 10-24 of the lengths required for the partition thickness.

3.6 GRAB-BAR ANCHORS

Through-bolt anchors shall be used for solid masonry or concrete walls where the backplate is concealed or covered with a subsequent finish. An adhesive-applied anchor plate shall be used only when a through-bolt plate would be exposed. An embedded plate anchor shall be used for hollow partitions and solid gypsum partitions.

Through-bolt anchors shall be designed and installed to have a withdrawal strength of not less than 136 kilogram per anchor. Front and back plates shall be fabricated from not less than 4.75 millimeter-thick steel with the surface area required for the design strength. Through bolts shall be not less than 6.35 millimeter diameter threaded rod with a hexnut and lockwasher. The length of the rod shall be determined by the wall thickness.

The adhesive-applied anchor plate shall be fabricated from not less than 1 millimeter-thick perforated plate adhesive-applied to the supporting substrate. The adhesive shall be a thermoset epoxy-based resin which shall develop not less than 136 kilogram shear strength per bar anchor. The grab-bar back plate shall be secured to the anchor plate with not less than two No. 10-24 screws of the length required for the thickness.

Embedded plate anchors shall be fabricated from not less than 3.18 millimeter-thick plates with the width and length of the bar as indicated. Plate shall be U-clamped to the partition studs or channels. Embedded plates shall be secured to the studs or channels on each side of the grab-bar support. The bar back plate shall be secured to the anchor plate with not less than two No. 10-24 screws of the length required for the thickness.

3.7 HANDICAP ACCESSORIES

Toilet and bath accessories designated for handicap requirements shall be installed in accordance with ANSI A117.1.

3.8 CLEANING

Surfaces of the work, and adjacent surfaces soiled as a result of the work, shall be cleaned as recommended by the manufacturer.

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DIVISION 11 - EQUIPMENT

SECTION 11161

DOCK LEVELERS

03/97

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-- End of Section Table of Contents --

SECTION 11161

DOCK LEVELERS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 10 (2000) Near-White Blast Cleaning (Nace No. 2)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings for Hand-Operated Dock Levelers shall be submitted prior to installation and shall indicate the type and location of welds; gage, thickness and grade of steel used for each member; and type and location of all components to be installed.

Installation Drawings for Hand-Operated Dock Levelers shall be submitted prior to installation and shall include operation, construction, and installation details; and dimensions of all members and details of recess construction necessary for installation and performance.

SD-03 Product Data

Manufacturer's Catalog Data, including installation hardware and accessories, shall be submitted for the following items:

Hand-Operated Dock Levelers
Spare Parts Data

SD-07 Certificates

Certificates of Compliance shall be submitted for Hand-Operated Dock Levelers showing that capacities and operational requirements are as specified.

SD-10 Operation and Maintenance Data

Contractor shall submit 4 copies of the Operation and Maintenance Manuals 30 days prior to testing the Leveler Systems. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

1.3 GENERAL DESCRIPTION

Dock levelers designed to span and compensate space and height differentials between a loading dock and a freight carrier shall be of the type shown on drawings and in compliance with the safety requirements of OSHA.

.

Levelers shall be fully recessed hand-operated counterbalanced units, securely anchored into dock recesses provided for them, and shall conform to the approved drawings.

Design shall be such that when the leveler is not in use it shall be supported in a manner to carry its rated 20,000 pounds in wheeled cross-traffic. It shall not be necessary to manually position platform supports to produce this result.

Platform shall be checkered steel to produce the maximum stiffness-to-weight ratio and provide maximum traction in use.

Access shall be provided so that lubrication may be accomplished without entry into the pit.

Water shall drain freely from all components and the unit shall be substantially weathertight when not in use.

1.4 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered to the site undamaged and shall be stored in a clean, dry area. Materials shall be handled to prevent damage.

1.5 MANUFACTURER'S WARRANTY

Contractor shall present a manufacturer's warranty certifying the leveler against operational malfunction or structural failure, or both, for a period of 10 years from the date of acceptance by the Government. Warranty may exclude failure through overloading evidenced by member breakage or residual deformation; but it may not exclude breakage of welds or fastenings, fatigue breakage of components, or wear of moving parts. Warranty shall cover the full costs of repairs, or replacements in case of a nonrepairable failure.

PART 2 PRODUCTS

2.1 COUNTERBALANCED, HAND-OPERATED, DOCK LEVELERS

2.1.1 Construction

Dock leveler shall be built into dock pits to provide a level and stable dock floor when the leveler is not in use. No part of leveler shall project beyond the leading edge of the dock.

Construction shall reflect stresses imposed by its role as both a part of the dock floor and as the ramp over which heavy loads are transferred between vehicles and the dock. Construction shall also keep moving parts

simple and rugged to ensure a minimum of adjustment, servicing, and repair. Operating mechanism shall employ no pulleys, cables, or chains other than possibly a lift chain by which operation is manually initiated.

Leveler shall be designed for rolling loads of not less than 10 tons in operating position and 15 tons when serving as part of the dock floor. Safety factor shall be 1-1/2 to 1 without residual deformation and 2 to 1 without structural failure.

Counterbalancing shall be such that when adjusted to automatically settle into operating position from raised position, the force required to initiate operation shall not exceed 50 pounds in hand lift, or 100 pounds on foot pedal.

If design is such that a foot pedal is employed to initiate operation, with the platform slowly elevated to maximum height by the counterbalancing system from where it is lowered to vehicle bed level, the force required to lower the platform shall not exceed 100 pounds applied within 1 foot of the end of the platform.

Toe guards or platform skirts shall be provided to prevent injury to dock personnel.

Range of vertical movement of the platform lip shall be not less than 16 inches above and 12 inchesbelow dock level.

Dock leveler shall be protected by the manufacturer's standard coating system.

Ferrous surfaces of the entire leveler assembly shall be abrasive blasted to near white metal as defined in SSPC SP 10 and coated with inorganic-zinc coating in accordance with the manufacturer's instructions.

Sliding surfaces, bearings, and pivots shall be protected during painting.

2.1.2 Operation

Initiation of operation shall be by pull ring in the platform or by a foot pedal located in a nonmoving member at dock level but out of dock traffic areas.

When the platform has reached its maximum height above dock level and lowering toward vehicle bed level begins, the platform lip shall automatically extend. Whether lowering is by counterbalance or an applied downward force, it shall continue until the lip firmly engages the vehicle bed; it shall remain so engaged until cargo transfer has been completed and the vehicle moves free of the platform lip, at which time the platform shall return to dock level. Return from a level below dock level shall be automatic. Platform either shall lock at dock level with the lip flush with the dock face or shall rise to 1 or 2 inches above dock level where a pressure of not more than 100 pounds applied within 1 foot of the front edge of the platform will lower it into locked, dock-level position. If the return to dock level is from a position above dock level, the return to locked position at dock level either shall be automatic or shall occur upon application of a downward force of not more than 100 pounds applied to the platform within 1 foot of the front edge.

Dock leveler shall be provided with a safety that automatically supports the ramp if a vehicle pulls out while the ramp is carrying a load.

Design shall include automatic tilt adjustment to accommodate a minimum of 15 degree misalignment of dock and truck bed.

Design shall provide for slow changes in slope of ramp in response to changes in truck bed height during loading and unloading operations. This shall not permit the fall of a loaded ramp if truck pulls out.

Under no circumstances shall it be possible for the lip, when not serving a vehicle, to be in a position where it could damage a vehicle backing into position at the dock.

2.3 ACCESSORIES

2.3.1 Dock Truck or Trailer Restraining Device

Self-aligning device. Mount this device as recommended by the manufacturer which shall engage the ICC bar of the truck/trailer with a ositive restraining force of not less than 8150 kilograms. This device must be able to to service all truck or trailers having ICC bars located between 300 and 750 mm above the ground level and recessed up to 225 mm forn the rear of truck or trailer.

2.3.2 Dock Bumpers

Provide bumpers in accordance with Section 11165 "Dock Bumpers"

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's recommendations and approved drawings.

3.2 TEST

Before acceptance of the leveler by the Government, the Contractor shall conduct two load-bearing tests as follows:

With the platform in normal position flush with the dock floor, a 15-ton rolling load shall be imposed upon the platform. There shall be no residual deformation of any member.

With the lip of the platform resting upon a structural support to simulate its position on a truck bed, the platform shall be subjected to a rolling load of 10 tons for a period of 30 minutes. There shall be no failure or residual deflection of any component.

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SECTION 11165

DOCK BUMPERS

06/96

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-- End of Section Table of Contents --

SECTION 11165

DOCK BUMPERS
06/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM D 2000	(1999) Standard Classification System for Rubber Products in Automotive Applications

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication and Installation Drawings for Dock Bumpers shall be in accordance with the paragraph entitled, "Dock Bumpers," of this section, and shall show details of anchorage.

SD-04 Samples

Contractor shall provide the following samples:

One each of Fasteners, Connectors, Supporting Rods, Bolts, Nuts, etc., individually tagged and identified for use and location

One typical loading dock bumper completely assembled with supporting rods, end angles, bolts, and nuts. (This may be the smallest size bumper required.)

One section of Dock Bumper 8 inches wide by full depth and height of bumper including one end angle with the opposite end exposed for inspection

Sample of Rubber for bumper

SD-07 Certificates

Certificates of Compliance shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Fastening Materials

Rubberized Fabric
Steel Angles
Hardware Items

1.3 DESIGN AND GRADES OF MATERIAL

Design, material, fabrication, and assembly shall conform to approved drawings and samples, and the requirements specified.

PART 2 PRODUCTS

2.1 DOCK BUMPERS

Bumpers shall be constructed of resilient, laminated, rubberized-fabric pads, assembled on steel frames. Rubberized fabric shall conform to ASTM D 2000. Material shall be punched to receive 3/4-inch supporting rods. Bumpers shall be 4-1/2-inches thick, stand out from the dock, and be closed with two structural steel angles under 1,500 pounds pressure.

Solid rubber pieces may be used instead of rubberized fabric. Solid rubber shall conform to ASTM D 2000, Grade 4AA612A13B13F17.

2.2 STEEL ANGLES

Angles shall be 3- by 2-1/2- by 1/4-inch steel welded to 3/4-inch rods at one end (head of rods exposed on face of angle leg) and closed with threaded rod ends and nuts at the other end. Quantity of rods required for each bumper shall be as indicated and in accordance with approved drawings. The 2-1/2-inch leg of the steel angle on the face of the wall shall have 13/16-inch bolt holes, quantity and spacing as required.

2.3 FINISH

Metal for dock bumpers, including hardware, shall be hot-dip galvanized conforming to ASTM A 123.

PART 3 EXECUTION

3.1 INSTALLATION

Loading dock bumpers shall be installed in accordance with the manufacturer's written instructions and as approved.

-- End of Section --

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DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13121

PACKAGED METAL BUILDING SYSTEMS

10/01

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SECTION 13121

PACKAGED METAL BUILDING SYSTEMS
10/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-971	(1996) Specification & Commentary for the Design of Cold-Formed Steel Structural Members

AMERICAN RAILWAY ENGINEERING ASSOCIATION (AREA)

AREA-01	(Current Until Jul 31, 1991) Manual for Railway Engineering (Fixed Properties)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 1	(2000) Standard Specification for Carbon Steel Tee Rails
ASTM A 123/A 123M	(2001) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(2001) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 36/A 36M	(2000; Rev A) Standard Specification for Carbon Structural Steel
ASTM A 1008/A 1008M	(2001) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
ASTM A 500	(2001) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(2001) Standard Specification for Hot-Formed Welded and Seamless Carbon-Steel Structural Tubing
ASTM A 529/A 529M	(2000) Standard Specification for High Strength Carbon-Manganese Steel of Structural Quality

ASTM A 572/A 572M	(2000; Rev A) Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 653/A 653M	(2001) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 1036	(1991; R 1997) Standard Specification for Flat Glass
ASTM C 592	(2000) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM C 669	(2000) Standard Specification for Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM D 3841	(1997) Glass Fiber-Reinforced Polyester Plastic Panels
ASTM E 84	(2001) Standard Test Method for Surface Burning Characteristics of Building Materials

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel
AWS D1.3	(1998) Structural Welding Code - Sheet Steel

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.1	(2000) Butts and Hinges
BHMA A156.18	(2000) Materials and Finishes
BHMA A156.2	(1996) Bored and Preassembled Locks and Latches
BHMA A156.3	(2001) Exit Devices
BHMA A156.4	(2000) Door Controls - Closers
BHMA A156.6	(2001) Architectural Door Trim
BHMA A156.8	(2000) Door Controls - Overhead Holders

DOOR AND HARDWARE INSTITUTE (DHI)

DHI A115	(1990) Steel Door Preparation Standards

INTERNATIONAL CODE COUNCIL (ICC)

ICC-01 (2000) International Building Code

METAL BUILDING MANUFACTURERS ASSOCIATION (MBMA)

MBMA-01 (1996) Low Rise Building Systems Manual

STEEL DOOR INSTITUTE (SDOI)

SDOI 100 (1991) Standard Steel Doors and Frames

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Structural Framing System, indicating all framing, welds, connections, and other detail elements of the system
Roofing and Siding
Accessories
Interior Panels
Windows
Steel Doors and Frames
Overhead Door Frames
Ventilators and Louvers
Gutters and Downspouts

Foundation drawing indicating anchor bolt locations, diameter, and projections required to attach the metal building system. The Manufacturer shall also provide the loads imposed by the metal building system on the foundation at each attachment location.

Packaged Metal Building Systems Installation Drawings indicating erection sequence, accessory instructions, and details

SD-03 Product Data

Roofing and Siding Panelsding primary, Secondary, and Subframing
Coatings
Accessories
Interior Panels
Insulating Materials
Windows
Steel Doors and Frames
Weatherstripping
Overhead Door Frames
Glass and Glazing
Ventilators and Louvers
Gutters and Downspouts
Exterior Panel Color Chart
Interior Panels Color Chart
Accessories and Trim Color Chart

SD-04 Samples
Metal Roofing and Siding: One piece, 9 inches by width of panel

Color Panels: Three pieces, 4 by 4 inches, to indicate maximum color range

Exposed Fasteners: One of each type

Filler Strip: One piece, width of panel

Sandwich Wall: One piece, 8 by 11 inches

Insulation: One piece, 8 by 11 inches

One full-size Window, complete with hardware, operating vent, casing, and trim. After approval, sample window shall be installed where directed and the location shall be recorded.

SD-05 Design Data

Design Analysis and Calculations for the following items shall be in accordance with the paragraph entitled, "Design Criteria," of this section. Structural calculations shall be prepared and certified by a registered professional structural engineer.

SD-07 Certificates

Metal Building Manufacturer Product Installations
Manufacturer's Membership in MBMA

1.3 DESIGN CRITERIA

Design shall be in accordance with ICC-01.

Structural design shall be in accordance with the following, which shall be shown on the government design drawings:

a. Geometric Requirements: length, width, height, roof shape and slope, and any special clearance (vertical or horizontal) requirements.

b. Design Loads: live, dead (collateral), snow, wind, seismic, or any other special load necessary.

c. Coefficients and factors: Exposure, Importance.

d. Site Conditions: adjacency of structures which may cause snow drift.

e. Serviceability Requirements: vertical roof deflection (1/360th span), maximum roof drift or sidewall deflection (1/240th span).

f. Framed Openings: location, size, and any special design loadings.

Structural steel members shall be designed in accordance with Section 05120, "Structural Steel" and AISI SG-971.

Design of packaged metal building systems shall be in accordance with the MBMA-01.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

Provide a complete, integrated set of mutually dependent components and assemblies that form a metal building system capable of withstanding structural and other loads, thermally induced movement, and exposure to weather without failure or infiltration of water into building interior. Include primary and secondary framing, roof and wall panels and accessories complying with requirements indicated.

1.4.1 Primary Framing

Primary framing type shall be rigid clear span (no interior columns) solid-member, made of tapered or straight exterior columns and straight, single-tapered or multiple tapered girders.

1.4.2 End Wall Framing

End-wall framing shall be manufacturer's standard, for buildings not required to be expandable.

1.4.3 Secondary Framing

Girts shall be flush-framed girts. Girts and purlins shall be manufacturer's standard.

1.5 QUALIFCATIONS FOR STRUCTURAL STEEL WORK

Structural steel fabricator/erector shall be certified by AISC to perform structural steel work at level MB.

1.6 QUALIFICATIONS FOR WELDING WORK

Welders shall be certified to have qualified by tests in accordance with AWS D1.1 and AWS D1.3

1.7 MANURACTURER QUALIFICATIONS

Manufacturer shall be a member of MBMA.

PART 2 PRODUCTS

2.1 STRUCTURAL PRIMARY MEMBERS, SECONDARY MEMBERS, AND ACCESSORIES

Structural shapes shall comply with Section 05120, "Structural Steel."

Structural steel sheet shall comply with ASTM A 653/A 653M, structural quality, Grade 50, with G60(Z180) zinc coating.

Fasteners, anchor bolts, welding materials, protective coating, and grout shall conform with Section 05120, "Structural Steel."

2.2 ROOFING AND SIDING

Panels shall conform to ASTM A 653/A 653M, structural quality, grade 50, not less than 26-gage thick, before coating.

Metal fascia shall be of the same material as the roofing and siding and not less than 26-gage.

Roofing sheets shall be of sufficient length to bridge at least 3 purlin spans plus the required end lap. Siding sheets shall extend full height of walls, without horizontal joints. Roofing sheets shall extend full width from ridge to eave in buildings 60 feet and less in width. Roofing and siding sheets shall have concealed, semiconcealed, or exposed fasteners on exterior.

2.3 FINISH

Finish may be baked enamel, fluoropolymer, or silicone polyester, or as indicated in the task order.

Baked enamel coating shall be a two coat, thermosetting, acrylic enamel or vinyl-solution finish standard with the manufacturer, applied to outside of panels. Inside shall be primed.

Fluoropolymer coating shall consist of a primer and a finish coat of polyvinyl fluoride, or polyvinylidene fluoride standard with the manufacturer, applied to outside of panels. Inside shall be primed.

Silicone polyester coating shall consist of an epoxy primer and a finish coat of silicone polyester standard with the manufacturer. Coating shall be applied to the outside of the panels. Inside shall be primed.

2.4 ACCESSORIES

Sheet-metal accessories shall be formed of material of the same type and finish as roofing and siding panels and shall be not less than 26-gage.

Filler strips shall be premolded neoprene or polyvinylchloride.

2.5 INTERIOR PANELS

Panels shall conform to ASTM A 653/A 653M, grade and baked-enamel finish standard with the manufacturer.

2.6 INSULATION

2.6.1 Flame Spread

Insulation shall have a flame spread not in excess of 25 and a smoke developed rating not in excess of 50 when tested in accordance with ASTM E 84.

2.6.2 Rigid or Semirigid Board

Board insulation shall conform to ASTM C 592. Exposed insulation shall have a white nondusting and nonshedding painted finish.

2.6.3 Blanket Insulation

Blanket insulation shall conform to ASTM C 592.

2.7 WINDOWS

Windows shall be aluminum and shall conform to Section 08520, "Aluminum Windows". Windows shall be factory glazed.

2.8 STEEL DOORS AND FRAMES

Doors and frames shall conform to Section 08100, "Metal Doors and Frames".

2.9 FINISH HARDWARE

Hardware shall conform to Section 08710, "Finish Hardware".

Finishes shall conform to BHMA A156.18.

2.10 WEATHERSTRIPPING

Weatherstripping for the heads, jambs, meeting stiles, and sills of exterior doors shall conform to Section 08710, "Finish Hardware".

2.11 OVERHEAD DOOR FRAMES

Overhead door shall conform to Section 08331, "Overhead Coiling Doors".

2.12 GLASS AND GLAZING

Glass and glazing shall conform to Section 08805, "Glass and Glazing".

2.13 VENTILATORS AND LOUVERS

Ventilators and louvers shall conform to Section 10201, "Metal Wall Louvers".

2.14 GUTTERS AND DOWNSPOUTS

Gutters and downspouts shall conform to ASTM A 653/A 653M. Zinc coating shall be in accordance with ASTM A 653/A 653M, G90. Material shall be not less than 26-gage.

PART 3 EXECUTION

3.1 ASSEMBLY AND ERECTION

Assembly and erection shall be on a prepared foundation in accordance with the manufacturer's instructions and recommendations.

See Section 05120, "Structural Steel", PART 3-Execution for additional requirements.

Manufacturer shall furnish templates or an anchor bolt layout drawing that must be used for location of anchor bolts.

3.2 INSPECTION AND ACCEPTANCE PROVISIONS

See Section 05120, "Structural Steel" for Inspection and Acceptance requirements.

-- End of Section --

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08/98

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SECTION 13285

ASBESTOS ABATEMENT
08/98

PART 1 GENERAL

1.1 SUMMARY

The Government has performed sampling and testing of materials throughout the areas to be altered or demolished in this Project. All material found to be asbestos containing material (ACM) is indicated on the Drawings, and shall be removed or encapsulated in accordance with this Section. Any Class II (nonfriable) ACM flooring removal work as defined in 29 CFR 1926 article 1101, such as vinyl asbestos tile (VAT) or sheet flooring must comply only with section 3.9, Nonfriable ACM Removal, of Part 3. Other Class II (nonfriable) ACM removal work such as roofing materials and transite board shall comply with the requirements in 29 CFR 1926 article 1101.

1.2 REFERENCES

The following publications form a part of these specifications to the extent indicated by their references. The exclusion of a publication from this Section will not relieve the Contractor from complying with the publication reference elsewhere.

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910	(2001) Occupational Safety and Health Standards
29 CFR 1926	(2001) Safety and Health Regulations for Construction
40 CFR 61	National Emission Standards for Hazardous Air Pollutants
94-40797	United States Court of Appeals, case nos. 94-40797, 94-41051, 94-41068, 95-60125. "Flooring Industry vs. OSHA"

1.3 SUBMITTALS

The following shall be submitted for friable asbestos projects in accordance with Section 01330, "Submittals:"

SD-01 Preconstruction Submittals

Asbestos Removal Work Plan

The contractor's Work Plan shall describe the following items, as applicable to the project:

a. Layout of the work area, including locations of all required Regulated Areas, Critical Barriers, Decontamination Areas and

Change Areas;

b. Approximate amount and type of material to be removed;
c. Class of the asbestos work;
d. Schedule for turning off, and means of securing and sealing existing ventilation systems;
e. Personnel hygiene procedures and Air Monitoring plan;
f. Personal protective equipment and clothing to be worn by employees;
g. Control Method and asbestos removal and encapsulation methods to be used;
h. Local exhaust ventilation systems to be used and how they are to be tested;
i. Work area cleaning and restoration after asbestos abatement;
j. Method to transport waste material, and location of the dump site.

Include a certification by the Competent Person that the plan complies with specified regulations, as applicable to the work involved.

If the contractor proposes any methods which are alternative to those specified and detailed in the regulations, they shall be described and clearly labeled "alternative" in the work plan submitted for approval, and copies of the evaluation and certification required by OSHA shall be attached to the Work Plan. If any work (except intact flooring removals) must use dry removal methods, the Work Plan shall indicate the reason wet methods are not feasible, and any extra control measures proposed for use of the dry methods. If a project involves glove bag removal of more than 260 linear feet 80 linear meters on pipes, or more than 160 square feet on other surfaces, the Work plan shall include a copy of the required Maryland Department of the Environment variance.

SD-02 Shop Drawings

Coordination Drawings shall include drawings of proposed work areas, clean room/change areas, mini-enclosures, shower, equipment room, staging areas, work areas, emergency routing and areas to be modified.

Detail Drawings shall be submitted for Asbestos Abatement Systems consisting of fabrication and assembly drawings for all parts of the work in sufficient detail to enable the Government to check conformity with the requirements of the contract documents.

SD-03 Product Data

Material, Equipment, and Fixture Lists shall be submitted for all Major Components proposed to be furnished and used under this section, to include but not limited to:

Manufacturer and specifications of negative air/air purifying equipment and HEPA vacuums.

Encapsulant selected and quantities of intended use.

Amended water solution type.

Water filtration unit and specification.

Identification of manufacturer and specifications of all proposed personal protective equipment to be used.

SD-06 Test Reports

The Contractor shall submit Test Reports of all results of final clearance air samples, showing the type of microscopy used, to the Contracting Officer. To comply with State of Maryland regulations, the asbestos removal contractor shall submit the final written results to the State within 24 hours of receiving the written results.

SD-07 Certificates

Qualifications

State of Maryland license to remove or encapsulate asbestos.

American Board of Industrial Hygiene certification for the contractor's Certified Industrial Hygienist (CIH)

Employee Training - Documented proof that the employees have had the required training for the class of work to be done, as defined by 94-40797 for intact flooring removal, or by 29 CFR 1926.1101(k)(9) for all other work.

Competent Person - Documented proof that the designated competent person has current certification and has attended the training specified in the paragraph "Contractor's Designated Competent Person".

Copies of Notifications to the agencies as specified in this section, under paragraph entitled "Notifications".

Copy of Medical Certification of physical examination for asbestos and respiratory protection on all employees engaged in the operation.

SD-07 Certificates

Within 10 days after the completion of asbestos removal work, Contractor shall submit to the Contracting Officer, in writing, the following items:

Waste disposal permit and disposal tickets.

Copies of air monitoring data conducted during the abatement.

Copies of entry logs maintained during the abatement task.

Copies of logbook kept by Certified Industrial Hygienist or Competent Person.

1.4 DESCRIPTION

The Contractor shall furnish all labor, materials, services, and equipment necessary for the complete enclosure, encapsulation, removal, and approved disposal of asbestos located at the job site and any asbestos-contaminated materials resulting from the work performed.

All work shall be performed in accordance with the documents referenced herein.

1.5 EQUIPMENT

Equipment to be used shall be selected from the following lists.

1.5.1 Disposable Equipment

Disposable coveralls (Tyvek or approved equal).

Disposable hood (Tyvek or approved equal).

Disposable booties (Tyvek or approved equal).

Disposable gloves (Tyvek or approved equal).

Disposable asbestos waste containers, such as 55 gallon drums, 6-mil polyethylene bags.

Disposable sponges/rags.

Glove bags - 6-mil thick (minimum).

6-mil polyethylene sheets.

Duct tape/baling wire.

Spray glue.

Wetting Agent

1.5.2 Nondisposable Equipment

NIOSH approved respirators/HEPA filter cartridges.

HEPA vacuum.

HEPA negative air unit.

Prefabricated Decontamination Unit.

Airless spray applicator.

Barrier ropes/tapes.

Asbestos danger labels/signs.

Hard hat/eye protection if needed.

Ladders/scaffolding.

Nylon bristle brush (not wire).

Differential pressure gage (such as Magnahelic, or Incline Manometer)

Showers

1.6 DOCUMENTATION

The Contractor shall have in his possession at all times one office copy and one job site copy of the latest edition of each of the following documents:

a. Occupational Safety and Health Act (OSHA): 29 CFR 1910, Section 1910.134 "Respiratory Protection", 29 CFR 1926, Section 1926.1101 "Asbestos".

b. Environmental Protection Agency (EPA): 40 CFR 61, Subpart M, "National Emission Standards for Hazardous Air Pollutants (NESHAPS)".

c. State of Maryland: COMAR 26.11.21, "Control of Asbestos".

d. The approved Work Plan.

1.7 NOTIFICATIONS

The Contractor shall provide written notification of the asbestos abatement work by completing and submitting a State of Maryland's Notice of Asbestos Project form at least 10 days before commencement of asbestos abatement work. The Contractor shall submit one copy of the State of Maryland's Notice of Asbestos Project form to each of the following:

Asbestos Coordinator, Steve Copeland
U.S. Environmental Protection Agency, Region 3
Code 3AM 22
841 Chestnut Building
Philadelphia, PA 19107

State of Maryland
Department of The Environment
Air Management Administration
2400 Broening Highway
Baltimore, MD 21224

For any project where the contractor proposes use of alternative methods, for Class I work in excess of 25 linear or 10 square feet, he shall send a copy of the required evaluation and certification to:

U.S. Department of Labor
Occupational Safety and Health Administration
Office of Technical Support
Room N3653
200 Constitution Avenue, NW
Washington, DC 20210

1.8 PROTECTIVE EQUIPMENT FOR AUTHORIZED VISITORS

The Contractor shall have available on-site, daily for the duration of the project, two sets of full protective clothing, including respirators, for use by GSFC and other personnel authorized to enter the regulated area. As sets of disposable clothing are used by non-Contractor personnel, the Contractor shall replace them daily to return the number of available sets to two. Any clothing and respirators not used will remain the property of the Contractor, without charge to NASA/GSFC for unused items.

1.9 CONTRACTOR'S DESIGNATED COMPETENT PERSON

1.9.1 Definition

A competent person shall meet the following qualifications as defined in 29 CFR 1926 article 1101:

A. An individual capable of identifying existing asbestos, tremolite, anthophylite, or actinolite in the workplace and who has the authority to take prompt corrective measures to eliminate them, and who is capable of selecting the appropriate control strategies for an asbestos project.

B. An individual trained in all aspects of asbestos, tremolite, anthophylite, or actinolite abatement and the contents of 29 CFR 1926, article 1101. Such training shall be as defined in 29 CFR 1926 article 1101(o)(4), for either Class I and II work, or for Class III and IV work as applicable to the project; or as defined in 94-40797 for compliant flooring removal work.

1.9.2 Responsibilities

The Contractor shall provide a designated Competent Person, who shall select and implement appropriate asbestos exposure control strategies for the project in accordance with all applicable provisions of 29 CFR 1926 article 1101. The Competent Person shall be on site at all times that asbestos removal work is in progress to conduct the following:

1. Establish the regulated area, critical barriers and the negative pressure enclosure (if applicable) and ensure their integrity.

2. Control entry to and exit from the regulated area and enclosure.

3. Supervise any employee exposure monitoring.

4. Ensure that all employees working within the regulated work area or enclosure wear appropriate personal protective equipment, are trained in the use of appropriate methods of exposure control, and use the hygiene facilities and decontamination procedures specified, in accordance with the specified standards, and in accordance with the Contractor's approved Work Plan.

5. Ensure that engineering controls in use are in proper operating condition and are functioning properly.

6. Maintain a daily log indicating work progress. A copy of the daily log shall be provided to the Contracting Officer's Technical Representative on a daily basis.

1.10 DEFINITIONS

The following are selected key definitions from the regulations indicated.

OSHA (29 CFR 1926 article 1101):

"Asbestos-containing material (ACM)", means any material containing more than one percent asbestos.

"Class I asbestos work" means activities involving the removal of Thermal System Insulation (TSI) and surfacing ACM. "Thermal system insulation (TSI)" means materials applied to pipes, fittings, boilers, breeching, tanks, ducts or other structural components to prevent heat loss or gain. "Surfacing material" means material that is sprayed, 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, and other purposes). "Thermal system insulation ACM" or "Surfacing ACM" means such materials which contain more than 1% asbestos.

"Class II asbestos work" means activities 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, ceiling tiles, roofing, siding shingles or panels, construction mastics, and gaskets.

"Class III asbestos work" means repair and maintenance operations where any type of ACM is likely to be disturbed. Disturbance means 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, in order to access a building component. For the job to qualify as Class III, the amount of ACM disturbed shall not exceed the amount which can be contained in one standard sized (maximum 60 inches in length and width) glove bag or waste bag.

"Class IV asbestos work" means maintenance and custodial 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.

"Critical barrier" means one or more layers of plastic sealed over all openings into a work area or any other similarly placed physical barrier sufficient to prevent airborne asbestos in a work area from migrating to an adjacent area.

"Intact" means that the ACM has not crumbled, been pulverized, or otherwise deteriorated so that the asbestos is no longer likely to be bound with its matrix.

"Negative Initial Exposure Assessment" (NEA) means a demonstration by the contractor, which complies with the criteria in 29 CFR 1926.1101(f)(2)(iii) that employee exposure during an operation is expected to be consistently below the PEL.

"Regulated area" means: an area established by the contractor to demarcate areas where Class I, II, and III asbestos work is conducted, and any adjoining area where debris and waste from such asbestos work accumulate; and a work area within which airborne concentrations of asbestos, exceed or there is a reasonable possibility they may exceed the permissible exposure limit.

"Thermal system insulation (TSI)" means ACM applied to pipes, fittings, boilers, breeching, tanks, ducts or other structural components to prevent heat loss or gain.

EPA (40 CFR 61, Subpart M):

"Category I nonfriable asbestos-containing material (ACM)" means asbestos-containing packings, gaskets, resilient floor covering, and

asphalt roofing products containing more than 1 percent asbestos.

"Category II nonfriable ACM" means any material, excluding Category I nonfriable ACM, containing more than 1 percent asbestos that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

"Friable asbestos material" means any material containing more than 1 percent asbestos that, when dry, can be crumbled, pulverized, or reduced to powder by hand pressure.

"Nonfriable asbestos-containing material" means any material containing more than 1 percent asbestos that, when dry, cannot be crumbled, pulverized, or reduced to powder by hand pressure.

"Regulated asbestos-containing material (RACM)" means (a) Friable asbestos material, (b) Category I nonfriable ACM that has become friable, (c) Category I nonfriable ACM that will be or has been subjected to sanding, grinding, cutting, or abrading, or (d) Category II nonfriable ACM that has a high probability of becoming or has become crumbled, pulverized, or reduced to powder by the forces expected to act on the material in the course of demolition or renovation operations. The NESHAP Regulations (40 CFR 61) generally apply to demolition or renovation projects involving more than 260 linear feet of RACM on pipes, or 160 square feet of RACM on other facilitiy components.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 ASBESTOS REMOVAL METHODS - GENERAL

Asbestos-containing materials shall be removed by one of the methods indicated below for the type of work involved, subject to the approval of the Work Plan by the Contracting Officer. Full containment, with a negative-pressure enclosure, is generally used for large asbestos abatement operations. Other methods for certain types of work, as defined in 29 CFR 1926 and summarized below, may be used where appropriate.

3.2 REQUIREMENTS FOR ALL ASBESTOS WORK

The Competent Person shall perform an initial exposure assessment prior to beginning the work, and results of the assessment shall be reflected in the submitted Work Plan for the job. If any exceptions to the specified requirements are to be based on a Negative Exposure Assessment, the negative assessment and the exceptions shall be fully documented as part of he Work Plan. (A Negative Exposure Assessment is not required for work in accordance with the paragraph “ACM Flooring Removal”, but the Competent person is requred to assess whether the flooring can be removed intact).

In addition to the training specified for the Competent Person specified elsewhere, all other employees who will work on asbestos removal or have access to the Regulated Area, shall be trained in accordance with the requirements for the type of asbestos work involved. For work described in the paragraph “ACM Flooring Removal”, training shall be as required by 94-40797. For all other work, training shall be as required by 29 CFR 1926.1101(k)(9) for the Class of work to be done. The contractor shall provide medical monitoring of employees in accordance with 29 CFR 1926.1101(m). Training and medical records shall be retained by the contractor for all employees as required by the referenced regulations.

All removal shall be accomplished using wet methods, including all handling, cutting and cleanup, except where not feasible and dry methods have been specifically approved as part of the Work Plan.

HEPA equipped vacuum cleaners shall be used to collect all dust and debris. All Regulated ACM debris, including contaminated filters and clothing, shall be promptly cleaned up and disposed in leak tight containers. Debris shall be kept wetted until transferred to containers.

The "Class" of work is as defined in 29 CFR 1926 article 1101, and is summarized in the paragraphs below for each Class. Where the requirements specified below refer to "Regulated Area", "Critical Barriers", "Respirators", "Protective Clothing" or other defined wording, refer to the paragraphs with those titles for more specific information.

3.3 REQUIREMENTS FOR CLASS I WORK

In addition to the provisions of the paragraph “Requirements for All Work”, the following engineering controls and work practices and procedures shall be used for all Class I Work:

Provide a Regulated Area, and ensure that access to the regulated area is restricted to authorized persons.

The Competent Person shall supervise all Class I work, including the installation and operation of the control system, and shall inspect the entire work area not less than once per shift.

HVAC systems shall be isolated in the regulated area by sealing with a double layer of 6 mil plastic or the equivalent.

Impermeable dropcloths shall be placed on surfaces beneath all removal activity. All objects within the regulated area shall be covered with impermeable dropcloths or plastic sheeting which is secured by duct tape or an equivalent.

For all Class I jobs without a negative exposure assessment, or where exposure monitoring shows that a PEL is exceeded, the contractor shall:

Provide ventilation of the regulated area to move contaminated air away from the breathing zone of employees toward a HEPA filtration or collection device.

For all Class I jobs involving the removal of more than 25 linear or 10 square feet of thermal system insulation or surfacing material; for all other Class I jobs without a negative exposure assessment; or where employees are working in areas adjacent to the regulated area, while Class I work is being performed; the contractor shall:

Provide Critical Barriers over all the openings to the regulated area, except where activities are performed outdoors.

Provide respirators and protective clothing to all employees and any other authorized person requiring access to the Regulated Area, and ensure their use.

Provide hygiene facilities and practices within the Regulated Area, in accordance with 29 CFR 1926 article 1101(j)(1), including equipment

room, showers, change room, and decontamination of workers, equipment and containers.

For all Class I jobs involving the removal of less than 25 linear or 10 square feet of thermal system insulation or surfacing material:

Provide hygiene facilities and practices within the Regulated Area, in accordance with 29 CFR 1926 article 1101(j)(2), including equipment room or area for changing and for decontamination of workers, equipment and containers.

3.3.1 Control Methods for Class I Work

In addition, Class I asbestos work shall be performed using one or more of the following control methods pursuant to the limitations stated below:

(i) Negative Pressure Enclosure (NPE) systems: NPE systems may be used where the configuration of the work area does not make the erection of the enclosure infeasible. NPE systems and work practices shall be as specified in the paragraph entitled "Negative Pressure Enclosure (NPE) Systems".

(ii) Glove bag systems may be used to remove PACM and/or ACM from straight runs of piping, elbows and other connections, where the temperature of the piping does not exceed 150 degrees F. Glove bag systems shall be as specified in the paragraph entitled "Glove Bags".

(iii) Negative Pressure Glove Bag Systems. Negative pressure glove bag systems may be used to remove ACM or PACM from piping. (iv) Negative Pressure Glove Box Systems: Negative pressure glove boxes may be used to remove ACM or PACM from pipe runs with the following specifications and work practices.

(v) Water Spray Process System. A water spray process system may be used for removal of ACM and PACM from cold line piping if, employees carrying out such process have completed a 40-hour separate training course in its use, in addition to training required for employees performing Class I work. The system shall meet the following specifications and shall be performed by employees using the following work practices.

(vi) A small walk-in enclosure which accommodates no more than two persons (mini-enclosure) may be used if the disturbance or removal can be completely contained by the enclosure with the following specifications and work practices.

3.3.2 Alternative Methods for Class I Work

Any alternative control method, or any modification of one of the above methods, shall be clearly identified in the Work Plan submittal as “Alternative”, and the Work Plan shall include the certification, evaluation and notification to OSHA of the alternative method, as required by 29 CFR 1926 article 1101(g)(6). For any Class I removal of more than 25 linear feet or 10 square feet of material, the certification and evaluation must be done by a Certified Industrial Hygienist or Professional Engineer who also is qualified as an asbestos abatement Project Designer, and OSHA must be notified. For smaller amounts the certification and evaluation may be done by the Competent Person, and OSHA notification is not required.

3.4 REQUIREMENTS FOR CLASS II WORK

In addition to the provisions of the paragraph “Requirements for All Work”, the following engineering controls and work practices and procedures shall be used for all Class II Work (with the exception of ACM resilient flooring materials that can be removed in accordance with the paragraph entitled "ACM Flooring Removal"):

Provide a Regulated Area, and ensure that access to the regulated area is restricted to authorized persons.

The Competent Person shall supervise all Class II work.

Provide impermeable drop cloths under all removal activity (except removal of flooring or roofing materials).

Remove materials intact if feasible, using wet methods. Avoid or minimize any cutting, abrading or breaking of materials.

For Class II work without a Negative Exposure Assessment, provide also:

Daily exposure monitoring, unless positive pressure respirators are used.

Critical Barriers.

Equipment room or area covered by impermeable drop cloth for entry and decontamination.

Respirators for all employees and any other authorized person requiring access to the Regulated Area.

For Class II work where the PEL is exceeded, provide also:

Critical Barriers.

Equipment room or area covered by impermeable drop cloth for entry and decontamination.

Respirators for all employees and any other authorized person requiring access to the Regulated Area.

For Class II work where ACM is not removed intact, provide also:

Critical Barriers.

Equipment room or area covered by impermeable drop cloth for entry and decontamination.

Respirators for all employees and any other authorized person requiring access to the Regulated Area.

For Class II work where wet methods are not used, provide also:

Respirators for all employees and any other authorized person requiring access to the Regulated Area.

For Class II Work with Specific Required Work Practices:

The contractor shall ensure that the specific work practices of 29 CFR 1926 article 1101 indicated below are followed for Class II work involving removal of the following types of ACM:

Flooring Materials (those which cannot be removed intact as specified in the paragraph “ACM Flooring Removal”); 29 CFR 1926 article 1101(g)(8)(i)

Roofing Materials; 29 CFR 1926 article 1101(g)(8)(ii)

Cementitious siding, shingles, or transite panels; 29 CFR 1926 article 1101(g)(8)(iii)

Gaskets; 29 CFR 1926 article 1101(g)(8)(iv)

3.4.1 Alternative Methods for Class II Work

Any alternative control method, or any modification of one of the above methods, shall be clearly identified in the Work Plan submittal as “Alternative”, and the Work Plan shall include a copy of the Competent Person's certification and evaluation of the alternative method required by 29 CFR 1926 article 1101(g)(8)(vi).

3.5 REQUIREMENTS FOR INTACT REMOVAL OF FLOORING MATERIALS

These requirements apply to the removal of ACM resilient flooring materials that can be removed substantially intact, and using compliant work procedrues, in accordance with the paragraph entitled "ACM Flooring Removal". If those conditions cannot be met, removal of ACM flooring materials shall be as incicated under "Requirements for Class II Work".

In addition to the provisions of the paragraph “Requirements for All Work”, the following engineering controls and work practices and procedures shall be used:

The Competent Person shall assess the project before removal begins, and determine that the flooring material is "intact", and is likely to remain "intact" throughout the removal process. For this application "intact" is as defined in 94-40797.

Provide a Regulated Area, and ensure that access to the regulated area is restricted to authorized persons.

The Competent Person shall supervise all work.

3.6 REQUIREMENTS FOR CLASS III WORK

In addition to the provisions of the paragraph “Requirements for All Work”, the following engineering controls and work practices and procedures shall be used for all Class III Work:

Provide a Regulated Area, and ensure that access to the regulated area is restricted to authorized persons.

Provide local exhaust ventilation if feasible.

For Class III Work where thermal systems insulation or surfacing ACM is cut drilled sawed, sanded, abraded, chipped or broken, provide also:

Impermeable dropcloths under removal operations.

One of the control methods indicated for Class I work, such as glovebag or mini-enclosure, as appropriate to contain the work.

Respirators for all employees and any other authorized person requiring access to the Regulated Area.

For Class III Work where no Negative Exposure Assessment exists; or if the PEL is exceeded, provide also:

Impermeable dropcloths under removal operations.

Plastic barriers around the work area, or one of the control methods indicated for Class I work, as appropriate to contain the work.

Respirators for all employees and any other authorized person requiring access to the Regulated Area.

3.7 REQUIREMENTS FOR CLASS IV WORK

In addition to the provisions of the paragraph "Requirements for All Work", the following engineering controls and work practices and procedures shall be used for all Class IV Work.

For Class IV Work done in a Regulated Area set up for Class I, II or III work, provide:

Respirators as required for other work within the regulated area.

Hygiene facilities and procedures as required for other work within the regulated area.

For Class IV Work involving cleanup of Class I ACM debris (from thermal system insulation or surfacing materials), provide also:

Hygiene facilities and practices within the Regulated Area, in accordance with 29 CFR 1926 article 1101(j)(2), including equipment room or area for changing and for decontamination of workers, equipment and containers.

3.8 WORK AREA PREPARATION

3.8.1 Regulated Areas

Where a Regulated Area is required by other portions of this section, the Contractor shall provide and display asbestos warning signs to demarcate the Regulated Area, as required by 29 CFR 1926 article 1101(k)(7).

The Contractor shall ensure that access to the regulated area is restricted to authorized persons. The Contractor shall maintain at the work site a list of names of authorized people, provided by the Contracting Officer, and limit access to those on the list. The Contractor shall ensure compliance with all regulations noted on the warning signs, and shall ensure that all persons entering the Regulated Area use any protective clothing and respriators required for the type of work in the Regulated Area.

3.8.2 Critical Barriers

Where critical barriers are requried by the other portions of this section, the following requirments shall apply:

Remove extraneous materials such as desks and boxes prior to abatement activities. All materials/surfaces will be cleaned utilizing amended water and HEPA vacuumed. Carefully protect existing equipment and hardware which cannot be removed from the work area with polyethylene sheeting at least 6-mil thick and securely tape in place with duct tape. Drap and tape horizontal or vertical runs of piping. Energized or pressurized systems shall be locked out, tagged out or otherwise rendered safe. The Contracting Officer shall approve of the adequacy of these precautions prior to the application of any water or wetting agent.

Thoroughly seal openings and fixtures including, but not limited to, heating and ventilation ducts, skylights, doors, windows, and lighting with polyethylene taped securely in place. Completely isolated the work area from other parts of the building so as to prevent the asbestos-containing materials or debris from passing beyond the isolated area.

Unless otherwise directed, air-handling units, fans and duct inlets or outlets in the work area shall be locked out and tagged out, or otherwise blanked or isolated and shall remain secure throughout the asbestos abatement work period. Secure air-moving equipment in accordance with the Contractor's approved Work Plan.

If the Contractor proposes to use any other method to prevent the migration of airborne asbestos from the regulated area, it must be approved in advance as part of the Work Plan, and shall be subject to monitoring and verification as required by 29 CFR 1926 article 1101(g)(4).

3.8.3 Hygiene Facilities and Practices

3.8.3.1 Hygiene Facilities and Practices for Large Class I Jobs

These requirements apply to Class I asbestos jobs involving over 25 linear or 10 square feet of TSI or surfacing ACM.

The Contractor shall establish a decontamination area that is adjacent and connected to the regulated area. The decontamination area shall consist of an equipment room, shower area, and clean room in series. The contractor shall ensure that all employees, and other authorized persons, enter and exit the regulated area through the decontamination area. The equipment room shall be supplied with impermeable, labeled bags and containers for the containment and disposal of contaminated protective equipment. Shower facilities shall be provided which comply with 29 CFR 1910.141(d)(3), unless the Contractor can demonstrate that they are not feasible. The showers shall be adjacent both to the equipment room and the clean room, unless the Contractor can demonstrate that this location is not feasible.

Where the Contractor can demonstrate that it is not feasible to locate the shower between the equipment room and the clean room, or where the work is performed outdoors, the Contractor shall ensure that employees:
{1} Remove asbestos contamination from their worksuits in the equipment room using a HEPA vacuum before proceeding to a shower that is not adjacent to the work area; or {2} Remove their contaminated worksuits in the equipment room, then don clean worksuits, and proceed to a shower that is not adjacent to the work area.

The clean change room shall be equipped with a locker or appropriate storage container for each employee's use.

When the Contractor can demonstrate that it is not feasible to provide a clean change area adjacent to the work area or where the work is performed outdoors, the Contractor may permit employees engaged in Class I asbestos jobs to clean their protective clothing with a portable HEPA-equipped vacuum before such employees leave the regulated area. Following showering, such employees however must then change into street clothing in clean change areas provided by the Contractor which otherwise meet the requirements of this section.

Decontamination area entry procedures. The Contractor shall ensure that employees:

Enter the decontamination area through the clean change room;

Remove and deposit street clothing within a locker provided for their use; and

Put on protective clothing and respiratory protection before leaving the clean room.

Before entering the regulated area, the Contractor shall ensure that employees pass through the equipment room.

Decontamination area exit procedures. The Contractor shall ensure that:

Before leaving the regulated area, employees shall remove all gross contamination and debris from their protective clothing.

Employees shall remove their protective clothing in the equipment room and deposit the clothing in labeled impermeable bags or containers.

Employees shall not remove their respirators in the equipment room.

Employees shall shower prior to entering the clean room.

After showering, employees shall enter the clean room before changing into street clothes.

In addition, the Contractor shall provide and post a20 x 14 inch work practice sign at all entrances to the Regulated Area. The sign shall display the following legend with letter sizes and styles at least equal to that specified below, and with spacing between lines at least equal to the height of the upper letters of any two lines:

Legend	Notation
No Food, Beverages or Tobacco Permitted	19 mm Block
All Persons Shall Don Protective Clothing (Coverings) Before Entering the Work Area	19 mm Block
All Persons Shall Shower Immediately After Leaving Work Area and Before Entering The Clean Room	19 mm Block

The work area shall be sealed off by erecting double barriers of polyethylene sheeting at least 6-mil thick at all entrances and exits to the work area. These sheets, when closed, shall overlap the fixed barriers to seal the opening. The work area shall always be sealed off by one sheet whenever the area is entered or exited.

3.8.3.2 Hygiene Facilities and Practices for Small Class I Jobs

These requirements apply to Class I work involving less than 25 linear or 10 square feet of TSI or surfacing ACM. They also apply to Class II and Class III asbestos work operations where exposures exceed a PEL or where there is no negative exposure assessment produced before the operation. They also apply where employees cleaning up debris and material which is Class I (TSI or surfacing ACM).

The Contractor shall establish an equipment room or area that is adjacent to the regulated area, for the decontamination of employees and their equipment. The equipment room or area shall consist of an area covered by a impermeable drop cloth on the floor or horizontal working surface. The area shall be of sufficient size as to accommodate cleaning of equipment and removing personal protective equipment without spreading contamination beyond the area (as determined by visible accumulations).

Work clothing shall be cleaned with a HEPA vacuum before it is removed. All equipment and surfaces of containers filled with ACM shall be cleaned prior to removing them from the equipment room or area.

The Contractor shall ensure that all employees and authorized persons enter and exit the regulated area through the equipment room or area.

3.8.4 Full Containment and Mini-Enclosure Methods

All extraneous materials such as desks and boxes shall be removed prior to abatement activities. When specified by the Contracting Officer, all materials/surfaces will be cleaned utilizing amended water and HEPA vacuumed. All existing equipment and hardware which cannot be removed from the work area shall be carefully protected with polyethylene sheeting at least 6-mil thick and shall be securely taped in place with duct tape. Draping and taping of horizontal or vertical runs of piping is also required. At the direction of the Contracting Officer all energized or pressurized systems shall be locked out, tagged out or otherwise rendered safe. The Contracting Officer shall approve of the adequacy of these precautions prior to the application of any water or wetting agent.

The Contractor shall thoroughly seal all openings and fixtures including, but not limited to, heating and ventilation ducts, skylights, doors, windows, and lighting with polyethylene taped securely in place. The work area shall be completely isolated from other parts of the building so as to prevent the asbestos-containing materials or debris from passing beyond the isolated area.

3.8.5 Glove Bag and Removal of Components Methods

Unless otherwise directed by the Contracting Officer, establish a control barrier around the work area to prevent access of unauthorized personnel.

When specified by the Contracting Officer, all extraneous materials such as desks and boxes shall be cleaned and removed from the work area prior to abatement activities and all materials/surfaces within the enclosure will

be cleaned with amended water and HEPA vacuumed.

3.9 SECURING AIR MOVING EQUIPMENT

Unless otherwise directed, all air-handling units, fans and duct inlets or outlets in the work area associated with the abatement action shall be locked out and tagged out, or otherwise blanked or isolated and shall remain secure throughout the asbestos abatement work period. Air-moving equipment shall be secured in accordance with the Contractor's approved Work Plan.

3.10 FULL CONTAINMENT (NEGATIVE PRESSURE EXHAUST) SYSTEMS (REMOVAL)

Wherever feasible, the Contractor shall construct negative pressure enclosures containing an attached decontamination unit before commencing removal, demolition, and renovation operations.

3.10.1 Work Area Set-Up for Full Containment

The Contractor shall set up a decontamination facility in a predesignated area that will house a separate changing room, shower area, and equipment area. The decontamination facilities shall be arranged and constructed to meet the standards of Appendix F and main body to 29 CFR 1926, Article 1101. Where feasible, a separate equipment room and air lock will be installed.

The work area shall be sealed off by erecting double barriers of polyethy lene sheeting at least6-mil thick at all entrances and exits to the work area. These sheets, when closed, shall overlap the fixed barriers to seal the opening. The work area shall always be sealed off by one sheet whenever the area is entered or exited.

The work area shall have minimum of 2-ply staggered polyethylene sheets (6-mil minimum thickness) taped securely in place covering all the walls and floors. One layer of polyethylene shall be used to cover the ceiling, or the structure/slab above. The polyethylene sheeting covering the floors shall overlap the walls by at least 24 inches to prevent the loss of any water used in the abatement.

The polyethylene shall be flush with the walls at each corner to prevent damage by foot traffic. In addition, all sheeting shall be sized to minimize seams. If the floor necessitates seams, those on successive layers of sheeting shall be staggered to reduce the potential for water to penetrate the flooring material. Seams shall not be located at wall/floor joints.

If stairs, ramps, or other potential slippery spots must be covered with polyethylene, care shall be taken to provide traction for foot traffic. Thin wood strips can be placed on top of the polyethylene to provide traction for foot traffic in these areas.

Electrical circuits in the enclosure shall be deactivated, unless equipped with ground-fault circuit interrupters.

3.10.2 Full Containment Negative Pressure Exhaust Systems

Upon completion of the work identified in paragraphs "Work Area Preparation" and "Securing Air Moving Equipment," HEPA filtered negative air exhaust units shall be installed. The exhaust unit(s) shall be located

so that make-up air traverses the work area. The system shall maintian a minimum of four air changes per hour within the enclosure. Air movement shall be directed away from employees performing asbestos work within the enclosure, and toward a HEPA filtration or a collection device. Unless otherwise directed by the Contracting Officer, HEPA filtered exhaust air shall be vented outside the building where abatement work is taking place. Prior to beginning abatement activities, the containment area shall be tested to verify that a negative pressure differential of 0.02-inches H2O can be created and maintained. Before beginning work within the enclosure, and at the beginning of each shift, the NPE shall be inspected for breaches and smoke-tested for leaks, and any leaks shall be sealed prior to beginning the work. Once activated, the negative air exhaust unit(s) shall remain in operation until final clearance air monitoring has been performed and the Contracting Officer has approved their shutdown/removal. HEPA filters or prefilters must be accessible from the contaminated side of the work area to facilitate changeout of used filters. Used filters shall be disposed of as contaminated waste. At no time shall the exhaust unit be allowed to exhaust unfiltered air outside of the contaminated work area.

3.10.3 Full Containment Methods of Asbestos Removal

Unless otherwise specified, wet methods shall be used for all asbestos removal. Dry removal of asbestos-containing materials will not be permitted.

Asbestos removal shall be accomplished by the following methods:

a. A wetting agent or surfactant combined with amended water shall be used to saturate the asbestos-containing materials prior to removal. This agent should be the equivalent of a 1:1 mixture of polyoxyethylene ether and polyoxyethylene ester, diluted 1 ounce in every 5 gallons of water.

b. Saturate the material to the substrate. Avoid the accumulation of excessive water in the area.

c. Keep asbestos-containing material wet until it is bagged for disposal.

d. Asbestos-containing materials shall be placed in 6-mil polyethylene disposal bags as it is removed from the substrate. Avoid visible accumulation of asbestos debris on the floor or workstands.

e. Pipes, HVAC units or structural members that are covered or coated with asbestos-containing materials may be removed as intact units with prior approval of the Contracting Officer. The asbestos materials must be thoroughly wetted, double wrapped in 6-mil polyethylene sheeting and securely sealed with duct tape.

f. After the asbestos has been removed, surfaces shall be wet brushed and wet cleaned with a HEPA vacuum to remove remaining visible debris from the substrate.

3.10.4 Full Containment Access Control

Contractor shall ensure that unauthorized people do not enter the work enclosure. The Contractor shall maintain at the work site a list of names of authorized people, provided by the Contracting Officer, and limit access

to those on the list.

3.10.5 Full Containment Workplace Inspections

Contractor shall inspect the work place prior to each work shift to ensure the integrity of containment, proper function and negative pressure system, and posting of signs and labels. Contractor shall also ensure, through frequent inspections during each work shift, that negative pressure is maintained, appropriate work practices are followed, appropriate protective clothing and equipment are used, and decontamination procedures are being followed.

3.10.6 Full Containment Cleanup Procedure

a. Place all visible debris into 6-mil polyethylene waste disposal bags.

b. HEPA vacuum or wet wipe all surfaces or both.

c. Decontaminate all tools and equipment.

d. Remove the first layer of polyethylene sheeting and dispose of as asbestos waste.

e. Double bag all asbestos waste. Place all contaminated waste into the waste storage area in the equipment room. Ensure external surfaces of asbestos waste bags or materials are visually clean of all dust or debris.

f. A visual inspection will be performed by a representative of the Contracting Officer. Additional cleaning will be required if the area fails the visual inspections.

g. After the areas have passed the final visual inspection and permission has been granted from the Contracting Officer, coat the exposed edges of the asbestos-containing material to remain with a spray encapsulant or lockdown material. This material shall be dry before final clearance air sampling is begun.

h. Final clearance air sampling shall be performed prior to containment removal. If the work area fails the final clearance air sampling, additional cleaning and monitoring shall be required at no cost to the Government.

3.10.7 Loss of Containment

If at any time a loss of containment occurs, the Contractor shall immediately stop removal work, notify the GSFC Safety, Environmental and Security Office (Code 205) at phone number 112 and implement corrective action.

3.11 MINI-ENCLOSURE

A small walk-in enclosure which accommodates no more than two persons (mini-enclosure) may be used if the disturbance or removal can be completely contained by the enclosure. With the approval of the Contracting Officer, short-duration, small-scale asbestos renovation and maintenance work as defined in 29 CFR 1926 article 1101, can be performed in certain areas where a full containment is unfeasible or inappropriate.

3.11.1 Work Area Set-Up for Mini-Enclosure

The work area and change room shall be completely isolated from other parts of the building to prevent any ACM from escaping.

The floor of the work area shall be covered with two layers of polyethylene which will extend approximately two feet up the wall to prevent the loss of any water used in the abatement. The walls shall be covered with two layers of polyethylene which shall extend to the center of the floor. One layer of polyethylene shall be used to cover the ceiling (as necessary). The work area can be small enough to restrict entry to one worker.

The change room shall be constructed of a wooden frame encased in 6-mil polyethylene, or by applying the polyethylene directly to the existing walls, floor and ceiling. The entrance/exit to the change room shall be sealed off with two, 6-mil polyethylene sheets measuring at least three feet across. The double-flapped barrier sheets shall be weighted and overlapped so they close quickly after being released.

All polyethylene sheeting used in establishing work site barriers shall be at least 6-mil thick. The polyethylene shall be flush with the walls at each corner to prevent damage by foot traffic. Sheeting shall be sized to minimize seams. If floor necessitates seams, stagger successive layers of sheeting to reduce the potential for water to penetrate the flooring material. Seams shall not be located at wall/floor joints.

If stairs, ramps, or other potential slippery spots require polyethylene covering, care shall be taken to provide traction for foot traffic. Place masking tape or thin wood strips on top of the polyethylene to provide traction for foot traffic in these areas.

Electrical circuits in the enclosure shall be deactivated, unless equipped with ground-fault circuit interrupters.

3.11.2 Mini-Enclosure Negative Pressure Exhaust Systems

A negative pressure exhaust system shall be utilized to maintain a negative pressure differential of 0.02-inches H2O inside the work and change area. A HEPA vacuum may be used for this purpose. Before use, the mini-enclosure shall be inspected for breaches and smoke-tested to detect leaks, and leaks shall be sealed prior to beginning the work. During use, air movement shall be directed away from the employee's breathing zone within the mini-enclosure, towards the exhaust system.

3.11.3 Mini-Enclosure Methods of Asbestos Removal

Unless otherwise specified, wet methods shall be used for all asbestos removal. Dry removal of asbestos-containing materials will not be permitted.

Asbestos removal shall be accomplished by the following methods:

a. A wetting agent or surfactant combined with amended water shall be used to saturate the asbestos-containing materials prior to removal. This agent should be the equivalent of a 1:1 mixture of polyoxyethylene ether and polyoxyethylene ester, diluted 1 ounce in every 5 gallons of water.

b. Saturate the material to the substrate. However, avoid the accumulation of excessive water in the area.

c. All asbestos-containing material shall be kept wet until it is bagged for disposal.

d. Removed asbestos-containing materials shall be placed in 6-mil polyethylene disposal bags as it is removed from the substrate. Avoid the accumulation of asbestos debris on the floor or workstands.

e. Pipes, or structural members that are covered or coated with asbestos-containing materials may be removed as intact units in accordance with 29 CFR 1926 article 1101. The asbestos materials must be thoroughly wetted, double-wrapped in 6-mil polyethylene sheeting and securely sealed with duct tape.

f. After the asbestos has been removed, surfaces shall be wet brushed and wet cleaned to remove remaining visible debris from the substrate.

3.11.4 Mini-Enclosure Cleanup Procedure

a. Place all visible debris into 6-mil polyethylene waste disposal bags.

b. HEPA vacuum or wet wipe all surfaces.

c. Decontaminate all tools and equipment.

d. Remove the first layer of polyethylene sheeting and dispose of as asbestos waste.

e. Double bag all asbestos waste. Place all contaminated waste into the waste storage area in the equipment room. Ensure external surfaces of asbestos waste bags or materials are visually clean of all dust or debris.

f. A visual inspection by a representative of the Contracting Officer will be performed at this time. Additional cleaning shall be required if the area fails the visual inspections.

g. After the area has passed the final visual inspection and permission has been granted from the Contracting Officer, coat the appropriate work surfaces with a spray encapsulant or lockdown material.

h. After the encapsulant has dried, final clearance air sampling shall be performed prior to containment removal. If the work area fails the final clearance air sampling, additional cleaning and monitoring shall be required.

i. Before reuse, the interior shall be completely washed with amended water and HEPA-vacuumed.

3.11.5 Loss of Containment

If at any time a loss of containment occurs, the Contractor shall immediately stop removal work, notify the GSFC Safety, Environmental and

Security Office (Code 205) at phone number 112 and implement corrective action.

3.12 GLOVE BAGS

Glove bags are a single-use control device which is disposed of after each use. Glove bags may be used to remove ACM from straight runs of piping and elbows and other connections. Glovebags used on elbows and other connections must be designed for that purpose and used without modifications. Glovebags shall not be used on surfaces whose temperature exceeds 150 degrees F.

A minimum of two persons shall perform all Class I glovebag removal operations.

Prior to beginning a glove bag operation, which exceeds the limits below, the Contractor shall obtain a written variance to perform glove bag work from the Air Management Administration of the Maryland Department of the Environment and shall submit the variance to the Contracting Officer. Such a variance is required if the amount of friable ACM being removed is greater than 260 linear feet on pipes, or greater than 160 square feet on other surfaces.

3.12.1 Glove Bag Set-Up

Before beginning the operation, any loose and friable material adjacent to the glovebag operation shall be wrapped and sealed in two layers of six mil plastic or otherwise rendered intact. Glove bags shall be installed so that they completely cover the component where asbestos is to be removed. All openings around the glove bag shall be sealed with duct tape or an equivalent material. All tools and materials to be used during the removal work must be placed into the glove bag prior to installation. Glovebags shall be smoke-tested for leaks, and any leaks sealed prior to use. Glovebags may be used only once and may not be moved.

3.12.2 Glove Bag Methods of Asbestos Removal

Asbestos removal shall be accomplished by the following methods:

a. A wetting agent or surfactant combined with amended water shall be used to saturate the asbestos-containing materials prior to removal. This agent should be the equivalent of a 1:1 mixture of polyoxyethylene ether and polyoxyethylene ester, diluted 1 ounce in every 5 gallons of water.

b. Saturate the material to the substrate. However, avoid the accumulation of excessive water in the glove bag.

c. Once the asbestos material has been thoroughly wetted, it can be removed from the pipe, beam or other surface. The choice of tool to use to remove the asbestos-containing materials depends on the type of material to be removed. Asbestos-containing materials are generally covered with painted canvas or wire mesh or both. Painted canvas can be cut with a razor knife and peeled away from the asbestos-containing material underneath. Once the canvas has been peeled away, the asbestos-containing material underneath may be dry, in which case it shall be re-sprayed with a wetting agent to ensure that it generates as little dust as possible when removed. If the asbestos-containing material is covered with wire

mesh, the mesh shall be cut with nips, tin snips, or other appropriate tools and removed.

A wetting agent shall then be used to spray any layer of dry material that is exposed beneath the mesh, the surface of the stripped underlying structure, and the inside of the glove bag.

d. After the asbestos has been removed, surfaces shall be wet brushed and wet cleaned to remove remaining visible debris from the substrate.

e. Any asbestos-containing insulation edges that have been exposed as a result of removal or maintenance activity, and that are to remain in place, shall be encapsulated with bridging encapsulant to ensure that the edges do not release asbestos fibers to the atmosphere after the glove bag has been removed.

f. When the asbestos removal and encapsulation have been completed, a vacuum hose from a HEPA-filtered vacuum must be inserted into the glove bag through the port to remove any air in the bag that may contain asbestos fibers. When the air has been removed from the bag, the bag should be squeezed tightly (as close to the top as possible), twisted, and sealed with tape, to keep the asbestos materials safely in the bottom of the bag. The HEPA vacuum can then be removed from the bag, and the glove bag can be removed from the work component.

3.12.3 Glove Bag Cleanup Procedure

a. Decontaminate all tools and equipment or dispose of in the glove bag.

b. Double bag all asbestos waste into 6-mil millimetre bags. Ensure external surfaces of asbestos waste bags or materials are visually clean of all dust or debris.

c. A visual inspection by a representative of the Contracting Officer will be performed at this time. Additional cleaning shall be required if the area fails the visual inspections.

d. After the area has passed the final visual inspection and permission has been granted from the Contracting Officer, control barriers can be removed.

3.12.4 Negative Pressure Glovebag and Glovebox Systems

Negative Pressure Glovebag and Glovebox systems may also be used to remove ACM from piping, subject to the above requirements for Glovebags and to additional requirements as specified in 29 CFR 1926 article 1101(g)(5).

3.13 REMOVAL OF COMPONENTS

The procedure designated as "Removal of Components" in this specification is similar to that formerly described in 29 CFR 1926 article 58 and Appendix G of that document under the heading "Removal of Entire Structures". With prior approval of the Contracting Officer, this procedure may be used where appropriate, and where components are to be removed rather than stripped of ACM and reinsulated. Examples of such components are valves and pipe fittings insulated with ACM where the

adjoining pipe is covered with non-ACM insulation. Where a pipe is completely insulated with ACM, it may be reasonable to strip small sections using the Glove Bag method, then wrap the lengths of ACM-covered pipe using this Removal of Components procedure, and then cut the pipe at the stripped sections.

This procedure is intended for "Small-Scale, Short-Duration Activities", as defined in 29 CFR 1926 article 1101, and shall not be used as a substitute for proper enclosures required for larger-scale jobs.

3.13.1 Removal of Components Method of Asbestos Removal

a. Before the adjoining pipe is cut, the ADM-insulated component(s) to be removed shall be completely double-wrapped with 6-mil polyethylene sheets and securely sealed with duct tape or equivalent.

b. A visual inspection by a representative of the Contracting Officer will be performed at this time, to ensure that the wrapping is properly sealed, and to ensure that external surfaces of wrapped components are visually clean of all dust or debris. Additional cleaning, wrapping or sealing shall be required if the work is unsatisfactory.

c. Cut the pipe on each side of the wrapped component, at a location where the pipe is not covered with any ACM.

3.13.2 Removal of Components Cleanup Procedure

a. A visual inspection by a representative of the Contracting Officer will be performed at this time. Additional cleaning shall be required if the area fails the visual inspections.

b. After the area has passed the final visual inspection and permission has been granted from the Contracting Officer, control barriers may be removed.

3.14 FULL CONTAINMENT (ENCAPSULATION)

Encapsulation is a process in which asbestos-containing material (ACM) is sprayed with a sealant that reduces the release of fibers.

3.14.1 Work Area Set-Up for Encapsulation

The Contractor shall set up a decontamination facility in a predesignated area that will house a separate changing room, shower area, and equipment area. The decontamination facility shall be arranged and constructed to meet the standards of Appendix F or main body (as applicable) to 29 CFR 1926 article 1101. Where feasible, a separate equipment room and air lock will be installed. The Contractor shall provide adequate toilet facilities for employees outside the regulated area. The toilet facilities should be positioned immediately adjacent to the controlled area.

The work area shall be sealed off by erecting double barriers of polyethylene sheeting at least 6-mil thick at all entrances and exits to the work area. The work area shall always be sealed off by one sheet whenever the area is entered or exited. These sheets, when closed, shall overlap the fixed barriers to seal the opening.

The work area shall have a minimum of 2-ply staggered polyethylene sheets (6-mil minimum thickness) taped securely in place covering all the walls and floors. One layer of polyethylene shall be used to cover the ceiling, or the structure/slab above. The polyethylene sheeting covering the floors shall overlap the walls by at least 24 inches to prevent the loss of any water used in the abatement.

The polyethylene shall be flush with the walls at each corner to prevent damage by foot traffic. In addition, all sheeting shall be sized to minimize seams. If the floor necessitates seams, those on successive layers of sheeting shall be staggered to reduce the potential for water to penetrate the flooring material. Seams shall not be located at wall/floor joints.

If stairs, ramps, or other potential slippery spots must be covered with polyethylene, care shall be taken to provide traction for foot traffic. Masking tape or thin wood strips can be placed on top of the polyethylene to provide traction for foot traffic in these areas.

Electrical circuits in the enclosure shall be deactivated, unless equipped with ground-fault circuit interrupters.

3.14.2 Encapsulation Negative Pressure Exhaust Systems

Upon completion of the work identified in paragraphs entitled, "Work Area Preparation," "Securing Air-Moving Equipment," and "Work Area Set Up for Encapsulation," HEPA filtered negative air exhaust units shall be installed. The exhaust unit(s) shall be located so that make-up air traverses the work area. The system shall maintian a minimum of four air changes per hour within the enclosure. Air movement shall be directed away from employees performing asbestos work within the enclosure, and toward a HEPA filtration or a collection device. Unless otherwise directed by the Contracting Officer, HEPA filtered exhaust air shall be vented outside the building where abatement work is taking place. Prior to beginning abatement activities, the containment area shall be tested to verify that a negative pressure differential of 0.02-inches H2O can be created and maintained. Before beginning work within the enclosure, and at the beginning of each shift, the NPE shall be inspected for breaches and smoke-tested for leaks, and any leaks shall be sealed prior to beginning the work. Once activated, the negative air exhaust unit(s) shall remain in operation until final clearance air monitoring has been performed and the Contracting Officer has approved their shutdown/removal. HEPA filters or pre-filters must be accessible from the contaminated side of the work area to facilitate changeout of used filters. Used filters shall be disposed of as contaminated waste. At no time shall the exhaust unit be allowed to exhaust unfiltered air outside of the contaminated work area.

3.14.3 Encapsulation Procedures

The Contractor shall, at the onset of encapsulation, test an area of approximately four square feet per room of the friable material with the encapsulant to ensure that the required penetration/probing can be attained and the application will not cause the friable base material to fall from its own weight. The Contracting Officer shall be notified of the test results before continuing with the spraying operation.

The manufacturer's printed instructions for use of his product as an asbestos coating shall be strictly observed. Any deviations from those instructions shall be obtained in writing from the Contracting Officer

prior to starting or continuing the spraying operations.

Carefully hand pick all loose or hanging insulation material prior to spraying operations. Place all removed material in plastic bags and properly dispose of according to paragraph entitled "Disposal of Asbestos Waste Materials."

The coatings shall be applied by an airless spray gun. Pressures and nozzle orifice shall be as recommended by the sealer manufacturer. The coating shall be applied at a rate to achieve maximum penetration.

Apply two coats of the approved material over all the asbestos containing insulation material. The encapsulant shall be applied uniformly at full strength to achieve an even build-up of the sealant. All overspray insulation is also to be encapsulated.

The Contractor shall receive approval from the Contracting Officer of installation of the first coat, prior to application of the second (finish coat). This approval is a general one, not a day-to-day requirement.

Asbestos material which has been broken away from the surface prior to, during or after the spraying shall be immediately packed into double plastic bags sealed according to paragraph entitled "Disposal of Asbestos Waste Materials."

3.14.4 Encapsulation Cleanup Procedure

a. Place all visible debris into 6-mil polyethylene waste disposal bags.

b. HEPA vacuum or wet wipe all surfaces not encapsulated or both.

c. Decontaminate all tools and equipment.

d. Remove the first layer of polyethylene sheeting and dispose of as asbestos waste.

e. Double bag all asbestos waste. Place all contaminated waste into the waste storage area in the equipment room. Ensure external surfaces of asbestos waste bags or materials are visually clean of all dust and debris.

f. A visual inspection by a representative of the Contracting Officer will be performed at this time. Additional cleaning shall be required if the area fails the visual inspections.

g. After the encapsulant has dried, final clearance air sampling shall be performed prior to containment removal. If the work area fails the final clearance air sampling, additional cleaning and monitoring shall be required.

3.14.5 Loss of Containment

If at any time a loss of containment occurs, the Contractor shall immediately stop removal work, notify the GSFC Safety, Environmental and Security Office (Code 205) and implement corrective action.

3.15 ACM FLOORING REMOVAL

All nonfriable ACM flooring shall be removed substantially intact using compliant work practices as defined in 94-40797. This publication is available from the Contracting Officer. Workers must have completed the required 8-hour training course on rmoval of resilient floor coverings before removing vinyl asbestos tile or vinyl asbestos sheet flooring. Refer to 94-40797 for procedures to remove ACM sheet flooring. If for some reason the nonfriable ACM cannot be removed substantially intact, it will be considered a friable ACM removal and must comply with other parts of this section for Class II work.

3.15.1 VAT Removal Procedure

1. Before removal begins, the entire floor is vacuumed using a HEPA vacuum with a metal floor attachment.

2. Each floor tile is pried up individually using a stiff bladed scraper. If a tile does not release from the adhesive when the scraper is forced under the tile by hand, the scraper may be struck with a hammer to cuse the tile to release and/or the tile is heated to soften the adhesive and facilitate removal. Water shall be used with all removal methods except when using the heat machine.

3. Alternatively, without first prying up floor tiles using a scraper, heat is applied to the floor tile from a heat source (e.g. infrared heat machine) and the tiles are removed by hand or by using a scraper.

4. After the tile is removed it is placed in a heavy duty impermeable trash bag or other closed leak tight container without further breakage.

5. As small areas of floor are cleared of tile, residual adhesive is removed, to the extent necessary to prepare the surface for installation of new flooring material, by being wetted and scraped using a stiff bladed floor scraper.

6. Alternatively, after the tile is removed, residual adhesive is removed by using a low speed floor machine and wet sanded or a removal solution.

7. Adhesive residues are place while still wet in a heavy duty impermeable trash bag or other closed leak-tight container.

8. The area from which the adhesive has been formed is vacuumed using a HEPA vacuum with a metal floor attchment.

9. After the entire floor has been removed and has dried, it is vacuumed using a HEPA vacuum with a metal floor attachment.

3.16 PERSONAL PROTECTIVE EQUIPMENT AND PROCEDURES

3.16.1 Protective Clothing

Each person present at the job site (workers, supervisors, inspectors, and others) shall be provided with work clothing in accordance with 29 CFR 1926 and shall follow procedures in accordance with the following instructions.

Work clothes shall consist of full body coveralls, disposable head covers, boots or sneakers, protective gloves, and respiratory protective equipment as required by OSHA regulations. Eye protection and hard hats shall be available as appropriate. Coveralls shall be of a paper disposable type, unless otherwise approved.

3.16.2 Respirators

The contractor shall provide respirators, and ensure that they are used, as required by 29 CFR 1926 article 1101(h), summarized below.

Respiratory protection selection and use shall be based on the Class and conditions of work, and the airborne fiber concentrations outlined below. Respirators assigned for high environmental concentrations may be used at lower concentrations, or when required respirator use is independent of concentration.
Concentrations indicated refer to exposure of employees above either the TWA or the excursion limit. Use of an upgraded form of respiratory protection, if required, shall be maintained until airborne fiber concentrations are below the prescribed limit.

At a minimum, half-mask air purifying respirator (not a disposable respirator), with HEPA filters, shall be used for any of the following:

Class I work with NEA, or

Class II or III work without NEA, or

Class II work where the ACM is not removed in a substantially intact state, or

Class II and III work which is not performed using wet methods (except for: 1) removal of ACM from sloped roofs in an intact state, with NEA; 2) removal of ACM flooring materials in an intact state, with fully compliant methods as specified in paragraph "ACM Flooring Removal"), or

Class III work where TSI or surfacing ACM is disturbed, or

Any work with airborne asbestos concentration greater than PEL, but less than 1 f/cc (10 X PEL).

At a minimum, full facepiece air-purifying respirators with HEPA filters, with HEPA filters, shall be used for any of the following:

Any work with airborne asbestos concentration greater than PEL, but less than 5 f/cc.

At a minimum, powered air-purifying respirators with HEPA filters, or supplied air respirators operated in continuous flow mode, shall be used for any of the following:

Any work with airborne asbestos concentration greater than PEL, but less than 10 f/cc (100 X PEL).

At a minimum, powered air purifying respirators with HEPA filters, or full facepiece supplied air respirators operated in the pressure demand mode with HEPA egress cartridges or an auxiliary positive pressure

self-contained breathing apparatus, shall be used for any of the following:

Class I work without NEA, where exposure assessment indicates TWA will be less than 1f/cc.

At a minimum, full facepiece supplied air respirator operated in pressure demand mode, shall be used for any of the following:

Any work with airborne asbestos concentration greater than PEL, but less than 100 f/cc (1,000 X PEL)

At a minimum, full facepiece supplied air respirator operated in pressure demand mode, equipped with an auxiliary positive pressure self-contained breathing apparatus, shall be used for any of the following:

Class I work without NEA, where exposure assessment indicates levels will be over 1f/cc (TWA), or

Any work with airborne concentration of asbestos greater than 100 f/cc (1,000 X PEL), or with unknown concentration.

Provide employees performing any Class IV work within regulated areas, where employees performing other work are required to wear respirators, with the same type as required for other work in the regulated area.

The contractor shall institute a respirator program in accordance with 29 CFR 1910.134(b)(d)(e) and (f); and shall comply with fit testing, medical clearance, and other usage requirements in accordance with 29 CFR 1926 article 1101(h)(3) and (4).

3.17 ASBESTOS WORKER CONTAMINATION PREVENTION

3.17.1 Full Containment

a. All workers, without exception, shall remove all street clothing and don recommended work clothing in designated areas prior to start of days work. Lockers or suitable substitutes shall be provided by the Contractor for street clothes and personal articles.

b. All contaminated work clothing shall be removed, excluding respiratory protective equipment, in the designated contaminated change area prior to departure. Workers shall then proceed to the shower area for decontamination. Respirators shall be removed and cleaned while showering. Hot water, towels, soap, shampoo, and hygienic conditions shall be provided and maintained by the Contractor. Showers must be taken any time egress from the contaminated work area is necessary. Once showers have been taken, workers may then proceed to the clean room.

c. No smoking, eating, applying cosmetics or drinking shall take place in the controlled work area. Prior to smoking, eating or drinking, workers shall fully decontaminate by showering. Workers may then dress into new, clean disposable coveralls and exit the controlled area for eating, smoking or drinking. This new coverall may then be utilized to reenter the work area.

d. Work footwear shall remain in the contaminated area until completion of the job. Following completion of the job work, footwear shall be disposed of as contaminated waste or decontaminated with soap and water prior to removal from the work area.

3.17.2 Mini-Enclosures

a. All workers shall don the recommended clothing and respiratory protection prior to entering the mini-enclosure change room.

b. Prior to exiting the work area, the worker shall HEPA vacuum off his disposable protective clothing in the change room. The worker shall then remove the disposable protective clothing in the change room prior to exiting the enclosure. Note: The respiratory protection shall continue to be used until the worker has exited the enclosure.

c. No smoking, eating, applying cosmetics or drinking shall take place in the controlled work area.

3.17.3 Glove Bag and Removal of Components

In the event of a glove bag or wrapping failure which releases asbestos-containing materials into the work area, the worker shall HEPA vacuum the protective clothing prior to removal of the clothing and prior to leaving the work area such as the control area. Respiratory protection shall be utilized until the worker has left the work area.

3.18 WARNING SIGNS AND LABELS

The Contractor shall provide and display asbestos warning signs to demarcate the Regulated Area, and labels for all ACM wastes and contaminated materials, as required by 29 CFR 1926 article 1101. In addition, the Contractor shall provide and post a 20 x 14 inch work practice sign at all entrances to the work area. The sign shall display the following legend with letter sizes and styles at least equal to that specified below:

Legend	Notation
No Food, Beverages or Tobacco Permitted	19 mm Block
All Persons Shall Don Protective Clothing (Coverings) Before Entering the Work Area	19 mm Block
All Persons Shall Shower Immediately After Leaving Work Area and Before Entering The Clean Room	19 mm Block

Spacing between line shall be at least equal to the height of the upper of any two lines.

The Contractor is responsible for ensuring compliance with all regulations noted on the warning signs and labels.

3.19 DISPOSAL OF ASBESTOS WASTE MATERIALS

a. All Regulated ACM waste shall be double bagged or double wrapped

in 6-mil polyethylene. Any material which might tear the bags should be placed in fiber drums or barrels.

b. All Regualted ACM waste containers shall be labeled in accordance with OSHA (29 CFR 1926,k,8) and NESHAPS (40 CFR 61) regulations.

c. All regulated ACM shall be placed in an enclosed or covered vehicle and transported to a landfill approved for asbestos waste. The enclosed area of the transport vehicle shall be lined with polyethylene sheeting to prevent contamination from leaking or spilled containers.

d. Workers loading or unloading the regulated ACM shall be protected with disposable clothing and respiratory protection.

3.20 AIR MONITORING

Representatives of the GSFC Safety, Environmental and Security Office (Code 205), may conduct air monitoring during abatement operations to ensure compliance with NASA, State and Federal Regulations. However, this in no way relieves the Contractor of responsibility to perform monitoring as described below.

All air monitoring described below shall be conducted by a Certified Industrial Hygienist (CIH) or a Competent Person as defined in 29 CFR 1926 article 1101. The CIH or Competent Person shall be provided by the Contractor.

Results of all air monitoring shall be posted daily at the job site. Written laboratory results shall be provided to the Government as soon as they become available from the laboratory. Air monitoring shall be conducted in accordance with 29 CFR 1910, Section 1910.1001(f) and 29 CFR 1926 article 1101 main body and Appendix B to represent asbestos concentrations in the entire work area.

3.20.1 Daily Air Monitoring

Daily personal air samples shall be taken inside the enclosure or work area, in the breathing zone of those workers who can be expected to have the highest exposure to asbestos.

Daily air samples shall be collected in the following areas outside the enclosure:

a. At the entrance to the negative pressure enclosure or work area.

b. At the exhaust of the negative pressure ventilation unit, if applicable.

c. At the perimeter of the work area.

The Contractor shall have breathing zone and area samples analyzed in accordance with National Institute for Occupational Safety and Health (NIOSH) 7400 methods and standard industrial hygiene procedures.

3.20.2 Final Clearance Monitoring

The CIH or Competent Person shall perform a final clearance inspection and advise the asbestos removal contractor of any corrective actions to be

taken, and shall conduct final clearance air sampling.

The Contractor shall ensure that clearance air samples are analyzed by phase contrast microscopy (PCM).

The Contractor shall ensure that air samples are submitted promptly to a full service, AIHA accredited laboratory and results are received within acceptable turnaround times. All analyses are to be performed by trained analysts under supervision of a CIH.

The Contractor shall immediately report lab results to the Contracting Officer and to GSFC Safety, Environmental and Security Office (Code 205).

The Contractor shall ensure that written laboratory results are transmitted promptly to both Code 205 and the Contracting Officer.

3.20.3 Aggressive Air Monitoring

For final clearance monitoring of a Full Containment operation, aggressive air monitoring techniques shall be utilized to verify airborne fiber levels are below the clearance level of 0.01 f/cc. A strong fan or leaf blower of approximately 1 hp shall be activated inside the containment for a period of at least five minutes per 10,000 cubic feet of room volume before final clearance air samples are taken.

3.21 REMOVAL OF CONTAMINATION BARRIERS

3.21.1 Full Containment or Mini-Enclosure Methods

The Contractor shall not remove containment barriers or shut down negative air units until notification from the Contracting Officer or his representative of satisfactory completion of the abatement operation. The abatement operation shall be considered satisfactory when the asbestos work area is visually clean of all ACM dust/debris and all of the final clearance air samples are at or below 0.01 fibers/cc. The method of monitoring, analysis, and number of samples taken will be determined by the Contracting Officer.

3.21.2 Glove Bag or Removal of Components Methods

For glove bag or component removal operations which do not utilize a totally enclosed work area, a visual inspection by a representative of the Contracting Officer will be conducted to verify the area is clean prior to bag removal.

3.22 MARKING OF NEW AND REMAINING INSULATION

3.22.1 Asbestos-Free Insulation

New and remaining asbestos-free insulation in the work area shall be clearly marked with white-on-blue vinyl, adhesive-backed labels, reading "ASBESTOS FREE INSULATION." Labels shall be similar to Brady Catalog Number 93450 or 93451.

3.22.2 Remaining Asbestos Containing Insulation

Any asbestos containing insulation within the work area to remain shall be clearly marked with black-on-yellow vinyl adhesive-backed labels, reading "ASBESTOS INSULATION." labels shall be similar to Brady Catalog Number

93460 or 93461. In addition the end(s) of each section of remaining ACM shall be indicated with black-on yellow arrow tape, similar to Brady Catalog Number 91420. Tape shall be applied completely around pipes and ducts, and shall be applied on other insulated surfaces as necessary to clearly delineate the extent of the remaining ACM.

3.22.3 Location of Labels

Labels shall be applied to insulated surfaces throughout the work area, in the following locations:

a. Each point of entry and exit of pipe or duct passing through walls.

b. Each change in direction; i.e., elbows, tees in pipes or ducts.

c. In congested or hidden areas and at all access panels at each point required to clarify hazard or lack of hazard.

d. In long straight runs of pipe or duct, and on other surfaces, labels shall be located at distances within eyesight of each other but in no case shall be distance between labels exceed 75 feet. Where the size of pipes, bare or insulated, is 2-1/2 inches outside dimension and smaller, labels shall be affixed to 16-gage aluminum sheet and attached to the pipe with No. 12 AWG corrosion-resistant steel wire. All labels shall be visible and legible from the primary service and operating area.

-- End of Section --

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SECTION 13851

FIRE ALARM SYSTEMS (LOW VOLTAGE NON-ADDRESSABLE SYSTEMS)
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A117.1	(1998) Accessible and Usable Buildings and Facilities
ANSI A17.1	(1996) Safety Code for Elevators and Escalators

FEDERAL STANDARDS (FED-STD)

FED-STD 795	(1988) Uniform Federal Accessibility Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Safety to Life from Fire in Buildings and Structures
NFPA 13	(1999) Installation of Sprinkler Systems
NFPA 70	(1999) National Electrical Code
NFPA 72	(1999) National Fire Alarm Code
NFPA 90A	(1999) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 268	(1996; 4th Ed; May 2, 1989) Smoke Detectors for Fire Protection Signaling Systems
UL 38	(1999; 7th Ed) Manually Actuated Signaling Boxes for Use with Fire Protection Signaling Systems
UL 464	(1996; 7th Edition) Audible Signal Appliances
UL 864	(1996; 8th Edition) Control Units for Fire Protective Signaling Systems

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Schematics consisting of ladder diagrams of Fire Alarm Systems showing interaction of components as a system shall be submitted for approval prior to installation.

Module schematic drawings, minimum size 11 inches by 17 inches, shall also be submitted prior to system acceptance testing.

SD-02 Shop Drawings

Installation Shop Drawings shall be submitted for Fire Alarm Systems in accordance with the paragraph entitled, "Installation," of this section.

Include the following:

A descriptive index of drawings in the submittal with drawings listed in sequence by drawing number.

A legend sheet identifying device symbols, nomenclature, and conventions used in the package.

Floor plans drawn in metric at a scale not less than 1:200 which clearly show locations of devices, equipment, risers, panels, electrical power connections, approximate location of conduit runs, and other details required to clearly describe the proposed system.

Location of control panels, detectors, supervisory switches, manual alarm stations, and other electrical devices. Clearly and completely indicate the function of the control panel and devices. Indicate conduit routing and sizes, and the number of conductors contained in each. Indicate points of connection and terminals used for electrical field connections in the system, with a wiring color code. Indicate termination points of devices and indicate the interconnection of modules required for proper operation of the system. Indicate interconnection between modules and devices. Control diagrams shall be supplemented with a narrative description of the system. Point-to-point wiring diagrams shall indicate control panel wiring and make and model of devices and equipment.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Fire Alarm Systems
Fire Alarm Enclosures
Fire Alarm Modules
Remote Reporting Devices

Annunciation Devices
Heat Detectors
Smoke Detectors
Manual Alarm (Pull) Stations
Sprinkler Flow Switches
Valve Tamper Switches
Supervisory Devices
Bells
Horns
Strobe Lights
Magnetic Door Holders
Wiring and Raceway

SD-03 Product Data

Material, Equipment, and Fixture Lists shall be submitted for Fire Alarm Systems including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

SD-05 Design Data

Design Analysis and Calculations shall be submitted for Fire Alarm Systems consisting of the following:

Detector location analysis and calculations.

Battery capacity and loading calculations to verify the requirements listed in the paragraph entitled, "Fire Alarm Control Panel."

SD-06 Test Reports

Test Reports shall be submitted for Fire Alarm Systems for the following field tests in accordance with the paragraph entitled, "System Field Wiring," of this section.

Preliminary Tests
Acceptance Tests
Existing System Tests
Current Output
Ground Detection Tests
Standby Power Tests
Trouble Tests

SD-07 Certificates

Certificates of Compliance from the manufacturer shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Fire Alarm Systems
Fire Alarm Enclosures
Fire Alarm Modules
Remote Reporting Devices
Annunciation Devices
Heat Detectors
Smoke Detectors, including Duct Detectors
Manual Alarm (Pull) Stations

Sprinkler Flow Switches
Valve Tamper Switches
Supervisory Devices
Bells
Horns
Strobe Lights
Magnetic Door Holders
Wiring and Raceway
Licensed Fire Alarm Contractor Qualifications

SD-07 Certificates

Listing of Product Installations for Fire Alarm Systems shall include identification of at least 5 systems, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. List shall include purchaser, address of installation, service organization, and date of installation.

SD-11 Closeout Submittals

Upon completion, and before final acceptance of the work, submit a complete set of as-built drawings for the fire alarm system, including components and any other associated appurtenances. Include as-built circuit diagrams complete with conductor color codes and a listing of initiating device locations. As-builts shall be submitted on reproducible mylar film; size and title block shall be similar to the contract drawings.

1.3 QUALITY ASSURANCE

Equipment to be provided shall be the standard catalog product of a manufacturer regularly engaged in the manufacture of fire alarm equipment. Fire alarm equipment shall be the latest standard design and approved by Underwriters' Laboratories and Factory Mutual. Devices shall be approved by the control panel manufacturer and fire alarm authority having jurisdiction for use with the new or existing panel.

1.4 FIRE ALARM CONTRACTOR QUALIFICATIONS

A licensed fire alarm contractor shall supervise the installation and testing on the fire alarm system at the site.

Licensed fire alarm contractor shall have conducted installation and testing for not less than five projects of comparable size and complexity.

Work shall be done by or under the direct supervision of the licensed fire alarm contractor.

1.5 GENERAL REQUIREMENTS

Section 16003 applies to work specified in this section.

1.6 DEFINITIONS

Wherever mentioned in this specification or on the drawings, the equipment, devices, and functions shall be defined as follows:

EVACUATION ALARM SIGNAL: A signal which signifies a state of emergency requiring immediate notification of the Emergency Console (via the Operator

Workstation) and of the building occupants. This signal is produced through activation of the following initiating devices:

a. Automatic Sprinkler Waterflow Switch
b. Manual Fire Alarm (Pull) Station
c. Remote Evacuation Signal

LOCAL ALARM SIGNAL: A signal which signifies a state of emergency requiring immediate notification of the Emergency Console (via the Operator Workstation) and select building occupants but not requiring the immediate evacuation of the building's occupants. This signal is produced through activation of the following initiating devices:

a. A Single Photoelectric or Ionization Smoke Detector
b. Duct Smoke Detector
c. Heat Detector (fixed temperature/rate of rise/rate compensated)
d. Flame Detector (UV, IR, or UV/IR)
e. Hazardous Gas Detector

SUPERVISORY SIGNAL: A signal which indicates an abnormal condition of the fire protection system which may prevent its normal use and which requires notification of the Emergency Console (via the Operator Workstation). This signal is produced through activation of the following initiating devices:

a. Sprinkler Valve Tamper Switch
b. Dry Pipe Low Air Pressure Switch
c. Fire Alarm System Primary Power Failure
d. Fire Pump Running
e. Fire Pump Power Failure
f. Fire Pump Phase Reversal

TROUBLE SIGNAL: A signal which indicates that a fault, such as an open circuit or ground, has occurred in the system and requires notification of the Emergency Console (via the Operator Workstation).

HARDWIRED SYSTEM: A signalling method in which initiating and indicating devices are directly connected through dedicated circuits to the FACP.

ALARM NOTIFICATION APPLIANCE/CIRCUIT: Any evacuation or local alarm notification device or series of devices arranged to visually and/or audibly indicate an alarm signal.

FIRE ALARM CONTROL PANEL (FACP): Alarm system that receives inputs from automatic and manual fire alarm devices and operates notification devices such as audible/visual alarms, and other output devices not specifically stated. FACP communicates with remotely located operator work station (OWS) located in Building 24.

OPERATOR WORK STATION (OWS): A computer terminal with standard keyboard, monitor, printer and software capable of receiving and displaying all alarm, supervisory, and trouble conditions from all FACPs attached to the fire alarm network.

CLASS A WIRING: A circuit that is electrically supervised such that a single break or single ground fault condition will be indicated by a trouble signal on the FACP. The circuit shall be capable of operating for its intended use during a single break and/or ground fault no matter where the break and/or ground fault condition occurs. This would be Style 6 for the signalling line circuits, Style E for initiating device circuits, and

Style Z wiring for notification appliance circuits.

CLASS B WIRING: A circuit that is electrically supervised such that a single break or single ground fault condition will be indicated by a trouble signal on the FACP no matter where the break and/or ground fault condition occurs. The circuit shall be capable of operating for its intended use during a single break and/or ground fault up to, but not beyond the break and/or ground fault. This would be Style 3.5 for the signalling line circuits, Style B for initiating device circuits, and Style Y wiring for notification appliance circuits.

1.7 SYSTEM REQUIREMENTS

Provide a complete fire alarm system capable of performing all of the operations described within this section.

Provide a fire alarm control panel (FACP) as indicated on the contract drawings.

The system shall conform to the applicable requirements of NFPA 72, NFPA 70, NFPA 90A, NFPA 13 and NFPA 101. Also, the fire alarm system shall conform to the requirements of ANSI A17.1, ANSI A117.1 and FED-STD 795.

As a minimum, fire alarm system shall be capable of the following:

a. Manual pull station activation
b. Smoke or heat detection
c. Sprinkler flow detection
d. Supervisory functions for sprinkler systems, dry pipe, and fire pump systems
e. Alarm notification
f. Annunciation at the main annunciator
g. Local alarm annunciation
h. Interface with gas detection systems for annunciation and notification.
i. Interface with mechanical systems for air handling unit shut-down.
j. Interface with elevator systems for recall and shut-down.
k. Alarm and trouble notification to the emergency OWS in Building 24, through the use of remote reporting devices.

Each circuit shall be individually and independently arranged so that an open circuit, a ground, or an open circuit and a ground occurring at the same time in the circuit will not prevent the transmission of a clear and intelligible alarm signal before the trouble is cleared.

Circuits shall be electrically supervised through closed-loop circuits to detect interruptions, shorts, or ground faults and report these as trouble.

1.8 SYSTEM OPERATION

All work performed under this specification shall result in a fully functioning system, in complete compliance with NFPA 72. The following functions and features shall be included:

The manual or automatic operation of any alarm or supervisory device or the occurrence of any trouble condition shall cause the transmission of the appropriate signal to the FACP. The FACP shall then cause annunciation of the signal at the FACP and the building's main annunciator panel, as well as transmit a signal to

the OWS.

Upon operation of any alarm (manual or automatic), a manual reset at the building's fire alarm control panel shall be necessary to return the system to full normal operation. Reset operations shall only be possible through the use of a key or from behind a locked panel door.

All components shall be immune from false alarms caused by RFI or EMI.

Operation of the building's evacuation system may only be silenced from inside the locked FACP. Operation of an audible alarm at any remote annunciator may be silenced by a button or switch on the annunciator. Silencing any audible alarm shall not reset the FACP.

The FACP shall interface with the mechanical air handling systems to provide for motor shutdown. All interfaces between the FACP and the mechanical air handling unit shall conform to the requirements of NFPA 72 and NFPA 90A.

Equipment connected to alternating current circuits shall be protected from power line surges. Equipment shall meet the requirements of UL 864. Fuses shall not be used for surge protection.

1.9 EXISTING FIRE ALARM SYSTEMS

Major buildings at the GSFC utilize either a hardwired (non-multiplexed) Pyrotronics System 3 fire alarm system or a Pyrotronics MXL (addressable) fire alarm system.

Buildings 4, 11, 12, 25, 26, 27, 31, 32 and 33 utilize a fully addressable, Pyrotronics MXL fire alarm system. A project is in place to install the Pyrotronics MXL system in Building 22. In addition, Buildings 25F and 76 utilize the Pyrotronics MXL system.

Fire alarm system modifications/alterations and additions shall be made by expanding the existing MXL system in the above buildings.

The remaining major buildings utilize a Pyrotronics System 3 fire alarm system. New Pyrotronics MXL fire alarm control panels have been installed in these buildings to monitor the existing Pyrotronics System 3 FACP and interface with the OWS in Building 24. The Pyrotronics MXL system monitors the status of Form C relay contacts in the existing FACP and transmits the status of these points to the OWS. The MXL system is capable of initiating an Evacuation Signal in each building through an output relay interfaced to the existing FACP.

Fire alarm system modifications/alterations and additions shall be made by either expanding the MXL system or the Pyrotronics System 3 as indicated in the contract drawings.

New devices installed under this contract shall be compatible with the existing fire alarm systems being utilized in each building.

PART 2 PRODUCTS

2.1 FIRE ALARM SYSTEM

Fire alarm system shall contain, but not be limited to:

Fire alarm control panels
Fire alarm control panel modules
Emergency battery and charger unit
Remote reporting devices
Annunciation devices
Heat detection
Smoke detection, including duct detection
Manual alarm (pull) stations
Sprinkler flow switches
Valve tamper switches
Bells
Combination alarm bell/strobe lights
Horns
Strobe lights
Magnetic door holders
Auxiliary components and devices
Raceways
Wiring and associated circuitry

2.2 FIRE ALARM CONTROL PANEL

A fire alarm control panel (FACP) shall be installed as indicated on the contract drawings. The FACP shall monitor and control all initiating, notification, and output devices. The FACP shall be a U.L. listed stand-alone panel.

Panel shall have the number of active zones required to perform as specified herein.

The FACP shall function when a detector, manual alarm station or water flow switch connected to the panel is activated. Fire alarm notification circuits shall energize and activate the audible, visual and auxiliary devices, provide zone indication and send an alarm signal to the OWS located in Building 24.

The FACP shall contain components and circuitry to operate a local annunciator and auxiliary devices such as air handlers, ventilating fans, damper solenoids, and magnetic door holders.

The FACP shall contain power-on, fire and trouble indicating lights that are plainly visible when the cabinet is closed. The panel shall also contain the alarm silence switch, the trouble silence switch, the power on-off switch, and the alarm/trouble reset switch, and shall be accessible only by unlocking and opening the unit.

2.2.1 Alarm Control Unit Switches

Power on-off switch shall disconnect all power sources, 120 VAC and 24 VDC, to the control panel.

Alarm/trouble reset switch shall reset the detector system in alarm or trouble. Trouble signals shall not be self-restoring without activating the reset switch.

Alarm and trouble silence switches shall silence the alarm and trouble audibles. Either switch placed in other than the normal position shall provide the following:

Report as a trouble to the OWS located in Building 24.

Transfer audible noise to a panel lamp visual indication.

Re-ring the trouble audible when the problem has been cleared but the switch has been left in the silence position.

When the alarm silencing switch is in the silence position, subsequent alarms in other zones shall operate the alarm-sounding devices.

2.2.2 Control Relays

Relays shall be supervised, continuous duty, have self-cleaning contacts of silver or an alloy of equivalent performance, and be UL and FM approved for system use. Supervisory relays shall be protected against dust by individual covers. Relays that provide zone and external functions such as remote reporting, control device activation, signal lights, and bells shall have at least one set of spare contacts. Relays shall be permanently marked with the coil resistance, operating-current range, and internal pin connections identified by standard pin numbers.

2.2.3 Enclosure

Fire alarm enclosure shall be steel and shall be provided with a hinged cover and an integral pin-tumbler cylinder lock that will accept the key presently in use with other fire alarm systems existing in the area. Cabinet shall be painted with a prime coat and two finish coats of scratch-resistant baked red enamel in accordance with manufacturer's instructions.

An engraved laminated-plastic identification plate shall be affixed to the cabinet door of the fire alarm control panel to identify the cabinet as a fire alarm cabinet.

2.2.4 Remote Annunciation at the Operator Work Station

The FACP shall contain supervised normally closed, dry, single pole double throw (SPDT) contact that opens for trouble conditions and a normally open, dry, SPDT contact that closes for alarm conditions. Conductors shall be installed from these contacts to the existing Pyrotronics MXL Addressable FACP.

2.2.5 Secondary Power

Control units shall be provided with a battery backup automatically switched alternate power source. Interruption of primary power shall cause the unit to switch automatically to the alternate power source and initiate a trouble signal.

Backup battery shall be capable of operating the alarm control unit in normal supervisory condition for 24 hours, minimum. An alarm signal receipt during battery backup operation shall cause an alarm signal to be sent via the remote reporting devices and shall sound the local alarm signaling appliances for 15 minutes, minimum.

Alarm control unit shall be able to operate on facility power when the backup batteries are disconnected for any reason. A system trouble signal shall be sent if the battery is disconnected or has low voltage.

2.3 ANNUNCIATION PANELS

Provide the annunciation panels as indicated on the contract drawings. The annunciator shall have the capability of annunciating each zone alarm signal through the use of LEDs. Each local annunciator shall be capable of annunciating each detector in that zone individually. A map shall be mounted beside each annunciator showing the location of the zone and the devices connected to that annunciator. The map shall be mounted in a frame with a clear, plexiglass cover.

2.4 HEAT DETECTORS

Heat detectors shall be U.L. listed, and shall be of the plug-in, twist type, compatible with system smoke detectors. Heat detectors shall operate on the fixed temperature principle, and shall have a lower RTI value than the sprinkler heads located in the area around the detector. Heat detectors shall be self-restorable after an activation. An LED mounted on the detector shall indicate operation of each detector.

Heat detectors shall have a set of normally open contacts that close to initiate an alarm. Components of the heat detectors shall be rust- and corrosion-resistant.

2.5 SMOKE DETECTORS

Smoke detectors shall operate on the ionization, photoelectric, or the smoke obscuration principle, or any combination thereof, as indicated in the contract drawings, and shall be activated by the presence of combustion gases, invisible particles, or visible smoke particles. Smoke detectors shall include a molded base, detector head, and locking means. Smoke detectors shall conform to UL 268.

Smoke detector heads shall be plug-in units and shall contain no moving parts. Replacements or readjustments shall not be required to restore it to normal operation after an alarm has been given. Sensitivity shall be adjustable to compensate for ambient operating conditions.

Base shall have terminals for making connections and shall incorporate a light emitting diode or neon indicator that shall provide a visual indication when the detector initiates an alarm. Base shall contain the receptacle for the plug-in detector head. Components of the detectors shall be rust- and corrosion-resistant.

Duct smoke detectors shall meet the requirements for smoke detectors. Duct smoke detector base shall include integral housing with all required air sampling equipment. Length of air sampling tubes shall be as required by the manufacturer for a particular duct installation. Duct smoke detector base shall include at least two sets of dry contacts for alarm output. Duct smoke detectors shall be the ionization type.

2.6 MANUAL ALARM STATIONS

Manual alarm stations shall be double-action alarm initiating devices designed in accordance with UL 38 for use with automatic and manual fire alarm systems. Devices using a break-glass or glass-rod mechanism are not acceptable.

Stations shall be the noncoded type which, when operated, close one or more sets of contacts and lock the contacts in the operated position until

reset. Stations shall not be resettable without the use of a key or a wrench.

Manual alarm stations shall be positioned so that they are readily accessible. Locations shall comply with FED-STD 795, NFPA 101 and NFPA 72.

2.7 WATER FLOW SWITCHES

Each water flow switch shall be connected to the FACP. Flow switches shall be provided with two sets of single pole, double throw contacts rated at a minimum of 2 amps at 24 VDC. The cover for the flow switches shall be provided with an integral tamper switch and tamper resistant screws. Flow switches shall be U.L. listed for its intended purpose. Flow switches shall be provided and installed by the sprinkler contractor, but shall be wired and connected to the FACP by the fire alarm contractor.

2.7.1 Vane Type Flow Switch

Vane type flow switches shall consist of a cast aluminum pipe saddle which houses an electromechanical device to which is attached a corrosion-free flexible, low-density polyethylene paddle. The saddle shall conform to the inside diameter of the sprinkler pipe and sense all water movements. To prevent false alarms, the flow switch shall incorporate an adjustable time delay mechanism between the paddle-operated stem and the alarm initiating contacts. The time delay shall be field adjustable from zero to ninety seconds, and shall be initially set at 30 seconds minimum - 60 seconds maximum.

2.7.2 Pressure Type Flow Switch

Pressure type flow switch shall be all metal with a 13 millimeter NPT polysulfone (or equivalent) pressure connection. Pressure switch shall be adjustable to operate at varying pressure increases. Set points shall range from at least 0 to 20 psi. The pressure switch shall be initially set to alarm upon a pressure increase of 10 psi.

2.8 VALVE TAMPER SWITCHES

Tamper switches shall be U.L. list as "Extinguishing System Attachment" for the location and the type of valve specified. Operation of the switch shall cause a supervisory signal to be transmitted to the FACP upon not more than two complete turns of the valve wheel or a closure of ten percent, whichever is less. Tamper switches shall be provided with two sets of single pole, double throw contacts rated at a minimum of 2 amps at 24 VDC. The cover for the tamper switches shall be provided with an integral switch for detection of device tampering and it shall have tamper resistant screws. Tamper switches shall be provided and installed by the sprinkler contractor, but shall be wired and connected to the FACP by the fire alarm contractor.

2.9 AUDIBLE ALARM NOTIFICATION DEVICES

All audible devices shall be U.L. listed for the intended service.

2.9.1 Evacuation Alarm Signal

A marched time bell shall be used for the audible evacuation signal. Bells shall be red, 254millimeters or 150millimeters, 24 VDC vibrating, under-dome, alarm indicating devices in accordance with UL 464. Bells

shall be capable of producing 90 dB measured at 3050millimeters.

Alarm bells shall be solenoid-operated plunger sounding devices. Operating mechanism shall be rustproof, protected from dust and insects and shall be located behind the gong shell.

Surface-mounted alarm bells installed in unfinished areas with conduit exposed shall be secured to surface-mounted back boxes. Back boxes shall be cast iron or cast aluminum, with threaded conduit connections. Surface-mounted alarm bells installed outdoors shall be weatherproof with a neoprene gasket and shall be protected against corrosion.

Exposed metal surfaces shall be factory painted with a prime coat and one or more finish coats of red enamel to provide a smooth, hard, durable finish.

If a bell and a strobe are to be placed in the same location, a combination bell/strobe unit is acceptable. The strobe portion of the combination unit shall be in accordance with the applicable provisions of the paragraph entitled "Visual Alarm Indicating Devices".

2.9.2 Local Alarm Signal

A continuous sounding, 4 inch klaxon horn shall be used for the audible local alarm signal. A klaxon horn shall be located on or directly above each remote local annunciator panel. The horn shall be silenceable via a push-button switch located on the front of each remote annunciator panel. The switch shall not require the use of a key. The klaxon horn shall be capable of producing 90 dB measured at 10 feet.

2.9.3 Visual Alarm Indicating Devices

Visual alarm indicating devices shall be 15, 30, 75, or 110 candela strobe lights producing between 60 and 120 flashes per minute. Strobe light shall include a red cast metal housing, a clear lexan lens with red "FIRE" lettering on at least two sides, and a zenon flash tube with solid state circuitry. Strobe light shall be U.L. listed for fire protective service.

2.10 MAGNETIC DOOR HOLDERS

Provide magnetic hold open devices where indicated on the contract drawings. Magnetic devices shall develop a hold open force of 25 pounds. The door portion of the holder shall have a stainless steel pivotal mounting device with a shock absorbing bearing. Hold open devices shall operate on a 120 VAC power source. All hold open devices shall release upon activation of the building evacuation signal.

2.11 WIRING AND RACEWAY

Wiring materials shall conform to the requirements of NFPA 70.

2.12 POWER SOURCE

FACP shall normally operate from a 120 VAC power source, from a dedicated electrical circuit. Battery back-up power shall be provided to ensure operation of the entire FACP including but not limited to all remote annunciator panels, and all auxiliary function relays. Magnetic door holders need not operate during times of battery usage.

PART 3 EXECUTION

3.1 SYSTEM SEQUENCE OF OPERATION

3.1.1 Normal Operation

All switches shall be in the normal position. Available power lamp shall be "ON" and the trouble and detector identification lamps shall be "OFF." All circuits shall be electrically supervised.

3.1.2 Alarm Condition

Detectors, manual alarm stations, water flow switches, or other alarm devices shall close a contact that activates the appropriate signal in the fire alarm control panel. The fire alarm control panel shall transmit a signal to a remote reporting device, activate the building alarm bells, provide zone indication when used, control air-handling and ventilating units, provide an input to remote annunciators when used, and provide indication or control to other devices.

3.1.3 Trouble Condition

System conditions, identified in the paragraph entitled, "Fire Alarm Control Panel," that will transmit a trouble signal to the remote reporting device, shall provide zone indication when used, activate a trouble signal in the fire alarm control panel, and provide input to remote annunciators when used. Trouble signal in the fire alarm control panel shall be comprised of a trouble lamp and buzzer.

3.2 INSTALLATION

3.2.1 Fire Alarm Control Panel

A fire alarm control panel, complete with accessories and devices, shall be installed in each protected building.

3.2.2 Annunciation Devices

Locate the annunciation panels as shown on the contract drawings. Locate the map adjacent to the annunciator at the same level. Clearance shall be maintained in front of the panel. Panel shall be installed so that the cabinet door may be fully opened.

Standard lens color to be used as the graphic panel indicating lights shall be:

Color	Device Indicated
Amber	Trouble
Red	Alarm
Green	System Normal

3.2.3 Heat Detectors

Heat detectors shall be provided and installed in accordance with analysis and calculations required by NFPA 72. Heat detectors located in elevator machine rooms or elevator hoistways shall be located within 2 feet of each

sprinkler head.

3.2.4 Smoke Detectors

Smoke detectors shall be installed in accordance with applicable NFPA standards. Smoke detectors shall be installed after the work of other trades has been accomplished. Smoke detectors shall not be installed closer than 3 feet from any air supply diffuser.

Duct smoke detectors shall be installed in accordance with the manufacturer's requirements, NFPA 72, and NFPA 90A. All duct penetrations shall be sealed air and water tight.

3.2.5 Manual Alarm Stations

Manual alarm stations shall be mounted in accordance with the requirements of NFPA 101, NFPA 72, FED-STD 795, and ANSI A117.1. Manual alarm stations shall be mounted so that the top of the station is located at 48 inches above the finished floor level. When stations are located next to a door, they shall be located within 18 inches of the latch side of the door unless otherwise indicated.

3.2.6 Water Flow Detectors and Tamper Switches

Water flow detectors and tamper switches shall be located as shown on the contract drawings.

3.2.7 Alarm Bells

Bells shall be mounted 90 inches above the finish floor level or 6 inches below the bottom surface of the ceiling, whichever is lower. All bell circuits shall be wired as Class A and shall be capable of being silenced from the FACP without reset.

3.2.8 Visual Alarm Indicating Devices

Strobes shall be mounted 80 inches above the finished floor or 6 inches below the finished ceiling, whichever is lower. Locations of the strobe lights shall be unobstructed and allow viewing by area occupants.

Strobe lights shall have the intensities as indicated on the contract drawings. Strobe lights shall be provided with a label attached to the outside of the device witch indicates the intensity of the light. The label shall not be removed at any time.

In large areas where three or more strobe lights can be seen at the same time, a syncronization module shall be installed to keep the flash rate below three hertz.

All strobe circuits shall be wired as a Class A, continuous powered notification circuit. Strobe lights shall not be affected by the operation of the alarm silence switch in the FACP.

3.2.9 Wiring

Conductors shall be continuous from device to device. Splices shall not be permitted.

Fire alarm system conductors shall be contained in a separate raceway

system.

3.2.9.1 Power Source

120 VAC 60-hertz power which may be required for the FACP, Main Annunciator, Remote Annunciator, and other auxiliary devices (magnetic door holders are not included) shall be obtained from the indicated panelboard from a dedicated circuit. Where a panel and circuit are not indicated, it shall be permissible to obtain the power from a dedicated circuit in the closest appropriate electric panel. The circuit breaker shall be painted red and labelled "Fire Alarm".

There shall be one black phase conductor, one white solidly grounded neutral conductor and one green equipment grounding conductor. Conductors shall be a minimum #12 AWG copper. Surge arrestors shall be installed in accordance with NFPA 72.

3.2.9.2 Color Codes

Initiating circuits shall have one black loop and one blue loop. Alarm signaling circuits wired in series shall have both wires colored red. Signaling circuits wired in parallel shall have a red wire for the positive conductors and an orange wire for the negative conductor. Notification circuits shall have brown wires. Each circuit shall maintain the same color code throughout its length.

3.2.9.3 Installation in Cabinets and Boxes

Wiring in control cabinets and boxes shall be installed with wires properly grouped parallel and perpendicular to the major axis of the building and shall be supported and identified. Control wiring shall be continuous from terminal point to terminal point with no splices. Wires entering or leaving control cabinets and boxes shall be permanently marked and terminated on screw terminals.

3.3 SYSTEM FIELD WIRING

The following tests shall be performed on the external wiring of the system before connection to the control panel:

Resistance of each zone circuit shall be checked with an ohmmeter. Temporary jumpers shall be inserted in appropriate sockets of missing detectors and the end-of-line resistor shall be installed when this test is performed. Resistance reading for each zone circuit shall be the value of the end-of-line resistor, plus or minus 10 percent.

Resistance of supervised notification circuit wiring shall be checked with the resistor connected to the last notification device in the circuit. Resistance shall be the value of the end-of-line resistor, plus or minus 10 percent.

Each wire shall be checked for grounds with a 500-volt insulation resistance test set. Resistance to ground shall be not less than 20 megohms.

3.3.1 Field Testing

After complete installation of the equipment and at such time as directed by the Contracting Officer, tests shall be conducted to demonstrate that

the installation requirements of this specification have been met and that the sequential functions of the system comply with the given requirements. The following tests shall be performed:

Preliminary (Prior to final acceptance): This "in house" test shall verify the systems and components. Preliminary test shall be performed as many times as necessary to perform one full test without malfunction.

Final Acceptance: After successful completion of the preliminary testing, the systems be fully tested in the presence of the Contracting Officer for final acceptance.

Contractor shall provide one copy of the test procedures and recording forms for the preliminary tests.

Contractor shall provide 5 copies of the test procedures and recording forms for the final acceptance tests for approval 7 working days prior to system testing.

3.3.2 Fire Alarm System Preliminary Tests

After completion of the above tests, the external wires of the system shall be connected to the appropriate terminals in the control panel and the following tests shall be performed:

Each manual alarm station shall be activated to demonstrate proper operation.

Each smoke detector shall be activated in accordance with the manufacturer's recommendations to demonstrate proper operation.

One lead on each smoke detector, manual pull station, heat detector, or other input device shall be removed to simulate the trouble condition.

Leads at each alarm initiating and notification device shall be removed to verify trouble and then alarm over trouble.

Each alarm initiating circuit shall be demonstrated to operate its associated alarm control module.

Each remote reporting device shall be demonstrated to operate in all modes.

Each alarm control module shall be demonstrated to operate in all modes.

Interconnections with fire protection systems and motor controllers shall be demonstrated to operate as indicated.

3.3.3 Final Fire Alarm System Acceptance Test

After preliminary testing, the Contractor shall perform final system acceptance testing. Testing shall include preliminary functional test and requirements defined in NFPA 72. Testing shall further demonstrate device and equipment functions.

3.3.4 Existing System Tests

Prior to any work, the existing fire alarm devices, including those at the point of connection and those that are electrically on both sides of the

point of connection, shall be functionally tested.

Upon completion of the modification, the newly installed devices and the devices that are electrically on both sides of the point of connection.

Reproducible copies of the test results shall be furnished to the Contracting Officer.

3.3.5 Test Procedures and Test Record Forms

Contractor shall use the following test procedure and test record forms to conduct and record the test.

3.3.5.1 Fire Detection and Alarm System Test Procedure

PRIOR TO TEST, VERIFY THE FOLLOWING:

Contracting Officer has been notified at least 7 working days prior to test.

Low voltage wiring continuity and 500 VDC insulation resistance tests have been performed.

Record test results on Fire Alarm Test Log.

PRELIMINARY TEST:

POWER ON - Apply power to fire alarm control panel and verify that "Power On" lamp illuminates. All switches should be in normal position. All other lamps should be off. When other lamps are on, depress reset button for 3 seconds.

LAMP TEST - Depress lamp test button and verify all zone alarm and trouble lamps on. Trouble signal will sound during lamp test.

TROUBLE TEST:

Remove one lead at a time from each alarm initiating and notification device, including heat detectors, smoke detectors, manual stations and flow switches, to simulate trouble condition. Verify trouble lamp comes on for each zone, troubler buzzer, remote report signal at remote reporting device, trouble silence, trouble ringback, reset.

ALARM TEST:

Activate each alarm initiating device in accordance with paragraph entitled, "Fire Alarm System Acceptance Test." Coordinate flow switch activation with water flow test.

For each of the alarm initiating devices, verify the following:

1. Fire alarm bells ring and strobes flash. (Depress "PUSH TO SILENCE ALARM SIGNALS" pushbutton.)

2. Zone alarm lamp is on.

3. Alarm signal at remote reporting devices.

4. Shut-down of air-handling units

Verify alarm signal over trouble condition for each loop and ground.

GROUND DETECTION TEST:

Connect temporary jumper from ground to each initiating and notification circuit and to each zone circuit conductor at a terminal in panel or at a device.

1. Verify trouble buzzer and trouble lamp are on and verify remote recording.

2. Remove the temporary jumper and verify trouble buzzer is off. Verify lamps off except "POWER ON" lamp.

STANDBY POWER TEST:

Place system on standby power by turning off 120V primary power. Verify trouble indication is on.

Initiate an alarm. Verify fire alarm bells and strobes, alarm signal at remote reporting device, and air-handling units shutdown.

Reset system.

Reapply 120V primary power and verify "POWER ON" lamp is on.

With batteries fully charged, turn off 120V primary power. Upon completion of 24 hours of operation on battery, place the system in alarm and verify operation of all alarm devices for 15 minutes, recording battery voltage under no load conditions.

3.3.5.2 Test Record Form

Fire detection system acceptance test report (Table I) shall be completed after each test. Acceptance shall be witnessed by the Contractor Officer.

TABLE I

FIRE DETECTION SYSTEM ACCEPTANCE TEST REPORT

Date: _____

1. Building: _____

2. Type of System:

3. Name of Owner: _____

4. Name and Address of Inspector: _____
_____

5. Others Present During Test: _____
_____
_____

6. Approving Agency(ies) Name, Address and _____
_____

TABLE I

FIRE DETECTION SYSTEM ACCEPTANCE TEST REPORT

Representative: _____

7. System Description:
Control Panel Manufacturer & Part #: _____
_____

Control Panel Configuration: _____

Serial #: _____

Control Panel Condition: _____

8. Battery Standby: _____

Type: _____ Amount: _____

Calculations Provided? Yes _____ No _____

9. Generator: Yes _____ No _____

Type: _____

10. Control Panel Tested For: (List Functions Tested) _____
_____
_____
_____

11. Heat Detectors: Manufacturer & Model # _____
_____

Type: _____

Number/Zone: _____ Total: _____

Total Heat Detectors Tested (Alarm): _____

12. Smoke Detectors: Manufacturer & Model # _____
_____

Type: _____

Number/Zone: _____ Total: _____

Total Smoke Detectors Tested: _____

13. Other Detectors/Sprinkler Devices: Manufacturer & Model # _____
_____

Type: _____

Number/Zone: _____ Total: _____

Total Other Detectors, etc. Tested: _____

14. Audible/Visual Signals: Manufacturer & Model # _____

TABLE I

FIRE DETECTION SYSTEM ACCEPTANCE TEST REPORT

_____

Type: _____

Number/Circuit: _____ Total: _____

Total Audible/Visual Signals Tested: _____

15. Supervision:

Detection Circuits (Circle One) Class A Class B

Number of Circuits Tested for Supervision: _____

Locations: _____

_____

_____

16. Audible/Visual Circuits (Circle One) Class A Class B

Number of Circuits Tested for Supervision: _____

Locations: _____

_____

_____

17. Supplementary Functions:

Type: _____

Operation: _____

Satisfactory (Circle One) Yes No

18. Supplementary Functions:

Type: _____

Operation: _____

Satisfactory (Circle One) Yes No

19. System Malfunctions Found: _____

_____

_____

_____

20. Corrective Action Taken: _____

_____

_____

_____

21. System Left in Normal Status (Circle One) Yes No

Inspector's Signature: _____

TABLE I

FIRE DETECTION SYSTEM ACCEPTANCE TEST REPORT

ZONE TEST REPORT

ZONE #: _____ LOCATION: _____

PULL STATIONS:

_____ # Tested _____ Satisfactory: Yes _____ No _____

HEAT DETECTORS:

Type: _____ Qty.: _____ # Tested: _____

Satisfactory: Yes _____ No _____

SMOKE DETECTORS:

Type: _____ Qty.: _____ # Tested: _____

Satisfactory: Yes _____ No _____

DOOR HOLDERS:

Type: _____ Qty.: _____ # Tested: _____

Satisfactory: Yes _____ No _____

Other Auxiliary Functions/Comments:

_____

_____

_____

_____

_____

_____

TESTS FOR FIRE DETECTION AND ALARM SYSTEMS
(INSTRUCTIONS)

INSTALLATION TESTS: (For Acceptance)

1. All alarm initiation devices shall be tested on completion of the installation.

2. Where such tests would destroy the device, other means of testing shall be provided.

3. Where local energy is used, tests shall be made using both primary and secondary power.

4. Master box or other connection shall be tested at least once on each circuit.

-- End of Section --

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DIVISION 13 - SPECIAL CONSTRUCTION

SECTION 13852

FIRE ALARM SYSTEMS (ADDRESSABLE SYSTEMS)

02/96

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SECTION 13852

FIRE ALARM SYSTEMS (ADDRESSABLE SYSTEMS)
02/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A17.1	(1996) Safety Code for Elevators and Escalators
ANSI A117.1	(1998) Accessible and Usable Buildings and Facilities

FEDERAL STANDARDS (FED-STD)

FED-STD 795	(1988) Uniform Federal Accessibility Standards

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Safety to Life from Fire in Buildings and Structures
NFPA 13	(1999) Installation of Sprinkler Systems
NFPA 70	(1999) National Electrical Code
NFPA 72	(1999) National Fire Alarm Code
NFPA 90A	(1999) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 268	(1996; 4th Ed; May 2, 1989) Smoke Detectors for Fire Protection Signaling Systems
UL 38	(1999; 7th Ed) Manually Actuated Signaling Boxes for Use with Fire Protection Signaling Systems
UL 464	(1996; 7th Edition) Audible Signal Appliances

UL 497B	(1993) Protectors for Data Communication and Fire Alarm Circuits
UL 864	(1996; 8th Edition) Control Units for Fire Protective Signaling Systems

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Schematics consisting of ladder diagrams of Control System showing interaction of components as a system shall be submitted for approval prior to installation.

Module schematic drawings, minimum size 11 inches by 17 inches, shall also be submitted prior to installation.

SD-02 Shop Drawings

Installation Drawings shall be submitted for Fire Alarm Systems in accordance with the paragraph entitled, "Installation," of this section.

Include the following:

A descriptive index of drawings in the submittal with drawings listed in sequence by drawing number.

A legend sheet identifying device symbols, nomenclature, and conventions used in the package.

Floor plans drawn to a scale not less than 1/8-inch equals 1 foot which clearly show locations of devices, equipment, risers, panels, electrical power connections, approximate location of conduit runs, and other details required to clearly describe the proposed system.

Location of control panels, detectors, supervisory switches, manual pull stations, and electrical devices. Clearly and completely indicate the function of the control panel and devices. Indicate conduit routing and sizes, and the number of conductors contained in each. Indicate points of connection and terminals used for electrical field connections in the system, with a wiring color code. Indicate termination points of devices and indicate the interconnection of modules required for proper operation of the system. Indicate interconnection between modules and devices. Control diagrams shall be supplemented with a narrative description of the system. Point-to-point wiring diagrams shall indicate control panel wiring and make and model of devices and equipment.

SD-03 Product Data

Material, Equipment and Fixture Lists shall be submitted for Fire Alarm Systems including manufacturer's style or catalog numbers,

specification and drawing reference numbers, warranty information, and fabrication site information.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Fire Alarm Systems
Fire Alarm Control Panels and related components
Alarm Control Units
Graphic Annunciator Panels
Textual Annunciators
Heat Detectors
Smoke Detectors
Manual Alarm (Pull) Stations
Sprinkler Flow Switches
Valve Tamper Switches
Bells
Horns
Addressable Interface Devices
Addressable Controllable Relays
Strobe Lights
Wiring and Raceways

SD-05 Design Data

Design Analysis and Calculations shall be submitted for Fire-Alarm and Detection Systems consisting of the following:

Detector installation location analysis and calculations.

Battery capacity and loading calculations to verify the requirements listed in the paragraph entitled, "Power Requirements."

SD-06 Test Reports

Test Reports shall be submitted for Fire Alarm Systems for the following field tests in accordance with the paragraph entitled, "System Field Wiring," of this section.

Preliminary Tests
Acceptance Tests
Existing System Tests
Current Output
Ground Detection Tests
Standby Power Tests
Trouble Tests

SD-07 Certificates

Certificates of Compliance from the manufacturer shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Fire Alarm Systems
Alarm Control Units
Heat Detectors

Smoke Detectors
Manual Alarm (Pull) Stations
Sprinkler Flow Switches
Valve Tamper Switches
Bells
Horns
Strobe Lights
Wiring and Raceways
Licensed Fire Alarm Contractor Qualifications

SD-07 Certificates

Listing of Product Installations for Fire Alarm Systems shall include identification of at least 5 units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. The list shall include purchaser, address of installation, service organization, and date of installation.

SD-11 Closeout Submittals

Upon completion, and before final acceptance of the work, submit a complete set of As-Built Drawings for the fire alarm system, including components and any other associated appurtenances. Include as-built circuit diagrams complete with conductor color codes and a listing of initiating device locations. As-builts shall be submitted on reproducible mylar film; size and title block shall be similar to the contract drawings.

1.3 QUALITY ASSURANCE

Equipment to be provided shall be the standard catalog product of a manufacturer regularly engaged in the manufacture of fire alarm equipment for the past ten years. Fire alarm equipment shall be the latest standard design and approved by Underwriters' Laboratories and Factory Mutual. Devices shall be approved by the control panel manufacturer and fire alarm authority having jurisdiction for use with the new or existing panel.

1.4 FIRE ALARM CONTRACTOR QUALIFICATIONS

A licensed fire alarm contractor shall supervise the installation and testing on the fire alarm system at the site.

Prior to installation, submit data for approval by the Facilities Management Division, GSFC, showing that the Contractor has successfully installed addressable, analog intelligent interior fire alarm systems of the same type as specified herein, or that the Contractor has a firm contractual agreement with a subcontractor having such required experience. Include the names and locations of at least five installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months. Submit names and phone numbers of points of contact at each site.

1.5 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.6 DEFINITIONS

Wherever mentioned in this specification or on the drawings, the equipment, devices, and functions shall be defined as follows:

EVACUATION ALARM SIGNAL: A signal which signifies a state of emergency requiring immediate notification of the Emergency Console (via the Operator Workstation) and of the building occupants. This signal is produced through activation of the following initiating devices:

a. Automatic Sprinkler Waterflow Switch
b. Manual Fire Alarm (Pull) Station
c. Two Smoke Detectors in the same Fire Zone
d. Remote Evacuation Signal

LOCAL ALARM SIGNAL: A signal which signifies a state of emergency requiring immediate notification of the Emergency Console (via the Operator Workstation) and select building occupants but not requiring the immediate evacuation of the building's occupants. This signal is produced through activation of the following initiating devices:

a. A Single Photoelectric or Ionization Smoke Detector
b. Duct Smoke Detector
c. Heat Detector (fixed temperature/rate of rise/rate compensated)
d. Flame Detector (UV, IR, or UV/IR)
e. Hazardous Gas Detector

SUPERVISORY SIGNAL: A signal which indicates an abnormal condition of the fire protection system which may prevent its normal use and which requires notification of the Emergency Console (via the Operator Workstation). This signal is produced through activation of the following initiating devices:

a. Sprinkler Valve Tamper Switch
b. Dry Pipe Low Air Pressure Switch
c. Fire Alarm System Primary Power Failure
d. Fire Pump Running
e. Fire Pump Power Failure
f. Fire Pump Phase Reversal

TROUBLE SIGNAL: A signal which indicates that a fault, such as an open circuit or ground, has occurred in the system and requires notification of the Emergency Console (via the Operator Workstation).

MULTIPLEX WIRED SYSTEM: A signalling method characterized by the simultaneous and/or sequential transmission and reception of multiple signals via the same conduction paths (communication channels) to the Fire Alarm Control Panel (FACP).

HARDWIRED SYSTEM: A signalling method in which initiating and indicating devices are directly connected through dedicated circuits to the FACP.

ALARM NOTIFICATION APPLIANCE/CIRCUIT: Any evacuation or local alarm notification device or series of devices arranged to visually and/or audibly indicate an alarm signal.

ADDRESSABLE INTERFACE DEVICE: An addressable device which converts hardwired systems or devices to a multiplex wired system.

ADDRESSABLE CONTROLLABLE RELAY: An addressable device which can be connected to an initiating device circuit and can be individually controlled by the FACP or Operator Workstation to open or close a set of form C dry contacts.

FIRE ALARM CONTROL PANEL (FACP): Alarm system consisting of the Central Processing Unit (CPU) necessary to furnish power to the system; receive and process signals transmitted from addressable devices; operate associated output devices such as: Audible/Visual Devices, Printers, Annunciators, Video Display Units (VDU) and other output devices not specifically stated; and communicate with remotely located operator workstation(s).

OPERATOR WORK STATION (OWS): A computer terminal with standard keyboard, monitor, printer and software capable of receiving and displaying all alarm, supervisory, and trouble conditions from all FACPs attached to the fire alarm network.

CLASS A WIRING: A circuit that is electrically supervised such that a single break or single ground fault condition will be indicated by a trouble signal on the FACP. The circuit shall be capable of operating for its intended use during a single break and/or ground fault no matter where the break and/or ground fault condition occurs. This would be Style 6 for the signalling line circuits, Style E for initiating device circuits, and Style Z wiring for notification appliance circuits.

CLASS B WIRING: A circuit that is electrically supervised such that a single break or single ground fault condition will be indicated by a trouble signal on the FACP no matter where the break and/or ground fault condition occurs. The circuit shall be capable of operating for its intended use during a single break and/or ground fault up to, but not beyond the break and/or ground fault. This would be Style 3.5 for the signalling line circuits, Style B for initiating device circuits, and Style Y wiring for notification appliance circuits.

DTM WIRING: Wire line data transmission system between buildings used to connect addressable fire alarm control panels and the Operator Workstation to form a fire alarm network.

BUILDING INTERCONNECT WIRING: Wire system used to link addressable fire alarm system devices located in multiple buildings to a FACP located in a single building.

1.7 SYSTEM REQUIREMENTS

Provide complete and operational multiplex fire alarm system in each of the Buildings indicated in the contract drawings and specifications. The new system shall be capable of performing all operations described within this specification and on contract drawings. Each new FACP shall be connected to the existing DTM cabling to form a fire alarm network.

As a minimum, the new fire alarm systems in each Building shall have, but not be limited to, the following capabilities:

a. Manual pull station activation
b. Smoke/Heat detection
c. Sprinkler flow detection
d. Supervisory functions for sprinkler, dry pipe, and firepump systems
e. Alarm notification by evacuation zones
f. Local alarm annunciation

g. Central alarm annunciation at a main annunciator
h. Interface with gas detection systems for annunciation and notification
i. Interface with mechanical systems for air handling unit shut down.
j. Interface with elevator controls for recall and shut-down
k. Full two way communication with the OWS in Building 24, annunciation to the OWS as well as full control of the FACP by the OWS.

The system shall use closed loop initiating devices, circuits with individual zone supervision, individual initiating appliance circuit supervision, and incoming and standby power supervision.

The system shall provide communication with every initiating and control device, and each device shall be individually annunciated at the FACP, the building's main annunciator panel, and at the OWS. Annunciation for each device shall include the following conditions:

a. Alarm
b. Trouble
c. Open Circuit
d. Short Circuit
e. Ground Condition
f. Date and Time of Off-Normal condition

Each initiating device shall be capable of being individually enabled or disabled from the FACP and the OWS.

At least 60 addressable initiating devices shall be completely supported on a single pair of wires used for alarm initiation.

Addressable initiating devices shall be able to be added anywhere on an initiating circuit loop. A "T" splice is acceptable whenever class B wiring is used. Systems and devices that require factory reprogramming to add or delete devices are not acceptable.

Each smoke detector shall transmit its current status to the FACP at least once every 5 seconds.

The smoke detection system shall have the ability to:

a. Analyze and filter signal information to reduce false alarms due to changes in environmental conditions other than smoke.

b. Maintain a fixed alarm threshold between the average value of the detector and the alarm set point.

c. Develop an average signal value for each sensor and determine if this average signal indicates a dirty detector. If a dirty detector is indicated, the FACP and OWS shall be notified.

d. Allow different smoke detector alarm settings based on time of day and day of week.

The Fire alarm control panel shall allow for loading or editing special instructions and operating sequences as required in the field, by Goddard Space Flight Center (GSFC) personnel. The system is to be capable of on site programming to accommodate and facilitate expansion, building parameter changes or changes as required by GSFC management.

Software operations shall be included in a programmable memory within fire alarm control panel. Loss of power shall not erase the instructions stored in memory.

The software shall allow the selective input and output of control functions.

Initiation circuits shall be individually configurable on site. System shall have the capability of interchangeable detectors using the same base.

Fire alarm system shall be in full compliance with NFPA 72, and NFPA 70 (with emphasis on Article 760). All work shall be coordinated with other work being performed in the location/vicinity of this project, and shall be coordinated with existing conditions present in the area in which the work is to be accomplished.

1.8 SYSTEM OPERATION

1.8.1 General

All work performed under this specification shall result in a fully functioning system, in complete compliance with NFPA 72. The following functions and features shall be included:

a. All fire alarm initiating circuits shall be electrically supervised and wired as Class B.

b. All fire alarm notification circuits shall be electrically supervised and wired as Class A

c. Automatic response functions shall be accomplished by the first zone initiated. Alarm functions resulting from initiation by the first zone shall not be altered by subsequent alarms. An alarm signal (smoke, heat, manual pull station, sprinkler flow, or remote evacuation) shall be the highest priority. A supervisory signal shall have second priority, and a trouble signal shall have third priority. Signals of a higher level priority shall take precedence over signals of lower level priority even if a lower priority condition occurred first. All signals shall be annunciated, regardless of the priority or order received.

d. The manual or automatic operation of any alarm or supervisory device or the occurrence of any trouble condition shall cause the transmission of the appropriate signal to the FACP. The FACP shall then cause annunciation of the signal at the FACP and the building's main annunciator panel as well as transmit the signal to the OWS. The annunciation shall include the exact nature of the signal, location in the building, and the device that operated. The signal, with all appropriate information (including time and date), shall be recorded on the system printer at the OWS.

e. The maximum permissible elapsed time between the actuation of any alarm initiating device, supervisory signal, or trouble condition and its transmission to the FACP as well as its indication on the main annunciator panel and OWS shall be 5 seconds.

f. Upon operation of any alarm (manual or automatic), a manual re-set at the building's fire alarm control panel shall be necessary to

return the system to full-normal operation. Reset operations shall only be possible through the use of a key or from behind a locked panel door.

g. All addressable devices shall have the capability of being disabled or enabled individually, or as a group, at the building's FACP and OWS. Each such action shall be recorded on the printer at the OWS.

h. All components shall be immune from false alarms caused by RFI or EMI.

i. The system shall be fully field programmable from the FACP. It shall be possible to set the alarm sensitivity of each individual detector from the FACP or the OWS.

j. The smoke detection system shall have the capability of alarm verification for each smoke detector. Under alarm verification, the FACP will reset a detector and wait for a second alarm from that detector or from another detector in the same zone before performing output operations. If after 60 seconds, a second alarm is not received, the FACP shall return to normal standby operation. All alarm verification modes shall be annunciated at the FACP and the OWS and shall be printed on system printers.

k. Audible Alarm Silencing:

Operation of the building evacuation system may only be silenced from inside the locked FACP, from the main annunciator panel through the use of a key, or from the OWS using the appropriate password.

Operation of an audible alarm at any remote annunciator may be silenced by a button or switch at the annunciator.

Silencing any audible alarm shall not reset the fire alarm control panel.

l. The system shall be capable of supervising, communicating with and/or monitoring either addressable devices or addressable interface devices supervising non-addressable alarm, and supervisory devices. The system shall be capable of operating hardwired indicating devices as specified.

1.8.2 Elevator Control

Work shall be performed in accordance with NFPA 13, NFPA 72, NFPA 101, ANSI A17.1, other applicable local and national codes, and authorities having jurisdiction.

1.8.2.1 Smoke Detection

Provide a smoke detector at each elevator lobby, in each elevator machine room, and at the top of each elevator hoistway, as indicated in the contract drawings. Smoke detectors in the hoistways and the machine rooms shall be installed adjacent to the heat detectors.

Upon activation of any of the above mentioned smoke detectors, the FACP shall send a signal to the appropriate elevator controller(s) to initiate

Phase I Emergency Recall Operations. A signal shall be sent for either primary or secondary recall as indicated on the contract drawings.

1.8.2.2 Heat Detection

Provide a heat detector located within two feet of each sprinkler head in the elevator machine rooms and at the top of elevator hoistways, as indicated in the contract drawings. The heat detectors shall have a lower temperature rating and a lower response time index than the existing sprinkler heads.

Upon activation of any heat detector in a hoistway or elevator machine room, the FACP shall send a signal to automatically activate the existing shunt-trip breaker for the affected elevator(s).

1.8.3 Evacuation Alarm Signal

Upon activation of any Evacuation Alarm Signal, the FACP shall send a signal to all elevator control panels to initiate Phase I emergency recall operations and to return the elevators to the level for primary recall.

1.8.4 System Testing

Provisions to fully test the system shall be made, and shall meet the criteria of NFPA 72.

The system shall have the capability to be tested by one person. This capability shall be such that individual initiating devices or zone(s) can be deactivated, and tested with a system printer reporting the results. If other initiating devices or zones indicate an alarm or supervisory signal during the same time, the signal shall be processed normally.

If during system testing, a pre-set system testing time is exceeded, the system shall restore to full-normal operation automatically.

1.8.5 Electrical Supervision

Provide a system having electrical supervision in accordance with the requirements of NFPA 72 and this specification. All system devices shall be supervised. Faults shall be indicated with trouble signals at the FACP and the OWS. The maximum elapsed time between the occurrence of the trouble condition and its indication at the CPU shall not exceed 5 seconds.

1.8.6 Overvoltage and Surge Protection

Equipment connected to alternating current circuits shall be protected from power line surges. Equipment shall meet the requirements of UL 864 and IEEE C62.41. Fuses shall not be used for surge protection.

All Communications equipment shall be protected against surges induced on any signalling or power line circuit.

1.9 EXISTING FIRE ALARM SYSTEMS

Major buildings at the GSFC utilize either a hardwired (non-multiplexed) Pyrotronics System 3 fire alarm system or a Pyrotronics MXL (addressable) fire alarm system.

Buildings 4, 11, 12, 25, 26, 27, 31, 32 and 33 utilize a fully addressable,

Pyrotronics MXL fire alarm system. A project is in place to install the Pyrotronics MXL system in Building 22. In addition, Buildings 25F and 76 utilize the Pyrotronics MXL system.

Fire alarm system modifications/alterations and additions shall be made by expanding the existing MXL system in the above buildings.

The remaining major buildings utilize a Pyrotronics System 3 fire alarm system. New Pyrotronics MXL fire alarm control panels have been installed in these buildings to monitor the existing Pyrotronics System 3 FACP and interface with the OWS in Building 24. The Pyrotronics MXL system monitors the status of Form C relay contacts in the existing FACP and transmits the status of these points to the OWS. The MXL system is capable of initiating an Evacuation Signal in each building through an output relay interfaced to the existing FACP.

Fire alarm system modifications/alterations and additions shall be made by either expanding the MXL system or the Pyrotronics System 3 as indicated in the contract drawings.

New devices installed under this contract shall be compatible with the existing fire alarm systems being utilized in each building.

PART 2 PRODUCTS

2.1 FIRE ALARM CONTROL PANEL (FACP)

2.1.1 General

A Fire Alarm Control Panel (FACP) shall be installed as indicated on the contract drawings. The FACP shall monitor and control all initiating devices and output devices for it's respective Building and any support structures around the building as indicated on the contract drawings. Each FACP shall be a U.L. Listed stand alone panel.

2.1.2 Fire Alarm Status Changes

FACP shall receive all status changes from connected addressable devices and direct appropriate output to the building evacuation system, the main annunciator panel, appropriate remote annunciator panels, OWSs, and other facility functions as required per this specification or contract drawings.

Maximum allowable time from the beginning of a status change to the transmission of the status change to the FACP and subsequent transmission of the status change from the FACP to the OWS and other output devices shall be 5 seconds. The status change shall be displayed on an alphanumeric display at the FACP. The information to be shown includes, but is not limited to:

a. The exact location of the signal within the building
b. The nature of the signal (eg. alarm, walk-test, trouble, etc.)
c. The type of device activated (eg. pull station, sprinkler flow, smoke, etc.)
d. The date and time the signal occurred

Upon activation of any alarm, supervisory, or trouble condition, a silencable audible signal shall sound at the FACP.

2.1.3 Operating Features

2.1.3.1 Smoke Detection Disconnects

Each FACP shall be equipped with smoke detector disconnect switches for detectors located in each of the areas described below:

1. Building

   The FACP shall be provided with a switch (physically operated or software driven) which will disconnect all smoke detectors, except those used for elevator recall, within the building while leaving all other initiating devices unaffected. This shall be accomplished via a process requiring fewer than five steps by qualified personnel only.

2. Floor

   The FACP shall be provided with a switch (physically operated or software driven) which will disconnect all smoke detectors, except those used for elevator recall, on a given floor, while leaving all other initiating devices unaffected. This shall be accomplished via a process requiring fewer than five steps by qualified personnel only.

3. Fire Zone

   The FACP shall be provided with a switch (physically operated or software driven) which will disconnect all smoke detectors, except those used for elevator recall, within a given fire zone, while leaving all other initiating devices unaffected. This shall be accomplished via a process requiring fewer than five steps by qualified personnel only.

4. Under Floor and Above Ceiling

   The FACP shall be provided with a switch (physically operated or software driven) which will disconnect all smoke detectors, except those used for elevator recall, located below a raised floor or above a suspended ceiling area while leaving all other initiating devices unaffected. This shall be accomplished via a process requiring fewer than five steps by qualified personnel only.

2.1.3.2 Displays

The FACP shall be provided with at least an 80 character alphanumeric display for annunciation of all status changes. The alphanumeric display shall be a permanent component of the FACP.

2.1.3.3 External Printer

The ability to connect a standard 80 character per line, 8-1/2" x 11" continuous form feed dot matrix printer to the FACP via a standard printer cable, without hardware modifications, shall be provided. The standard dot matrix printer shall be capable of performing all hardcopy output operations when attached to the FACP. This printer shall be able to print a status report of all individual addressable circuits and/or devices, including sensitivity settings and thresholds limits of smoke detectors.

The printer shall also be able to print the status of all devices tested during a walk-test. All information printed on the printer shall be in easy to read English language.

A standard 80 character per line, 8-1/2" x 11" continuous form feed dot matrix printer, complete with all software and hardware needed to connect the printer to the FACP shall be provided under this contract.

2.1.3.4 Lap-Top Computer and External Printer

The ability to connect a lap-top computer, without hardware modifications, shall be provided. This lap-top computer shall be capable of performing all software modifications for programming and reprogramming of the fire alarm system; however the lap-top computer shall not be required for minor modifications to the fire alarm system program.

2.1.3.5 Silencing Switches

FACP shall provide for the acknowledgement of all status changes, trouble silence, alarm silence, and alarm reset. Subsequent alarms shall cause the audible signal to sound again until they are silenced in turn by acknowledging the signal. Restoration of alarm, supervisory, and trouble conditions to normal shall extinguish the associated annunciator signal, and cause the audible signal to sound until the restoration is acknowledged. Alarm silence and alarm reset functions shall be possible only with the use of a key or from behind a locked panel door.

2.1.3.6 Non-Interfering

Supervision of each fire alarm device shall be such that a signal from one device does not prevent the receipt of signals from any other device. Devices shall be manually resettable by a switch in the FACP after the initiating device or devices have been restored to normal.

2.1.3.7 Resetting

Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm or trouble condition still exists on the system.

2.1.3.8 System Memory

FACP shall have multiple levels of alarm priority for displaying alarms and other events. System shall be provided with a memory so that no event will be lost. All alarms, supervisory, or trouble conditions shall remain in the memory until acknowledged by the user. Memory shall be non-volatile so that no information is lost upon complete power loss at the FACP. A complete reboot of the FACP shall not require any reprogramming.

2.1.3.9 Communication with OWS

The FACP shall be capable of normal operations even if communication with the OWS is interrupted.

2.1.4 Output Functions

The FACP shall perform output functions as described within this specification and on the contract drawings and as further described below:

1. Upon activation of any Evacuation Alarm Signal the FACP shall:

    a. Operate all evacuation alarm bells sounded in marched time (Note: Bells shall be silencable from the FACP, the main annunciator panel, and the OWS)
    b. Operate all evacuation strobe lights from a continuous power source (Note: Strobes shall not be affected by the alarm silence function)
    c. Annunciate the status of the initiating device(s) at the FACP, main annunciator panel, OWS, and system printers
    d. Activate Phase I Emergency Recall operations for elevators as further described in this specification
    e. Release all doors normally held open by magnetic holders

2. Upon activation of any Local Alarm Signal the FACP shall:

    a. Operate the appropriate local annunciator horn
    b. Annunciate the status of the initiating device(s) at the FACP, main annunciator, appropriate local annunciator, OWS, and system printers
    c. Activate Phase I Emergency Recall operations for elevators as further described in this specification. (Only when elevator smoke detectors or elevator heat detectors are active)
    d. Activate elevator power shut-down procedures as further described in this specification. (Only when elevator smoke detectors or elevator heat detectors are active)
    e. Release all doors normally held open by magnetic holders as further described in this specification

3. Upon activation of any Supervisory Signal or Trouble Signal the FACP shall:

    a. Annunciate the status of the device(s) at the FACP, main annunciator, OWS, and system printers
    b. Sound an audible signal at the FACP and the main annunciator

2.1.5 Operator Access

Multiple levels of access shall be provided for firefighters, operators, and supervisors via user-defined passwords. The following shall be provided for each level:

1. Firefighter Level Access Functions (Firefighter Level functions shall not require a password. Functions shall be accessible from behind a locked panel door):

    a. Display and acknowledgement of all off-normal conditions
    b. Activate building evacuation devices
    c. Trouble/Supervisory Silence
    d. Alarm Silence
    e. System Reset

2. Operator Level Access Functions:

    a. All functions under Firefighter Level
    b. Display system directory, definable by device
    c. Display status of individual devices
    d. Report generation, definable by device or zone; output on

either the alphanumeric display or the printer, selectable by the user operator

3. Supervisor Level Access Functions

   a. All functions under Operator Level
   b. Reset Time and Date
   c. Enable or disable event initiated programs, printouts and initiators
   d. Enable or disable individual devices and system components
   e. Enable or disable system walk-tests

4. Programmer Level Access Functions

   a. All functions under Supervisor Level
   b. Reprogram system devices, components or outputs

2.1.6 System Capacity

The FACP shall have the capacity to handle at least 10 addressable initiating device circuits with at least 60 addressable initiating devices on a circuit. Each initiating circuit shall use only two wires, and the same two wires shall be used for device power and data transmission. The FACP shall be capable of transmitting information to at least 12 separate remote zone annunciator panels and at least two graphic annunciator panels.

2.1.7 Power Requirements

FACP shall normally operate from a 120 VAC power source, from a dedicated electrical circuit. Battery back-up power shall be provided to ensure operation of the entire FACP including but not limited to all remote annunciator panels, and all auxiliary function relays. Magnetic door holders need not operate during times of battery usage.

2.2 AUXILIARY SYSTEM FEATURES

2.2.1 Main Graphic Annunciator

Provide a graphic annunciator panel as indicated on the contract drawings.

The main annunciator panel shall contain both a graphic and alpha-numeric display unless otherwise indicated. The graphic panel shall indicate, in an easy to understand and quickly identifiable way, the location of an alarm, the floor level of the alarm, and the nature of the alarm.

The graphic display shall show the building footprint and all fire zones. It shall have color coded building/zone outlines and text on a smoked glass background which is backlit by color coded LEDs. All stairway and elevators shall be shown on the panel with their appropriate identification number. The location of the dry pipe system, fire control room, fire pump room, fire department connections, and remote annunciator panels shall all be indicated on the graphic display.

The annunciator shall have an 80 character, minimum, alpha-numeric display which will indicate in simple, clear, and exact language, the most current event.

The ability to display backward from the current event, each of the prior 100 events; shall be incorporated in the annunciator.

The display shall return to normal when the FACP is manually reset, but shall retain the information for the last 100 events until manually cleared.

An audible device shall be provided at the main annunciator that will sound upon activation of any alarm, supervisory, or trouble signal. A silence push-button type switch shall be provided to silence the audible alarm at the main annunciator.

A system reset switch shall be provided at the main annunciator panel. The reset switch shall be operable only through the use of a key or from behind a locked panel door. The key for reset shall be the same as that used for the main FACP.

Both the graphic and alpha-numeric annunciator panels shall be fully supervised by the FACP.

2.2.2 Remote Local Annunciators

FACP shall be capable of supporting up to twelve (12) remote local annunciators. Remote local annunciators shall be fully supervised by the FACP.

Each remote annunciator panel shall have an 80 character, minimum, alpha-numeric display which shall indicate in simple, clear, and exact English language any local alarm signal within its zone boundaries. Upon activation of a local alarm signal, the status of the device shall show on the annunciator, and a continuous sounding klaxon horn shall sound indicating an off-normal status of the fire alarm system. The klaxon horn shall be an integral part of the annunciator panel or mounted directly above the annunciator panel. Provide a push-button switch on the annunciator panel to silence the horn. Activated devices within a zone boundary shall not affect local annunciators outside of the affected device's boundary.

Provide a Cadd drawn map of the zone showing, as a minimum, zone boundaries, corridor and room layout, room and stair numbers, "You Are Here" indication, and all device type and locations within the zone boundary. With each device, a number (or other form of identification) shall be indicated which would cross-reference the identification on the alpha-numeric display. This identification number is for exact point location of all local alarm devices.

Zone map shall be installed in a metal frame behind a clear acrylic cover and permanently mounted to the wall directly adjacent the local annunciator. Minimum size for the map shall be A4.

2.3 EMERGENCY POWER SUPPLY

2.3.1 Batteries

Provide a secondary source of emergency power to the FACP. The secondary power source shall be sealed lead-acid or nickel cadmium batteries. The battery system shall be maintained in 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.

2.3.2 Capacity

Provide the battery powered secondary power system with sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. Following this period of operation on battery power, the batteries shall have sufficient capacity to operate all components of the system, including, but not limited to all alarm indicating devices in alarm or supervisory mode for a period of 15 minutes.

2.3.3 Battery Charger

Provide a solid state, fully automatic, variable charging rate battery charger. The charger shall be capable of providing 150 percent of the connected system load and shall maintain the batteries at full charge. In the event the batteries are fully discharged, the charger shall recharge the batteries to charge in four hours or less, such that the batteries can operate all of the functions as described in this specification.

2.3.4 Trouble Signals

The loss of primary power at the FACP shall result in a trouble signal at the FACP and the annunciator. An "Emergency Power" signal shall be displayed at both locations, and also transmitted to the OWS.

2.4 INITIATING AND NOTIFICATION DEVICES

2.4.1 Manual Pull Stations

Manual pull stations shall be addressable, and shall communicate the station's status - normal or alarm - to the FACP on a 2 wire system which also provides power to the pull stations. Each station shall have a unique address, indicating the exact location of each manual pull station, and the address shall be programmable in the field.

A key shall be required to open and reset each station.

The stations shall be metal or plastic, finished in red with molded raised letter operating instructions of contrasting color. Stations shall be double action. Stations requiring the breaking of a glass panel or the breaking of a concealed glass rod are not acceptable.

There shall be no limit to the number of pull stations which may be activated simultaneously, and each alarm shall be individually received at the FACP. All equipment used shall be U.L. listed.

2.4.2 Water Flow Switches

2.4.2.1 General

Each flow switch shall be connected to the FACP via an addressable interface device. Each flow switch shall have a unique address, indicating the exact location of each device and the sprinkler zone for which the device is monitoring. The address shall be programmable in the field.

Flow switches shall be provided with two sets of single pole double throw contacts rates at a minimum 2 amps @ 24 VDC. The cover for the flow switches shall be provided with an integral tamper switch and tamper resistant screws. The addressable interface device shall be wired to the flow switch such that an alarm occurs on a short circuit, and a trouble

occurs on an open circuit. The occurrence of a trouble condition shall not prevent the transmission of an alarm condition.

Flow switches shall be provided and installed by the sprinkler contractor, but shall be wired and connected to the FACP by the fire alarm contractor.

2.4.2.2 Vane Type Flow Switch

Vane type flow switches shall consist of a cast aluminum pipe saddle which houses an electromechanical device to which is attached a corrosion-free flexible, low-density polyethylene paddle. The paddle shall conform to the inside diameter of the sprinkler pipe and sense all water movements. To prevent false alarms, the flow switch shall incorporate an adjustable time delay mechanism between the paddle-operated stem and the alarm initiating contacts. The time delay shall be field adjustable from zero to sixty seconds, and shall be initially set at 20 seconds.

A tapped 1/2 inch conduit connection shall be provided. Flow switches shall be UL listed for its intended purpose. A screw-type terminal block shall be provided for making connections.

2.4.2.3 Pressure Type Flow Switch

Pressure type flow switch shall be all metal with a 1/2 inch NPT polysulfone (or equivalent) pressure connection. Pressure switch shall be adjustable to operate at varying pressure increases. Set points shall range from at least 0 to 20 psi. The pressure switch shall be initially set to alarm upon a pressure increase of 10 psi .

A tapped 1/2 inch conduit connection shall be provided. Flow switches shall be UL listed for its intended purpose. A screw-type terminal block shall be provided for making connections.

2.4.2.4 Dry Pipe Low Pressure Switch

Low pressure switch shall be of the adjustable set point low-differential type.

2.4.3 Smoke Detectors

2.4.3.1 General

Smoke detectors shall be smoke density measuring devices having as a minimum, 3 alarm set points (fixed thresholds). The alarm set point for each sensor shall be programmable at either the FACP or the OWS.

All detectors shall be UL listed for use with the installed FACP and shall include all required accessories. Detectors and accessories installed shall be rust and corrosion resistant. Detectors shall be installed per their listing and as shown on contract drawings.

Detectors shall contain no moving parts, nor shall they require readjustment or removal to resume normal operation after an alarm. All detector openings shall be screened to prevent the entry of insects and debris.

A visual indication shall be provided on the detector or detector base to indicate when a detector is in alarm.

Detectors shall have the capability to sound an audible alarm from each initiating device upon activation.

Detectors shall be able to recognize when the detection chamber is excessively dirty and likely to cause a false alarm. When this happens, a "Dirty Detector" warning shall be annunciated at the FACP and OWS along with the detector's address and location.

Detectors shall be the plug in, twist lock type, and shall all use a common base. Detectors shall be supervised to initiate a trouble signal at the FACP if the detector is removed from its base. The smoke detector base shall be the same as that used for heat detectors.

Ionization, photoelectric, and duct detectors shall be addressable analog devices and send their status signal and their address over a 2-wire circuit, and shall receive their operating power from the same 2-wire circuit. There shall be no limit to the number of detectors which can simultaneously be in alarm and transmit signals over a 2 wire system. Every alarm initiated shall be acted upon by the fire alarm control panel.

2.4.3.2 Ionization Detectors

Detectors shall operate on the ionization principle and shall activate when products of combustion are present in the air. Detectors shall have multiple detection chambers and shall automatically adjust for atmospheric conditions to reduce the likelihood of false alarms.

2.4.3.3 Photoelectric Detectors

Detectors shall operate on the photoelectric light scattering principle and shall activate when products of combustion are present in the air. Detectors shall be of solid state design and use an LED light source.

Photo-electric detectors shall be used where specified on contract drawings.

2.4.3.4 Duct Detectors

Duct detectors shall meet the same criteria as listed above for "smoke detectors."

Detector base for air duct use shall include integral housing with all required air sampling equipment. Length of air sampling tubes shall be as required by the manufacturer for a particular duct installation. Detector base shall include at least one set of Form-C dry contacts for alarm output.

A duct detector shall be placed at each location shown in the contract drawings and shall be of the ionization type.

2.4.4 Heat Detectors

Heat detectors shall be U.L. listed, and shall be of the plug-in, twist type, compatible with system smoke detectors. Heat detectors shall operate on the fixed temperature principle, and shall have a lower temperature rating and smaller RTI value than the sprinkler heads located in the area around the detector. Heat detectors shall be self-restorable after an activation. The base used for the heat detectors shall be the same as that used for the smoke detectors. If a heat detector is removed from its base,

a trouble signal shall be indicated at the FACP. A light shall indicate the operation of each detector.

The location of each heat detector will be as shown on the drawings.

Detectors shall be of the addressable, low voltage type and shall operate on a 2-wire system.

Each detector shall have the capability to sound an audible alarm from the initiating device upon activation.

2.4.5 Gas Detector Alarms

The FACP shall monitor, via addressable interface devices, dry contacts provided in the existing gas detection alarm panel as indicated on the contract drawings. The FACP shall monitor two levels of alarm output, high and low, for each type of gas being monitored. Each alarm output shall have a unique address. Additionally, the FACP shall monitor a gas detection alarm panel trouble condition via dry contacts by using an addressable interface device.

2.4.6 Incipient Smoke Detection

Incipient smoke detection shall be provided as indicated on the contract drawings. Air sampling smoke detection shall be designed and installed by a licensed fire alarm contractor. Incipient smoke detectors utilizing the Wilson Cloud principle are not acceptable. Detectors requiring maintenance beyond routine cleaning or replacement of filters (if provided) are not acceptable.

Incipient smoke detectors shall be monitored by the building FACP for the conditions indicated. Where the conditions to be monitored are not specified, as a minimum, trouble and alarm conditions shall be monitored at the FACP.

2.4.7 Supervisory Switches

2.4.7.1 Valve Tamper Switches

Provide tamper switches as shown on the contract drawings. Tamper switches shall be UL listed as "Extinguishing System Attachment" for the location and type of valve specified. Operation of the switch shall cause a supervisory signal to be transmitted to the FACP upon not more than two complete turns of the valve wheel or a closure of ten percent, whichever is less. Provide terminal blocks for making connections.

Each tamper switch shall be connected to the FACP via an addressable interface device. Each tamper switch shall have a unique address, indicating the exact location of each device and the sprinkler zone for which the device is monitoring. The address shall be programmable in the field.

Tamper switches shall be provided with two sets of single pole double throw contacts rated at a minimum 2 amps @ 24 VDC. The cover for the tamper switches shall be provided with an integral switch for detection of device tampering and it shall have tamper resistant screws.

Tamper switches shall be provided and installed by the sprinkler contractor, but shall be wired and connected to the FACP by the fire alarm

contractor.

2.4.7.2 Other Supervisory Functions

Where other supervisory functions are required, i.e. firepump supervision status of existing FACPs etc., each supervisory state shall be monitored via an addressable interface device using a unique address, indicating the exact location and nature of the alarm.

2.4.8 Audible Alarm Indicating Devices

All audible devices shall be UL listed for the intended service.

2.4.8.1 Evacuation Alarm Signal

A marched time bell shall be used for the audible evacuation signal. Bells shall be red, 254mm or 150mm, 24 VDC vibrating, under-dome, alarm indicating devices in accordance with UL 464. Bells shall be capable of producing 90 dB measured at 3050mm.

Alarm bells shall be solenoid-operated plunger sounding devices. Operating mechanism shall be rustproof, protected from dust and insects, and located behind the gong shell.

If a bell and a strobe are to be placed in the same location, a combination bell/strobe unit is acceptable. The strobe portion of the combination unit shall be in accordance with the applicable provisions of the paragraph entitled "Visual Alarm Indicating Devices".

2.4.8.2 Local Alarm Signal

A continuous sounding 4" klaxon horn shall be used for the audible local alarm signal. A klaxon horn shall be located on or directly above each remote local annunciator panel. The horn shall be silencable via a push-button switch on each annunciator panel; switch shall not require the use of a key. Horn shall be capable of producing 90 dB measured at 3050mm.

2.4.8.3 Trouble/Supervisory Alarm Signal

Pico sounders shall sound for trouble and supervisory conditions. Sounders shall be located at all remote local annunciator panels, the main annunciator panel, and the FACP. Means shall be provided to silence the pico sounders.

2.4.9 Visual Alarm Indicating Devices

Visual alarm indicating devices shall be 15, 30, 75, or 110 candela strobe lights as indicated on the contract drawings producing between 60 and 120 flashes per minute. Each strobe light shall include a red cast metal housing, a clear lexan lens with red "FIRE" lettering on at least two sides, and a zenon flash tube with solid state circuitry. Strobe light shall be UL listed or FM approved for fire protective service.

2.5 CONTROL/AUXILIARY DEVICES

2.5.1 Addressable Interface Device

The addressable interface device shall provide an addressable input interface to the FACP for monitoring normally-open contact devices using

a Class B wiring method. End of line resistors shall be located at the contacts being supervised. The addressable interface device shall operate from the 2 wire initiating circuit which provides 24 VDC power and 2 way communications for initiating devices. Circuits shall be supervised for both open and ground fault conditions. The interface device shall be capable of transmitting its required signal from hardwired contact devices, onto the 2-wire multiplexed fire alarm system.

2.5.2 Magnetic Door Holders

Where indicated on the drawings, provide magnetic fire door hold open devices. They shall develop 25 pounds of holding force.

The door portion of the holder shall have a stainless steel pivotal mounting device with a shock absorbing bearing.

Hold open devices shall operate on a 120 VAC power source. All hold open devices shall release upon activation of any evacuation alarm signal. If a smoke detector adjacent to a hold open device activates, then only the device adjacent to the smoke detector shall release.

2.5.3 Addressable Controllable Relays

Addressable controllable relays shall have continuous duty coils rated at 24 VDC. Relays shall have at least one single pole double throw contact rated at 3 amps at 30 VDC or 250 VAC. Where auxiliary control circuits connected to the relay are protected at a higher ampacity than the relay contacts are rated, fusing rated to protect the relay contacts shall be installed in the relay enclosure. Addressable controllable relays shall connect to the 2 wire initiating circuit to receive power and 2 way communications from the FACP/OWS.

PART 3 EXECUTION

3.1 GENERAL

The complete fire alarm installation shall be in full compliance with NFPA 72, the manufacturer's instructions, and U.L. listing. This includes all wiring, products, and product installation.

The complete installation shall conform to the requirements of NFPA 70, with particular attention to Article 760.

3.2 ELECTRIC POWER

120 VAC 60-hertz power which may be required for the FACP, Main Annunciator, Remote Annunciator, and other auxiliary devices (magnetic door holders are not included) shall be obtained from the indicated panelboard from a dedicated circuit. Where a panel and circuit are not indicated it shall be permissible to obtain the power from a dedicated circuit in the closest appropriate electric panel. The circuit breaker shall be painted red and labelled "Fire Alarm".

There shall be one black phase conductor, one white solidly grounded neutral conductor and one green equipment grounding conductor. Conductors shall be a minimum #12 AWG copper. Surge arrestors shall be installed in accordance with NFPA 72.

3.3 SYSTEM FIELD WIRING

3.3.1 General

Cabling and wiring shall conform to the requirements of NFPA 70 and the following special requirements:

Fire alarm system circuits shall be installed in a separate raceway system. Within the fire alarm system, 60-hertz power circuits and fire alarm initiating, alarm and control circuits shall be installed in separate cabling systems. 60-hertz power circuits shall not enter enclosures containing fire alarm circuits except where required to connect to the fire alarm system.

Conductors shall be continuous from a terminal point at one device to a terminal point at the next device and from a device to the FACP. Break wires at each terminal; wires shall not be looped over a terminal. Approved explosion proof devices provided with pigtail wiring connection leads shall be terminated on a field installed terminal strip installed in the box on which the device is mounted. Solderless ring tongue terminal lugs shall be installed with manufacturer's required tooling on the device wiring connection leads. Ring tongue type lugs shall be used only on stranded wire. Termination of solid wire shall be made using compression or screw type terminals. When screw type terminals are used the conductor must be captured under 80 percent of the screw head surface.

Surge suppression in accordance with UL 497B shall be installed on each conductor of fire alarm circuits which extend beyond the building. Protection shall be located as close as practical to the point where the circuits leave the building. Protectors shall be installed in enclosures of adequate size with terminal strips for all wiring connections plus 25 percent spare. Enclosures shall be painted with a prime coat and one or more coats of red baked enamel finish to provide a smooth, hard, and durable finish. Protectors shall be connected to a earth ground electrode system in accordance with the manufacturer's requirements and NFPA 70.

Conductors installed on fire alarm systems shall be solid copper, with an insulation rating of not less than 300 volts. Conductors shall be marked with the AWG size, voltage rating and manufacturer's name permanently marked on the conductor jacket at not less than 70mm intervals. Conductor size and color shall be as specified in this Section. Where modifications are made to existing systems, the new and added conductors shall match the size and color coding of the existing system.

Conductors for multiplexed communication circuits, remote phone circuits, remote station signaling circuits, and addressable initiating circuits shall be solid copper, shielded, twisted pairs. Cable shall be listed as type FPLP, Power-Limited Fire Protective Signaling Circuit Plenum Cable. Conductor size shall be as indicated, or required by FACP manufacturer, but not less than #16 AWG for signaling or initiating circuits. Cables shall be red and marked with circuit designations and consistent color coding for the positive and negative loops which shall be maintained throughout the cable system. All new initiating device circuits shall be installed such that 25 percent of their full capacity is available for future expansion.

Power leads from the FACP for auxiliary devices requiring 24 VDC shall be one white positive and one black negative, and shall be sized accordingly, but not less than #14 AWG type THHN/THWN.

Direct current notification device circuits shall be wired as Class A. Strobe positive conductor shall be colored blue and the negative conductor shall be colored white. Bell positive conductor shall be colored orange and the negative conductor shall be colored red. Conductor size shall be not less than #14 AWG. Conductor insulation shall be type THHN/THWN for #14 and larger. For the Class A loop, the two feeds for a circuit shall be run in separate conduit. The risers, horizontal or vertical, for each zone shall be separated by at least a one hour fire barrier. All new notification device circuits shall be installed such that 25 percent of their full capacity is available for future expansion.

Direct current auxiliary device control circuits shall be wired as Class A. Conductor size shall be not less than #16 AWG. Conductor insulation shall be type TFFN for #16AWG and type THHN/THWN for #14 and larger. Positive conductor shall be colored red and the negative conductor shall be colored black.

3.3.2 Wiring Within Cabinets

Provide wiring within cabinets installed parallel with or at right angles to the sides and back of the enclosure. All conductors which are terminated, spliced or otherwise interrupted in any enclosure associated with the fire alarm system shall be connected to terminal blocks. Mark each terminal in accordance with the wiring diagrams of the system. Make all connections with either crimp-on terminal spade lugs or with approved pressure type terminal blocks.

3.3.3 Cable Taps

Provide a terminal cabinet where any circuit tap is made.

3.3.4 Junction Boxes

All junction boxes and cover plates shall be painted red and labelled "Fire Alarm".

3.3.5 Wiring to Annunciators

Wiring to each annunciator shall be supervised for open and ground conditions. A separate annunciator trouble signal shall be included.

3.3.6 Cabinets

Provide a cabinet for addressable interface devices. Terminal cabinets shall be constructed of code gauge steel with welded return corners and have a lockable piano hinged door opened by a key which matches the FACP cabinet locking system identically. Cabinet shall have removable subplates with double screw terminal boards mounted to the subplate. Provide an adequate number of terminal boards to make a connection to all zones served by the terminal cabinet, including any spare conductor connections shown or identified on the contract drawings. The cabinet, door and subplate shall be painted on all surfaces with epoxy enamel, color to be as directed. Cabinet shall have no knockouts. Conduits shall enter and exit the top and bottom of the cabinet within 75mm of the same side for conduit runs

(risers). Minimum size of cabinet 300mm by 300mm by 150mm in depth.

3.3.7 Conduit and Raceways

Minimum size for fire alarm system initiating, alarm and control circuit conduit and raceways shall be 20mm. Installation shall be in accordance with NFPA 70.

Rigid galvanized heavy wall steel conduit shall be installed in all hazardous (classified) locations, exterior above grade, interior exposed, from floor to five feet above finished floor in unfinished areas unless shown otherwise on the contract drawings. EMT with hexnut expansion gland-type fittings may be installed in all other areas. Flexible metal conduit, maximum length six-feet, shall be used as the final connecting raceway to a fire alarm device mounted on vibrating equipment or on a suspended ceiling.

Conduit direct buried in earth shall be rigid galvanized heavy wall steel with a 40-mil PVC coating or painted with a bitumastic compound.

Conduit in interior finished areas shall be concealed. Conduit through fire-resistant rated walls, floors, ceilings, etc. shall be fire-stopped in a manner that maintains the fire-resistant rating.

Conduit installed in a vertical position shall be parallel with walls and perpendicular with the floor and ceiling. Conduit installed in a horizontal position shall be parallel with the floor and ceiling and be parallel and perpendicular with the walls. Changes in direction of runs shall be made with symmetrical bends. Bends of over 25.4mm in diameter shall be factory made elbows.

3.4 FIRE STOPPING

3.4.1 General

Provide fire stopping systems for all penetrations made in fire barriers for the installation of the fire alarm system. Fire stopping systems shall be equal to or greater than the barrier being penetrated. All materials used for fire stopping shall comply with the UL listing for fire stop systems and Section 07840, "Firestopping and Smokestopping".

3.5 INSTALLATION

3.5.1 General

Intrinsically safe components and wiring methods shall be provided in areas as specified on contract drawings, as directed by the authority having jurisdiction, or as required by local and national codes. Installation of all system components shall be in accordance with the NFPA standards, all applicable codes and the manufacturers recommendations.

The mounting locations of all equipment shown in the contract drawings are approximate. The Contractor shall coordinate the new installation with existing devices in the area whether the existing devices are shown on the drawings or not.

Conduit routing is not shown in the contract drawings and shall be determined by the Contractor. Conduit and raceway installation shall be in

accordance with Section 16145, "Standard Wiring Systems".

3.5.2 Fire Alarm Control Panels

Locate the panels where indicated on the contract drawings and install in accordance with the manufacturers instructions. The enclosure shall be surface mounted with the top of the cabinet not more than 1830mm feet above the finished floor.

3.5.3 Main Graphic Annunciator Panel

The main annunciator panels shall be installed in the areas indicated on the contract drawings. On a gypsum board wall, the panel shall be recessed or flush mounted with no portion of the panel protruding out from the wall more than 2 inches concealed. The top of the panel shall not be more than 1980mm above the finished floor, nor shall the bottom of the panel be lower than 1220mm above the finished floor.

For recessed or flush mounted panels, provide two spare 1 inchconduit risers from the annunciator panel to an Conduit shall terminate at a junction box, and the box shall be labelled as "Spare to Main Annunciator".

The panel shall be installed such that the doors do not come into contact with the panel, nor shall doors interfere with the use of the panel. Annunciator panels require a minimum of three 1000mm clearance directly in front of the panel.

3.5.4 Remote Local Annunciator Panel

The remote local annunciator panels shall be installed as indicated on the contract drawings. The panels shall be recessed or flush mounted with no portion of the panel protruding out from the wall more than 2 inches. All conduit leading to the panels shall be concealed. The top of the panels shall be 66 inches above the finished floor.

Provide one spare 1 inch conduit riser from the annunciator panel to an accessible location above the finished ceiling above the panel. Conduit shall terminate at a junction box, and the box shall be labelled as "Spare to Remote Annunciator".

Zone maps shall be mounted to the right or left of the annunciator panel with the top of the map 66 inches above the finished floor.

If the klaxon horn is not an integral part of the annunciator panel, then it shall be mounted above the panel with the top of the horn 90 inches above the finished floor or 6 inches below the finished ceiling, whichever is lower.

3.5.5 Manual Pull Stations

All manual pull stations shall be mounted so they are readily accessible, and in full compliance with NFPA 101, NFPA 72, FED-STD 795, and ANSI A117.1. Top of the pull stations shall be mounted 48 inches above finished floor. Locations of manual pull stations shall be as shown on Drawings.

When stations are located next to a door, they shall be located within 450mm of the latch side of the door unless otherwise indicated.

3.5.6 Water Flow Detectors and Tamper Switches

Locate water flow detectors and tamper switches where shown on the drawings.

3.5.7 Smoke Detectors

Locate smoke detectors as shown on the contract drawings. The installation shall comply with the requirements of NFPA 72 and their UL listing. Smoke detectors shall not be installed closer than 3 feet from an air supply diffuser. Detectors shall not be installed until the work of other trades is complete.

Duct smoke detectors shall be installed in accordance with the manufacturer's requirements, NFPA 72, and NFPA 90A. All duct penetrations shall be sealed air and water tight.

3.5.8 Heat Detectors

Heat detectors shall be installed per their listing in areas specified on contract drawings.

Heat detectors installed in elevator machine rooms for elevator shut-down operations shall be mounted within 600mm of each sprinkler head.

3.5.9 Addressable Interface Devices

Addressable interface devices shall be installed in locations necessary to monitor hard wired contacts or devices as indicated on the contract drawings or within this specification. Addressable interface devices shall be installed in cabinet as described in the paragraph entitled, "System Field Wiring."

The cabinet shall be labelled to indicate the function of the interface devices. If more than one interface device is located within the cabinet, then a separate label shall be provided for each interface device. Label shall be self adhesive red micarta strips with white engraved lettering. Lettering shall be a minimum of 1/4 inch tall.

In finished areas, the addressable interface devices shall be mounted in an accessible location but concealed from view. Supervised wiring shall then be run from the interface device to the contacts or device being monitored.

In unfinished areas, the addressable interface devices shall be installed in easily accessible locations.

3.5.10 Magnetic Hold Open Devices

Magnetic door holders shall be installed as indicated on the contract drawings. Unless otherwise indicated on contract drawings, the holders shall be wall surface mounted. Floor mounted devices shall not be used unless a wall mount is not practical for the particular installation.

Power for each magnetic door holder shall be obtained from the nearest available continuously energized 120 V lighting circuit. Power shall then be routed through the normally open contacts on an addressable controllable relay. The relay shall be energized (to close the normally open contacts) during normal conditions and shall de-energize during alarm conditions.

3.5.11 Addressable Controllable Relays

Addressable controllable relays shall be mounted in enclosures indicated or, if not indicated, in manufacturer's required enclosure. Relays installed outdoors shall be installed in a weatherproof enclosure with a neoprene gasket and shall be protected against corrosion.

Enclosure shall be painted with a prime coat and one or more finish coats of red enamel to provide a smooth, hard, and durable finish. Enclosure shall be labelled with an engraved phenolic nameplate which reads, "F/A RELAY".

Addressable controllable relays must be mounted and supervised within 1000mm of the controlled device in accordance with NFPA 101.

3.5.12 Evacuation Alarm Signals

Bells shall be installed as indicated on the contract drawings. Bells shall be mounted 90 inches above the finished floor (measured from the top of the bell) or 6 inches below the finished ceiling (measured from the top of the bell) whichever is lower. Bells shall be surface mounted unless otherwise indicated on the contract drawings.

All bell circuits shall be wired as Class A and shall be capable of being silenced from the FACP without a system reset.

3.5.13 Visual Alarm Indicating Device

Strobe lights shall be installed as indicated on the contract drawings. Strobes shall be mounted 80 inches above the finished floor (measured from the bottom of the strobe) or 6 inches below the finished ceiling (measured from the top of the strobe), whichever is lower. Locations of the strobe lights shall be unobstructed and allow viewing by area occupants.

Strobe lights shall have the intensities as indicated on the contract drawings. Strobe lights shall be provided with a label attached to the outside of the device witch indicates the intensity of the light. The label shall not be removed at any time.

In large areas where three or more strobe lights can be seen at the same time, a synchronization module shall be installed to keep the flash rate below three hertz.

All strobe circuits shall be wired as a Class A, continuous powered notification circuit. Strobe lights shall not be affected by the operation of the alarm silence switch in the FACP.

3.6 MINIMUM SYSTEMS TESTS

3.6.1 General

Test the system in accordance with the procedures outlined in NFPA 72, and NFPA 72 Chapter 8. The required tests are as follows:

a. Verify the absence of unwanted voltages between circuit conductors and ground.

b. Megger test all conductors other than those intentionally and permanently grounded.

c. Test all conductors for short circuits utilizing an insulation testing device.

d. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on the as built drawings.

e. Verify the control unit is in the normal condition as detailed in the manufacturer's operating and maintenance manual.

f. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with the manufacturers recommended test instruments. Canned smoke will not be allowed.

g. Test the system for all specified functions in accordance with the manufacturer's operating and maintenance manual.

h. Test both primary power and secondary power. Verify, by test, the secondary power system is capable of operating the system for the period and in the manner specified.

i. Verify that each alarm indicating device functions as specified. Determine that the system is operable under trouble conditions as specified.

j. Verify the full and proper operation of each annunciator (main and remote) light.

3.7 TEST PROCEDURES AND TEST RECORD FORMS

The Contractor shall use the attached test procedure forms to conduct and record the test. Any additional documentation necessary to fully test the system shall also be provided and used.

PRIOR TO TEST, VERIFY THE FOLLOWING: COTR has been notified and attends testing. (Notification required 5 working days prior to test). The fire detection system acceptance test report (Table I) shall be completed after each test. Acceptance shall be witnessed by the COTR.

3.8 KEYS

3.8.1 General

Keys and locks for all equipment shall be identical where possible. Provide not less than six keys of each type required. Identify keys by an appropriate number stamped on each key or on a metal tag attached thereto. Provide a key numbering chart in each operation and maintenance manual furnished.

3.9 SYSTEM TRAINING

Contractor shall provide training on the operations, testing, maintenance, programming and design of the complete fire alarm system in accordance with Section 01770, "Task Order Closeout" of this Specification.

3.10 SOFTWARE AND PROGRAMS

The contractor shall provide GSFC's Fire Alarm Shop with the entire program for each FACP and the OWS. The contractor shall also provide the GSFC Fire Alarm Shop with all necessary programming software required to modify FACP and OWS programs.

3.11 SPARE PARTS AND PARTS LIST

Spare parts and spare parts lists shall be provided in accordance with Section 01770 "Task Order Closeout".

3.12 TABLES FOR TESTING

TABLE I

FIRE DETECTION SYSTEM ACCEPTANCE TEST REPORT

Date: _____

1. Property: _____

Address: _____

2. Type of System: _____

3. Name of Owner: _____

4. Name and Address _____

of Inspector: _____

5. Others Present _____

During Test: _____

_____

6. Approving Agency(ies)_____

Name, Address and _____

Representative: _____

7. System Description:

Control Panel Manufacturer & Part #:_____

_____

Control Panel Configuration:_____

Serial #: _____

Control Panel Condition:_____

8. Battery Standby: _____

Type: _____ Amount: _____

Calculations Provided? Yes _____ No _____

9. Generator: Yes _____ No _____

Type: _____

10. Control Panel Tested For: (List Functions Tested) _____

_____

_____

_____

11. Heat Detectors: Manufacturer & Model # _____

_____

Type:_____

Number/Zone: _____ Total: _____

Total Heat Detectors Tested (Alarm): _____

12. Smoke Detectors: Manufacturer & Model # _____

_____

Type: _____

Number/Zone: _____ Total: _____

Total Smoke Detectors Tested: _____

13. Other Detectors/Sprinkler Devices: Manufacturer & Model # _____

_____

Type: _____

Number/Zone: _____ Total: _____

Total Other Detectors, etc. Tested: _____

14. Audible/Visual Signals: Manufacturer & Model # _____

Type: _____

Number/Circuit: _____ Total: _____

Total Audible/Visual Signals Tested: _____

15. Supervision:

Detection Circuits (Circle One) Class A Class B

Number of Circuits Tested for Supervision: _____

Locations: _____

_____

_____

16. Audible/Visual Circuits (Circle One) Class A Class B

Number of Circuits Tested for Supervision: _____

Locations: _____

_____

_____

17. Supplementary Functions:

Type: _____

Operation: _____

Satisfactory (Circle One) Yes No

18. Supplementary Functions:

Type: _____

Operation: _____

Satisfactory (Circle One) Yes No

19. System Malfunctions Found: _____

_____

_____

_____

20. Corrective Action Taken: _____

_____

_____

_____

21. System Left in Normal Status (Circle One) Yes No

Inspector's Signature: _____

ZONE TEST REPORT

ZONE #: _____ LOCATION: _____

PULL STATIONS:

_____ # Tested _____ Satisfactory: Yes ____ No ____

HEAT DETECTORS:

Type: _____ Qty.: _____ # Tested: _____

Satisfactory: Yes ____ No ____

SMOKE DETECTORS:

Type: _____ Qty.: _____ # Tested: _____

Satisfactory: Yes ____ No ____

DOOR HOLDERS:

Type: _____ Qty.: _____ # Tested: _____

Satisfactory: Yes ____ No ____

Other Auxiliary Functions/Comments:

_____
_____
_____
_____
_____
_____

TESTS FOR FIRE DETECTION AND ALARM SYSTEMS (INSTRUCTIONS)

INSTALLATION TESTS: (For Acceptance)

1. All alarm initiation devices shall be tested on completion of the installation.

2. Where such tests would destroy the device, other means of testing shall be provided.

3. Tests shall be made using both primary and secondary power.

4. The mounting base or other connection point shall be tested at least once on each circuit.

-- End of Section --

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SECTION 13855

AIR ASPIRATING SMOKE DETECTION SYSTEMS

04/06

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SECTION 13855

AIR ASPIRATING SMOKE DETECTION SYSTEMS
04/06

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.

ASTM INTERNATIONAL (ASTM)

ASTM F 402	(1993; R 1999) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 442/F 442M	(1999) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)

FM GLOBAL (FM)

FM P7825	(2006) Approval Guide

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA TC 13	(2005) Standard for Electrical Nonmetallic Tubing (ENT)
NEMA TC 3	(2004) Standard for PVC Fittings for Use With Rigid PVC Conduit and Tubing

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2006) Life Safety Code, 2006 Edition
NFPA 318	(2002) Protection of Cleanrooms
NFPA 70	(2005) National Electrical Code
NFPA 72	(2007) National Fire Alarm Code
NFPA 75	(2003) Protection of Electronic Computer/Data Processing Equipment
NFPA 90A	(2002) Standard for the Installation of Air Conditioning Ventilating Systems

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1016-2	(2003; 8th Ed) Program Detail Manual Fire Alarm Systems

UNDERWRITERS LABORATORIES (UL)

UL 1449	(2003) Transient Voltage Surge Suppressors
UL 497B	(1999; 3rd Ed) UL Standard for Safety Protectors for Data Communications and Fire Alarm Circuits
UL 651	(2005e7) Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings
UL FPED	(2006) Fire Protection Equipment Directory

1.2 SUBMITTALS

Submit the following in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Fully verified and dated copies of all test data and results shall be submitted with a copy of the approved test procedure and any factory test information.

The Contractor shall provide two copies of the test procedures and recording forms for the preliminary tests. For the final acceptance tests, the Contractor shall provide 10 copies of the test procedures and recording forms.

SD-02 Shop Drawings

The following shall be submitted for air sampling detection systems in accordance with the paragraph entitled, "General Requirements," of this section.

Connection Drawings
Schematics

As-Built Drawings shall be submitted for approval 14 days prior to the acceptance testing phase of the project as described in the paragraph entitled, "Field Testing" of this specification section. Magnetic media and hard copies of all new and revised software and drawings shall be provided with the submittal. As-Built drawings shall document final system configuration including deviations from and amendments to the drawings, and field installation changes, concealed and visible.

Autocad (DXF or DWG Format) computer generated floor plan layouts indicating location of monitoring facility fire alarm control panel, air sampling piping (lengths of pipe) and sampling ports (sizes and locations) shall be provided. Floor plan shall also indicate geographic monitor zone boundaries, location of display control panel and bar level annunciation panels if separate and all other associated equipment that is required to provide a complete operational system.

SD-03 Product Data

Manufacturer's catalog data and Display Control Panel shall be submitted for the following items:

Detector Assembly
Aspirating Fan
Power Supply
Filter
Piping Materials
Pipe Hangers and Supports
Batteries and Charger
Software and Programming
Interface Equipment for Reporting and Monitoring

SD-05 Design Data

Design Analysis and Calculations shall be submitted for the Air Sampling Detection Systems consisting of the battery capacity, loading calculations, and fan speed and air flow/transport calculations with schematic diagrams showing pipe segments, pipe diameters, lengths of pipe, node numbers, sample port diameters to verify the requirements are met.

List of Parts and Components shall be submitted for air sampling detections systems in accordance with the paragraph entitled, "System Requirements," of this section.

List of parts and components for the installed system by manufacturer's name, part number, and nomenclature, and recommended stock level required for normal maintenance and unscheduled repairs.

SD-07 Certificates

Quality Assurance Plan shall be submitted consisting of the following:

Contractor shall prepare a test procedure and test record forms for conducting and recording complete tests on control panels, wiring systems, and air sampling piping networks installed in accordance with the manufacturer's requirements and these specifications. Contractor shall submit for approval the test procedure to the Contracting Officer at least 30 days prior to the preliminary system test described in the paragraph entitled "Field Testing" of this specification section. The test procedure shall identify each device, circuit, piping network, and sampling port to be tested, describe the initial condition, each step or function in the test, required test results annotating acceptable ranges and actual values, and submit manufacturer's specifications for all test equipment that will be used. Test forms with suitable spaces shall be provided for recording test results on all equipment, devices, wiring and sampling ports. The test record forms will also have identified spaces for verification signatures of official witnesses and dates of the tests.

Contractor shall submit proof that all components are currently Underwriter Laboratory (UL) listed UL FPED or Factory Mutual (FM) FM P7825 approved for their intended use and function.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted for Air

Sampling Detection Systems. Information bound in manual format and grouped by technical sections consisting of manufacturer's standard brochures, schematics, procedures, recommended spare parts, recommended test equipment, and safety precautions. This information shall be submitted prior to any acceptance tests being performed.

1.3 GENERAL REQUIREMENTS

Section 16003 GENERAL ELECTRICAL PROVISIONS applies to work specified in this section.

Connection Drawings shall be submitted for approval for Air Sampling Smoke Detection Systems.

Connection Drawings shall consist of point-to-point wiring diagrams of internal and external wiring including, but not limited to, all smoke detection devices, and panel wiring. Point-to-point wiring is defined as wiring from device with integral terminal strip to next device with integral terminal strip, wiring between modules internal to control panels, circuit termination's on terminal strips in control panels, and terminal boxes with integral terminal strips.

Autocad (DXF or DWG Format) computer generated Connection Drawings shall be submitted.

Schematics shall be submitted for approval for each Air Sampling Smoke Detection Systems consisting of the following:

Module schematic drawings (minimum size 11 inches by 17 inches) to be provided prior to system acceptance testing.

Program logic and/or ladder logic diagrams that show interaction of system components.

Components used in the installation must be no more than two (2) years old.

As-built drawings shall be submitted for approval 21 days prior to the acceptance testing phase of the project as described in the paragraph entitled, "Formal Tests and Inspections," of this specification. Two (2) sets of magnetic media and hard copies of all new and revised software and drawings shall be provided with the submittal. As-built drawings shall document final system configuration including deviations from the amendments to the drawings, and field installation changes, concealed and visible.

1.4 SYSTEM REQUIREMENTS

List of Parts and Components for the installed system by manufacturer's name, part number, and nomenclature, and recommended stock level required for normal maintenance and unscheduled repairs shall be submitted.

The air sampling detection system(s) shall be compatible with the existing GSFC fire alarm system and shall contain all of the equipment, devices, software and programming, and piping networks required for system operation in accordance with NFPA Codes and GSFC requirements, including communication, interface equipment for reporting and monitoring to the central fire alarm system Operator Workstation located in Building 24 via the existing Siemens MXL fire alarm control panel (FACP). The Air Sampling

system(s) circuits shall be NFPA 72 Class B Style C initiating device circuits and NFPA 72 Class B Style 3.5 signaling line circuits. Initiating and signaling line circuits shall be 24 Vdc. System shall conform to all the applicable requirements of NFPA 70, NFPA 72, NFPA 75, NFPA 90A, NFPA 101, and NFPA 318.

Contractor shall provide all addition equipment, cabinets, conduit, and labor to meet the requirements and intent of this specification.

1.5 QUALITY ASSURANCE

Equipment to be provided under this specification shall be that manufactured fire-alarm equipment which meets the requirements of the section entitled, "System Requirements." It shall be the latest standard design, and shall be listed by Underwriters' Laboratories (UL FPED) or approved by Factory Mutual FM P7825 for it's intended use. All devices installed will function with the display control panel and not interfere with the operation of the control panel.

1.6 SERVICES OF A CERTIFIED FIRE ALARM SPECIALIST

Services of a Certified Specialist thoroughly experienced in installation of Air sampling detection systems and fire alarm system work shall be provided on site to perform or directly supervise the installation, make all necessary adjustments, and perform all tests on the Air Sampling smoke detection system at the site.

The specialist shall be considered certified when the specialist holds a valid Fire Alarm System, Level III Certification from the National Institute for Certification in Engineering Technologies, or a Professional Engineer with Principles an Practices in Fire Protection.

Certification of other recognized agencies with equivalent requirements will be considered. Evidence of the equivalent certification and the basis of certification shall be provided to the Contracting Officer and be approved by the Contracting Officer prior to any work being performed at Goddard Space Flight Center. Contractor submitted certification requirements shall be in accordance with NICET 1016-2.

PART 2 PRODUCTS

2.1 DISPLAY CONTROL PANEL

The display control panel shall be offered in various configurations to control and monitor all operations of the detector assembly and aspiration system to suit particular applications. All power and communication for the air sampling smoke detection system shall be channeled and distributed from the display control panel including referencing and chart recording. All alarm lamps, trouble lamps, and alarm level threshold set-points, shall be visible on the panel face. All time delays, alarm level adjustments, and testing facilities for detector sensitivity shall be protected within a secured enclosure to prevent tampering. An override circuit per manufacturer's requirements shall provide fail-safe operation in the event that the programmed alarm threshold is not set or is disabled, the fourth alarm threshold automatically defaults to the full-scale smoke level. The display control panel shall maintain a smoke level history log and a historical event log. The storage capacity for the smoke level history log shall be a minimum of 40,000 samples. The historical event log shall have

a minimum storage capacity of 100 events. The display control panel shall be capable of retaining this information upon loss of both primary and secondary power sources.

For single zone or multiple zone applications a unitized, self-contained, single enclosure detector/display control panel may be utilized.

In multiple zone installations where it is desirable to have a central control point monitoring and controlling the remote detector assembly panels; a multi-zone display control panel shall be used. The display control panel shall be appropriately sized depending on the number of remote detectors used.

2.2 DISPLAY CONTROL PANEL STATUS INDICATIONS

The display control panel shall display the detector's continuous output of smoke levels per active zone; in a minimum 10 percent increments of full scale. Each controller shall include a bar graph display feature with bar graph indicators being light-emitting-diodes (LED) or liquid crystal display(LCD).

2.2.1 Alarm Threshold

The display control panel shall be provided with a minimum of four (4) alarm threshold levels for each zone:

Alarm Level 1 - ALERT
Alarm Level 2 - ACTION
Alarm Level 3 - FIRE 1
Alarm Level 4 - FIRE 2

Programmed alarm thresholds shall be clearly visible on the face of the display control panel, and shall be adjustable through the full bar graph scale of the display control panel. The visual alarm level indicator shall illuminate and/or flash when the detector output signal reaches the programmed threshold level for the programmed time. The visual alarm indicators on the display control panel shall have circuitry arranged so that they must be manually reset through the display control panel reset feature. Alarm thresholds shall be programmed to the following values unless the results of the System Acceptance Tests, required by this specification, indicate a clear need to change them. In the event that such a need is indicated, the Contracting Officer shall be notified, and provided with complete documentation concerning the need to deviate from these values. The deviation documentation shall include information that complies with the paragraph entitled, "Sensitivity Verification Test". The initial threshold levels shall be approved prior to the final acceptance test.

Alarm Level 1: ALERT shall be set at 0.0250 percent obsc./foot

Alarm Level 2: ACTION shall be set at 0.0500 percent obsc./foot

Alarm Level 3: FIRE 1 shall be set at 0.1000 percent obsc./foot

Alarm Level 4: FIRE 2 shall be set at 0.2000 percent obsc./foot

The display control panel shall contain individual adjustable alarm time delay features for each of the alarm threshold levels. The range of adjustment shall be 0 to 60 seconds. The alarm threshold time delays shall

be programmed to 30 seconds for alarm levels 1 and 2 , and 15 seconds for alarm level 3 and 4.

2.2.2 Air Flow Status Indicators

The display control panel shall receive signals from the detector air flow sensor and shall continuously display the status of the air flow through the detector. The display control panel shall indicate a trouble condition when the air flow through the detector is insufficient to permit proper operation of the detection system. The initial setting shall be set at the factory and the final setting shall be selected based on the system configuration to be 10 percent reduction in air flow through the detector assembly. The display control panel shall transmit a trouble signal to the central fire alarm Operator Workstation in Building 24 via the facility fire alarm control panel and fire alarm network.

The air flow fault threshold setting(s) shall be adjustable by the manufacturer's on site representative to meet site specific conditions. The air flow fault alarm signal shall have a programmable time delay with a range of 0 to 60 seconds for each zone. The air flow fault time delay shall be programmed to the following value unless the results of the system acceptance and commissioning tests, required in this specification, indicate a clear need to change them. In the event that such a need is indicated, the Contracting Officer shall be notified, and provided with complete documentation concerning the need to deviate from these values. The time delay shall be set at ten seconds.

2.3 DETECTOR STATUS INDICATORS

A separate detector lamp shall indicate normal operating status when the system is functioning as designed. Detector status shall indicate a fault upon the loss of power, an open circuit or an electrical/electronic problem within the detector's circuitry or external wiring and shall transmit a Trouble signal to the central fire alarm Operator Workstation in Building 24 via the facility fire alarm control panel and fire alarm network.

Detector fault indicator shall be provided for each zone. The detector fault indicator shall flash and a trouble relay or separate detector failure relay shall operate when there is a failure/problem within the detector's circuitry or external wiring. The detector fault indicator setting shall be per the manufacturer's recommendations.

A detector fault time delay shall be provided. The time delay shall be adjustable from 0 to 60 seconds for each detector failure indicator lamp/relay.

Initial setting not more than 10 seconds.

The air flow fault and detector fault relay outputs shall be connected/wired to cause a zone trouble and general trouble conditions to be annunciated at the preaction control panel and transmitted to the CFMS via the facility fire alarm system. These functions shall be split as two separate trouble indications.

2.4 FRONT PANEL SWITCHES

A Reset switch shall be provided for each zone. Any alarm/fault condition shall cause the indicator lamps to flash and remain in this state until reset. Provide a disable switch or a separate maintenance by-pass switch

to isolate each detector for testing purposes.

A detector bar graph sensitivity test switch shall be provided for each zone and shall be capable of testing the sensitivity of the detector from the front of the control panel. Detector sensitivity testing shall be accomplished by pressing a switch on the control panel, and holding it until the bar graph indicates hundred 100 percent of full scale. Where remote sensitivity testing can be accomplished through data link to a remote computer or alarm panel, the display control panel shall incorporate logic to disable the remote test and return the detection system to normal operation after 60 seconds.

Detector fault test switch shall be provided for each zone. The test switch simulates a detector head fault condition and verifies the integrity of the communication link between the controller and the detector.

Activating the detector fault test switch shall cause the test relay to energize and the detector status indicator lamp to extinguish.

If the communication link between the controller and the detector is monitored automatically, a separate detector fault switch shall not be required.

2.5 DISPLAY CONTROL PANEL AND DETECTOR INTERFACE

Provide all contacts, hardware, conduit and wire, and power required for proper operation and interface between the Display Control Panel and the Air Sampling Detector Assembly. The display control panel shall have a minimum of four independently programmable ALARM LEVELS.

2.5.1 Alarm Level 1 (Alert)

The display control panel shall be configured and programmed so that when ALERT is reached for any detector, the alarm level lamp for that detector shall illuminate and an audible and a visual alarm shall sound at the display control panel. A TROUBLE alarm shall be activated and transmitted to the central fire alarm Operator Workstation in Building 24 via the facility fire alarm control panel and fire alarm network.

2.5.2 Alarm Level 2 (ACTION)

The display control panel shall be configured and programmed so that when ACTION is reached for any detector, the alarm level lamp for that detector shall illuminate and an audible and a visual alarm shall sound at the display control panel. A SUPERVISORY ALARM shall be activated and transmitted to the central fire alarm Operator Workstation in Building 24 via the facility fire alarm control panel and fire alarm network.

2.5.3 Alarm Level 3 (Fire 1)

The display control panel shall be configured and programmed so that when FIRE 1 is reached for any detector, the alarm level lamp for that detector shall illuminate and an audible and a visual alarm shall sound at the display control panel. A local audible alarm shall sound by means of a horn that is set to a distinctive sound different from the surrounding. An ALARM shall be activated and transmitted to the central fire alarm Operator Workstation in Building 24 via the facility fire alarm control panel and fire alarm network.

2.5.4 Alarm Level 4 (Fire 2)

The display control panel shall be configured and programmed so that when FIRE 2 is reached for any detector, the alarm level lamp for that detector shall illuminate and an audible and a visual alarm shall sound and at the display control panel. The building evacuation alarm shall sound. An ALARM shall be activated and transmitted to the central fire alarm Operator Workstation in Building 24 via the facility fire alarm control panel and fire alarm network.

2.5.5 Trouble Indications

The air sampling control panel shall be set-up so in the event of an air flow fault, or a detector fault; the appropriate air flow fault lamp or detector fault lamp shall illuminate. The display control panel shall activate and transmit a TROUBLE ALARM to the central fire alarm Operator Workstation in Building 24 via the facility fire alarm control panel and fire alarm network.

2.6 PROGRAMMING MODULE

The air sampling system shall contain a Programmer module located within the detector enclosure. The Programming module shall support the following features at a minimum:

Adjustment of the alarm thresholds the detector.

Setting of Day/night, weekend and holiday sensitivity threshold settings.

Multi-level password control.

Ability to Program latching or non-latching relay operation.

Programing engergised or de-energised relays.

Adjustment of high and low flow settings for airflow supervision.

Programing of aspirator speed control.

Programing of system maintenance intervals.

Testing of relays assigned to a specific zone to aid commissioning.

2.7 DETECTOR ASSEMBLY

A single detector shall be of type tested and approved, for a maximum coverage of 20,000 square feet. The detector shall be usable in environments with relatively high levels of airborne dust and other contaminants through the use of a filter or other approved method.

2.7.1 Nuisance Alarm Avoidance

Treatment of contaminants shall be by either an air filtration mechanism or by electronic discrimination of particle size. If a mechanical filtering system is used, a disposable filter cartridge shall be provided to permit visual inspection of the filter without having to dismantle the display control unit. The filter shall have a maximum nominal pore size of 20

microns per manufacturer's requirement.

2.7.2 Detector Head

The detector head shall consist of inlet and outlet ports, quick connector type electrical receptacles for controller interfacing, a detection chamber with light source and optical components, and a signal processing electronic circuitry; all in a single assembly.

2.7.3 Light Source

Air is drawn into the detector via the aspirating system, the air shall be exposed to the light source within the detection chamber. Light scattered by smoke particles within the air stream shall be converted to an electronic signal directly proportional to the obscuration level within the chamber. A signal corresponding to the obscuration level within the chamber shall then be transmitted to the display control panel.

2.7.4 Detector Sensitivity

The manufacturer shall provide a minimum sensitivity range from 0.0015 to 7.0 percent obscuration per foot (obs/ft). The manufacturer shall recommend the detector sensitivity for the area to be protected by zone. This detector sensitivity shall be approved by the contracting officer prior to installation of any equipment.

2.8 ASPIRATING FAN

The aspirating fan shall be a high-efficiency, ball bearing, electric centrifugal-flow impeller pump designed for long life. The aspirator flow and pressure ratings shall ensure that the maximum transport time for an air sample removed from the furthest sample point of each branch within the piping network shall not exceed 60 seconds.

2.9 AIR FLOW SENSORS

The detector shall be equipped with a sensing device(s) which will detect any change in the air flow through the detector which could impair the proper operation of the detector. The sensor(s) shall be wired to the control panel, and shall cause a TROUBLE condition to be transmitted to the central fire alarm Operator Workstation in Building 24 via the facility fire alarm control panel and fire alarm network..

2.10 AIR SAMPLING NETWORK

The air sampling network shall be a closed-end system, and shall be engineered for a maximum transport time of 60 seconds and have equal sensitivity throughout the entire system. The air sampling network shall be balanced so that the volume of air drawn from the last sampling point shall not be less than 60 percent of the volume from the first sampling point. Coverage of a single sampling pipe network shall not exceed 10,000 square feet. When the area to be protected exceeds the maximum square footage criteria, additional detectors shall be installed. Each sampling point (hole) shall have a maximum coverage of 250 square feet of floor area for above ceiling protection. Each underfloor sampling point shall have a maximum coverage of250 square feet.

2.10.1 Labeling

All pipe and sampling points shall be labeled identifying "SMOKE DETECTION SAMPLING PIPE DO NOT DISTURB" and "AIR SAMPLING POINT" respectively.

2.10.2 Piping Materials

The sampling pipe shall consist of 3/4 inch inside diameter material. Tubing and fittings as defined in this section, are limited to thermoplastic materials meeting or exceeding the requirements of PVC or an approved equal. Rigid Plastic Conduit CPVC conduit shall be not lighter than Schedule 40. Rigid CPVC shall be the slip-joint solvent-weld type and fittings shall be unthreaded solid CPVC. Conduit and fittings shall be airtight and installation shall conform to NEMA TC 3, TC 13, NFPA 70 and UL 651. The color shall be orange. Directional changes in the piping network shall be accomplished by long radius bends. The use of standard elbow joints shall be approved by the Contracting Officer prior to installation. Final connection to the detector shall not be glued, but shall use a compression type fitting.

2.10.3 Design Layout

The air sampling network shall be designed and installed to monitor total room/zone concentration of smoke. The design shall be accomplished using a computer program which is based on sound fluid dynamic principles and is approved by Factory Mutual Engineering (FM) FM P7825 or listed by Underwriters Laboratories (UL) UL FPEDfor it's intended use. This type of design requires that air samples be continuously drawn from the areas being protected.

2.10.3.1 Zone Coverage

When the floor area to be protected exceeds 10,000 square feet multiple detectors shall be used. The maximum allowable coverage for any single detector shall not exceed 10,000 square feet 10,000 square feet.

2.10.3.2 Sample Port Coverage Area

Each high level above floor sampling port shall have a maximum coverage of 250 square feet and underfloor area coverage shall not exceed 250 square feet. The sampling piping shall be installed above the suspended ceiling and supported from the building structure. The sampling point fitting(s) shall be centered in the ceiling tiles and connected to the main air sampling pipe using 3 to 6 feet lengths of 0.1875 to 0.25 inches ID flexible tubing. The sampling port shall be sized as specified on the approved design drawings and confirmed by the computer generated design calculations.

2.11 PRIMARY POWER SUPPLY

The normal power for the detectors and the display air sampling control panel shall be 120 volts AC, 60 hertz. All system components shall operate satisfactorily between 85 and 110 percent of normal voltage. The air sampling detection system disconnect/protective device shall be a fused switch with a red factory finish. This disconnect switch shall be mounted adjacent to the air sampling detection system. In addition, it shall be marked AIR SAMPLING DETECTION SYSTEM DISCONNECT with a label that is plastic or phenolic type red background with white lettering with a minimum of 0.25 inch block lettering. The label shall be permanently affixed to

the disconnect switch. Switch shall be capable of being locked in the "on" or "off" position. This feature shall not interfere with the circuit protection capability of the device. Switch shall be equipped with surge suppression for all phase and neutral conductors. Current limiting Class RK1 fuses properly sized to protect the Air Sampling detection system equipment shall be installed.

2.12 SECONDARY POWER SUPPLY

Batteries and charger, and power transfer shall provide a means of automatically supplying the entire smoke detection system with battery backup power in the event the primary power system fails. The system shall switch to battery backup power in the event of AC power failure and switch back to AC power upon return of primary power. The air sampling control panel shall operate if the backup batteries are removed for any reason. The system shall control charging and floating level to maintain batteries in optimum condition. Capability to recharge batteries in event of discharge shall be provided. Wiring shall be fused to protect against battery over-current and polarity reversal. Primary power, battery, or charging equipment failure shall result in a trouble signal and visual indication at the display control panel. Trouble signal shall be transmitted to the central fire alarm Operator Workstation in Building 24 via the facility fire alarm control panel and fire alarm network.

Battery modules shall be sealed (no corrosive fumes) and spill proof. Batteries shall be listed for fire alarm service and shall be suitable for high discharge currents required under alarm conditions. Batteries shall be sized to operate the Air Sampling smoke detection system in normal supervisory condition for 24 hours, minimum , then operate the system in the alarm mode for 15 minutes, minimum.

2.12.1 Grounding

The design of equipment will allow for low-impedance bond to the protective grounding system. Equipment must function in an environment which supplies only a safety ground per local electrical code requirements. Cabinet and equipment ground must be isolated from battery return at the equipment and within the frame or cabinet.

2.13 COMMUNICATION NETWORK

The network shall utilize RS 232 or RS 485 using type TFN for No. 18 or No. 16 AWG twisted shielded pair cable for digital communication. Unauthorized access shall be achieved by utilizing a minimum of two levels of password protection. Computer access shall be achieved via an RJ 11 six conductor receptacle.

PART 3 EXECUTION

3.1 SYSTEM SEQUENCE OF OPERATION

3.1.1 Normal Operation

The display control panel shall consist of an enclosure assembly, installation kit, and required number of display control cards, 1 to 4 zones as required and shown on drawings. Each display control panel shall be powered from a 24 VDC source and monitored for alarm and trouble conditions by the facility fire alarm control panel. The display control panel shall have the following light indications:

Bar Graph Display	Alarm Level Lights
Air Flow Fault Light	Detector Fail Light
CPU Fail Light	Normal Operation Indicator
Power Supply Light	Isolate Light
Trouble Light	

Normal operation, air from the protected zone is drawn through a piping network to the detector unit by an aspirating fan in the detector assembly. The air is then illuminated by a light source. Smoke particles scatter this light to a sensitive, solid-state photo sensor. An analog signal is transmitted to the display control panel which displays smoke obscuration levels on a bar graph display. Each increment on the bar graph represents a percentage of the full scale sensitivity of the detector. Independently programmable alarm points provide additional visual indication on the display control panel and activate associated relays for additional annunciation and alarm.

3.2 INSTALLATION

All equipment shall be installed in accordance with manufacturer's recommendations, and this document.

3.2.1 Display Control Panel

Equipment shall be installed in each protected area, located where indicated on the approved drawings, and shall be complete with all indicated accessories and devices. Equipment shall be installed in accessible locations in such a manner as to prevent damage from vibration or jarring. Equipment requires a minimum of 3 feet clearance directly in front of the display control panel and the detector unit for maintenance per NFPA 70. With multiple equipment, the three (3) foot clearance is required directly in front of the complete configuration. In addition, a 28 inch clear aisle way will be provided for access to the equipment. Cabinets shall be provided with a pin-tumbler cylinder lock (Cat 45) currently in use with all other fire alarm control panels at GSFC

3.2.2 Smoke Detector

The smoke detector shall be securely mounted to the building structure (i.e. ,column, permanent wall) using approved type anchors. The mounted detector's orientation shall be determined by the piping layout and application; while maintaining total access for servicing with a minimum clearance of 3 feet directly in front of the detector. Mounting of the detector to cable trays, movable walls and other equipment or frames shall be approved by the Contracting Officer prior to installation.

3.2.3 Air Sampling Network

The smoke detection system shall be supplied with an air sampling network for air/smoke transport to the detector from the protected area. The piping network shall be designed using a FM approved or UL listed air sampling system computer modeling program for design calculations. The air sampling network shall consist of a balanced piping system including main branch piping with sampling points (holes) at pre-determined locations with end caps. All piping network supports shall be from the building structure only. Alternate means of support as from cable trays, raceways, duct work, etc. shall be approved by the Contracting Officer prior to installation. All piping which is adjacent to the detector shall be

mounted tight against the wall or other structural elements which the detector is mounted on, and shall terminate within 18 inches of the detector inlet ports. The air sampling piping shall be connected to the detector by a union with an 18 inch PVC nipple of the same ID as the air sampling network piping, to facilitate maintenance. Optional open or closed end system, per manufacturer's approved computer modeling design program may be used. Main piping runs shall not exceed 300 feet. All fire rated penetrations of floors, ceilings and walls, shall be sealed with a U.L approved fire rated assembly with a rating equal or greater than the barrier penetrated. No silicone containing materials may be used. The air sampling tubing shall be cleaned inside and out, and joined using manufacturer's approved methods and materials for air-tight connections except at the detector enclosure connections for servicing. Sampling ports shall be located so that they are clear of all supply air registers and/or air flows. Exhaust from the detector shall be routed into the above ceiling space to limit the fan noise.

3.2.3.1 Non-Metallic Tubing

Refer to ASTM F 402 for safe handling of solvent cements, primers and cleaners used for joining thermoplastic pipe and fittings. All piping shall be supported at approximately 5 feet maximum intervals on center with bracing for end of pipe run not to exceed 1 foot. Pipe hangers and supports and fasteners must be of appropriate dimensional size for supporting tubing without distortion. Refer to construction documents for additional and/or special attachment details. Conduit and fittings shall be airtight and installation shall conform to NEMA TC 3, NEMA TC 13, NFPA 70, UL 651 and ASTM F 442/F 442M.

3.2.4 Spare Parts

Spare parts shall be directly interchangeable with the corresponding components of the installed system. Spare parts shall be suitably packaged and identified by nameplate, stamping, or tagging. Furnish the following:

Two (2) filter assemblies
10% Nozzles (If Used)

3.2.5 Wiring

Wiring shall conform to the requirements of NFPA 70 and NFPA 72 and the following special requirements:

Air sampling system circuits shall be installed in a separate raceway or conduit system. Within the air sampling system, 60-hertz power circuits and air sampling initiating and signaling line circuits shall be installed in separate raceway or conduit systems. 60-hertz power circuits shall not enter enclosures containing 24 Vdc air sampling system circuits except where required to connect to the air sampling system.

Conductors shall be continuous from a terminal point at the detector to a terminal point at the display control panel. Break wires at each terminal; wires shall not be looped over a terminal. Solderless ring tongue terminal lugs shall be installed with manufacturer's required tooling on the device wiring connection leads. This ring type lug will be used on stranded wire only. Termination of solid wire conductors shall be made on compression or screw type terminals. When screw type terminals are used the conductor must be captured under 80 percent of

the screw head surface.

Conductors shall be solid copper with an insulation rating of not less than 300 volts. Conductors shall be marked with the AWG size, voltage rating and manufacturer's name permanently marked on the conductor jacket at no less than 2 feet intervals. Conductor size and color are listed below. Where modifications are made to existing systems, the new or added conductors shall match the size and color coding of the existing system.

Conductors for network communication circuits shall be solid copper, shielded, twisted pairs. Conductor size shall be as indicated but not less than No. 16 AWG diameter for signaling circuits. Cables shall be marked with circuit designation and consistent color coding for the positive and negative loops shall be maintained throughout the cable system. Cable shall be listed as type FPLP, Power-Limited Plenum Rated Fire Protective Signaling Cable.

Direct current initiating detector circuits shall be a two loop circuit per NFPA 72, Style D with the positive loop conductor colored blue and the negative loop conductor colored black. Conductors size shall be as indicated, but not less than No. 16 AWG diameter. Conductor insulation shall be Type TFN for No. 16 AWG diameter, and Type THHN/THWN for No. 14 AWG diameter and larger.

3.2.6 60-Hertz Power

60-hertz power to the display control panel shall be 120 volts. There shall be one black phase conductor, one white solidly grounded neutral conductor and one green equipment grounding conductor. Conductor size shall be as shown on the drawing with the minimum size No. 12 AWG copper. Surge arresters shall be installed in accordance with NFPA 70, UL 497B and UL 1449.

3.2.7 Installation In Cabinets and Boxes

Wiring in control cabinets and boxes shall be installed in a neat and orderly manner with wire properly grouped, tie-wrapped, or laced parallel and perpendicular to the major axis, supported and identified. Control wiring shall be continuous from device to device with no splices. All wires entering or leaving control cabinets, boxes, and devices shall be permanently marked and terminated on screw terminals. Marking shall be consistent throughout the Air Sampling smoke detection system and shall be the same as the identification shown on the connection drawings.

3.2.8 Conduit and Raceways

Minimum size for fire alarm system initiating, alarm and control circuit conduit and raceways shall be 3/4-inch minimum. Installation shall be in accordance with NFPA 70.

Rigid galvanized heavy wall steel conduit shall be installed in all hazardous (classified) locations, exterior above grade, interior exposed, from floor to 5 feet above finished floor unless shown on the drawings. EMT with hexnut expansion gland-type fittings may be installed in all other areas. Flexible metal conduit, maximum length 6 feet, shall be used as the final connecting raceway to a air sampling system mounted on vibrating equipment or on a suspended ceiling.

Conduit in interior finished areas shall be concealed. Conduit penetrating fire-rated construction i.e., walls, floors, ceilings, roofs, etc. shall be fire-stopped with a UL listed or FM approved material commensurate with the fire resistance rating of the structure penetrated.

Conduit installed in a vertical position shall be parallel with walls and perpendicular with the floor and ceiling. Conduit installed in a horizontal position shall be parallel with the floor and ceiling and be perpendicular with the walls. Changes in direction of runs shall be made with symmetrical bends. Bends of over one inch in diameter shall be factory made elbows.

3.2.9 Labeling

Provide at the smoke detector labels that are plastic or phenolic type red background with white lettering with a minimum of 0.25 inch block lettering to indicate detector and zone. Example: "AIR SAMPLING SMOKE DETECTOR No. 1-1 ZONE No. 5"

Provide at the display control panel labels that are plastic or phenolic type red background with white lettering with a minimum of 0.25 inch block lettering to indicate the controller, the detectors controller served, and location.

The pipe network shall be clearly labeled every 5 feet in open room areas, and within ceiling cavity; and every 2 feet, centered in the floor panels, within the raised floor cavity. This is to distinguish the pipe from other facility pipe work or protective cabling enclosures. The labeling shall read: "SMOKE DETECTION SAMPLING TUBE. DO NOT DISTURB".

Every air sampling point shall be labeled with a round red label with a center hole to match the diameter of the drilled sampling point; and shall read: "AIR SAMPLING POINT DIA _____ inches". Fractional dimensions shall be in decimal format indicating a minimum of four decimal places.

All electrical junction boxes and covers shall be painted "red", and labeled with a plastic or phenolic label, red background with white lettering with block lettering sized as needed to read: "AIR SAMPLING SMOKE DETECTOR SYSTEM".

3.3 FIELD TESTING

After complete installation of the equipment and at such time as directed by the Contracting Officer, tests shall be conducted to demonstrate that the installation requirements of this specification have been met and that the sequential functions of the system comply with the requirements specified herein. The tests covered in the following paragraphs shall be done in two parts:

a. Preliminary - This will be an "in house" test to verify all the system(s) and components function in accordance with the approved contract drawings and specifications. This functional test shall be performed in the presence of government inspectors and shall be repeated until the Contractor can perform one full test without device or system malfunction.

b. Final Acceptance - After the successful completion of the preliminary testing, the system(s) shall be fully tested formally with full documentation (including As-Built Drawings) using the

previously approved recording form. The Authority Having Jurisdiction (AHJ) will witness this test and final acceptance of the system will be based upon his written approval of the test. On both preliminary and final tests, the approved testing procedures shall be followed.

3.3.1 External System Wiring

The following tests shall be performed on the external system wiring before connection to the control panel: Continuity of circuits shall be checked with an ohmmeter. Temporary jumpers shall be inserted in appropriate sockets of missing detectors and the end-of-line resistor shall be installed when this test is performed. Resistance reading for each circuit shall be the value of the end-of -line resistor, plus or minus 10 percent. Each wire shall be checked for grounds with a 500-volt insulation resistance test set. Resistance to ground shall not be less than 20 megohms. All tests shall be witnessed by the Contracting Officer or designee.

3.3.2 System Acceptance Testing

Each zone of every system shall be subjected to a full operational test, in the presence of the contracting officer which must successfully pass before any system shall be considered acceptable. The approved operational test procedure submitted by the subcontractor for the air sampling system and display control panel shall include the following tests:

3.3.2.1 Acceptance Criteria

Acceptance criteria for air sampling piping network(s) and detector(s) shall include the following measurements and tests for each detector and it's air sampling piping network.

3.3.2.2 Suction Pressure Test

Pressure at all sampling ports, except the end cap port, shall be measured, recorded, and compared to APPROVED Design Calculations. The Suction Pressure shall be within the manufacturer's specified range and be measured in inches of water or pascals.

3.3.2.3 Smoke Transport Time Test

The time required for smoke to travel from the most remote sampling port in each air sampling piping network to the detector shall be measured, recorded, and compared to APPROVED Design Calculations. This TIME shall be determined on each branch line individually by introducing a "gross" smoke source into the sampling port which is hydraulically most remote from the detector. The TIME from the beginning of smoke introduction until the bar-graph on the display control panel reflects the presence of smoke in the detector is the Transport Time. The MAXIMUM ALLOWABLE Transport Time is 60 seconds.

3.3.2.4 Deviations

If the measured and recorded results significantly differ from the measurement predicted by the APPROVED Design Calculations, the cause of deviation should be determined and corrected. If the cause is a difference between the system as built and the system as designed, revised shop drawings and calculations shall be resubmitted for approval to the

contracting officer. If the revised drawings and calculations agree with measured results, the system shall be considered acceptable provided that all other provisions of this specification have been met.

3.3.2.5 Sensitivity Verification Test

This test is a month long (30 day minimum) test for all detection system installations. Each air sampling piping network by zone shall be subjected to this test before the system is considered acceptable. The purpose of this test is to ensure that the earliest possible alarm for smoke is rendered with the fewest number of false alarms; this shall be considered mandatory. Due to the fact that the ambient levels of dust or other air borne particulate which the detector may sense as smoke varies from building to building or room to room within a given building or area.

a. Proper test procedures and data analysis should eliminate all false alarms from transient dust or smoke which may become airborne due to installation activity, cleaning and/or normal operations.

b. During the period while the sensitivity verification test is being conducted, normal operations shall continue unaltered within the area being protected. The air sampling detection system shall be mionitored by the facility fire alarm control panel. The air sampling detection system shall only transmit supervisory and trouble conditions to the central fire alarm operator Workstion in Building 24.

c. After the air sampling detection system has been installed and all acceptance tests successfully conducted, the event log and the smoke level history log shall be maintained for a period of not less than 30 calendar days.

d. Data review and analysis should be conducted after 7 calendar days of operation to identify any gross trends, and again at the end of 30 calendar days of operation. Additional interim analysis maybe required depending on the results of the first week review.

e. Data review and analysis shall consider the normal base line, or ambient, pollutant level recorded, and all deviations from the established base line as recorded by the data logger from the display control panel.

   The level of the ambient base line shall be compared with the alarm threshold levels selected. The minimum acceptable range between the ambient base line and the first alarm threshold shall be minimum twenty percent of the detector's full scale sensitivity calibration setting.

   Each peak recorded shall be investigated to determine its cause. Analysis shall consider whether the peak recurrence is at regular intervals, or whether it is a single event. Recurring peaks are usually related to activities within the protected area. Non-recurring peaks are generally the results of other types of activities, including fires. Consideration of normal activity within the fire zone, the time of day, and day of the week may be of assistance in determining the cause of a peak.

   The magnitude and duration of the recorded peaks shall be compared

to the alarm threshold levels selected and initial time delay settings to determine if a false alarm would have occurred.

Based on the data review, adjustments will be made to alarm levels and time delay settings, as required to eliminate false alarms.

Peaks or alarms that are attributed to smoking in the protected area ARE NOT considered to be false alarms. The air sampling detection systems shall be configured specifically to alarm when smoking takes place within the protected area.

If data indicates that the adjustments to the alarm threshold levels and the time delay settings will not eliminate false alarms the detector sensitivity shall be changed. If the false alarms can not be eliminated alternative solutions shall be provided by the contractor to the Contracting Officer for approval and implementation.

Any change to the initial settings as prescribed by this specification shall be fully documented with supportive analysis and review data and submitted by the manufacturer's to the contracting officer for approval.

3.4 ACCEPTANCE TEST DOCUMENTATION

The results of the acceptance testing shall be recorded by the installer. At least six copies of the completed documentation shall be submitted to the Contracting Officer. At least three copies of the "Operation and Maintenance Manuals" shall be submitted for the complete Air Sampling Detection System

3.5 SYSTEM TRAINING

Conduct an onsite training class at GSFC covering the operations, maintenence and repair of the installed system. Class shall be taught by the manufacturer's representative prior to final acceptance testing and shall not exceed 8 hours in duration. Contractor shall provide 10 copies of all handouts. <END/>

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SECTION 13920

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03/98

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SECTION 13920

FIRE PUMPS
03/98

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 in the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME B31.1	(1998) Power Piping

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	(2001) Approval Guide

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 20	(1999) Standard for the Installation of Stationary Fire Pumps for Fire Protection
NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL FPED	(2001) Fire Protection Equipment Directory

1.2 FIRE PUMP SYSTEM

Provide fire pumps and associated equipment complete and ready for operation. Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with NFPA 20 and NFPA 70, except as modified herein. Devices and equipment for fire protection service shall be UL FPED listed or FM P7825 approved. In the NFPA 20, the advisory provisions shall be considered to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittals."

SD-02 Shop Drawings

Prepare working drawings on sheets not smaller than 24 by 36 inches; include data for the proper installation of each system. Show detail plan view of the pump room including elevations and sections showing the fire pumps, associated equipment, and piping. Show piping schematic of pumps, devices, valves, pipe, and

fittings. Show point to point electrical wiring diagrams. Show piping layout and sensing piping arrangement. Include:

Pumps, drivers, and controllers

Hose valve manifold test header

Circuit diagrams for pumps

Wiring diagrams of each controller

Piping layout and sensing piping arrangement

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

Fire pumps

Driver, (electric motor)

Controller

Valves, including check, and relief

Hose valve manifold test header

Flow meter

SD-05 Design Data

Submit manufacturer's certified test characteristic curves for each pump, including pump discharge curves.

SD-06 Test Reports

Field Test Reports shall be submitted for the items listed below. Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the contractor, by an authorized official of the testing laboratory or agency (if applicable), and by the Government inspector who witnessed the test.

Preliminary Tests

Formal Inspection and Tests

SD-07 Certificates

Qualifications of welders

Submit certificates of each welder's qualifications prior to site welding; certifications shall not be more than one year old.

Qualifications of Installer: Prior to installation, submit data for approval showing that the Contractor has successfully installed fire pumps and associated equipment of the same type and design as specified herein, or that he has a firm contractual agreement with a subcontractor having such required experience. The data shall include the names and locations of at least two installations where the Contractor, or the subcontractor referred to above, has installed such systems. Indicate the type and design of each system and certify that each system has performed satisfactorily in the manner intended for a period of not less than 18 months.

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the items listed below, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

Fire Pumps

Driver

Controller

Valves, including check and relief

Flow meter

SD-10 Operation and Maintenance Data

Submit in accordance with Section 01770, "Task Order Closeout", Operation and Maintenance Data on the following:

Fire pumps

Driver

Controller

Valves, including check and relief

Flow meter

SD-11 Closeout Submittals

Submit posted operating instructions for fire pump components.

1.4 ELECTRICAL MOTORS, CONTROLLERS, CONTACTORS, AND DISCONNECTS

Furnish motors, controllers, contactors, and disconnects with their respective pieces of equipment. Motors, controllers, contactors, and

disconnects shall be provided as specified herein and shall have electrical connections provided under Division 16, Electrical. Controllers and contactors shall have a maximum of 120-volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment furnished are larger than sizes indicated, the cost of providing additional electrical service and related work shall be included under this section.

1.5 ELECTRICAL WORK

Provide electrical work associated with this section under Division 16, Electrical, except for fire alarm wiring. Provide fire alarm system under Section 13851, "Fire Alarm Systems." Provide control wiring under this section in accordance with NFPA 70. Provide wiring in rigid metal conduit or intermediate metal conduit, except electrical metallic tubing conduit may be provided in dry locations not enclosed in concrete or where not subject to mechanical damage.

1.6 SEQUENCE OF OPERATION

The pump shall start automatically whenever the pressure in the main system is reduced to the indicated pressure, automatically upon tripping of the sprinkler system, or manually when the starter is operated. Pump shall continue to run until shut down manually.

1.7 POSTED OPERATING INSTRUCTIONS

Provide for pumps, drivers, controllers, and flow meters.

PART 2 PRODUCTS

2.1 SYSTEM COMPONENTS

2.1.1 Fire Pumps

Provide electric motor driven fire pumps. Pumps shall be automatic start and manual stop. Each pump capacity at rated head shall be not less than that indicated, at the indicated discharge pressure. Each pump shall furnish not less than 150 percent of rated capacity at not less than 65 percent of total rated head. Pumps shall be of the centrifugal horizontal split case with automatic air release. Motor voltage and pump capacity shall be as indicated on the drawings.

2.1.2 Alarm

Remote alarm signal shall be activated at the Fire Alarm Control Panel upon the following conditions: electric motor controller has operated into a pump running condition, loss of electrical power to electric motor starter, and phase reversal on line side of motor starter. Provide a red signal lamp, labelled "Power Off When Lit," with signal lamp arranged to come on when switch is placed in OFF position. Provide an amber or yellow signal lamp, labeled "Phase Reversal When Lit," with signal lamp arranged to come on when the lineside or motor controller has a phase reversal.

Provide single pole double throw dry contact minimum 5 amps 24 V.D.C. or 120 V.A.C. for the following status indication: Contacts to be wired to labelled terminal blocks.

a. Fire Pump Running

b. Fire Pump Phase Reversal

c. Fire Pump Power Loss

2.1.3 Pressure Maintenance (Jockey) Pump

Provide pump with controller to maintain the indicated pressure on the system. Provide pump of the electrically driven, horizontal shaft, centrifugal type with a rated discharge. Pump shutoff pressure shall not exceed the design working pressure of the system. Pump shall draft from the suction supply side of the suction pipe gate valve of the pump and shall discharge into the system on the downstream side of the pump discharge gate valve. Provide approved indicating gate valves of the outside screw and yoke type in the maintenance pump suction and discharge piping. Provide pressure gage and an approved check valve in the maintenance pump discharge outlet. Pump shall start when the pressure drops to starting pressure indicated, and to stop when the pressure reaches the stopping pressure indicated..

2.1.4 Electric Motor Driver

Provide electrical motors, controllers, contactors, and disconnects as specified herein. Power supply to each motor and controller shall be as indicated.

2.1.4.1 Motors

Motor power shall be not less than pump power requirements at all points on the pump operating curve.

2.1.4.2 Controller

Controllers shall be approved for fire pump service and arranged for automatic pump starting and manual pushbutton pump shutdown. Controller shall be completely terminally wired, ready for field connections, and mounted in a moisture resistant enclosure arranged so that controller current carrying parts will not be less than 12 inches above the floor. Starter shall be in accordance with Section 16286, "Overcurrent Protective Devices". Fault current interrupting capacity, and horsepower (HP) rating at the indicated voltage, shall be as required for the motor size provided. If indicated, provide an approved power transfer switch to transfer emergency power to the fire pump; the transfer switch shall transfer power from an emergency power switchgear.

2.1.5 Flow Meter

Provide UL listed or FM approved flow meter for fire pump installation with direct flow readout device. Meter shall be of the venturi type.

2.2 ABOVEGROUND WATER PIPING SYSTEMS

Piping shall be provided in accordance with Section 13930, "Fire Sprinkler and Standpipe Systems".

2.2.1 Check Valves

Provide flanged clear opening swing check type valve with flanged inspection and access cover plate for sizes 4 inches and larger.

2.2.2 Relief Valve

Provide each pump with an approved pilot operated or spring operated relief valve conforming to NFPA 20.

2.2.3 Hose Valve Manifold Test Header

Construct header of steel pipe as specified in paragraph entitled "Aboveground Water Piping Systems." Provide ASME/ANSI B16.5, Class 150 flanged inlet connection to hose valve manifold assembly. Provide approved bronze hose gate valve with 2.5 inch National Standard male hose threads with cap and chain; locate 3 feet above grade in the horizontal position for each test header outlet. Welding shall be metallic arc process in accordance with ASME B31.1.

2.3 UNDERGROUND PIPING SYSTEMS

2.3.1 Pipe and Fittings

Underground piping shall be provided in accordance with Section 02515, "Water Systems".

PART 3 EXECUTION

3.1 INSTALLATION

Equipment, materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with NFPA 20, except as modified herein. Install piping straight and true to bear evenly on supports.

GOMAR equipment tags, and markers for concealed equipment, shall be provided in accordance with Section 01600, "Material and Equipment", as specified herein, and as required by the referenced standards.

Pump installation and alignment shall be in accordance with Section 01750, "Equipment Alignment and Balancing for RCM".

3.2 FLUSHING

Flush all new pump suction and discharge piping at 150 percent of rated pump capacity. Where the pump installation involves more than one pump, the flushing volume shall be the total quantity of water flowing when all pumps are discharging at 150 percent of their rated capacities. The new pumps may be used to attain the required flushing volume. Continue flushing operations until water is clear, but for not less than 10 minutes. Submit a signed and dated flushing certificate with a request for field testing.

3.3 FIELD INSPECTIONS AND TESTS

3.3.1 Inspections

Piping related to fire pumps shall be tested, prior to pump operation and testing, in accordance with Section 02515, "Water Systems" (underground) or Section 13930, "Fire Sprinkler and Standpipe Systems" (aboveground).

Prior to initial operation, inspect equipment and piping systems for compliance with drawings, specifications, and manufacturer's submittals.

3.3.2 Preliminary Tests

Perform tests on pumps, drivers, and equipment, including visual equipment checks to ensure compliance with approved detail drawings; pump start-run to ensure proper operation and to detect leakage of piping, valves, and fittings; sequence of operation check; verification that required pump accessories have been provided; test of pump alarm devices; and additional inspections and tests necessary to ensure that the entire pump installation is correct, complete, and ready for operation.

3.3.3 Formal Inspection and Tests

The Government will witness formal tests and approve all systems before they are accepted. Submit the request for formal inspection at least 15 days prior to the date the inspection is to take place. An experienced technician regularly employed by the pump installer shall be present during the inspection. Tests shall include 100 and 150 percent capacity flows and pressures, and no-flow pressures for compliance with manufacturer's characteristic curves. At this inspection repeat the required tests as directed. Correct defects in the work provided by the Contractor, and make additional tests until the Contractor has demonstrated that the system complies with the contract requirements. Manufacturer's certified shop test characteristic curves for each pump being tested must be furnished by the Contractor at the time of the pump acceptance test. Furnish appliances, equipment, electricity, instruments, connecting devices, and personnel for the tests. The Government will furnish water for the tests.

3.4 CLOSEOUT REQUIREMENTS

Provide an Operational Readiness Review in accordance with Section 01770, "Task Order Closeout", including a complete demonstration of all controls, alarms and modes of operation, for main fire pump and jockey pump.

-- End of Section --

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SECTION 13930

FIRE SPRINKLER AND STANDPIPE SYSTEMS
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC M017	(1992) Manual of Steel Construction, Volume II, Connections

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 126	(1995) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 135	(1997; Rev C) Specification for Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1998) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A 234/A 234M	(1999) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 53/A 53M	(2001) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 563	(2000) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2000) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM B 749	(1997) Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products
ASTM C 592	(2000) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM C 920	(1998) Standard Specification for Elastomeric Joint Sealants
ASTM D 2000	(1999) Standard Classification System for Rubber Products in Automotive Applications

ASTM F 568M	(1998) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.18.1	(2000) Plumbing Fixture Fittings
ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.34	(1996) Valves - Flanged, Threaded, and Welding End
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions, Classes 150, 250, and 300
ASME B16.4	(1992) Cast-Iron Threaded Fittings Classes 125 and 250
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(1998) Power Piping

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	(2001) Approval Guide

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1922A	(1995) Shield, Expansion (Caulking Anchors, Single Lead)
CID A-A-1924A	(1995) Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors)
CID A-A-55614	(1995) Shield, Expansion (Non-Drilling Expansion Anchors)
CID A-A-55615	(1995) Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors)

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(1999) Installation of Sprinkler Systems
NFPA 14	(2000) Installation of Standpipe, Private Hydrants and Hose Systems
NFPA 1963	(1998) Fire Hose Connections

NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances

UNDERWRITERS LABORATORIES (UL)

UL-04	(1995) Fire Protection Equipment Directory
UL-19	(1992) Lined Fire Hose and Hose Assemblies, Standard for

1.2 GENERAL REQUIREMENTS

This section specifies installation of, or modifications to, wet pipe and dry pipe automatic sprinkler systems, and Class I standpipes. Work on any other type system shall be subject to other requirements specified in the task order.

Section 15003, "General Mechanical Provisions," applies to work specified in this section. Design and installation shall be in accordance with NFPA 13 and NFPA 14. Underground piping and valves, fire hydrants, and post-indicator valves shall be in accordance with Section 02515, "Water Systems".

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification.

SD-01 Preconstruction Submittals

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.

SD-02 Shop Drawings

Installation Drawings shall be submitted indicating the locations and connections of the following items. Drawings shall also include hydraulic design data.

Piping Materials
Supporting Elements
Fire-Department Connections
Devices Connected to or monitored by Alarm Systems
Compressors
Sprinkler Heads, indicating type and temperature rating
Valves
Standpipe Equipment

SD-02 Shop Drawings

Schematics shall be submitted for Dry Pipe Sprinkler Systems indicating functional and physical interfaces with facilities and other systems, layout of all controls, and tubing and wiring details.

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.

Piping and Fitting Materials
Valves
Fire-Department Connections
Riser Alarm Equipment
Dry-Pipe Maintenance Air Equipment
Standpipe Equipment
Sprinkler Heads
Miscellaneous Materials
Supporting Elements

SD-05 Design Data

Design Analysis and Hydraulic Calculations shall be submitted for Sprinkler and Standpipe Systems including hazard classification, required density, size and location of most remote area, and hose-stream allowance.

SD-06 Test Reports

Test Reports shall be submitted for the following tests in accordance with the paragraph entitled, "System Testing," of this section. Reports shall be in the form of the "Contractor's Material and Test Certificate" in accordance with NFPA 13 and NFPA 14.

SD-10 Operation and Maintenance Data

0Operation and Maintenance Manuals shall be submitted for all sprinkler and standpipe system components other than piping, supports, and miscellaneous materials

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.

SD-11 Closeout Submittals

As-Built Drawings shall be submitted for Installation Drawings and Schematics providing current factual information including deviations and amendments to the drawings, and concealed and visible changes in the work.

1.4 SYSTEM DESIGN AND PIPE SIZING

All sprinkler and standpipe systems shall be the wet-pipe type, unless otherwise indicated on the drawings.

Modifications involving relocation of existing sprinkler heads or branch lines shall use the same pipe sizing as existing, unless otherwise noted. Modifications involving the addition of 5 sprinkler heads or less to an existing system or zone shall be sized in accordance with the pipe schedule method of NFPA 13. Calculations and Installation Drawings are not

required to be submitted for these projects unless otherwise noted.

More extensive modifications, and all new systems or zones, shall be hydraulically designed in accordance with NFPA 13 for the hazard classification and existing system pressure/flow data as indicated on the drawings. Calculations and Installation Drawings shall be submitted for all hydraulically designed projects. Maximum coverage area, sprinkler head spacing, and other sprinkler location and installation requirements shall be in accordance with NFPA for the hazard classification indicated. If not indicated, the classification shall be Ordinary Hazard, Group 1.

Standpipe systems shall be in accordance with NFPA 14, Class 1, and additional requirements as indicated.

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 P7825) Approval Guide.

Products with UL label or seal or listing in UL-04, and products with FM label or listed in the FM P7825 Approval Guide are acceptable fire-protection system materials and equipment. Materials and equipment furnished shall be compatible with existing system.

2.2 ABOVEGROUND PIPING MATERIALS

2.2.1 Type BCS - Black Carbon Steel

Pipe (1/2 through 1-1/2 inches): Schedule 40 furnace butt weld black-carbon steel conforming to ASTM A 53/A 53M, or ASTM A 135, Type F furnace butt welded; Schedule 10 conforming to ASTM A 135, Grade B

Pipe (2 through 8 inches, where indicated): With threaded couplings and fittings: Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to ASTM A 53/A 53M or ASTM A 135, Type E (electric-resistance welded), Grade B, or Type S (seamless), Grade B. With grooved couplings and fittings: Schedule 10 conforming to ASTM A 135, Grade B; Grooves shall be rolled only; cut grooving will not be allowed. Rolled grooves shall be dimensionally compatible with the couplings.

Pipe (10 inches and over): Schedule 30 black carbon steel conforming to ASTM A 53/A 53M, 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): 175-psigminimum working pressure with a housing fabricated in two or more parts of black malleable-iron castings. Coupling gasket shall be molded of synthetic rubber, conforming to requirements of ASTM D 2000. Coupling bolts shall be oval-neck, track-head type with heavy hexagonal nuts, conforming to ASTM A 183

Fittings (4 inches and under): 175-psig working pressure, cast iron,

screwed, conforming to ASTM A 126, Class A, and ASME B16.4

Fittings (6 inches and larger): 175-psig working pressure, cast iron, conforming to ASTM A 126, Class A, screwed, conforming to ASME B16.4, or flanged, conforming to ASME B16.1

Grooved fittings (all sizes): 175-psig working pressure fittings used with grooved couplings shall be fabricated of black malleable-iron castings. If a manufacturer's standard-size malleable-iron fitting pattern is not available, fabricated fittings shall be used; fittings shall be fabricated from Grade B seamless-steel pipe and long-radius seamless welding fittings, with wall thickness to match pipe, conforming to ASTM A 234/A 234M and ASME B16.9.

2.3 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. Hangers shall not support any non-sprinkler/standpipe-system components.

Supporting elements which attach directly to the pipe or the building structure shall be FM approved or UL listed and shall conform to ASME B31.1, MSS SP-58, and ASME B16.34, and shall be standard cataloged and load-rated products. All supporting elements and components shall be of ferrous materials.

2.3.1 Building-Structure Attachments

2.3.1.1 Anchor Devices, Concrete and Masonry

Anchor devices shall conform to CID A-A-1922A, CID A-A-1924A, CID A-A-55614 or CID A-A-55615, and load per anchor shall not exceed the recommended safe working load as indicated in those standards.

Cast-in floor-mounted equipment-anchor devices shall provide adjustable positions.

Powder-actuated anchoring devices shall not be used to support sprinkler and standpipe systems components.

2.3.1.2 Beam Clamps

For pipes over 2 inches: Beam clamps shall be center-loading Types 21, 28, 29, and 30.

For pipes 2 inches and under: Beam clamps shall be Type 20 side-loading, or shall be Type 23 (C0clamp) or Type 19 (C-type beam clamps). C-clamps and C-type clamps shall be equipped with locknuts and with restraining straps not less than 1/8 by 1 inch. Clamps secured to one side of beam with only setscrews are not acceptable.

Two Type 25 beam clamps shall be used per point of pipe support.

2.3.1.3 Inserts, Concrete

Concrete inserts shall be constructed in accordance with the requirements of MSS SP-58 for Type 18 or 19 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.

2.3.2 Horizontal-Pipe Attachments

2.3.2.1 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.

2.3.2.2 Parallel Fire-Protection Pipes

Trapeze hangers fabricated from approved structural steel shapes, with U-bolts, shall be used when so specified. Structural-steel shapes and rod sizes shall conform with the requirements of NFPA 13 for trapeze hangers.

2.3.3 Vertical-Pipe Attachments

Single vertical-pipe attachments shall be Type 8.

2.3.4 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.

2.3.5 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 M017.

2.4 FIRE-DEPARTMENT CONNECTIONS

Hose connections shall have National Firehose standard-thread form and rocker lugs in accordance with NFPA 1963.

Cast-in function identifying lettering shall consist of raised letters, at least 1 inch in height, and read "STANDPIPE", "AUTOSPKR" or "AUTOSPKR AND STANDPIPE" as applicable. For work which involves the connection of existing separate sprinkler and standpipe systems, the existing fire department connections shall be removed and replaced with ones with the combined designation.

2.4.1 Wall Siamese

Unit shall be cast brass or bronze flush-mounted escutcheon-plate type, 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.

2.4.2 Wall Hydrant

Unit shall be of cast brass or bronze flush-mounted escutcheon-plate type with two 2-1/2-inch, fire-department, male outlets; 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.

2.4.3 Roof Manifold

Unit shall be of cast brass or bronze, horizontal type, with two 2-1/2-inch, 175-pound rated hose valves fitted with rocker-lug caps and chains. Finish shall be rough body with polished trim.

2.5 RISER ALARM EQUIPMENT

Riser alarm equipment shall be UL listed or FM approved for fire-protection use. Section 13851, "Fire Alarm Systems" specifies alarm system and wiring; all devices specified below shall be compatible with, and coordinated with that system.

2.5.1 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.

2.5.2 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.

2.5.3 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.

2.5.4 Water-Flow Alarm Device

Water-flow alarm devices shall be UL listed for the particular type of system.

2.5.4.1 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.

2.6 DRY-PIPE MAINTENANCE AIR

Dry-pipe maintenance air shall be from an independent source provided by contractor, unless drawings indicate connection to an existing facility system.

2.6.1 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, inlet air filter, and necessary unloader and intercomponent piping and wiring. Spare inlet-air filter media shall be provided.

2.6.2 Connection to Existing 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.

2.6.3 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.

2.7 STANDPIPE EQUIPMENT AND CABINETS

2.7.1 Standpipe Valve

Valve shall be 2-1/2-inch angle hose type, 175-psi rated, with 2-1/2-inch female to 1-1/2-inch male reducer, 1-1/2-inch cap and chain, and chrome-plated polished brass.

In multistory buildings with fire pumps, valve shall include orifice plate to restrict discharge pressure to 65 psig.

No hose rack or hose shall be provided.

2.7.2 Cabinet

Where standpipes are concealed, valves shall be enclosed in cabinets, but without hose racks or hoses. Cabinet body shall be recessed heavy-gage steel with primed surfaces and baked white enamel interior, and baked red enamel exterior.

Door shall be fitted with full size 1/4-inch thick safety or tempered glass

and dual friction latches. If cabinet comes with a label stating "Fire Hose for Use by Occupants of Building", or similar, the label shall be removed.

Cabinet shall be sized to accommodate the valve and either one 2-1/2-gallon air-pressurized water fire extinguisher or one 15-pound carbon-dioxide extinguisher. Extinguisher will be furnished by the Government.

2.7.3 Pressure Gauges

Pressure gauges shall be listed, with minimum 3.5 inch dial, with isolation valve and arrangement for draining. Gauges shall have dual scales with both English (psig) and Metric (kPa) units.

2.8 SPRINKLER HEADS

2.8.1 Head Types

Unless otherwise indicated, sprinkler heads shall be standard pendant or upright spray, or standard sidewall spray, with 1/2 inch orifice, listed for the applicable hazard classification. Temperature rating shall be ordinary, except in proximity to heat sources higher ratings shall be provided in accordance with NFPA 13.

In finished areas, heads and sprinkler escutcheons shall be chrome-plated brass. Heads located on suspended ceilings shall be recessed pendant type, unless otherwise indicated.

Concealed pendant heads shall be provided only where specifically indicated.

Corrosion-resistant heads shall be lead-coated, and provided only where specifically indicated.

Any other type of head shall be selected in accordance with NFPA 13 for the application, and manufacturer's data shall be submitted for the individual task order.

2.8.2 Spares

For new buildings and additions, or where a different type of head is installed in an existing facility, spares shall be furnished for each type of sprinkler head, complete with appropriate storage cabinet and wrench.

2.8.3 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 VALVES

2.9.1 Control Valves

All valves controlling water supply to sprinkler or standpipe systems, or isolating zones, shall be FM approved or UL listed, outside screw and yoke (OS&Y), gate valves with ferrous body and bronze trim, rated 175 psi.

Valves shall have provisions for handle to be locked, and shall be equipped with tamper switches (specified in Section 13851, "Fire Alarm Systems"), unless otherwise noted.

2.9.2 Drain and Test Valves

Drain valves and inspector's test valves shall be ball valves, 2 inches and under, shall be FM approved, rated 300 psi, with provisions to wire or lock handle in place.

2.10 MISCELLANEOUS MATERIALS

2.10.1 Bolting

Flange and general-purpose bolting shall be hex-head and shall conform to ASTM F 568M, Class 4.8 or higher.Heavy hex-nuts shall conform to ASTM A 563. Square-head bolts and nuts are not acceptable.

2.10.2 Elastomer Calk

Polysulfide- or polyurethane-base elastomer-calking material shall be two-component type, conforming to ASTM C 920.

2.10.3 Piping Escutcheons

Piping 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.

Piping escutcheons shall be one-piece or split-pattern type. Piping escutcheons shall have provisions consisting of internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.10.4 Flashing

2.10.4.1 Lead

Sheet lead shall conform to ASTM B 749, and shall weigh not less than 4 16 ounces per square foot.

2.10.5 Flange Gaskets

Gaskets shall be suitable for the intended use and shall contain no asbestos.

2.10.6 Pipe-Thread Compounds

Tetrafluoroethylene tape or other suitable compounds shall be used.

2.11 FIRE-PROTECTION SYSTEM IDENTIFICATION

2.11.1 Piping Identification

All sprinkler and standpipe system piping shall be service-labeled in accordance with Section 15003, "General Mechanical Provisions", except that sprinkler branches with visible heads need not be labeled.

2.11.2 Sprinkler Hydraulic Design Information Sign

Each hydraulically designed sprinkler system shall be identified with a permanently marked and attached metal or rigid plastic sign, located at the alarm valve or dry pipe valve supplying the area. The sign shall include the following information:

(a) Location of the design area or areas.

(b) Discharge densities over the design area or areas.

(c) Required flow and residual pressure demand at the base of riser.

(d) Occupancy classification or commodity classification and maximum permitted storage height and configuration.

(e) Hose stream demand included in addition to the sprinkler demand.

2.11.3 Fire Department Connection Sign

In addition to the service designation integral to the fire department connection, a sign shall be provided at each connection indicating the pressure required at the inlets to deliver the system demand. Where a fire department connection services only a portion of a building, the sign shall also indicate the portions of the building served. Sign shall be red with white lettering, minimum 0.5 inch high.

2.11.4 Valve Identification

Control valves and inspector test valves shall be identified with "GOMARS Number" tags as specified in Section 01600, "Material and Equipment". Drain valves shall have tags attached reading "Main Drain Valve" or "Auxiliary Drain Valve" as applicable.

Where any of these valves is concealed, an additional tag indicating its function, and GOMARS number where applicable, shall be attached to the access door, ceiling tile, or other means of access, and shall be clearly visible from the occupied space. Tags shall be red with white lettering, minimum 0.5 inch high.

2.11.5 Standpipe Hydraulic Design Information Sign

The installing contractor shall provide a sign identifying the basis of the system design as either hydraulic calculations or pipe schedule. The sign shall be located at the water supply control valve for automatic or semiautomatic standpipe systems and at an approved location for manual systems.

The sign shall indicate the following:

(a) The location of the two hydraulically most remote hose connections

(b) The design flow rate for the connections identified in (a)

(c) The design residual inlet and outlet pressures for the connections identified in (a)

(d) The design static pressure and the design system demand (i.e., flow and residual pressure) at the system control valve, or at the pump

discharge flange where a fire pump is installed, and at each fire department connection.

2.12 PAINTING OF EQUIPMENT

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 14, and NFPA 24. Work shall be performed in the presence of the Contracting Officer 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.

3.2 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. 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. Additional hangers shall be provided as necessary so there is not less than one hanger per section of pipe on branch lines, and not less than one hanger between branches on cross-mains.

PIPE SIZE (INCHES)	ROD SIZE (INCHES)	MAXIMUM SPACING (FEET)
Up to 1	3/8	8
1-1/4	3/8	12
1-1/2 to 4	3/8	15
5 to 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, and 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.

3.3 FIRESTOPPING AND SMOKESTOPPING

Firestopping or smokestopping shall be provided in accordance with Section 07840, "Firestopping and Smokestopping" at all penetrations through fire-rated structures or smoke barriers.

3.4 SOUND STOPPING AND SEALING (NON-RATED)

The following provisions apply only where the structure is not fire-rated.

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.

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 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.

3.5 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. 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 C 592 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.

3.6 PIPING ESCUTCHEONS

Piping escutcheons shall be provided at penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, piping 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. Piping escutcheons shall be chrome plated in occupied spaces and shall conceal openings in building construction. Piping 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 Contracting Officer, or replaced with new undamaged equipment at no additional cost to the Government.

Painting of other surfaces shall be in accordance with Section 09915, "Painting".

3.10 ELECTRICAL WORK

Electrical work is specified in Division 16, "Electrical," except for control and fire alarm wiring which is specified in Section 13851, "Fire Alarm Systems".

Motors, controllers, contactors, and disconnects shall be furnished with their respective pieces of equipment. Motors, controllers, contactors, and disconnects shall conform to and shall have electrical connections provided under Section 16145, "Standard Wiring Systems." 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

Prior to acceptance of the work, completed systems shall be tested in the presence of the Contracting Officer.

The following tests shall be performed, on the entire system if new, or on the modified portion for existing systems:

Wet-Pipe Sprinkler Systems: Hydrostatic test and sprinkler system operational test.

Dry-Pipe Sprinkler Systems: Hydrostatic test, air leakage test, and sprinkler system operational test

Standpipe Systems: Hydrostatic test and standpipe system operational test

Government will supply testing water at a location determined by the Contracting Officer, 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 Contracting Officer.

3.11.1 Test Gages

Test pressure shall be measured at the lowest elevation of the tested system or zone. 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 days prior to the test, test gage number, and the project number.

3.11.2 Dry Systems Air Pressure Leakage Test

Compressed air used for testing shall be oil-free.

Preliminary leak testing shall include swabbing all joints under a test pressure of 5 psig with a standard high film strength soap solution and observing for bubbles. Joints showing leakage shall be repaired and retested.

Air pressure leakage test shall be performed at 40 psi for 24 hours. Any leakage that results in a loss of pressure in excess of 1.5 psi during the 24 hour test shall be corrected, and the test repeated.

3.11.3 Hydrostatic Test

Work involving the installation, relocation, or modification of five or less sprinkler heads shall not be tested unless otherwise indicated. A visual inspection following re-pressurization of the lines shall be

performed. Dripping or weeping joints shall be repaired.

Work involving the installation, relocation, or modification of six to twenty sprinkler heads serviced by a sectional valve shall be tested in accordance with Method A as specified in this section, unless otherwise indicated. Other sprinkler work shall be tested in accordance with Method B as specified in this section. Work involving any installation, relocation or modification of standpipe systems shall be tested in accordance with Method B.

Only potable water shall be used for testing.

Test Method A: Above ground systems shall be tested at 50 psi above normal static pressure, or at 125 psi, whichever is greater. The applied pressure shall be maintained without further addition of test media and without loss for not less than 3 hours. Loss shall be determined by a drop in gauge pressure or visual leakage.

Test Method B: Above ground systems shall be tested at 200 psi, or at 50 psi above expected working pressure, whichever is greater. The applied pressure shall be maintained without further addition of test media and without loss for not less than 2 hours. Loss shall be determined by a drop in gauge pressure or visual inspection.

For either test method, dripping or weeping of joints shall be repaired, and the system shall be re-tested.

3.11.4 Sprinkler System Operational Test

Flow testing shall be performed through the inspector's test valve for each new zone, and shall be coordinated with testing of the fire alarm system. The waterflow alarm for the zone shall be activated within 5 minutes of the beginning of the flow and until flow stops.

For dry pipe systems, the test shall also measure the time from opening the test valve until the dry pipe valve opens, and the time until water is discharged from the test connection.

3.11.5 Standpipe System Operational Test

Flow testing shall be performed by flowing water from the hydraulically most remote hose connections (typically, each roof outlet or outlet at the top of stairs). The flow test shall verify that the specified pressure is available at the specified flow. Automatic standpipe systems without fire pumps shall be tested with the connected water supply. Automatic standpipe systems fed by a fire pump shall be tested with the pump in operation. Manual standpipe systems shall be tested with a portable pump of adequate capacity, pumping from the nearest fire hydrant into the standpipe fire department connection.

Threads of all fire department connections, and all hose outlets, shall be verified to match the equipment used by the local fire department. All valves shall be manually opened and shut, with outlets capped, to verify proper operation. After test, caps shall be removed, water drained, and caps reinstalled.

3.11.6 Main Drain Flow Test

For sprinkler systems and standpipe systems, the main drain valve shall be

opened, and once system pressures have stabilized, static and residual pressures shall be recorded. When the drain valve is closed, record the time for the pressure to return to the original static pressure.

3.12 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 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-disinfected. After successful disinfection the piping shall be thoroughly flushed before placing into service. Water for disinfection, and flushing will be furnished by the Government.

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 OPERATIONAL READINESS REVIEW (ORR)

Conduct an ORR in accordance with section 01770, "Task Order Closeout", including location and function of any new or modified control valves, drain valves, inspector test valves, alarm equipment, dry pipe system equipment, and hose valves.

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SECTION 14210

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SECTION 14210

ELECTRIC TRACTION ELEVATORS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR METALS (ASM)

ASM-01	(1985) Metals Handbook

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 325	(2000) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength
ASTM A 325M	(2000) Standard Specification for High Strength Bolts for Structural Steel Joints (Metric)
ASTM A 568/A 568M	(2000; Rev B) Standard Specifications for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A17.1	(1996) Safety Code for Elevators and Escalators; (Includes Interpretations)
ASME A17.2	(1988; A17.2a-1989) Inspector's Manual for Elevators and Escalators
ASME B17.1	(1967; R 1973) Keys and Keyseats

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel

COUNCIL OF AMERICAN BUILDING OFFICIALS (CABO)

CABO A117.1	(1992) American National Standards for Buildings and Facilities Providing Accessibility and Usability for Physically Handicapped People

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IES RP-1	(1982) Office Lighting

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA MG 1 (1998; Rev. 1) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 102 (1982) Black Alkyd Paint

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.2.2 Design Requirements

Provide passenger and freight elevators, accessory equipment, and installation that meets or exceeds requirements of ASME A17.1 and requirements indicated on the drawings. Typically, requirements on drawings will include:

For Passenger Elevators:

Rated Load	in
Speed	in
Approx. Travel Distance	in
Travel	in number of floors
Platform Size	in wide by deep
Clear Car Inside	in wide by deep by millimeters high
Landings	as indicated
Hoistway & Car Door Type:	center opening-horizontal sliding, single speed horizontal sliding, or two-speed horizontal sliding.

For Freight Elevators:

Rated Load	in
Loading:	ASME A17.1 Class (A, B, C1, C2, or C3)
Speed	in
Approx. Travel Distance	in meters
Travel	in number of floors
Platform Size	in wide by deep
Clear Car Inside	in wide by deep by millimeters high
Landings	as indicated

Hoistway Door Type:	Vertical, Horizontal, bi-parting, or lift
Size:	in wide by high
Car Gate Type:	Balanced counterweighted, or Vertical sliding

1.2.3 Performance Requirements

Hoist motor shall provide continuous service of not less than 140 floor stops per hour, and with this service motor windings shall not exceed 50 degrees C ambient temperature rise. Speed regulation, when the car is carrying its rated load, shall not exceed plus or minus 5 percent of the average round trip speed. Acceleration under full load, up and down, shall be not less than or greater than measured from start of car motion to time of attaining 80 percent of full rated speed. Acceleration control shall be adjustable.

1.2.4 Operational Requirements

1.2.4.1 Hoistway and Car Door - Passenger Elevator

Doors shall operate smoothly in both directions and shall be cushioned to stop at full-open and full-closed positions. Doors shall open and close with average speed of.

Door operations shall be integrated with car-leveling system to prevent elevator movement before doors close.

Doors shall operate in following manner:

a. Hoistway door closure shall lead car-door closure; car-door opening shall lead hoistway-door opening.

b. Opening of car door shall begin when car is in last 300 millimeter of travel before stopping; hoistway door opening shall not begin until car is stopped.

c. Upon initial opening, doors remain open for a predetermined interval, adjustable from 0 to 8 seconds.

d. DOOR OPEN buttons shall open doors unless elevator is in motion. DOOR CLOSE button is supplementary to automatic closure of doors when a call button is pressed.

e. Pressing DOOR OPEN button shall temporarily open doors unless car is moving. Pressing DOOR CLOSE button shall close doors, subject to door-edge controls specified.

f. Door closing reverses when: using DOOR OPEN button, car door safety edge activates, or when light sensors are interrupted.

g. Upon initial interruption of photoelectric light beam, door reclosing time shall become shorter at a predetermined interval, adjustable from 0 to 4 seconds.

h. Should either light beam be interrupted while doors are closing, doors shall return to open position, reclosing again after a predetermined interval.

i. When doors are unable to close within an interval of 0 to 30 seconds, the photoelectric unit and door safety edge devices shall be made inoperative and a loud buzzer shall be activated while doors close at reduced speed.

1.2.4.2 Hoistway and Car Gate - Freight Elevator

Operators shall move car gates at a minimum speed of per second in a sequenced operation.

Equip doors for manual operation from within car when power fails. Mechanical interlock shall prevent doors from opening except when elevator is at landing. Electrical controls shall prevent car movement unless gate is closed. Equip gates with safety devices which reopen gates when obstructions are encountered.

Integrate door operation with car-leveling system preventing car movement prior to door closure. Prevent doors from opening prior to elevator stop.

1.2.4.3 Operation and Control System - Passenger Elevator

Design system for automatic flush leveling of car at each stop.

Single Car Operation: Operation system shall be "selective collective automatic operation" as defined by ASME A17.1. Car shall return to first-floor landing after calls are satisfied, remaining there with doors open until a call is registered. Key-activated maintenance switch shall deactivate call buttons and permit car operation by car station buttons.

Multiple Car Operation: Operation system shall be "selective collective automatic operation." Provide these additional features with key-operated selector switch:

a. When no calls are registered, cars shall be stationed at first floor, and be fully lighted.

b. When car is at first floor while another car is answering calls, standing car shall respond to calls for up travel, registered on floors below an active elevator traveling up; car shall respond to calls for down travel registered on floors above an active elevator traveling down.

c. First car returning to home floor shall remain there. Car shall then respond when up calls are registered on floors below an active car traveling up, or down calls from floors above an active car traveling down.

d. When, with one car standing at first landing, another car arrives at first-floor with calls answered, the last car to arrive becomes reserve car.

e. Provide key-activated switches to place any car in single car operation, or to remove any car from service while others remain in multiple car operation.

1.2.4.4 Operation and Control Systems - Freight Elevator

Design system for automatic flush leveling of car at each stop.

Provide "single automatic operation" systems defined by ASME A17.1. Key-activated maintenance switch shall deactivate call buttons and permit car operation by car station buttons.

When car is not in use, depression of call buttons at any landing shall operate doors and dispatch car. When car arrives at landing, car gates and hoistway doors shall open. Car shall remain at landing until a button in car or at another landing is pressed.

Pressing CLOSE DOOR button shall close doors.

Pressing call button at landing where car is stationed with doors closed shall open doors.

Pressing call buttons at other landings while car door is closed shall dispatch car.

When call is made at another landing while car doors are open, alarm shall sound to warn user.

When DOOR OPEN button in car is not pressed within 30 seconds, doors shall close and car shall proceed to landing from which call originated unless door is obstructed.

When DOOR OPEN button is pressed within 30 seconds after warning sounds, provide an interval of 60 seconds before next warning.

Pressing landing DOOR CLOSE button when car is free to respond shall close doors and dispatch elevator to satisfy call.

After car is underway in response to car panel commands, no landing calls shall be answered until car calls have been completed. Car calls shall have precedence over landing calls.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Connection Diagrams shall be submitted for Electric Passenger and Freight Elevator Systems 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.

Schematics shall be submitted for Elevator Systemsincluding annotated ladder logic diagrams for programmable logic controllers.

Fabrication Drawings shall be submitted for Electric Passenger and Freight Elevator Systems consisting of fabrication and assembly details to be performed in the factory.

Installation Drawings shall be submitted for Electric Passenger and Freight Elevator Systems accordance with the paragraph

entitled, "Installation," of this section. Drawings shall include hoistway layout in plan, in elevation, with guiderails, brackets, layout information, equipment room layout and design, and dimensions required by ASME A17.1. Drawings shall indicate maximum loads/loading points applied by guiderails/brackets on shaft enclosure.

SD-03 Product Data

Manufacturer's Catalog Data and Equipment and Performance Data shall be submitted for the following items consisting of load ratings, design speeds, car and platform dimensions, and opening and closing speeds.

Car Frame and Platforms
Driving Machines
Hoist Motor
Motor Controller
Hoistway and Car Doors
Hoistway Entrances and Car Gates
Operation and Control Systems
Operating Systems
Emergency Operating and Signaling
Operating Devices
Telephones
Guiderails
Terminal Stopping Devices
Safeties
Electrical Protective Devices
Electrical Equipment
Counterweights
Hoisting Ropes
Emergency Exits
Entrance Sills
Paint Materials

SD-04 Samples

Manufacturer's Standard Color Charts shall be submitted for elevator systems showing the manufacturer's recommended color and finish selections. Sample alarm covers shall also be submitted for approval.

SD-06 Test Reports

Test Reports on the following tests shall be submitted for elevator systems in accordance with ASME A17.1.

Continuous-Operation Tests
Temperature Rise Tests
Acceptance Inspection

SD-07 Certificates

Certificates of Compliance shall be submitted certifying that each product used complies with ASME A17.1, Rule 1101, and has been tested to those requirements by an independent testing laboratory within a two year period.

SD-07 Certificates

Notice to the Contracting Officer shall be given at least 14 days prior to date proposed for conducting each training course.

SD-10 Operation and Maintenance Data

Manual shall have complete instructions for operation, inspection, testing, and maintenance of each system, including equipment malfunction checklists.

1.4 QUALIFICATIONS

1.4.1 Independent Testing Laboratory

Contractor shall employ an independent testing laboratory to conduct tests specified.

1.4.2 Certifications

Contractor shall certify that each product used complies with ASME B17.1, Rule 1101, and been tested to those requirements by independent laboratories within a two year period.

1.5 QUALIFICATIONS FOR WELDING WORK

Welding shall comply with AWS D1.1

PART 2 PRODUCTS

2.1 CAR FRAME AND PLATFORM

Car and platform shall be designed and built in conformance with ASME A17.1. Platform floor shall be of steel over a steel base.

Sides and rear of the car from floor to the decorative ceiling shall be constructed of 5-ply, plastic-laminate-surfaced wood core of not less than 1-1/8-inch total thickness. Plywood base shall be exterior-grade western softwood plywood. Plastic-laminate facing shall be fiber-reinforced phenol-formaldehyde, color and pattern as selected.

Front and sides of car shall be fire-retardant protected with No. 26 U.S. standard gage black-iron sheathing.

Rear corners of the car shall be rounded to a radius of not less than 4 inches.

Base of the car shall be of 6-inch high 14-gage corrosion-resistant steel, recessed under the car panels.

Directly above the base, within the recessed section, continuous vent slots shall be provided around the perimeter of the paneling for exhausting the air of the ventilation system. Directly above this slot a 14-gage corrosion-resistant steel cover shall be provided for the edge of the paneling.

Side emergency exit doors, where required, shall be flush-panel hinged type.

Front return panel and entrance columns shall be integral, shall extend

from the floor to the fascia, and shall be constructed of 14-gage corrosion-resistant steel with No. 6 finish, as defined in ASM-01 Metals Handbook.

Directly above the opening, a fascia panel shall be provided with the front section splayed sufficiently to accommodate the box and operating parts of the car position indicator. Entire splayed section shall be designed for relamping by hinging or other equally suitable device. Fascia shall be constructed of 14-gage corrosion-resistant steel with No. 6 finish.

Handrails shall be corrosion-resistant steel with No. 6 finish, continuous around sides and back, except at side emergency exit doors where the handrail shall be attached to the door and swing with the door. Rails shall be corrosion-resistant steel 38 millimeter in diameter and attached to the car body on corrosion-resistant steel brackets. Both brackets and attachment shall be consistent with the stresses and safety factors involved.

Car canopy shall be constructed of stretcher-level cold-rolled furniture steel of not less than 14-gage, reinforced to support a 400-pound load applied to 2 square feet anywhere on its surface without plastic deformation of any member of the canopy construction. Corners and reinforcing shall be welded or bolted to present one-piece construction.

Directly below the ceiling, a subceiling shall be mounted forming a plenum to distribute the air from the ventilating system around the perimeter of the car at the suspended ceiling height. This ceiling shall also support the fluorescent lighting equipment. Below this plenum chamber, a decorative ceiling shall be installed with diffusing acrylic grille suspended on a reinforced aluminum channel framing system. Entire ceiling system shall conform to the contour of the car body. An emergency exit shall be provided in the ceiling system.

A forced ventilating system shall be provided incorporating a three-speed squirrel-cage blower delivering a minimum of 100 cubic feet per minute per person of rated elevator capacity at top speed. Blower shall be sized to deliver the air requirement at a fan speed of not more than 1,600 revolutions per minute. Mounting shall be designed and installed to prevent any discernible vibration of the surface on which the blower is mounted.

Car lighting shall provide a minimum of 30 foot-candles of diffused illumination.

Car floor shall be covered with 1/8-inch vinyl tile in colors as specified. Attachment shall be by waterproof adhesive recommended by the tile manufacturer for bonding floor to either steel or wood substrate; emulsion adhesives will not be accepted.

Wherever corrosion-resistant steel is indicated for elevator cars, it shall be AISI Type 316. Finish for corrosion-resistant steel shall be No. 6 as defined in the ASM-01 Metals Handbook.

2.2 DRIVING MACHINE

2.2.1 General Machine Requirements

Elevator-driving machine shall be worm-gear, traction type. Gear housing, brake support, and motor support shall be single cast or components shall

be mounted on bedplate. Design and construction of equipment and parts subject to wear shall be completely interchangeable.

Mount rotating machinery to isolate machine noise from building. Isolation system design shall prevent failure of any component from interfering with elevator operations.

Provide gasketed handhole in bottom half of gear housing allowing access to worm gear. Provide drain plugs, overflow pipes, and oil-level indicators. Include seals preventing lubricant escape.

2.2.2 Gears and Bearings

Worm and high speed shaft shall be one piece steel construction, mounted with heavy-duty anti-friction bearings and preloaded thrust bearings. Mount worm gear on drive shaft with roller bearings. Provide means for bearing lubrication. Drive shaft shall have integral flange to connect driven shaft.

2.2.3 Drive Sheave

Sheave shall be steel with grooves, designed to provide maximum traction and minimum wear. Sheave shall be bolted to flange integral with shaft. Bearings for assembly shall be roller type. Provide means for bearing lubrication.

2.2.4 Brake

Provide spring-actuated electrically released brakes. Brake shoes shall be lined with fireproof friction material. Provide helical brake springs, operating in compression to apply brakes when released by magnet. Brake release shall be quick and controlled obtaining gradual stops under rated loads. Brakes shall be activated by:

a. Various safety devices,
b. Upon interruption of power,
c. When equipment fails to function safely in during car operations,
d. Upon stopping of car.

2.2.5 Hoist Motor

Hoist motor shall be totally enclosed, non-vented ac motor with Class F insulation designed for elevator service. Motor armature shall be dynamically balanced and supported by ball bearings of ample capacity.

2.3 MOTOR CONTROLLER

Provide microprocessor based, variable voltage variable frequency (VVVF) ac motor control. The controller shall be designed specifically for elevator motor control and shall control the starting, acceleration, deceleration and stopping of the elevator and to prevent damage to the motor from overload or excessive current. The system shall be non-regenerative.

2.4 HOISTWAY AND CAR DOORS

Provide doors having 1-1/2 hour UL rating.

Car and hoistway doors shall be motor-operated, two-speed, horizontal-sliding type and shall be flush construction of furniture steel

rolled to stretcher-level standard of flatness as defined in ASTM A 568/A 568M. Door panels shall be filled with sound-deadening mineral filler to maintain the planar nature of the door surfaces in use.

Car door shall be equipped with removable door guides to run in slots in the car sill.

Doors shall be carried on concealed overhead tracks secured to the structural steel of car frame and to the structural steel of the door framing. Hangers shall be ball-bearing sheave type with sealed bearings. Sheave diameter shall be commensurate with the door operating requirements but in no instance less than 2-1/4 inches. Adjustable upthrust rollers shall be of steel with sealed ball bearings. Tracks shall be of cold-drawn steel formed to contour of sheave and roller tracks; track thickness shall be at least 1/2 inch.

Ferrous surfaces, except doors and other surfaces visible from the car and its approaches, as well as sliding surfaces, tracks, and roller treads, shall be cleaned, primed with the manufacturer's standard rust-inhibitive primer, and finished with the manufacturer's standard enamel system.

Doors shall be formed stainless steel sheet, AISI Type 316 with a No. 6 satin finish.

Doors shall operate under the control of the operational system as specified. Hoistway-door closure shall lead car-door closure; car-door opening shall lead hoistway-door opening under the automatic control of the operation system.

Lead doors of both hoistway and car shall be provided with full-height safety edges whose operation is integrated with the elevator operation system in such a way that when an obstruction is encountered while closing, the doors will reopen; pressure against this device, while doors are open, shall hold the doors open. Construction of these edges shall be such that, even in the event of failure of either or both of the doors to stop, there will be no injury to a body member which may be in the plane of closure.

Door design and safety edge operation shall meet requirements of ASME A17.1.

Both hoistway and car doors shall be provided with a positive electromechanical interlock and auxiliary door-closing device to permit elevator operation only after interlock circuits have been closed.

2.5 ENTRANCES

Complete hollow metal entrances shall be provided, including frames, sills, struts and closer angles, hanger supports, hanger cover plates, fascia plates, toe guards, track hangers, and hardware necessary to the installation thereof.

Unit frames shall be made of not less than 14-gage, Type 302 corrosion-resistant steel in No. 6 satin finish.

Sills shall be cast iron not less than 7/16 inchthick with nonslip surface. Grooves for the door guides shall be accurately machined for free door travel with 3/32-inch clearances. Each sill shall be supported on steel anchors from the floor-supporting steel.

Structural-steel angle struts shall support the unit frame and the

door-operating hardware and structurally integrate the entrance with the hoistway structural system.

Fascia plates and dust covers shall be not less than 14-gage stretcher-level-flatness steel reinforced to retain this flatness in service, securely fastened to the entrance structural system, and provided with facilities for convenient removal for servicing.

Exposed surfaces of fascia plates, dust covers, cover plates, and other exposed ferrous entrance accessory items shall be of corrosion-resistant steel.

Nonexposed ferrous surfaces of the entrance accessory items shall be wire brushed to remove rust, solvent-cleaned of oil and grease, and protected by a two-coat rust-inhibitive paint system consisting of a primer and a finish coat of black alkyd paint conforming to SSPC Paint 102.

2.6 OPERATION AND CONTROL SYSTEMS

2.6.1 Operation

Operation system shall be the selective collective automatic type. Car shall automatically return to the first-floor landing after all calls have been satisfied, where it shall remain with doors open until either a car call or corridor call is registered. This will be referenced as "single selective collective operation."

Operation system shall be the multiple selective collective automatic type with each car operating under a system conforming to the definition of "selective collective automatic operation" with the following additional features under key-operated selector switch:

When no calls are registered, cars are stationed at the first floor; cars shall be fully lighted.

When one car is standing in the ready position at the first floor landing while the other cars are answering calls, the standing car shall respond to any corridor calls for up travel that are registered on floors below the active elevator when it is traveling in the up direction; it shall also respond to any corridor calls for down travel that are registered on floors above the active elevator when the active elevator is traveling in the down direction.

First elevator to return to the first floor after answering calls shall remain there unless there are unanswered up corridor calls registered on floors below the active elevator while it is traveling in the up direction, or unanswered down corridor calls from floors above the active elevator when it is traveling in the down direction.

When, with one elevator in the ready position at the first-floor landing, the other cars arriving at the first-floor landing with all corridor calls answered, shall become the reserve cars.

Keyed switches shall be provided to place the cars on single selective collective service and to remove either car from service while the other remains in single selective collective operation.

When in multiple selective collective operation, each car, after it has left the first floor landing in response to car or corridor calls,

shall operate in "selective collective automatic operation" mode, which shall be referenced as "single selective collective operation."

2.6.2 Control Panel

A control panel or panels shall be provided and installed where indicated. Panels shall include relays, switches, and accessory electrical items necessary to the specified operation. Panels located in finished area shall be flush-mounted with covers finished in baked enamel in color indicated or as directed. If installed in corridors, lobbies, or other locations accessible to the public, panels shall be equipped with cylinder locks.

Control devices shall conform to Section 16286, "Overcurrent Protective Devices," and be UL listed.

2.6.3 Car Stations

Cars shall be equipped with an operating station incorporating individually illuminated operating push buttons numbered to correspond to the floors served, an EMERGENCY STOP switch, an emergency signal-device button or telephone, and light switches. Depressing a pushbutton shall produce illumination of that pushbutton from the rear; illumination shall continue until a stop has been made at the indicated floor.

Car station shall include DOOR OPEN and DOOR CLOSE buttons. Depressing the DOOR OPEN button shall temporarily open the doors unless car travel has started. Depressing the DOOR CLOSE button shall initiate the closing of doors, subject to the door-edge controls as specified.

Car stations shall also incorporate key-operated INDEPENDENT SERVICE operation switches.

2.6.4 Corridor Stations

A flush-mounted corridor station of a design consistent with the decor of the area and incorporating a rear-illuminated UP pushbutton shall be installed 42 inches above the floor, adjacent to the elevator, at the lowest floor landing. A matching station incorporating DOWN pushbutton shall be installed adjacent to the elevator at the top floor. The corridor station shall incorporate a rear-illuminated car position indicator.

In the corridors of floors other than the lower and top floors, corridor stations shall be installed, matching the one on the first floor but incorporating both UP and DOWN illuminated pushbuttons.

Face plates shall be metal, finished to match the adjacent exposed metal at entrances.

2.6.5 Car-Position Indicators

Car shall be equipped with a front overhead illuminated panel that identifies the floor being approached by the elevator; numerals shall be at least 1 inch high and shall be of a lighting intensity that is easily readable from any point in the car under operating car lighting. Panels shall be 18-gage Type 302 corrosion-resistant steel with an ASM No. 6 finish.

Each indication shall be illuminated from the rear by an individual light

of sufficient intensity to permit easy reading of the numeral without glare. Light for each numeral shall be enclosed in a light-tight compartment which confines the light supply to the numeral it serves. Change of illuminations shall be continuous, shall be anticipatory of the floor being approached, and shall change as the car leaves the indicated floor.

2.6.6 Alarms

An emergency signal device shall be provided.

Emergency signal device shall be an indoor alarm bell installed either in the hoistway or behind a grille consistent with the decor of the area in which it is located.

Provide vandal resistant speaker telephone meeting requirements of telephone system and ASME A17.1.

Provide car and hoistway wiring in accordance with ASME A17.1 and Section 16145, "Standard Wiring Systems." Provide junction boxes for connection to wiring outside car and hoistway.

2.6.7 Elevator Leveling

Operation system shall include automatic accelerating when cars are leaving stops and decelerating as cars approach a floor where a stop is to be made.

Acceleration and deceleration rates shall be not less than 3 nor more than 5 feet per second. System shall be designed for automatic flush leveling of the car at each stop, controlled by a sensing system which, once set, requires no periodic adjustment.

Door operation shall be integrated with the car-leveling system in a way to make elevator start dependent upon prior complete closing of the car doors and the doors of the hoistway at the platform from which the elevator is departing. Opening of the car door shall begin when the car is in its last foot of travel before a stop; hoistway door opening shall not begin until the car is at a complete stop.

Leveling tolerance, as measured by a 6-foot straightedge laid flat on the higher of the two surfaces, shall be plus or minus 1/8 inch.

2.6.8 Button Control

Car buttons which are depressed shall remain illuminated until the car has made its stop at the indicated floor; the illuminated buttons on the car station shall show the stops still to be made by the car in the direction in which it is traveling or about to travel.

Corridor buttons which have been actuated to call for a car stop shall remain illuminated until a car traveling in the direction of desired service, as indicated by the illuminated call button, has made a stop at the floor where the button is located. When a car traveling in the indicated direction has stopped, the button illumination shall be extinguished.

2.6.9 Elevator Controls

Elevator car and corridor stations shall be placed at a maximum height of

48 inches from the floor, or a supplemental panel shall be provided to accommodate the physically handicapped.

Elevator-cab and landing call buttons shall be identified with braille markings to accommodate personnel with vision impairment, as specified in ASME A17.1.

2.7 GUIDERAILS

Provide guiderails conforming to ASME A17.1.

2.8 COUNTERWEIGHTS

Provide counterweights sized to equal weight of elevator plus 40 percent minimum and 45 percent maximum of elevator's rated capacity.

Concrete weights are not acceptable.

2.9 HOISTING ROPES

Provide wire ropes conforming to ASME A17.1.

2.10 EMERGENCY EXIT

Provide hinged exit in car ceiling. Attach exit cover with non-removable fasteners, accessible only from top of car.

Equip emergency exits with interlocks preventing movement of car when in use. Cause alarm system to sound when exit door opens.

2.11 TERMINAL STOPPING DEVICES

Provide stopping devices and control switches. Operate normal terminal stopping devices using switches meeting the requirements of ASME A17.1.

2.12 SAFETIES

Provide elevators with ASME A17.1 type A safeties.

2.13 ELECTRICAL PROTECTIVE DEVICES

Equip Elevator with electrical protective devices required by ASME A17.1, Rule 210.2.

Buzzer shall activate, and protective timing circuitry bypassed, in event of photoelectric unit failure or beam is interrupted by smoke or other means. Provide system bypass for either light beam permitting normal operation of unaffected systems. Provide individual cut out switches located in car station.

Timing functions shall be controlled by adjustable timing devices.

2.14 ELECTRICAL

Electrical service for drive system shall be 480 volt, 60 Hz, 3-phase ac, neutral grounded. Service for car lighting shall be 120 volt, single-phase, 60 Hz grounded. A feeder, with circuit breaker or fused disconnect switch located in elevator machine room, shall terminate at control panel for each elevator. A car lighting junction box conforming to

Section 16145, "Standard Wiring Systems," and telephone junction box meeting requirements of telephone system, shall be provided.

PART 3 EXECUTION

3.1 INSTALLATION

Install systems in accordance with the manufacturer's recommendations, ASME A17.1 and ASME A17.2.

Electrical wiring shall be in accordance with NFPA 70 and Section 16145, "Standard Wiring Systems."

Weld each connection between elevator structure, hoistway, and building in conformance with AWS D1.1.

In instances where removability is required, connection shall be with bolts conforming to ASTM A 325.

Mount Control panels flush when located in finished areas with covers finished in baked enamel in color shown, or as directed.

When installing panels in corridors, lobbies, or other public locations Install each panel with a lock and tag the keys for each lock installed.

3.2 TESTING

3.2.1 Test Weights

Test weights required will be furnished by the Government. Contractor shall arrange for their use and return.

3.2.2 Tests

Perform inspection and tests required by applicable portions of ASME A17.1.

Measured leveling tolerances, using 6-foot straightedge laid flat on higher of two surfaces, shall be plus or minus 1/8 inch under every rated loading condition.

Perform acceptance inspection and tests in accordance with Section 1003, ASME A17.1.

Continuous-operations test: Elevator is operated continuously with rated loading, starting cold, for 30 minutes over its entire operating range, stopping at every floor. No component will be permitted to fail.

Temperature rise test: At the end of continuous-operations test run, measure temperature rise of the following:

a. Insulated winding shall not exceed 50 degrees C ambient.

b. Commutator shall not exceed 55 degrees C rise.

c. Temperature within the driving machine enclosure shall not exceed 55 degrees C above ambient temperature.

3.3 MANUFACTURER'S FIELD SERVICE

Provide on-site training for operating staff. Training period shall start after system is functionally complete but prior to final acceptance testing. Provide training instruction for 8 hours, conducted during normal working hours, covering all items contained in each maintenance and operating manual. Demonstrate routine maintenance operations.

-- End of Section --

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SECTION 14240

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03/98

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PART 3 EXECUTION

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SECTION 14240

HYDRAULIC PASSENGER ELEVATORS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR METALS (ASM)

ASM-01	(1985) Metals Handbook

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 325	(2000) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength
ASTM A 325M	(2000) Standard Specification for High Strength Bolts for Structural Steel Joints (Metric)
ASTM A 568/A 568M	(2000; Rev B) Standard Specifications for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A17.1	(1996) Safety Code for Elevators and Escalators; (Includes Interpretations)

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel

ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION (AFBMA)

AFBMA 11	(1990) Load Ratings and Fatigue Life for Roller Bearings
AFBMA 9	(1990) Load Ratings and Fatigue Life for Ball Bearings

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA MG 1	(1998; Rev. 1) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 102	(1982) Black Alkyd Paint
SSPC SP 6	(1991) Surface Preparation Specification No. 6 - Commercial Blast Cleaning

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Connection Diagrams shall be submitted for Hydraulic Passenger and Freight Elevator Systems 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.

Schematics shall be submitted for Hydraulic Elevator Systems including annotated ladder logic diagrams for logic controllers.

Fabrication Drawings shall be submitted for Hydraulic Passenger and Freight Elevator Systems consisting of fabrication and assembly details to be performed in the factory.

Installation Drawings shall be submitted for Hydraulic Passenger and Freight Elevator Systems accordance with the paragraph entitled, "General," of this section. Drawings shall include hoistway layout in plan, in elevation, with guiderails, brackets, layout information, equipment room layout and design, and dimensions required by ASME A17.1. Drawings shall indicate maximum loads/loading points applied by guiderails/brackets on shaft enclosure.

SD-03 Product Data

Manufacturer's Catalog Data and Equipment and Performance Data shall be submitted for the following items consisting of load ratings, design speeds, car and platform dimensions, and opening and closing speeds.

Car Frame and Platforms
Power Units
Motors
Pumps
Valves
Plunger, Cylinder, and Casings
Tanks
Hoistway Entrances and Car Gates
Operation and Control Systems
Operating Systems
Elevator Cars
Door and Gate Operators
Entrance Frames
Entrance Sills

Paint Material
Inspection and Maintenance Switches

SD-06 Test Reports

Test Reports on the following tests shall be submitted for elevator systems in accordance with the paragraph entitled, "Testing," of this section.

Continuous-Operation Tests
Temperature Rise Tests
Acceptance Inspection

SD-07 Certificates

Contractor shall present certified copies of the results of tests required by Rule 1101.4 of ASME A17.1, that were conducted on identical equipment by an independent laboratory within the 2 previous years. Certified copies of the test results shall be accompanied by a certification by the manufacturer that the equipment installed is identical to that tested by the testing laboratory and reported by the laboratory in the submitted report of test results.

SD-07 Certificates

Notice to the Contracting Officer shall be given at least 14 days prior to date proposed for conducting each training course.

SD-10 Operation and Maintenance Data

Manual shall have complete instructions for operation, inspection, testing, and maintenance of each system, including equipment malfunction checklists.

1.3 DESIGN REQUIREMENTS

Provide elevators, accessory equipment, and installation that meets or exceeds requirements of ASME A17.1 and requirements indicated on the drawings. Typically, requirements on drawings will include:.

Rated Load	in
Speed	in
Approx. Travel Distance	in)
Travel	in number of floors
Platform Size	in wide
	by deep
Clear Car Inside	in wide
	by deep
Landings	as indicated
Hoistway & Car Door Type:	center opening-horizontal sliding, single speed horizontal sliding, or two-speed horizontal sliding.

Associated electrical equipment and installation shall comply with the requirements of Division 16, "Electrical," as specified.

1.4 WELDING

Welding shall conform to AWS D1.1.

PART 2 PRODUCTS

2.1 POWER UNIT

Power unit shall be self-contained and shall consist of pump, motor, solid state starter, and oil reservoir and necessary relief, check, and bypass valves mounted on a structural steel base. Rotating equipment shall be covered with a soundproofed steel enclosure.

Arrangement shall be such that power unit adjustments are accessible without disturbing oil lines or connections.

2.2 PUMP

Pump shall be positive-displacement pulsation-free designed for not more than 10 percent variation in output between no load and full load.

2.3 MOTOR

Motor shall be high-starting-torque, single-speed, totally enclosed or semienclosed with grease-lubricated ball or roller bearings. Bearings shall have a minimum rating life of 20,000 hours under full operating load as defined by AFBMA 9 or AFBMA 11, as applicable. Motor shall comply with NEMA MG 1, and Section 16225, "Motors," and be UL listed.

2.4 SOLID STATE STARTER

Provide a solid state starter to limit current inrush during starting and to provide gradual acceleration of the motor.

2.5 VALVES

Valve assembly shall include those valves necessary to:

Protect the system against excessive pressures by an appropriate bypass

Reduce the motor load during starting, and provide smooth starting of elevator ascent under all operating conditions

Control the rates of acceleration and deceleration for smooth starting and stopping on both ascent and descent

Valves shall be located to make them readily accessible for servicing. Provisions shall be incorporated to securely lock adjustments.

2.6 PLUNGER, CYLINDER, AND CASING

Plunger and cylinder shall be designed to lift the gross weight of the fully loaded elevator at full acceleration.

Plunger shall be constructed of seamless-steel tubing, turned smooth and true and finished to a fine polished surface, with a stop plate welded to the plunger bottom.

Cylinder shall be fabricated of steel tubing. Exterior shall be blast

cleaned in accordance with SSPC SP 6, primed, and given a topcoat of black alkyd paint conforming to SSPC Paint 102, applied to a minimum dry-film thickness of 3 mils in not less than two coats. When the coating system (primer and topcoat) is effectively cured, the cylinder shall be given a wrapping of 10-mil self-adhesive polyethylene tape half-lapped to provide a minimum of 20 mils over the entire surface. Tape shall be wrapped to a snug fit without stretching.

Cathodic protection shall be provided for the casing. Method of protection shall be submitted for approval.

Cylinder shall be placed in a heavy PVC casing sized to allow clearance for final alignment and plumbing. Casing shall extend a minimum of 3 feet below the bottom of the cylinder, and a minimum of 100 millimeter above pit floor. After the casing is in place and cleaned of debris and water, the bottom shall be sealed with concrete as follows:

Casing shall be filled to a depth of 1 foot with 3,000-pound per square inch300 millimeter with class 25 concrete., 28-day compressive-strength concrete. After a 24-hour cure period, a polyamide epoxy fluid grout shall be poured into the casing in an amount sufficient to produce a depth of 2 inches. After a cure period of not less than 20 minutes nor more than 30 minutes, another 300 millimeter of concrete shall be placed over the grout.

After the cylinder is in place in the casing, the space between the cylinder and the casing shall be filled with sand solidly packed in place. Cylinder shall be stabilized in position with a minimum of three radial spacer pins 5 feet from the bottom, welded to the cylinder. Tape wrapping shall be carried at least half the distance from cylinder to casing and shall be applied to prevent voids at the base of the pins. For elevators whose total travel exceeds 28 feet, spacers shall be provided at midpoint.

2.7 TANKS

Tanks necessary for the elevator shall conform to the requirements of ASME A17.1.

2.8 CAR FRAME AND PLATFORM)

Car and platform shall be designed and built in conformance with ASME A17.1. Platform floor shall be of steel over a steel base.

Sides and rear of the car from floor to the decorative ceiling shall be constructed of 5-ply, plastic-laminate-surfaced wood core of not less than 1-1/8-inch total thickness. Plywood base shall be exterior-grade western softwood plywood. Plastic-laminate facing shall be fiber-reinforced phenol-formaldehyde, color and pattern as selected.

Front and sides of car shall be fire-retardant protected with No. 26 U.S. standard gage black-iron sheathing.

Rear corners of the car shall be rounded to a radius of 4 inches.

Base of the car shall be of 6-inch high 14-gage corrosion-resistant steel, recessed under the car panels.

Directly above the base, within the recessed section, continuous vent slots

shall be provided around the perimeter of the paneling for exhausting the air of the ventilation system. Directly above this slot a 14-gage corrosion-resistant steel cover shall be provided for the edge of the paneling.

Side emergency exit doors, where required, shall be flush-panel hinged type.

Front return panel and entrance columns shall be integral, shall extend from the floor to the fascia, and shall be constructed of 14-gage corrosion-resistant steel with No. 6 finish, as defined in ASM-01 Metals Handbook.

Directly above the opening, a fascia panel shall be provided with the front section splayed sufficiently to accommodate the box and operating parts of the car position indicator. Entire splayed section shall be designed for relamping by hinging or other equally suitable device. Fascia shall be constructed of 14-gage corrosion-resistant steel with No. 6 finish.

Handrails shall be corrosion-resistant steel with No. 6 finish, continuous around sides and back, except at side emergency exit doors where the handrail shall be attached to the door and swing with the door. Rails shall be corrosion-resistant steel not less than 3/16 inch by 2 inches in section and attached to the car body on corrosion-resistant steel brackets. Both brackets and attachment shall be consistent with the stresses and safety factors involved.

Car canopy shall be constructed of stretcher-level cold-rolled furniture steel of not less than 14-gage, reinforced to support a 400-pound load applied to 2 square feet anywhere on its surface without plastic deformation of any member of the canopy construction. Corners and reinforcing shall be welded or bolted to present one-piece construction.

Directly below the ceiling, a subceiling shall be mounted forming a plenum to distribute the air from the ventilating system around the perimeter of the car at the suspended ceiling height. This ceiling shall also support the fluorescent lighting equipment. Below this plenum chamber, a decorative ceiling shall be installed with diffusing acrylic grille suspended on a reinforced aluminum channel framing system. Entire ceiling system shall conform to the contour of the car body. An emergency exit shall be provided in the ceiling system.

A forced ventilating system shall be provided incorporating a three-speed squirrel-cage blower delivering a minimum of 100 cubic feet per minute per person of rated elevator capacity at top speed. Blower shall be sized to deliver the air requirement at a fan speed of not more than 1,600 revolutions per minute. Mounting shall be designed and installed to prevent any discernible vibration of the surface on which the blower is mounted.

Car lighting shall provide a minimum of 30 foot-candles of diffused illumination.

Car floor shall be covered with 1/8-inch vinyl tile in colors as specified. Attachment shall be by waterproof adhesive recommended by the tile manufacturer for bonding floor to either steel or wood substrate; emulsion adhesives will not be accepted.

Wherever corrosion-resistant steel is indicated for elevator cars, it shall be AISI Type 316. Finish for corrosion-resistant steel shall be No. 6 as

defined in the ASM-01 Metals Handbook.

2.9 DOORS

Provide doors having 1-1/2 hour UL rating.

Car and hoistway doors shall be motor-operated, two-speed, horizontal-sliding type and shall be flush construction of furniture steel rolled to stretcher-level standard of flatness as defined in ASTM A 568/A 568M. Door panels shall be filled with sound-deadening mineral filler to maintain the planar nature of the door surfaces in use.

Car door shall be equipped with removable door guides to run in slots in the car sill.

Doors shall be carried on concealed overhead tracks secured to the structural steel of car frame and to the structural steel of the door framing. Hangers shall be ball-bearing sheave type with sealed bearings. Sheave diameter shall be commensurate with the door operating requirements but in no instance less than 2-1/4 inches. Adjustable upthrust rollers shall be of steel with sealed ball bearings. Tracks shall be of cold-drawn steel formed to contour of sheave and roller tracks; track thickness shall be at least 1/2 inch.

Ferrous surfaces, except doors and other surfaces visible from the car and its approaches, as well as sliding surfaces, tracks, and roller treads, shall be cleaned, primed with the manufacturer's standard rust-inhibitive primer, and finished with the manufacturer's standard enamel system.

Doors shall be formed stainless steel sheet, AISI Type 316 with a No. 6 satin finish.

Doors shall operate under the control of the operational system as specified. Hoistway-door closure shall lead car-door closure; car-door opening shall lead hoistway-door opening under the automatic control of the operation system.

Lead doors of both hoistway and car shall be provided with full-height safety edges whose operation is integrated with the elevator operation system in such a way that when an obstruction is encountered while closing, the doors will reopen; pressure against this device, while doors are open, shall hold the doors open. Construction of these edges shall be such that, even in the event of failure of either or both of the doors to stop, there will be no injury to a body member which may be in the plane of closure.

Door design and safety edge operation shall meet requirements of ASME A17.1.

The operating means for unlocking the doors shall be kept on the premises by personnel responsible for elevator maintenance and operation, in a location readily accessible to qualified individuals, in case of emergency.

Both hoistway and car doors shall be provided with a positive electromechanical interlock and auxiliary door-closing device to permit elevator operation only after interlock circuits have been closed.

2.10 ENTRANCES

Complete hollow metal entrances shall be provided, including frames, sills, struts and closer angles, hanger supports, hanger cover plates, fascia

plates, toe guards, track hangers, and hardware necessary to the installation thereof.

Unit frames shall be made of not less than 14-gage, Type 302 corrosion-resistant steel in No. 6 finish.

Sills shall be cast iron not less than 7/16 inchthick with nonslip surface. Grooves for the door guides shall be accurately machined for free door travel with 3/32-inch clearances. Each sill shall be supported on steel anchors from the floor-supporting steel.

Structural-steel angle struts shall support the unit frame and the door-operating hardware and structurally integrate the entrance with the hoistway structural system.

Fascia plates and dust covers shall be not less than 14-gage stretcher-level-flatness steel reinforced to retain this flatness in service, securely fastened to the entrance structural system, and provided with facilities for convenient removal for servicing.

Exposed surfaces of fascia plates, dust covers, cover plates, and other exposed ferrous entrance accessory items shall be of corrosion-resistant steel.

Nonexposed ferrous surfaces of the entrance accessory items shall be wire brushed to remove rust, solvent-cleaned of oil and grease, and protected by a two-coat rust-inhibitive paint system consisting of a primer and a finish coat of black alkyd paint conforming to SSPC Paint 102.

2.11 OPERATION AND CONTROL SYSTEMS

2.11.1 Operation

Operation system shall be the selective collective automatic type. Car shall automatically return to the first-floor landing after all calls have been satisfied, where it shall remain with doors open until either a car call or corridor call is registered. This will be referenced as "single selective collective operation."

Operation system shall be the multiple selective collective automatic type with each car operating under a system conforming to the definition of "selective collective automatic operation" with the following additional features under key-operated selector switch:

When no calls are registered, cars are stationed at the first floor; cars shall be fully lighted.

When one car is standing in the ready position at the first floor landing while the other cars are answering calls, the standing car shall respond to any corridor calls for up travel that are registered on floors below the active elevator when it is traveling in the up direction; it shall also respond to any corridor calls for down travel that are registered on floors above the active elevator when the active elevator is traveling in the down direction.

First elevator to return to the first floor after been answering calls shall remain there unless there are unanswered up corridor calls registered on floors below the active elevator while it is traveling in the up direction, or unanswered down corridor calls from floors above

the active elevator when it is traveling in the down direction.

When, with one elevator in the ready position at the first-floor landing, other cars arriving at the first-floor landing with all corridor calls answered, shall become the reserve cars.

Keyed switches shall be provided to place the cars on single selective collective service and to remove either car from service while the other remains in single selective collective operation.

When in multiple selective collective operation, each car, after it has left the first floor landing in response to car or corridor calls, shall operate in "selective collective automatic operation" mode, which shall be referenced as "single selective collective operation."

2.11.2 Control Panel

A control panel or panels shall be provided and installed where indicated. Panels shall include relays, switches, and accessory electrical items necessary to the specified operation. Panels located in finished area shall be flush-mounted with covers finished in baked enamel in color indicated or as directed. If installed in corridors, lobbies, or other locations accessible to the public, panels shall be equipped with cylinder locks.

Control devices shall conform to Section 16286, "Overcurrent Protective Devices," and be UL listed.

2.11.3 Car Stations

Cars shall be equipped with an operating station incorporating individually illuminated operating push buttons numbered to correspond to the floors served, an EMERGENCY STOP switch, an emergency signal-device button or telephone, and light switches. Depressing a pushbutton shall produce illumination of that pushbutton from the rear; illumination shall continue until a stop has been made at the indicated floor.

Car station shall include DOOR OPEN and DOOR CLOSE buttons. Depressing the DOOR OPEN button shall temporarily open the doors unless car travel has started. Depressing the DOOR CLOSE button shall initiate the closing of doors, subject to the door-edge controls as specified.

Car stations shall also incorporate key-operated INDEPENDENT SERVICE operation switches.

2.11.4 Corridor Stations

A flush-mounted corridor station of a design consistent with the decor of the area and incorporating a rear-illuminated UP pushbutton shall be installed 42 inches above the floor, adjacent to the elevator, at the first floor landing. A matching station incorporating DOWN pushbutton shall be installed adjacent to the elevator at the top floor.

In the corridors of floors other than the first and top floors, corridor stations shall be installed, matching the one on the first floor but incorporating both UP and DOWN illuminated pushbuttons.

Overhead car position indicators shall be provided for each elevator in the corridor of each floor.

Face plates shall be metal, finished to match the adjacent exposed metal at entrances.

2.11.5 Car-Position Indicators

Car shall be equipped with a front overhead illuminated panel that identifies the floor being approached by the elevator; numerals shall be at least 1 inch high and shall be of a lighting intensity that is easily readable from any point in the car under operating car lighting. Panels shall be 18-gage Type 302 corrosion-resistant steel with an ASM No. 6 finish.

Each indication shall be illuminated from the rear by an individual light of sufficient intensity to permit easy reading of the numeral without glare. Light for each numeral shall be enclosed in a light-tight compartment which confines the light supply to the numeral it serves. Change of illuminations shall be continuous, shall be anticipatory of the floor being approached, and shall change as the car leaves the indicated floor.

2.11.6 Alarms

An emergency signal device shall be provided.

Emergency signal device shall be an indoor alarm bell installed either in the hoistway or behind a grille consistent with the decor of the area in which it is located.

Provide vandal resistant speaker telephone meeting requirements of telephone system and ASME A17.1.

Provide car and hoistway wiring in accordance with ASME A17.1 and Section 16145, "Standard Wiring Systems." Provide junction boxes for connection to wiring outside car and hoistway.

2.11.7 Elevator Leveling

Operation system shall include automatic accelerating when cars are leaving stops and decelerating as cars approach a floor where a stop is to be made.

Acceleration and deceleration rates shall be not less than 3 nor more than 5 feet per second. System shall be designed for automatic flush leveling of the car at each stop, controlled by a sensing system which, once set, requires no periodic adjustment.

Door operation shall be integrated with the car-leveling system in a way to make elevator start dependent upon prior complete closing of the car doors and the doors of the hoistway at the platform from which the elevator is departing. Opening of the car door shall begin when the car is in its last foot of travel before a stop; hoistway door opening shall not begin until the car is at a complete stop.

Leveling tolerance, as measured by a 6-foot straightedge laid flat on the higher of the two surfaces, shall be plus or minus 1/8 inch.

2.11.8 Button Control

Car buttons which are depressed shall remain illuminated until the car has

made its stop at the indicated floor; the illuminated buttons on the car station shall show the stops still to be made by the car in the direction in which it is traveling or about to travel.

Corridor buttons which have been actuated to call for a car stop shall remain illuminated until a car traveling in the direction of desired service, as indicated by the illuminated call button, has made a stop at the floor where the button is located. When a car traveling in the indicated direction has stopped, the button illumination shall be extinguished.

2.11.9 Elevator Controls

Elevator car and corridor stations shall be placed at a maximum height of 48 inches from the floor, or a supplemental panel shall be provided to accommodate the physically handicapped.

Elevator-cab and landing call buttons shall be identified with braille markings to accommodate personnel with vision impairment, as specified in ASME A17.1.

2.12 PAINTING

Elevators for interior use shall be painted with the manufacturer's standard finish.

2.13 INSPECTION AND MAINTENANCE SWITCH

A key-operated inspection and maintenance switch whose closing deactivates the corridor buttons, cancels all car calls, and permits the operation of the car by continuous depression of the appropriate car station buttons shall be mounted on the control panel.

2.14 CONCRETE

Concrete shall comply with Section 03305, "Cast-In-Place Concrete".

PART 3 EXECUTION

3.1 GENERAL

Install systems in accordance with the manufacturer's recommendations, and ASME A17.1.

Electrical wiring shall be in accordance with NFPA 70 and Section 16145, "Standard Wiring Systems."

Weld each connection between elevator structure, hoistway, and building in conformance with AWS D1.1.

In instances where removability is required, connection shall be with bolts conforming to ASTM A 325.

3.2 TESTING

3.2.1 Testing Laboratory

Contractor shall employ an approved independent testing laboratory to conduct the tests as specified. Testing laboratory shall be experienced in

and fully equipped for the testing procedures as specified. Contractor shall submit full and valid evidence of these qualifications, listing the equipment the laboratory has at its disposal and the elevator installations (in the past 5 years) they have tested in a manner similar to the one specified.

Weights required for testing will be furnished by the Government. Contractor shall arrange for their pickup, storage, and return.

3.2.2 Test Weights

Test weights required shall be furnished by the Government. Contractor shall arrange for their pickup, storage, and return.

3.2.3 Tests

After completion of installation, the elevator shall be subjected to the following acceptance inspection and tests by the approved testing laboratory:

Inspection and tests required by applicable portions of ASME A17.1

A continuous-operating test in which the elevator under full-rated load is operated continuously for 1 hour over its entire operating range, stopping momentarily at every floor. There shall be no operational failure of any component. Temperature within the driving machine enclosure shall not exceed 86 degrees F above ambient temperature.

-- End of Section --

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SECTION 15003

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03/98

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SECTION 15003

GENERAL MECHANICAL PROVISIONS
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1	(1996) Scheme for the Identification of Piping Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 74	(1998) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM B 280	(1999) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 306	(1999) Copper Drainage Tube (DWV)
ASTM B 766	(1986; R 1998) Standard Specification for Electrodeposited Coatings of Cadmium
ASTM B 88	(1999) Standard Specification for Seamless Copper Water Tube
ASTM D 2665	(1999) Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.1	(1992) Gravimetric and Dust Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C 151	(1996) Ductile-Iron Pipe, Centrifugally Cast, for Water

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR Part 82	(2000) Protection of Stratospheric Ozone

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5	(2000) American National Standard for Centrifugal Pumps for Nomenclature, Definitions, Application and Operation

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System For Valves, Fittings, Flanges, and Unions

UNDERWRITERS LABORATORIES (UL)

UL-02	(2000) Building Materials Directory

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Mechanical Coordination Drawings shall be submitted for new and rehabilitated Mechanical Equipment Rooms, and for other areas as indicated. Drawings shall depict all mechanical systems and equipment in the area, although specified elsewhere in Division 15, "Mechanical", and be submitted under this Section as a single coordinated package. Drawings shall also show work by other trades, such as locations of walls, columns, electrical equipment, and connections to site utilities, as necessary to ensure proper coordination and layout of the work.

Mechanical Coordination Drawings shall graphically show the size, location and connections of all piping, ductwork and equipment in the area. Minimum scale shall be 1/4 inch to 1 foot. Visible side of equipment, ductwork and piping over 3 inches shall be drawn to scale; piping under 3 inches shall be drawn single-line. Sections, elevations or details shall be included as necessary for clarity. All access doors in equipment shall be shown, and any space which must be kept clear for future maintenance shall be outlined (for instance, coil pull space).

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Mechanical Systems Identification Materials
Hazardous Exhaust Stack Signage

SD-07 Certificates

For any work involving repair, maintenance, servicing or disposal of equipment containing ozone-depleting refrigerants, the contractor shall submit:

Proof of Technician Certification

Proof of Equipment Certification for recovery or recycling equipment

SD-07 Certificates

Submit, for all equipment operated during the construction period, a Record of Contractor-Performed Maintenance

SD-07 Certificates

If requested by the Government during review of technical submittals for materials or equipment in other Division 15 sections, the Contractor shall provide a Listing of Product Installations. List shall be submitted for the material or equipment identified, showing a minimum of 5 installed units, similar to those proposed for use, that have been in successful service for a minimum period of 5 yeas. List shall include purchaser, address of installation, service organization, and date of installation.

SD-11 Closeout Submittals

As-Built Drawings shall provide current factual information including deviations from, and amendments to the drawings and concealed or visible changes in the work, for Mechanical Coordination Drawings.

1.3 COORDINATION

Contractor shall coordinate the work of the different trades so that interference between piping, equipment, structural, and electrical work will be avoided. All necessary offsets in piping and all fittings, etc., required to install the work properly shall be furnished complete in place at no additional cost to the Government.

1.4 OPERATION OF EQUIPMENT PRIOR TO ACCEPTANCE

Where the contractor intends to operate any equipment for his benefit prior to acceptance (for instance to provide building heating during construction), all the requirements of Section 01750, "Equipment Alignment and Balancing for RCM" shall be completed prior to such operation. Belt driven equipment shall be equipped with fixed pitch sheaves prior to such use.

All air handling systems used for building heating or ventilation during construction shall be equipped with construction filters of a minimum efficiency equal to that of the filters specified for the equipment. During the construction period the contractor shall monitor filter condition and air pressure drop, and shall replace filters when pressure drop exceeds the specified changeout pressure, or whenever filters become wet or damaged. All filters used during construction shall be replaced with new filters prior to acceptance of the equipment.

All mechanical equipment used by the contractor during the construction period shall be maintained in accordance with the manufacturer's operating and maintenance instructions. Such equipment includes but is not limited to air handling systems, fans and pumps. Contractor shall maintain a "Record of Contractor-Performed Maintenance", documenting all such maintenance. This record shall be submitted prior to acceptance of the

equipment. All necessary oil, grease or other materials required for routine maintenance shall be furnished by the contractor.

1.5 MECHANICAL SYSTEMS IDENTIFICATION

1.5.1 GOMAR Ceiling Markers

Where new equipment is concealed above ceilings, provide markers in accordance with Section 01600, "Material and Equipment".

1.5.2 GOMAR Tags

In addition to standard manufacturer's identification plates, GOMAR Tags, as specified in Section 01600, "Material and Equipment", shall be provided for each new piece of mechanical equipment. GOMAR Tags shall show the equipment number as shown on the drawings.

1.5.3 Service Labeling

All new piping and ductwork, including that concealed in accessible spaces; exposed, bare and painted; and insulated, shall be labeled to designate service. Each label shall include an arrow or arrows to indicate flow direction.

Similar services with different temperatures or pressures shall be identified. Where pressures may exceed 125 pounds per square inch, gage, the maximum system pressure shall be included in the label.

Piping and ductwork shall be labeled and arrowed in accordance with the following:

Each point of entry and exit of pipe and ductwork passing through walls

Each change in direction, i.e., elbows, tees

Each control device, i.e., manual or automatic valves or dampers

Each access panel or access door into concealed areas, i.e., pipe chases

In congested or hidden areas at each point required to clarify service or indicated hazard.

In long straight runs, labels shall be located at distances within eyesight of each other but in no case shall the distance between labels exceed 75 feet. All labels shall be visible and legible from the primary service and operating area.

Bare or Insulated Outside Dimension	Minimum Height of Lettering
1/2 thru 1-1/4 inch	1/2 inch
over 1-1/4, thru 2 inch	3/4 inch
over 2 inch, thru 6 inch	1-1/4 inch
over 6 inch, thru 10 inch	2-1/2 inch
over 10 inch	3-1/2 inch

Labels shall be made of self-sticking, plastic film designed for permanent installation. Labels shall be color-coded in accordance with ANSI A13.1,

and legends shall be in accordance with "TABLE OF PIPING AND DUCTWORK LABELS AND COLOR CODING" at the end of this section.

1.5.4 Valve Tags and System Diagrams

Provide tags and system diagrams for new or modified Power Plant mechanical systems. When indicated on drawings, provide tags and system diagrams for other special mechanical systems. Identification tags made of brass or aluminum indicating function of a valve, control or similar component shall be installed on such system devices. Tags shall be 2 inches in diameter and marking shall be stamped. System or service abbreviation, and numbering, shall be as indicated on drawings.

Tags shall be wired to valve or equipment items with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire.

Diagrams shall show schematic arrangement of system piping or ductwork, location and tag identification of valves, dampers, controls or similar components, and GOMAR numbers for such equipment as pumps, water heaters, air-handling system equipment, refrigeration compressors, heat exchangers, and boilers.

Diagrams shall be neat mechanical drawings provided with extruded aluminum frames and 1/8-inch thick acrylic plastic protection. Location shall be as directed by the Contracting Officer. The number of charts and diagrams shall be equal to or greater than the number of mechanical equipment rooms. Where more than one chart per space is required, these shall be mounted in edge pivoted, swinging leaf, extruded aluminum frame holders which open to 170 degrees. Copies of diagrams shall also be included in the Operation and Maintenance Manuals for the system.

1.5.5 Color Coding

Except within the power plants (Buildings 24 and 31), painting of piping and ductwork shall not be color coded. Unless otherwise indicated piping and ductwork shall be painted to match surrounding surfaces in finished areas.

Piping in the power plants, Buildings 24 and 31, shall be painted with color codes in accordance with "TABLE OF PIPING AND DUCTWORK LABELS AND COLOR CODING" at the end of this section.

1.5.6 Hazardous Exhaust Stack and Fan Labeling

For purposes of labeling, all exhaust fans and stacks, other than toilet exhausts and building or air handler relief air vents, shall be considered "hazardous". Provide a 3 inch wide yellow band around the outlet of each hazardous exhaust outlet. In addition to the equipment identification plates specified elsewhere, provide a caution sign affixed to each hazardous exhaust fan or stack in a prominent location. Caution signs shall be a minimum 14 inches wide by 10 inches high, 0.020 inch thick aluminum. Top portion of the sign shall be a black band with "CAUTION" lettered in yellow. Below this shall be a yellow background with the following lettering (and blanks as shown, for field marking by the Government) in black:

HAZARDOUS EXHAUST

Hazard Classes:_____

Origin: Building _____ Room _____

User:_____

Signs shall be similar to model number W-CVAR, as manufactured by Allstate Sign and Plaque, Deer Park, NY

1.6 APPROVAL REQUIREMENTS

Except as otherwise specified, approval of materials and equipment will be based on manufacturer's published data.

Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL-02 will be acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, the Contractor may 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. Methods of testing used by the specified agencies shall be outlined.

Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the American Society for Testing and Materials (ASTM), the American Society of Mechanical Engineers (ASME), or other standards, a manufacturer's certificate of compliance of each item will be acceptable as proof of compliance.

Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

1.7 PREVENTION OF CORROSION

Metallic materials shall be protected against corrosion. Equipment enclosures shall be given rust-inhibiting treatment and standard finish by the manufacturer. Aluminum shall not be used in contact with earth, and where connected to dissimilar metal, shall be protected by approved fittings, barrier material, or treatment. Ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A 123 for exterior locations and cadmium-plated in conformance with ASTM B 766 for interior locations.

1.8 OZONE DEPLETING SUBSTANCES USED AS REFRIGERANTS

Releases of Ozone Depleting Substances (ODS) during repair, maintenance, servicing or disposal of appliances or equipment containing ODS's shall be minimized by complying with all applicable sections of 40 CFR Part 82 Subpart F. All labor materials and equipment required for compliance, including certified technicians and equipment, shall be provided by the Contractor.

Any person conducting repair, maintenance, servicing or disposal of appliances owned by NASA shall comply with the following. (In this context EPA defines an appliance as any device which contains and uses a class I (CFC) or class II (HCFC) substance as a refrigerant and which is used for household or commercial purposes, including any air conditioner,

refrigerator, chiller, or freezer.):

No Class I or Class II substances used as a refrigerant may be knowingly vented or otherwise released into the environment.

No appliances may be opened without meeting the requirements of 40 CFR Part 82.156 Subpart F, regarding required practices for evacuation and collection of refrigerant, and 40 CFR Part 82.158 Subpart F, regarding standards of recycling and recovery equipment.

No work may be conducted on appliances containing refrigerant except by persons who comply with 40 CFR Part 82.161 Subpart F, regarding technician certification.

In addition, copies of all applicable certifications shall be submitted to the Contracting Officer at least 10 working days prior to initiating maintenance, repair, servicing, dismantling or disposal of appliances, including:

Proof of Technician Certification by an EPA approved certifying organization for the type(s) of appliances to be worked on.

Proof of Equipment Certification of recovery or recycling equipment, by the Air-Conditioning and Refrigeration Institute (ARI) or by Underwriters Laboratories (UL), to meet EPA's minimum requirements for the type(s) of appliances to be worked on.

EPA's appliance type definitions are summarized below:

Type I: small appliances (fully manufactured, charged, and hermetically sealed in a factory with five pounds or less of refrigerant)

Type II: high- or very high-pressure appliances (with some exceptions including small appliances)

Type III: low-pressure appliances

Universal: all types of equipment

1.9 OZONE DEPLETING SUBSTANCES, OTHER THAN REFRIGERANTS

The use of Class I or Class II ODS's listed as nonessential in 40 CFR Part 82.66 Subpart C is prohibited. These prohibited materials and uses include:

Any plastic party spray streamer or noise horn which is propelled by a chlorofluorocarbon

Any cleaning fluid for electronic and photographic equipment which contains a chlorofluorocarbon; including liquid packaging, solvent wipes, solvent sprays, and gas sprays

Any plastic flexible or packaging foam product which is manufactured with or contains a chlorofluorocarbon, including, open cell foam, open cell rigid polyurethane poured foam, closed cell extruded polystyrene sheet foam, closed cell polyethylene foam and closed cell polypropylene foam except for flexible or packaging foam used in coaxial

Any aerosol product or other pressurized dispenser which contains a chlorofluorocarbon, except for those listed in 40 CFR Part 82.66 Subpart C.

A waiver may be requested should a programmatic or facility requirement dictate that a prohibited material is necessary to achieve project goals. A waiver request must be submitted in writing to the Safety and Environmental Branch. The waiver will be evaluated and dispositioned by the Safety and Environmental Branch.

1.10 PIPE, TUBING, VALVE, AND FITTING SIZES

Sizes indicated on the drawings and referenced in this specification correspond to nominal inch sizes and
actual outside diameters as indicated below. Sizes for valves, fittings, flanges, couplings and other items connected to piping are also indicated on the drawings corresponding to these nominal pipe sizes.
Some of the referenced standards for piping materials include DN or nominal metric sizes, but others do not. The tables below are provided to clarify the meaning of the nominal sizes used on the drawings and in this specification.

1.10.1 Copper Tubing Sizes

DN or nominal millimeters	NPS or IPS, or nominal inches	Copper Tube o.d. millimeters	Copper Tube o.d. inches
6	1/8	6.35	1/4
8	1/4	9.52	3/8
10	3/8	12.7	1/2
15	1/2	15.9	5/8
18	5/8	19.1	3/4
20	3/4	22.3	7/8
25	1	28.6	1-1/8
32	1-1/4	34.9	1-3/8
40	1-1/2	41.3	1-5/8
50	2	54.0	2-1/8
65	2-1/2	66.7	2-5/8
80	3	79.4	3-1/8
90	3-1/2	92.1	3-3/8
100	4	105	4-1/8
125	5	130	5-1/8
150	6	156	6-1/8
200	8	206	8-1/8

NPS is nominal size for copper water tubing (ASTM B 88, Types K, L, and M) and for copper DWV tubing (ASTM B 306). O.D. in inches (rather than NPS) is used as the nominal size for air-conditioning and refrigeration tubing (ASTM B 280, Type ACR); however the drawings will use the nominal millimeter sizes shown above, not the outside diameter in millimeters, for this tubing.

O.D. dimensions are the same for all three types, for either hard-drawn or soft-annealed temper. (Not all sizes shown may be specified or available in all types or tempers).

NOTE -- The metric standard for copper water tube (ASTM B 88M, for Types A, B and C) is not part of this specification. Tubing manufactured to that

standard is not readily available, and is in a different series of sizes (both nominal and actual) which do not match the ASTM B 88 (Types K, L and M) tubing or the fittings specified for use with it.

1.10.2 Steel and Plastic (PVC/CPVC) Pipe Sizes

DN or nominal millimeters	NPS or IPS, or nominal inches	Steel, PVC CPVC Pipe o.d. millimeters	Steel, PVC CPVC Pipe o.d. inches
8	1/4	13.7	0.540
10	3/8	17.1	0.675
15	1/2	21.3	0.840
20	3/4	26.7	1.050
25	1	33.4	1.315
32	1-1/4	42.2	1.660
40	1-1/2	48.3	1.900
50	2	60.3	2.375
65	2-1/2	73.0	2.875
80	3	88.9	3.500
90	3-1/2	101.6	4.000
100	4	114.3	4.500
125	5	141.3	5.563
150	6	168.3	6.625
200	8	219.1	8.625
250	10	273.0	10.750
300	12	323.8	12.750
350	14	355.6	14.000
400	16	406.4	16.000
450	18	457.2	18.000
500	20	508.0	20.000
600	24	609.6	24.000

Nominal sizes above apply for ASTM A53 and A106 steel pipe, and also for ASTM D1785 PVC and ASTM F441 CPVC pipe. O.D. dimensions are the same for all schedules or weight classes. (Not all sizes shown may be specified or available in all materials, schedules, or weights).

1.10.3 Cast Iron or PVC DWV Pipe Sizes

DN or nominal millimeters	NPS or IPS, or nominal inches	CISP DWV or PVC DWV Pipe o.d. millimeters	CISP DWV or PVC DWV Pipe o.d. inches
32	1-1/4	42.16	1.660
40	1-1/2	48.26	1.900
50	2	60.33	2.375
80	3	88.90	3.500
100	4	114.3	4.500
150	6	168.3	6.625
200	8	219.1	8.625
250	10	273.1	10.750
300	12	323.9	12.750

Nominal sizes and actual O.D. dimensions above apply for Type CISP-DWV (ASTM A 74 cast iron soil pipe, DWV, standard weight), and for Type PVC-DWV (ASTM D 2665 PVC, DWV pipe). (Not all sizes shown may be specified or available in both materials).

1.10.4 Ductile Iron Pipe Sizes

DN or nominal millimeters	NPS or IPS, or nominal inches	CISP DWV or PVC DWV Pipe o.d. millimeters	CISP DWV or PVC DWV Pipe o.d. inches
80 (75)*	3	102	4.0
100	4	122	4.8
150	6	175	6.9
200	8	230	9.1
250	10	282	11.1
300	12	335	13.2
350	14	389	15.3
400	16	442	17.4
450	18	495	19.5
500	20	549	21.6
600	24	655	25.8
750	30	813	32.0
900	36	973	38.3
1050	42	1130	44.5
1200	48	1290	50.8
1350	54	1462	57.6
1500	60	1564	61.6

Nominal sizes and actual O.D. dimensions above apply for ductile iron water pipe (AWWA C 151; tables in this standard do not list nominal metric sizes, but they are referred to in the text).

*AWWA C 151 uses 75 rather than 80 to refer to the metric equivalent of 3 inch nominal size. Where either designation appears on the drawings it shall mean the pipe size indicated in the table.

1.10.5 Pipe, Tubing, Valve and Fitting Pressure Ratings

Pressure ratings or class of valves and fittings are nominal pressure class (non-dimensional), in accordance with MSS SP-25, unless indicated otherwise as minimum psig cold water pressure (CWP) or steam working pressure (SWP), or minimum psig at other designated temperature (degrees F).

1.10.6 Insulation Thicknesses

Insulation thickness, for either pipe or duct insulation, is stated in nominal increments of mm, similar to those used for pipe sizes.

PART 2 PRODUCTS

2.1 PAINTING

Equipment units shall be painted in accordance with with approved equipment manufacturer's standards unless specified otherwise. Field retouching shall be accomplished only if approved; otherwise equipment shall be returned to the factory for refinishing.

PART 3 EXECUTION

3.1 INSTALLATION

Materials and equipment shall be installed in accordance with approved equipment manufacturer's standards unless specified otherwise. Field

retouching shall be accomplished only if approved; otherwise, equipment shall be returned to the factory for refinishing.

3.2 ANCHOR BOLTS

Anchor bolts shall be provided for equipment placed on concrete equipment pads or on concrete slabs. 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.

Anchor bolts for coupled or gear-driven equipment requiring aligned connections to other system components (such as pumps) shall be anchored in pipe sleeves, as shown in HI 1.1-1.5. Inner diameter of sleeve shall be at least 2.5 times the bolt diameter, to allow for final positioning.

3.3 EQUIPMENT PADS

Equipment pads shall be provided for all floor mounted mechanical equipment. Pad dimensions shown are approximate, and actual dimensions shall be coordinated with the approved equipment submittals. Pads shall conform to the shape of each piece of equipment served, with a minimum 3-inch margin around the equipment and supports. Pads shall be a minimum of 3 inches high unless otherwise noted. Pads for equipment with a driver mounted on a common baseplate, such as centrifugal pumps and motors, shall be poured to a height which allows for approximately 3/4 to 1-1/2 inches thickness of grout to be installed between the baseplate and the pad. Unless otherwise indicated provide one layer 6 x 6 inch, W1.4 x W1.4 wire mesh reinforcement in pad.

3.4 INSTALLATION, ALIGNMENT, AND BALANCING OF ROTATING EQUIPMENT

Rotating mechanical equipment shall be installed, aligned, and balanced in accordance with Section 01750, "Equipment Alignment and Balancing for RCM", plus any specific requirements contained in the specification sections for the equipment.

3.5 CUTTING AND PATCHING

Contractor shall install his work in such a manner and at such time as will require a minimum of cutting and patching. Except as detailed on the drawings, no structural members shall be penetrated without the specific approval of the Contracting Officer.

Holes in exposed locations, in or through existing floors, shall be drilled and smoothed by sanding. Use of a jackhammer will be permitted only where specifically approved. Protective measures shall be provided to control accumulation and migration of dust and dirt during all cutting and patching operations. Dust, dirt, and debris shall be removed from the areas of work daily. Protective measures shall prevent migration of dust or dirt from the construction area into adjacent occupied areas, including as necessary, temporary partitions or plastic sheeting enclosing the construction area, shutting or covering of return air intakes in the construction area, or exhaust from the construction area to the outside of the building.

Holes through masonry walls to accommodate sleeves shall be made with an iron pipe masonry core saw.

3.6 FIRE-RATED PENETRATIONS

Installation of all piping, tubing, conduit and ductwork shall be made so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors. All penetrations through fire-rated construction shall be sealed and fire stopped in accordance with Section 07840, "Firestopping and Smokestopping".

3.7 PROTECTION OF INSULATION MATERIALS

Porous materials such as pipe insulation, duct insulation and duct liner, shall be protected from moisture while in storage at the site. Any such materials that become wet shall be discarded. During and after installation, such materials shall be protected from moisture, and if they become wet shall be removed and discarded, and shall be replaced with new materials. Drying, cleaning, or disinfecting of such materials once they have been wet is not acceptable.

3.8 CLEANING

Exposed surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction shall be thoroughly cleaned before such surfaces are prepared for final finish painting or are enclosed within the building structure.

Before final acceptance, mechanical equipment, including piping, ducting, and fixtures, shall be clean and free from dirt, grease, and finger marks.

3.9 LABELS AND COLOR CODING OF PIPING AND DUCTWORK

Piping and ductwork shall be labeled in accordance with the paragraph entitled "Service Labeling". Label legends and color coding shall be as indicated in the following table:

TABLE OF PIPING AND DUCTWORK LABELS AND COLOR CODING

SERVICE	LABEL LEGEND	LABEL COLOR (Legend/Background)	PAINT COLOR (Power Plants Only)
Boiler Blowdown (Power Plants Only)	BOILER BLOWDOWN	black/yellow	red w/ 2 black bands
Boiler Feedwater (Power Plants only)	BOILER FEED WATER	black/yellow	blue w/ 2 black bands
Chilled Water Return	CHILLED WATER RETURN	white/green	
Chilled Water Supply	CHILLED WATER SUPPLY	white/green	
Compressed Air (shop, lab, control air over 20 psi/140 kPa)	COMPRESSED AIR	white/blue	
Condenser Water	CONDENSER WATER	white/green	

TABLE OF PIPING AND DUCTWORK LABELS AND COLOR CODING

SERVICE	LABEL LEGEND	LABEL COLOR (Legend/Background)	PAINT COLOR (Power Plants Only)
Return	RETURN		
Condenser Water Supply	CONDENSER WATER RETURN	white/green	
Control Air Supply (up to 20 psi/140 kPa)	INSTRUMENT AIR	white/blue	
Deionized Water	DEIONIZED WATER	white/green	
Domestic Water -- Cold (city water)	DOMESTIC COLD WATER	white/green	blue w/ 1 black band
Domestic Water -- Hot	DOMESTIC HOT WATER	black/yellow	
Domestic Water -- HW Return (circulating HW systems)	DOMESTIC HOT WATER RETURN	black/yellow	
Drain (from cooling coils or other mechanical equipment)	DRAIN	white/green	
Ductwork (hazardous/toxic exhaust)	EXHAUST	black/yellow	
Ductwork (outdoor air)	OUTSIDE AIR	white/blue	
Ductwork (relief air)	RELIEF AIR	white/blue	
Ductwork (return air)	RETURN AIR	white/blue	
Ductwork (supply air)	SUPPLY AIR	white/blue	
Ductwork (toilet/misc. non-hazardous exhaust)	EXHAUST	white/blue	
Fire Sprinklers	SPRINKLER	white/red	red
Fire Standpipe	STANDPIPE	white/red	

TABLE OF PIPING AND DUCTWORK LABELS AND COLOR CODING

SERVICE	LABEL LEGEND	LABEL COLOR (Legend/Background)	PAINT COLOR (Power Plants Only)
Foundation Drain	FOUNDATION DRAIN	white/green	
Fuel Oil Return	FUEL OIL RETURN	black/yellow	tan
Fuel Oil Supply	FUEL OIL SUPPLY	black/yellow	brown
Fuel Oil Vent	FUEL OIL VENT	black/yellow	
Gaseous Nitrogen	NITROGEN	white/blue	
Glycol Return	GLYCOL RETURN	black/yellow	
Glycol Supply	GLYCOL SUPPLY	black/yellow	
Hot Water Return (HVAC)	HEATING WATER RETURN	white/green	
Hot Water Supply (HVAC)	HEATING WATER SUPPLY	white/green	
Landfill Gas	LANDFILL GAS	black/yellow	yellow w/ 1 black band
Liquid Nitrogen	LIQUID NITROGEN	black/yellow	
Natural Gas	NATURAL GAS	black/yellow	yellow
Non-Potable water (downstream of BFP; lab supply, make-up for HVAC, boiler, chiller, or misc. service)	NONPOTABLE WATER	black/yellow	blue w/ 1 wide and 1 narrow black band
Process Cooling Water Return (other than Chilled or Secondary Water)	COOLING WATER RETURN	white/green	
Process Cooling Water Supply (other than Chilled or Secondary Water)	COOLING WATER SUPPLY	white/green	
Refrigerant Liquid	REFRIGERANT LIQUID	black/yellow	
Refrigerant Suction	REFRIGERANT SUCTION	black/yellow	
Roof Drain (rain leader)	ROOF DRAIN	white/green	

TABLE OF PIPING AND DUCTWORK LABELS AND COLOR CODING

SERVICE	LABEL LEGEND	LABEL COLOR (Legend/Background)	PAINT COLOR (Power Plants Only)
Sanitary Drain	SANITARY DRAIN	white/green	
Sanitary Sump Pump Discharge (Pumped main)	SANITARY PUMP DISCHARGE	white/green	
Sanitary Vent	SANITARY VENT	white/green	
Secondary Water Return (HVAC dual-temperature seasonal hot or chilled water)	SECONDARY WATER RETURN	white/green	
Secondary Water Supply (HVAC dual-temperature seasonal hot or chilled water)	SECONDARY WATER SUPPLY	white/green	
Soft Water Supply (Power Plants Only)			blue
Steam (High Pressure)	HIGH PRESSURE STEAM	black/yellow	red
Steam (Low Pressure)	LOW PRESSURE STEAM	black/yellow	red w/ 1 wide black band
Steam (Medium Pressure)	MEDIUM PRESSURE STEAM	black/yellow	
Steam Condensate Pump Discharge	CONDENSATE PUMP DISCHARGE	black/yellow	
Steam Condensate Return (High or Medium Pressure)	HIGH PRESSURE CONDENSATE	black/yellow	green
Steam Condensate Return (Low Pressure)	LOW PRESSURE CONDENSATE	black/yellow	green w/ 1 black band
Steam Relief Vent	STEAM RELIEF VENT	black/yellow	
Vacuum (housekeeping)	HOUSE VACUUM	white/green	
Vacuum (laboratory)	LAB VACUUM	black/yellow	

-- End of Section --

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DIVISION 15 - MECHANICAL

SECTION 15050

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SECTION 15050

BASIC MECHANICAL MATERIALS AND METHODS
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S328	(1986) Specification for Structural Steel Buildings Load and Resistance Factor Design

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 105/A 105M	(1998) Standard Specification for Forgings, Carbon Steel, for Piping Components
ASTM A 106	(1999; Rev E1) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 182/A 182M	(1999) Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service
ASTM A 197/A 197M	(2000) Standard Specification for Cupola Malleable Iron
ASTM A 216/A 216M	(1993 R 1998) Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service
ASTM A 234/A 234M	(1999) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 276	(2000; Rev A) Standard Specification for Stainless and Heat-Resisting Steel Bars and Shapes
ASTM A 278	(1993) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 Degrees F
ASTM A 278M	(1993; Rev E1) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 345 Degrees C (Metric)

ASTM A 307	(2000) Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 312/A 312M	(2000) Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipe
ASTM A 325	(2000) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 KSI Minimum Tensile Strength
ASTM A 325M	(2000) Standard Specification for High Strength Bolts for Structural Steel Joints (Metric)
ASTM A 480/A 480M	(1999; Rev B) Standard Specification for General Requirements for Flat Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A 53/A 53M	(2001) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 563	(2000) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2000) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A 6/A 6M	(2001) Standard Specification for Rolled Structural Steel Bars, Plates, Shapes, and Sheet
ASTM A 74	(1998) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM B 306	(1999) Copper Drainage Tube (DWV)
ASTM B 32	(1996) Standard Specification for Solder Metal
ASTM B 370	(1998) Standard Specifications for Copper Sheet and Strip for Building Construction
ASTM B 584	(1998 Rev A) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B 62	(1993) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 749	(1997) Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products
ASTM B 88	(1999) Standard Specification for Seamless Copper Water Tube

ASTM C 564	(1997) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 920	(1998) Standard Specification for Elastomeric Joint Sealants
ASTM D 1784	(1999; Rev A) Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1999) Standard Specification for Poly (Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2308	(1997) Standard Specification for Polyethylene Jacket for Electrical Insulated Wire and Cable
ASTM D 2466	(1999) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1999) Standard Specification for Socket-Type Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2665	(1999) Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2564	(1996; Rev A) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings
ASTM D 2855	(1996) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM E 1	(1998) Standard Specification for ASTM Thermometers
ASTM F 104	(1995) Standard Classification System for Nonmetallic Gasket Materials
ASTM F 438	(1999) Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F 439	(1999) Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 441/F 441M	(1999) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Schedules 40 and 80

ASTM F 568M	(1998) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners
ASTM F 1199	(1988, R 1998) Cast (All Temperature and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)
ASTM F 1200	(1988, R 1993) Fabricated (Welded) Pipe Line Strainers (Above 150 psig and 150 degrees F)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.19.2M	(1998) Vitreous China Plumbing Fixtures
ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.12	(1998) Cast-Iron Threaded Drainage Fittings
ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(1992) Cast Copper Alloy Solder Joint Drainage Fittings-DWV
ASME B16.3	(1999) Malleable-Iron Threaded Fittings, Classes 150 and 300
ASME B16.34	(1996) Valves - Flanged, Threaded, and Welding End
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions, Classes 150, 250, and 300
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B18.2.2	(1987; R 1999) Square and Hex Nuts (Inch Series)
ASME B18.2.4.6M	(1979; R 1998) Metric Heavy Hex Nuts
ASME B31.1	(1998) Power Piping
ASME B31.3	(1993) Chemical Plant and Petroleum Refinery Piping
ASME B31.9	(1996) Building Services Piping
ASME B36.10M	(1996) Welded and Seamless Wrought Steel Pipe

ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels, Division 1, Basic Coverage

AMERICAN WELDING SOCIETY (AWS)

AWS A5.13	(1989) Specification for Solid Surfacing Welding Rods and Electrodes
AWS A5.8	(1992) Specification for Filler Metals for Brazing
AWS-02	(1990) Welding Handbook; Eighth Ed; Vol Two - Welding Process

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(1997) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
CISPI 310	(1997) Couplings Joint for Use in Connection with Hubless Cast Iron Soil Pipe and Fitting

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1922A	(1995) Shield, Expansion (Caulking Anchors, Single Lead)
CID A-A-1924A	(1995) Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors)
CID A-A-55614	(1995) Shield, Expansion (Non-Drilling Expansion Anchors)
CID A-A-55615	(1995) Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors)

FLUID SEALING ASSOCIATION (FSA)

FSA-01	(1991) Rubber Expansion Joints and Flexible Rubber Pipe Connectors Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 515	(1990) Recommended Practice for the Testing, Design, Installation, and Maintenance of Electrical, Resistance Heat Tracing for Industrial Applications

MILITARY SPECIFICATIONS (MS)

MS MIL-C-18480	(Rev B; Notice 1) Coating Compound,

	Bituminous, Solvent, Coal-Tar Base

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(1996) Ball Valves, Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-67	(1995) Butterfly Valves
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-71	(1997) Cast Iron Swing Check Valves, Flanges and Threaded Ends
MSS SP-78	(1998) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
MSS SP-86	(1997) Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators

NATIONAL SANITATION FOUNDATION (NSF)

NSF 14	(1999) Plastics Piping Components and Related Materials

1.2 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

Section 15072, "Vibration Isolation for Air Conditioning Equipment," applies to work specified in this section.

Welding shall comply with the applicable requirements of Section 15055, "Welding and Pressure Vessels/Systems". All installation or modification of piping or components defined in Section 15055, "Welding and Pressure Vessels/Systems" as Pressure Vessels and Pressurized Systems (PV/S) shall comply with the applicable requirements of that section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings shall be submitted showing fabrication and assembly details for:

Supplementary Steel Support Assemblies

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

Pipe and Fittings
Piping Specialties
Valves
Miscellaneous Materials
Supporting Elements

SD-05 Design Data

Equipment Schedules shall be submitted for the items listed below. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

Valves (all types)
Air Separator
Compression Tank
Expansion Joints
Flexible Pipe and Hose

SD-06 Test Reports

Test Reports on the following tests shall be submitted for pipes, valves, and specialities.

Heat Trace Cable Tests

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the following items, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

Valves (all types)

Air Separator
Compression Tank
Expansion Joints
Flexible Pipe and Hose

SD-11 Closeout Submittals

PV/S Certification Records shall be submitted for PV/S piping and components, for approval and Certification prior to pressurization and operation. Pressure vessels and pressurized systems (PV/S), and the required contents of the PV/S Certification Records, shall be as defined in Section 15055, "Welding and Pressure Vessels/Systems"

PART 2 PRODUCTS

2.1 ELECTRICAL HEAT TRACING

Heat trace systems for pipes, valves, and fittings shall be in accordance with IEEE Std 515 and shall be UL listed. System shall consist of all necessary components, including heaters and controls to prevent freezing.

Self-regulating heaters shall consist of two 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature along its length. Heater shall be able to be crossed over itself without overheating and shall be approved before used directly on plastic pipe. Heater shall be covered by a radiation cross-linked modified polyolefin dielectric jacket in accordance with ASTM D 2308.

For installation on plastic piping, the heater shall be applied using aluminum tape. Heater shall have an outer braid of tinned-copper and an outer jacket of modified polyolefin in accordance with ASTM D 2308, to provide a good ground path and to enhance the heater's ruggedness.

Heater shall have a self-regulating factor of at least 90 percent, in order to provide energy conservation and to prevent overheating.

Heater shall operate on line voltages of 120, 208, 220, 240, or 277 volts, as indicated on drawings, without the use of transformers.

Heater shall be sized according to the following table:

Pipe Size (Inch, Diameter)	Minus 10 degrees F	Minus 20 degrees F
3 inches or less	5 watts per foot (wpf)	5 wpf
4 inch	5 wpf	8 wpf
6 inch	8 wpf	8 wpf
8 inch	2 strips/5 wpf	2 strips/8 wpf
12 inch to 14 inch	2 strips/8 wpf	2 strips/8 wpf

System shall be controlled by an ambient sensing thermostat set at 40 degrees F either directly or through an appropriate contactor, so that above set point the heater draws no power.

2.2 PIPE AND FITTINGS

2.2.1 Type BCS, Black Carbon Steel

Pipe (1/8 through 10 inches) shall be Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to ASTM A 53/A 53M, Type E, Grade B (electric-resistance welded) or Type S (seamless). Only grade A shall be used for permissible field bending, in both cases.

Pipe (12 through 24 inches) shall be 0.375-inch wall (standard weight class)seamless black carbon steel, conforming to ASTM A 53/A 53M, Type E, Grade B (electric-resistance welded) or Type S (seamless).

Fittings (2 inches and under) shall be Class 150 banded black malleable iron screwed, conforming to ASTM A 197/A 197M and ASME B16.3.

Unions (2 inches and under) shall be Class 250 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 A 234/A 234M and ASME B16.9 to match pipe wall thickness.

Flanges (2-1/2 inches and over) shall be Class 150 forged-steel conforming to ASME B16.5, welding neck to match pipe wall thickness.

2.2.2 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 A 53/A 53M, Type F (furnace butt welded, continuous welded) 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 A 53/A 53M, Type E, Grade B (electric-resistance welded) or Type S (seamless) and ASME B36.10M.

Pipe (12 through 24 inches) shall be 0.375-inch wall (standard weight class), seamless, or electric-resistance welded black carbon steel, conforming to ASTM A 53/A 53M Type E, Grade B (electric-resistance welded) or Type S (seamless) and ASME B36.10M.

Fittings (2 inches and under) shall be Class 150 banded black malleable iron screwed, conforming to ASTM A 197/A 197M 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 A 234/A 234M, Grade WPB and ASME B16.9.

Couplings (2 inches and under) shall be commercial standard weight for Schedule 40 pipe and commercial extra heavy weight for Schedule 80 pipe, black carbon steel where threaded, and 2,000-or 3,000-psi wog forged carbon steel, conforming to ASTM A 105/A 105M and ASME B16.11, where welded.

2.2.3 Type BCS-150 (150-psi Service)

Pipe or tube (1/8 inch through 10 inches): Schedule 40 for steam, Schedule 80 for condensate, seamless black carbon steel, conforming to ASTM A 106,

Grade B and ASME B36.10M

Fittings (1/8 inch through 2 inches): 300-psi working steam pressure (wsp) banded malleable iron, screwed end, conforming to ASTM A 197/A 197M and ASME B16.3

Fittings (1/8 inch through 2 inches): 2,000-or 3,000-psi water, oil, or gas (wog) forged carbon steel, socket weld or screwed end, conforming to ASTM A 105/A 105M and ASME B16.11

Fittings (2-1/2 through 10 inches): Wall thickness to match pipe, long radius, butt weld, black carbon steel, conforming to ASTM A 234/A 234M, Grade WPB, and ASME B16.9

Unions (1/8 inch through 2 inches): 250-psi wsp, malleable iron, screwed end, ground joint, with brass or bronze seat insert, conforming to ASME B16.39

Unions (1/8 inch through 2 inches): 2,000 or 3,000-psi wog, forged carbon steel; socket weld through 2-inch, screwed end through 1-inch, conforming to ASTM A 105/A 105M and ASME B16.11, with ground joint and stainless-steel seat insert

Flanges (2-1/2 through 10 inches): 150-pound, forged carbon steel, welding neck, with raised face or flat face and concentric finish, conforming to ASTM A 105/A 105M and ASME B16.5

Flange gaskets: Compressed non-asbestos sheet conforming to ASTM F 104, Type 1, P1161A, coated on both sides with graphite or similar lubricant, containing not less than 75-percent non-asbestos fiber materials

Bolting: Bolting and flange bolting shall be hexhead and shall conform to ASTM A 325. Heavy hex-nuts shall conform to ASME B18.2.2.. Square-head bolts and nuts are not acceptable.

2.2.4 Type PVC, Polyvinylchloride

PVC pipe shall be in accordance with ASTM D 1785. Material shall be PVC Class 12454-B in accordance with ASTM D 1784.

Pipe shall be Schedule 40 or 80 as indicated on the drawings.

Fittings shall be socket-type, schedule 40 in accordance with ASTM D 2466, or Schedule 80 in accordance with ASTM D 2467.

Solvent cement for pipe and fittings shall be in accordance with ASTM D 2564.

2.2.5 Type CPVC, Chlorinated Polyvinylchloride

CPVC pipe shall be in accordance with ASTM F 441/F 441M. Material shall be CPVC Class 23447-B in accordance with ASTM D 1784.

Pipe shall be Schedule 40 or 80 as indicated on the drawings.

Fittings shall be socket-type, schedule 40 in accordance with ASTM F 438, or Schedule 80 in accordance with ASTM F 439.

Solvent cement for pipe and fittings shall be in accordance with ASTM D 2564.

2.2.6 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 A 74, standard weight. Joints shall be calked and leaded in lines where necessary to provide proper leaktight support and alignment; other-wise joints may be two-gasket system type chloroprene, conforming to ASTM C 564. Hubless pipe, fittings, and couplings, confirming to CISPI 301 and CISPI 310 may be used.

2.2.7 Type CPR-DWV, Copper

Pipe shall be type DWV copper drainage tube conforming to ASTM B 306, with cast brass or wrought copper drainage fittings conforming to ASTM B 584 and ASME B16.23.

2.2.8 Type PVC-DWV, Polyvinylchloride (PVC)

Polyvinylchloride drain, waste, and vent piping-system materials shall be manufactured from Type I normal impact resins in conformance with ASTM D 2665 and with ASME B16.12. Pipe and fittings shall be white and specifically suited for joining socket interfaces into a homogeneous mass by solvent-cement welding.

Fittings shall be molded to produce upon insertion of pipe an interference fit at two-thirds depth of socket. No thread cutting shall be permitted.

2.2.9 Type CPR-AG, Copper Above Ground

Tubing (2 inches and under) shall be seamless copper tubing, conforming to ASTM B 88, Type L (hard-drawn for all horizontal and all exposed vertical lines, annealed for concealed vertical lines).

Fittings (2 inches and under) shall be Class 150 wrought-copper solder joint fittings conforming to ASME B16.22.

Unions (2 inches and under) shall be Class 150 wrought-copper solder joint, conforming to ASME B16.22.

Brazing rod shall be Classification BCP-5, conforming to AWS A5.8.

Solder shall be 95/5 tin-antimony, alloy Sb-5, conforming to ASTM B 32.

2.2.10 Type CPR-UG, Copper Under Ground

Piping shall be Type K seamless copper tube, conforming to ASTM B 88. No joints shall be permitted in underground copper piping unless specifically approved. Socket-joint fittings shall be wrought copper, conforming to ASME B16.22. Joints shall be brazed. Brazing rod shall be Classification BCP-5, conforming to ASTM B 32.

2.3 PIPING SPECIALTIES

Unless otherwise noted specialties shall be as indicated below, with soldered, threaded or flanged ends to match the fitting type specified for the piping in which they are installed. All packing and gasket materials shall be made of non-asbestos containing materials.

2.3.1 Air Separator

Air separated from converter discharge water shall be ejected by a reduced-velocity device vented to the compression tank.

Commercially constructed separator shall be designed and certified to separate not less than 80 percent of entrained air on the first passage of water and not less than 80 percent of residual on each successive pass. Shop drawings shall detail piping connections proposed for this work.

Air separator shall be carbon steel, designed, fabricated, tested, and stamped in conformance with ASME BPV VIII Div 1 for service pressures not less than 125 psi.

2.3.2 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 shall be not less than 1/4-inch ips. Orifice shall be 1/8 inch. Trim shall be corrosion-resistant steel conforming to ASTM A 276 or ASTM A 480/A 480M. Vent shall be fitted with try-cock. Vent shall discharge air at any pressure to 150 psi.

2.3.3 Compression Tank

Compression tank shall be designed, fabricated, tested, and stamped for a working pressure of not less than 125 psi in accordance with ASME BPV VIII Div 1. 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 gauge-glass complete with glass protectors and shutoff valves, air charger and drainer, and manual vent.

2.3.4 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.

2.3.5 Expansion Vibration Isolation Joints

Single or multiple arch-flanged expansion vibration isolation joints shall be constructed of steel-ring reinforced chloroprene-impregnated cloth materials. Joint shall be designed to absorb the movement of the pipe sections in which installed with no detrimental effect on pipe or connected equipment. Flanges shall be backed with ferrous-metal backing rings. Control rod assemblies shall be provided to restrict joint movement. All nonmetallic exterior surfaces of the joint shall be coated with chlorosulphinated polyethylene. Grommets shall be provided in limit bolt hole to absorb noise transmitted through the bolts.

Joints shall be suitable for continuous-duty working temperature of at least 250 degrees F .

Arches shall be filled with soft chloroprene.

Joint, single-arch, movement limitations and size-related, pressure characteristics shall conform to Tables I and II of FSA-01.

2.3.6 Flexible Pipe

Flexible pipe vibration and pipe-noise eliminators shall be constructed of wire-reinforced, rubber-impregnated cloth and cord materials and shall be flanged. Flanges shall be backed with ferrous-metal backing rings. Service pressure-rating shall be minimum 1.5 times actual service. Surge pressure shall be at 180 degrees F.

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 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
5 to 12 inches, inclusive	24 inches
To 3 inches, inclusive	18 inches
4 to 10 inches, inclusive	24 inches
12 inches and larger	36 inches

2.3.7 Flexible Metallic Pipe

Flexible pipe shall be the bellows-type with wire braid cover and shall be designed, constructed, and rated in accordance with the applicable requirements of ASME B31.1, or ASME B31.9.

Working pressure minimum rating shall be 50 100 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.

Welded end connections shall be Schedule 80 carbon steel pipe, conforming to ASTM A 106, Grade B or C.

Threaded end connections shall be hex-collared Schedule 40, AISI Type 316L corrosion-resistant steel, conforming to ASTM A 312/A 312M.

Flanged end connection rating and materials shall conform to specifications for system primary-pressure rating.

2.3.8 Flexible Metal Steam Hose

Hose shall be bellows type with wire braid cover and shall be designed, constructed, and rated in accordance with the applicable requirements of

ASME B31.1, or ASME B31.9.

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.

Welded end connections shall be Schedule 80 carbon steel pressure tube, conforming to ASTM A 106, Grade B or C.

Threaded end connections shall be hex-collared Schedule 40, AISI Type 316L corrosion-resistant steel, conforming to ASTM A 312/A 312M.

Flanged end connection rating and materials shall conform to specifications for system primary-pressure rating.

2.3.9 Pressure Gauges

Pressure gauges shall conform to ASME B40.1 and to requirements specified herein. Pressure gauges shall be Type I, (for air, steam, and water) Class 1 (pressure), Class 2 (vacuum) or Class 3 (pressure/vacuum), as required for the service. Pressure-gauge 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 A 6/A 6M, 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 gauge range. All gauges shall be equipped with gauge isolators.

Gauges shall have dual scales with both English (psig or inches w.g.) and Metric (kPa or Pa) units as appropriate for the service.

Steam gauges shall be fitted with black steel syphons and steam service pressure-rated gauge cocks or valves.

2.3.10 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 shall have a bronze, nylon, or tetrafluoroethylene rotating flow indicator mounted on an AISI Type 304 or 316 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.

2.3.11 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.

2.3.12 Thermometers

Thermometers shall conform to ASTM E 1. Thermometers shall be industrial pattern Type I, except red Organic-liquid-filled, Class 3 (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 as appropriate for the service or as indicated. Thermometers shall be provided with nonferrous separable wells. Lagging extension to accommodate insulation thickness shall be provided.

Thermometers shall have dual scales with both English (degrees F) and Metric (degrees C) units.

2.3.13 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 1,000 micrometer, 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 gauge with 0.25-pound graduations fitted with a two-way brass cock shall be provided across the strainer. Gauges shall have dual scales with both English (psig) and Metric (kPa) units.

Manual air vent cocks shall be provided in cap of each strainer.

2.3.14 Strainers, Low Temperature/Pressure Service (Type LTP)

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. Strainers shall comply with ASTM F 1199, and have a working pressure rating of 125 psig, and temperature rating of 150 degrees FBody shall have cast-in arrows to indicate direction of flow. All strainer bodies fitted with screwed screen retainers shall have straight threads and shall be 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 than 2-1/2-inches shall be fitted with manufacturer's standard ball-type blowdown valve. Body material shall be cast bronze conforming to ASTM B 62 or cast iron conforming to Class 30 ASTM A 278. 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 or 316 corrosion-resistant steel.

2.3.15 Strainers, High Temperature/Pressure Service (Type HTP)

Strainers shall be Y-type with removable strainer element.

Body end connections shall be flanged for all valves larger than 2 inches, unless butt weld ends are specified. Screwed or Socket weld shall be used for sizes 2 inches and under to suit specified piping system end connection.

Strainers located in tunnels, trenches, manholes, and valve pits shall have welded end connections.

Strainers shall comply with ASTM F 1200 and have a working pressure rating of 150 psig working steam pressure (wsp). 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. Strainers in sizes 2 inches and larger shall be fitted with manufacturers standard ball-type blowdown valve.

Body materials shall be cast steel conforming to ASTM A 216/A 216M, Grade WCB or forged carbon steel conforming to ASTM A 105/A 105M or manufacturer's standard metallurgical equivalents for service pressures of 150-psi wsp and greater.

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 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 or 316 corrosion-resistant steel and shall be fitted with backup screens where necessary to prevent collapse.

2.4 VALVES

Unless otherwise noted, valves shall be as specified below, with soldered, threaded or flanged ends to match the fitting type specified for the piping in which they are installed. Packing and gaskets shall be made of non-asbestos containing materials.

Chain operators, or manual gear operators with position indicators shall be provided on valves only where indicated on drawings.

2.4.1 Gate Valves (GAV-150)

Valves shall be rated 150-psi (wsp) and shall conform to ASME B16.34.

Body end connections shall be flanged for all valves larger than 2 inches unless butt weld ends are specified. Screwed or socket weld shall be used for sizes 2 inches and under to suit specified piping system end connection and maintenance requirements. Flange faces shall have concentric serrated finish.

Body to bonnet connection shall be union or gasketed-bolted type for valves 2 inches and under and gasketed-bolted type for valves larger than 2 inches. Bonnet shall be OS&Y type, rising stem.

Body and bonnet assembly shall be cast steel or forged carbon steel. Cast steel shall conform to ASTM A 216/A 216M, Grade WCB. Forged carbon steel shall conform to ASTM A 105/A 105M.

Trim for valves larger than 2 inches shall include hard surfaced solid or one-piece flexible-wedge disk and hard-surfaced seats. Trim for valves 2

inches and under shall include hard-surfaced, hardened-solid or one-piece flexible wedge disk and hard-surfaced hardened seats. Hardened components shall have Brinell hardness of not less than 500. Stem shall be rising and backseating type.

Trim materials and hard-surfaced substrates shall conform to ASTM A 182/A 182M, Grade F6 or shall be manufacturer's standard metallurgical equivalents for the specified service.

Hard-surfacing alloy shall conform to AWS A5.13, Class RNiCr-B or Class RCoCr-B.

Packing shall be wire reinforced, fiber braid impregnated with 30 percent tetrafluoroethylene or a corrosion-inhibiting lubricant specifically suitable for service with stem material provided.

Valve wheels shall be cast iron, malleable iron or wrought steel.

2.4.2 Drain, Vent, and Gauge Cocks

Drain, vent, and gauge cocks shall be T-head or lever handle, ground key type, with washer and screw, constructed of polished ASTM B 62 bronze, and rated 125-psi wsp. End connections shall be rated for specified service.

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.

2.4.3 Gate Valves (GAV)

Gate valves 2 inches and smaller shall conform to MSS SP-80, Type 2 (solid wedge disk/inside screw rising stem) union-ring bonnet. Valves shall be class 125.

Gate valves 2-1/2 inches and larger, shall conform to MSS SP-70, Type I, (solid wedge disk). Construction OF (outside screw and yoke/flanged ends), cast iron body with bronze trim, Class 125.

2.4.4 Globe Valves (GLV) and Angle Valves (ANV)

Globe valves and angle valves 2-1/2 inches and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Globe valves and angle valves 3 inches and larger shall conform to MSS SP-85, and shall be cast iron with bronze trim, and flanged or threaded ends.

2.4.5 Globe Valves (GLV-150) and Angle Valves (ANV-150)

Valves shall be rated 150-psi working steam pressure (wsp) and shall conform to ASME B16.34.

Body end connections shall be flanged for all valves larger than 2 inches, unless butt weld ends are indicated. Screwed or socket weld shall be used for sizes 2 inches and under to suit specified piping system end connection and maintenance requirements. Flange faces shall have concentric serrated finish.

Body to bonnet connection shall be union or gasketed-bolted type for valves 2 inches and under; gasketed-bolted type for valves larger than 2 inches;

and for valves 3/8 inchand under, assembly shall be screwed type. Bonnet shall be OS&Y type, except that valves 3/8 inch and under shall be inside screw type.

Body and bonnet assembly shall be cast steel or forged carbon steel. Cast steel shall conform to ASTM A 216/A 216M, Grade WCB. Forged carbon steel shall conform to ASTM A 105/A 105M.

Trim for valves larger than 2 inches and for all sizes of valves in bypass service shall include hard-surfaced, solid plug disk and hard-surfaced seats. Plug material in valves 2 inches and under shall be in accordance with AISI 400 series corrosion-resistant steel hardened to not less than 500 Brinell. Stem shall be rising and backseating type.

Trim materials and hard surface substrates shall conform to ASTM A 182/A 182M, Grade F6 shall be manufacturer's standard metallurgical equivalents for the specified service.

Hard-surfacing alloy shall conform to AWS A5.13, Class RNiCr-B or Class RCoCr-B.

Packing shall be wire reinforced, fiber braid impregnated with 30 percent tetrafluoroethylene or a corrosion-inhibiting lubricant specifically suitable for service with stem material provided.

Valve wheels shall be cast iron, malleable iron or wrought steel.

2.4.6 Standard Check Valves (SCV)

Check valves 2-1/2 inches and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Check valves 3 inches and larger shall conform to MSS SP-71, Type I, II, III, or IV, Class 125 or 150 and shall be cast iron with bronze trim and flanged or threaded ends.

2.4.7 Check Valves (CV-150)

Valves shall be rated 300-psi wsp and shall conform to applicable portions of ASME B16.34.

Valves shall be horizontal swing-check type.

Body end connections shall be flanged for all valves larger than 2 inches unless butt weld ends are specified. Screwed or socket weld shall be used for sizes 2 inches and under to suit specified piping system end connection and maintenance requirements. Flange faces shall have concentric serrated finish.

Body to cover connection shall be union or gasketed-bolted type.

Body and bonnet assembly shall be cast steel or forged carbon steel. Cast steel shall conform to ASTM A 216/A 216M, Grade WCB. Forged carbon steel shall conform to ASTM A 105/A 105M.

Trim materials, including hinge pin, shall be manufacturer's standard corrosion-resistant alloys for the specified service.

2.4.8 Butterfly Valves (BUV)

Butterfly valves shall be in accordance with MSS SP-67, Type 1 (tight

shutoff) and shall be 2 flange type, and shall be bubble tight with pressure from either side at 150 psig. Valve bodies shall be cast iron, malleable iron, or steel. Valves smaller than 8 inches shall have throttling handles with a minimum of seven locking positions. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

2.4.9 Plug Valves (PLV)

Plug valves 2 inches and larger shall conform to MSS SP-78, have flanged or threaded ends, and have cast iron bodies with bronze trim. Valves 2 inches and smaller shall be bronze with NPT connections for black steel pipe and brazed connections for copper tubing. Valves shall be lubricated, non-lubricated, or tetrafluoroethylene resin-coated type. Valves shall be resilient, double seated, trunnion mounted with tapered lift plug capable of 2-way shutoff. Valves shall operate from fully open to fully closed by rotation of the handwheel to lift and turn the plug.

2.4.10 Ball Valves (BAV)

Ball valves 1/2 inch and larger shall conform to MSS SP-72 or MSS SP-110 and shall be ductile iron or bronze with threaded, soldered, or flanged ends. Valves 8 inches or larger shall be provided with manual gear operators with position indicators.

2.4.11 Nonslam Check Valves (NSV)

Check valves at pump discharges in sizes 2 inches 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. Valve shall be rated for 200-psi maximum, nonshock pressure at 150 degrees F in sizes to 12 inches. Valves shall be fitted with flanges conforming to ASME B16.1. Valve body may be cast iron, conforming to ASTM A 278, Class 40 or equivalent strength ductile iron. Disks shall be manufacturer's standard bronze, aluminum bronze, or 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.

2.4.12 Plastic Valves (PVC)

Valves shall not be used in service where service temperature exceeds 140 degrees F.

Ball valves shall be manufactured from a PVC compound that meets the requirements of Type 1, Grade 1 PVC as outlined in ASTM D 1784. Valves shall also conform to NSF 14.

Valves shall have Teflon ball seals and Viton stem and body seals. Ball valves shall carry a pressure rating of 150-psi circulating water pressure (cwp) at 75 degrees F.

2.4.13 Plastic Valves (CPVC)

Valves shall not be used in service where service temperature exceeds 200 degrees F at 66 psi.

Ball valves shall be manufactured from a compound which meets or exceeds the requirements for Class 23447-B CPVC in ASTM D 1784. Valves shall also conform to NSF 14.

Valves shall have Teflon ball seals and Viton stem and body seals. Ball valves shall carry a pressure rating of 150-psi cwp at 75 degrees F.

2.5 MISCELLANEOUS MATERIALS

2.5.1 Bituminous Coating

Bituminous coating shall be a solvent cutback, heavybodied 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 MS MIL-C-18480.

2.5.2 Bolting

Flange and general purpose bolting shall be hex-head and shall conform to ASTM A 307, Grade B (bolts, for flanged joints in piping systems where one or both flanges are cast iron). Heavy hex-nuts shall conform to ASTM A 563. Square-head bolts and nuts are not acceptable. Threads shall be coarse-thread series.

2.5.3 Elastomer Calk

Polysulfide- or polyurethane-base elastomer calking material shall be two-component type, conforming to ASTM C 920.

2.5.4 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 A112.19.2M.

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 internal spring-tension devices or setscrews for maintaining a fixed position against a surface.

2.5.5 Flashing

Sheet lead shall conform to ASTM B 749, Grade B (intended for use in laboratories and shops in general application).

Sheet copper shall conform to ASTM B 370 and shall be of not less than 16 ounces per square foot weight.

2.5.6 Flange Gaskets

Compressed non-asbestos sheet, conforming to ASTM F 104, Type 7-P1161A, coated on both sides with graphite or similar lubricant, with nitrile composition, binder rated to 750 degrees F.

2.5.7 Pipe Thread Compounds

Tetrafluoroethylene tape not less than 2 to 3 mils thick shall be used in potable and process water and in chemical systems for pipe sizes to and including 1-inch ips. 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.

2.6 SUPPORTING ELEMENTS

All 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. 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 B31.1 or ASME B31.9, 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. 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. Support elements, except for supplementary steel, shall be cataloged, load rated, commercially manufactured products.

Piping shall not be supported from ductwork hangers or supports, or from hangers supporting fire protection (sprinkler and standpipe systems) piping.

2.6.1 Building Structure Attachments

2.6.1.1 Anchor Devices, Concrete and Masonry

Anchor devices shall conform to CID A-A-1922A, CID A-A-1924A, CID A-A-55614 or CID A-A-55615, and load per anchor shall not exceed the recommended safe working load as indicated in those standards.

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.

2.6.1.2 Beam Clamps

Beam clamps shall be center-loading Type 21, 28, 29, or 30.

When it is not possible to use center-loading beam clamps, eccentric-loading beam clamps, Type 20, 25, or 27 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.

2.6.1.3 C-Clamps

Type 23 C-clamps or type 19 C-type beam clamps may be used to support piping sizes 2 inches and smaller. C-clamps and C-type clamps shall be FM approved and UL listed with hardened cup-tip setscrew, locknut, and retaining strap not less than 1/8 inch by 1 inch. Clamps secured to one side of beam with only setscrews are not acceptable. Beam flange thickness to which clamps are attached shall not exceed 0.60 inch.

2.6.1.4 Inserts, Concrete

Concrete inserts shall be Type 18 or 19. When applied to piping in sizes 2 inches 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. Proprietary-type continuous inserts may be submitted for approval.

2.6.2 Horizontal Pipe Attachments

2.6.2.1 Single Pipes

Piping in sizes to and including 2-inch ips shall be supported by Type 6 solid malleable iron pipe rings, except that split-band-type rings may be used in sizes up to 1-inch ips.

Piping in sizes through 8-inch ips inclusive shall be supported by Type 1, 3, or 4 attachments.

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, Type 41, 44 through 47, or 49 pipe rolls shall be used.

Piping in sizes larger than 8-inch ips shall be supported with Type 41, 44 through 47, or 49 pipe rolls.

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.

Insulated piping without vapor barrier on roll supports shall be provided with Type 39a saddles for pipe sizes to 12-inch ips and Type 39b for pipe sizes 12-inch ips and larger.

Type 39a or 39b saddles shall be used for pipe guiding.

Spring supports shall be as indicated.

2.6.2.2 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.

2.6.3 Vertical Pipe Attachments

Vertical pipe attachments shall be Type 8.

Shop drawing data shall include complete fabrication and attachment details of any spring supports.

2.6.4 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.

2.6.5 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 S328.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

Piping systems shall be fabricated and installed in accordance with ASME B31.1 or ASME B31.9, as applicable to the service, MSS SP-69, and AWS-02, and other requirements or standards specified in the specification section for the type of system.

Connections between steel piping and copper piping shall be electrically isolated from each other with dielectric couplings (or unions) or flanged with dielectric gaskets rated for the service.

Final connections to equipment shall be made with unions or flanges. Unions or flanges shall be provided every 100 feet of straight run. Unions shall be provided in the line downstream of screwed- and welded-end valves.

All pipe ends shall be reamed 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.

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.

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.

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 B31.9 or ASME B31.1.

Field welded joints shall conform to the requirements Section 15055, "Welding and Pressure Vessels/Systems".

All necessary precautions shall be taken 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

Valves shall be provided in piping mains and all branches and at equipment where indicated and as specified. Valves shall be installed with the stems upright unless otherwise indicated or approved.

Valves shall be provided 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. Shutoff valve body shall be tapped and fitted with a 1/2-inch plugged globe valve.

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

Supporting elements shall be provided in accordance with the referenced codes and standards.

Piping shall be supported 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. Piping and components shall be spaced and installed 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.

Piping support elements shall be installed at intervals specified hereinafter, at locations not more than 3 feet from the ends of each runout, and not over 1 foot from each change in direction of piping.

Load rating for all pipe-hanger supports shall be based on insulated weight of lines filled with water and forces imposed. Deflection per span shall not exceed slope gradient of pipe. Supports shall be in accordance with the following minimum rod size and maximum allowable hanger spacing for specified pipe, unless otherwise indicated in the specification section for

the individual system. For concentrated loads such as valves, the allowable span shall be reduced proportionately:

PIPE SIZE INCHES	ROD SIZE INCHES	STEEL PIPE FEET	COPPER PIPE FEET
1 and smaller	3/8	8	6
1-1/4 to 1-1/2	3/8	10	8
2	3/8	12	10
2-1/2 to 3-1/2	1/2	12	12
4 to 5	5/8	16	14
6	3/4	16	16
8 to 12	7/8	20	20
14 to 18	1	20	20
20 and over	1-1/4	20	20

Vibration isolation supports shall be provided where needed. Refer to Section 15072, "Vibration Isolation for Air Conditioning Equipment," where A/C equipment and piping is installed.

Vertical risers shall be supported independently of connected horizontal piping, whenever practicable, with fixed or spring supports at the base and at intervals to accommodate system range of thermal conditions. Risers shall be guided for lateral stability. For risers subject to expansion, only one rigid support shall be provided at a point approximately one-third down from the top. Clamps shall be placed under fittings unless otherwise specified. Carbon-steel pipe shall be supported at each floor and at not more than 15-foot intervals for pipe 2 inches and smaller and at not more than 20-footintervals for pipe 2-1/2 inches and larger.

3.4 PLASTIC PIPING

Plastic piping shall be installed in accordance with the manufacturer's installation instructions.

3.4.1 Vertical Piping

PVC and CPVC piping shall be supported at intervals of not more than 3 feet.

Piping shall be secured at sufficiently close intervals to keep pipe in alignment and to support weight of pipe and contents.

Supports shall be installed at each floor.

Piping shall be secured in position by approved stakes or braces when piping is to stand free, or when no structural element is available for providing stability during construction.

3.4.2 Horizontal Piping, Suspended

All piping shall be supported at intervals in accordance with the

manufacturer's instructions and in no case more than 3 feet.

Hangers shall be installed at ends of runs or branches and at each change of direction or alignment.

3.4.3 Horizontal Piping, Underground

Piping shall be laid on a firm bed for the entire trench length, except where otherwise supported.

Partial backfilling and cradling shall be employed to secure piping during backfilling operations.

Piping laid on grade shall be firmly braced prior to embedment in concrete.

3.4.4 Cutting

Cuts shall be made square with pipe and burrs shall be removed by smoothing edges.

3.4.5 Joints

Joints shall be solvent cemented in accordance with ASTM D 2855, unless threaded joints are indicated. Threaded joints shall not be used for schedule 40 or thinner wall pipe.

Junction with other materials shall be the type of adapter and technique as recommended by the pipe manufacturer.

3.5 ANCHORS

Anchors shall be provided where necessary or indicated to localize expansion or prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed using turnbuckles where required. Supports, anchors, or stays shall not be attached in places where construction will be damaged by installation operations or by the weight or expansion of the pipeline.

3.6 PIPE EXPANSION

The expansion of supply and return pipes shall be provided for by changes in the direction of the run of pipe, by expansion loops unless expansion joints are indicated on drawings. If indicated, drawings shall include type of expansion joint, specification and ratings.

3.6.1 Expansion Loops

Expansion loops shall provide adequate expansion of the main straight runs of the system within the stress limits specified in ASME B31.1 or ASME B31.9, as applicable to the system. The loops shall be cold-sprung and installed where indicated. Pipe guides shall be provided as indicated.

3.7 PENETRATIONS

3.7.1 Firestopping and Smokestopping

Where piping penetrates fire-rated construction or smoke barriers firestopping or smokestopping shall be provided in accordance with Section

07840, "Firestopping and Smokestopping".

3.7.2 Other Penetrations

Where the structure is not fire-rated or a smoke barrier, 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.

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 1/2 inch. All surfaces to be calked shall be oil- and grease-free.

3.8 SLEEVES

Sleeves shall be provided where piping passes through roofs, masonry, concrete walls and floors.

Sleeves passing through steel decks shall be continuously welded to the deck.

Sleeves that extend through floors, roofs, or load bearing walls shall be continuous and fabricated from Schedule 40 steel pipe. 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 shall accommodate mechanical and thermal motion of pipe to preclude transmission of vibration to walls and the generation of noise.

Exterior wall sleeves shall be calked watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed metal components.

Sleeve height above roof surface shall be a minimum of 12 and a maximum of 18 inches.

3.9 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 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. Escutcheons shall be firmly attached with setscrews.

3.10 FLASHINGS

Flashings shall be provided at penetrations of building boundaries by mechanical systems and related work.

3.11 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.

Defective materials found shall be distinctly marked using a road-traffic quality yellow paint; defective material shall be promptly removed 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.

Changes in direction shall be made with long sweep fittings.

Necessary socket clamping, piers, bases, anchors, and thrust blocking shall be provided. Rods, clamps, and bolting shall be protected 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. Supports shall be protected 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.

3.12 HEAT TRACE CABLE INSTALLATION

Heater tape shall be field applied and cut to fit as necessary, linearly along the length of pipe after piping has been pressure tested and approved. Secure the heater to piping with heat resistant cable ties or fiberglass tape. Thermal insulation shall be labeled on the outside, with orange labels, "Electric Traced."

Power connection, end seals, splice kits and tee kit components shall be installed in accordance with IEEE Std 515 to provide a complete workable system. Connection to the thermostat and ends of the heat tape shall be terminated in a junction box. Cable and conduit connections shall be raintight.

3.13 CLEANING

Piping shall be flushed with potable water until visible grease, dirt and other contaminants are removed (visual inspection).

Additional flushing, cleaning, or disinfection shall be performed where indicated, and where specified in the specification section for the specific piping system.

3.14 HEAT TRACE CABLE TESTS

Heat trace cable system shall be tested in accordance with IEEE Std 515 after installation and before and after installation of the thermal insulation. Heater cable shall be tested using a 1000 vdc megger. Minimum insulation resistance shall be 20 to 1000 megohms regardless of cable length.

3.15 PRESSURE VESSELS/SYSTEMS (PV/S) CERTIFICATION

All installation or modification of PV/S piping and components shall comply with the requirements of Section 15055, "Welding and Pressure Vessels/Systems", and PV/S Certification Records shall be prepared as indicated in that section. This data shall be submitted and approved, and the system or components Certified by the Code 540 RECERT Group, prior to pressurization and operation.

3.16 TESTING AND OPERATIONAL READINESS REVIEW (ORR)

Testing and Operational Readiness Reviews for piping and valves are specified in other Division 15 sections, for the particular systems in which they are installed.

-- End of Section --

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SECTION 15055

WELDING AND PRESSURE VESSELS/SYSTEMS

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SECTION 15055

WELDING AND PRESSURE VESSELS/SYSTEMS
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1	(1998) Power Piping
ASME B31.9	(1996) Building Services Piping
ASME B31.5	(2000) Refrigeration Piping
ASME BPV V	(1998) Boiler and Pressure Vessel Code; Section V, Nondestructive Examination
ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels, Division 1, Basic Coverage
ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPV VIII Div 2	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 2 - Alternatives Rules for Basic Coverage

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC	(2000) International Plumbing Code

NATIONAL BOARD OF BOILER AND PRESSURE VESSEL INSPECTORS (NBBPVI)

NBBPVI-23	(1998) National Board Inspection Code

PIPE FABRICATION INSTITUTE (PFI)

PFI ES 1	(1992; R 1998) Internal Machining and Solid Machined Backing Rings for Circumferential Butt Welds
PFI ES 21	(1992; R 1998) Internal Machining and Fit-up of GTAW Root Pass Circumferential Butt Welds
PFI ES 3	(1981; R 2000) Fabricating Tolerances

PFI ES 31	(1992; R 2000) Standard for Protection of Ends of Fabricated Piping Assemblies
PFI ES 35	(1998) Nonsymmetrical Bevels and Joint Configurations for Butt Welds
PFI ES 7	(1994; R 2000) Minimum Length and Spacing for Welded Nozzles
PFI TB1	(1994; R 1999) Pressure Temperature Ratings of Seamless Pipe Used in Power Plant Piping Systems

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall show type, voltage and/or amperage for the following items:

Welding Equipment
Welding Rods and Accessories

SD-04 Samples

The following samples shall be submitted:

Welder's Pre-Qualification Samples

SD-07 Certificates

Within fifteen days after receipt of Notice to Proceed, the Contractor shall submit for approval to the Contracting Officer the following items:

Certified Welding Procedure Specifications (WPS)
Certified Brazing Procedure Specifications (BPS)
Certified Procedure Qualification Records (PQR)

SD-07 Certificates

Fifteen calendar days prior to any employee welding on project material, the Contractor shall submit for approval to the Contracting Officer the following items:

Certified Welder Performance Qualifications (WPQ)
Certified Brazer Performance Qualifications (BPQ)

SD-06 Test Reports

Test Reports shall be submitted for Radiographs

SD-11 Closeout Submittals

PV/S Certification Records shall be submitted for all pressure vessels and pressurized systems (PV/S). Records shall be identified with the description of the PV/S including all applicable GOMARS numbers for included equipment. Records shall include, as applicable to the particular PV/S installed in the task order, all applicable items specified in this section in the paragraph entitled, "Documentation for Pressure Vessels and Systems.

1.3 SCOPE OF PRESSURE VESSELS AND PRESSURIZED SYSTEMS (PV/S)

Pressure Vessels and Pressurized Systems (PV/S) in general include the following components: Pressure Vessels, Tanks, Vacuum Vessels, Flexible Hoses, Expansion Joints, Relief Valves, Piping and Piping System Components (includes pipe, pipe fittings, valves, pumps, compressors, gauges, and all other pressurized components not listed in the above categories).

The systems and components indicated below are those which at GSFC are specifically considered to be PV/S, and are subject to the requirements of this specification section:

High pressure compressed air systems, including all pressure vessels, flexible hose, expansion joints, relief valves, piping and piping system components, which have an operating pressure greater than 125 psig.

Low pressure compressed air systems, including all flexible hose, expansion joints and relief valves, which have an operating pressure of 125 psig or less; also including pressure vessels (as indicated below), and piping and piping system components (as indicated below), which have an operating pressure of 125 psig or less:

all pressure vessels, piping and piping system components which operate at temperatures greater than 130 degrees F;

large pressure vessels, with value units (defined as pressure times volume) greater than 37,500 psig gallons;

large piping and piping system components, with value units (defined as pressure times diameter squared) greater than 32,000 psig inches squared.

Pneumatic control systems, including only those portions which operate at greater than 20 psig, are included as above for low pressure compressed air systems.

High pressure and medium pressure steam and condensate systems and components, including all pressure vessels, flexible hose, expansion joints, relief valves, piping and piping system components, which have an operating pressure greater than 15 psig.

Water systems (domestic water systems; HVAC chilled water, secondary water, and hot water systems; and pumped condensate return systems), including: all pressure vessels (converter shells, expansion/compression tanks, hot water tanks); all flexible hose, expansion joints, and relief valves; piping and piping system components with diameter greater than 24 inches; and non-pressurized tanks with capacity greater than 30,000 gallons. (Wet pipe fire protection systems are not included).

Vacuum systems, including all relief valves, and vacuum vessels with a volume of 748 gallons or greater.

1.4 DOCUMENTATION FOR PRESSURE VESSELS AND PRESSURIZED SYSTEMS

Prior to initial operation of pressure vessels and pressurized systems, assemble the following information into a single, organized document, and submit as the PV/S Certification Records for that pressure vessel or system.

No pressure vessel, pressurized system, or components shall be pressurized or operated until the Government has approved this data and certified the system to be safe to operate.

1.4.1 Manufacturer's Drawings

For components such as pressure vessels, vacuum vessels, piping, and expansion joints, the drawings shall be either the certified shop fabrication drawings or as-built drawings. The drawings shall contain the following:

a. Manufacturers name
b. Date of manufacture
c. Identification of component
d. Configuration
e. Dimensions and details of construction
f. Design and operating conditions
g. Design code or design basis
h. Thicknesses
i. Corrosion allowance
j. Identification of materials and design properties
k. Efficiency of joints
l. Nondestructive examinations
m. Types of tests (e.g., hydrostatic, pneumatic)

For components such as pumps, compressors, valves, gages, and relief devices, the drawings shall be the certified outline and cross-sectional drawings showing information such as make, model number, materials of construction, and design and operating data.

1.4.2 Design Calculations

Design calculations for components such as pressure vessels, vacuum vessels, and piping shall include pressure, temperature, wind, seismic, deadload, and any other applicable loadings. They shall specify the applicable code, standard, or other design basis.

1.4.3 Manufacturer's Data Report

Manufacturer's data reports shall be furnished for all components built to the rules of the ASME Boiler and Pressure Vessel Code, as illustrated in the applicable sections of the code. The equivalent information shall be furnished for components such as pumps, compressors, valves, gages, and relief valves; data shall include performance curves, and shop test reports (e.g., hydrostatic test, performance test, net positive suction head test, mechanical running test, relieving capacity, and calibration test.)

1.4.4 Mill Test Reports

Mill test reports shall be as furnished by the material manufacturer for the material supplier to certify compliance with specifications. They shall contain information such as material manufacturer, purchaser, material specification, description of material furnished, heat number, chemical and mechanical properties, and results of test. These shall be furnished for all materials except those that are not necessary as identified in ASME BPV VIII Div 1, Paragraphs UG-ll (a) and UC-ll (c).

1.4.5 Welding Procedure and Procedure Qualification Records

Welding procedure and procedure qualification test records shall be as prepared and furnished by the manufacturer. They shall describe the welding procedure and record the test results obtained in welding procedure and welder performance qualifications and the results of examinations of welding operators. These shall be as illustrated in ASME BPV IX.

1.4.6 Record of Nondestructive Examinations

Nondestructive examinations reports shall be prepared by the manufacturer. The minimum requirements for the reports are given in the applicable sections of ASME BPV V.

1.4.7 Pressure Test Record

The pressure test record shall be prepared and furnished by the manufacturer.

1.4.8 Record of Post-Weld Heat Treatment

This document shall be prepared by the company performing the heat treatment and shall be furnished by the component manufacturer. It shall show rates of heating and cooling, holding temperature, and length of time at holding temperature.

1.4.9 Facsimile of Nameplate Stamping

This document shall be prepared by the manufacturer, and shall be a pencil rubbing of the actual nameplate as stamped.

1.4.10 Record of Impact Test

This document shall be furnished either by the material manufacturer of the component manufacturer, It shall contain the applicable specification, test procedure used, and results of all tests.

1.4.11 Record of Heat Treatment

This documentation of material heat treatment shall be provided only when such heat treatment is done by, or under the control of, someone other than the material supplier. It shall be attached as a supplement to the appropriate mill test report.

1.5 QUALITY ASSURANCE

1.5.1 Personnel Qualifications

This specification contains the minimum requirements for qualifying welding

procedures, welders, and welding operators for making and inspecting welds in mechanical fabrications of carbon steel, low alloy steel, extra-high-strength quenched and tempered low alloy steels, and austenitic stainless steel materials.

1.5.2 Pressure Vessels Qualification

Qualification documents WPS or BPS, PQR and WPQ or BPQ as applicable shall be in accordance with ASME BPV IX.

1.5.3 Piping Qualifications

Refrigeration Piping: Qualification documents for below 125 psig, WPS or BPS, PQR and WPQ or BPQ as applicable for "Refrigeration Piping" shall be in accordance with ASME B31.5.

Plumbing: Plumbing work shall be performed by a state licensed plumber.

Other Piping: Qualification documents, WPS or BPS, PQR and WPQ or BPQ as applicable shall be in accordance with ASME BPV IX.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 CONSTRUCTION

3.1.1 Pressure Vessels

3.1.1.1 New Construction

Contractor shall meet the fabrication, welding/brazing and inspection requirements of the ASME BPV VIII Div 1 or ASME BPV VIII Div 2.

3.1.1.2 Repairs to Existing Pressure Vessels

Code Stamped Vessels: Contractor shall meet the fabrication, welding/brazing and inspection requirements of NBBPVI-23.

Non-Code Vessels: Contractor shall meet the fabrication, welding/brazing and inspection requirements of NBBPVI-23 with the following exception:

a. It is not necessary that a National Board Code Inspector inspect the work.

b. National Board ("R" Stamp) Code stamping is not required.

3.1.2 Piping

High Pressure Compressed Air (over 125 psig), High Pressure (100 psig) and Medium Pressure (60 psig) Steam and Condensate Piping: Piping systems shall be fabricated, assembled and welded/brazed in accordance with ASME B31.1, and Power Piping Codes, PFI ES 1, PFI ES 3, PFI ES 7, PFI ES 21, PFI ES 31, PFI ES 35, and PFI TB1, of the Piping Fabrication Institute's companion code requirements.

Refrigeration Piping: Piping systems shall be fabricated, assembled and welded/brazed/soldered in accordance with ASME B31.5.

Plumbing: Plumbing systems shall be fabricated, assembled and welded/brazed/soldered in accordance with ICC IPC.

Other Piping: Other piping systems shall be fabricated, assembled and welded/brazed/soldered in accordance with ASME B31.9, or ASME B31.1 if size pressure or temperature exceed the limits of ASME B31.9.

3.2 HEAT INPUT REQUIREMENTS

3.2.1 Preheat

Welding shall not be done at ambient temperature below 32 degrees F, or when the surfaces are wet or exposed to rain, snow, or high wind. Temperature of the metals in the area where the welding is to be done shall be not less than 50 degrees F. When the ambient conditions are such that the normal temperature of the base metal is below 50 degrees F, the area surrounding the joint shall be preheated to provide a base metal temperature of 100 degrees F for a distance of at least 3 inches in all directions from the joint to be welded. Preheat shall be in accordance with ASME BPV VIII Div 1 or ASME BPV VIII Div 2 and ASME BPV V.

3.2.2 Interpass

In a multipass weld, the interpass temperature is the temperature of the weld metal before the next pass is started. Interpass requirements shall be in accordance with ASME BPV VIII Div 1 or ASME BPV VIII Div 2 and ASME BPV V.

3.2.3 Postweld

Weldments shall not be given a postweld heat treatment unless noted in the applicable code qualified/certified welding documentation, WPS, PQR and WPQ.

3.3 INSPECTION/NONDESTRUCTIVE TESTING (NDT)

3.3.1 General

Fabrication/Erection inspection shall be performed prior to assembly, during assembly, during welding and after welding to ensure that materials and workmanship meet the requirements of the contract documents.

Each specified radiograph shall, as a minimum, have the following additional information permanently included in the image:

Agency Weld No. (including repair cycle no.)

Agency drawing No.

Agency View No.

Agency Contract No.

Final interpretation and acceptance of all radiographs of welded joints, with the exception of code stamped pressure vessel welds, will be by the Contracting Officer.

Final acceptance of all welded/brazed joints shall be by the Contracting Officer.

Prior to the Contracting Officer's inspection, all slag and scale shall be removed from all welds. Procedure employed shall not produce notches in either the weld metal or adjacent base metal.

Unacceptable welds shall be immediately repaired and made ready for Government reinspection at no additional cost to the Government.

After weld joints have been satisfactorily completed by the Contractor and accepted by the Contracting Officer, the joint area shall be cleaned to a bright, unpitted, and unscarred surface and then protected in accordance with the contract documents.

3.3.2 Pressure Vessels

3.3.2.1 Test Method

All nondestructive testing shall be performed in accordance with the requirements of ASME BPV V.

3.3.2.2 Acceptance Requirements

Acceptance requirements shall be in accordance with ASME BPV V and ASME BPV VIII Div 2.

3.3.3 Piping

3.3.3.1 Test Method

NDT (Nondestructive Testing) of all piping systems, except plumbing systems, shall be performed in accordance with the requirements of ASME BPV V.

For high pressure (125 psig or above) systems. Not less than 10 percent of all butt welds shall be examined fully by random radiography. Welds to be examined shall be selected to ensure that the work product of each welder or welding operator doing the production welding is included. These welds shall satisfy the acceptance standards of the specified code. If any of the butt welds examined reveals an unacceptable indication, all butt welds welded by that welder(s) shall be examined/accepted by radiography.

3.3.3.2 Acceptance Requirements

a. High pressure (100 psig) and medium pressure (60 psig) steam and condensate piping systems shall meet the requirements of ASME B31.1.

b. High pressure compressed air (greater than 125 psig) piping systems shall meet the requirements of ASME B31.1.

c. Refrigeration piping systems shall meet the requirements of ASME B31.5.

d. Plumbing piping systems shall meet the requirements of ICC IPC.

e. Other piping systems shall meet the requirements of ASME B31.9, or ASME B31.1 if size, pressure or temperature exceed the limits of ASME B31.9.

3.4 PROTECTION OF ADJACENT MATERIALS

Contractor shall sufficiently protect machinery, materials, floor, etc., adjacent to the welding/brazing operations to prevent any damage from these operations.

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SECTION 15072

VIBRATION ISOLATION FOR AIR CONDITIONING EQUIPMENT

03/98

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SECTION 15072

VIBRATION ISOLATION FOR AIR CONDITIONING EQUIPMENT
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S2.40	(1984; R 1997) Mechanical Vibration of Rotating and Reciprocating Machinery - Requirements for Measuring Vibration Severity
ANSI S3.29	(1983; R 1996) Guide to the Evaluation of Human Exposure to Vibration in Buildings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE-02	(1999) Handbook, HVAC Applications (IP Edition)
ASHRAE-05	(1999) Handbook, HVAC Applications (SI Edition)

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB-01	(1998; 6th Ed) Procedural Standards for Testing-Adjusting-Balancing of Environmental Systems
NEBB-A	(1994)Sound and Vibration Design and Analysis

1.2 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section to the extent applicable.

Section 15050, "Basic Mechanical Materials and Methods," applies to work specified in this section to the extent applicable.

All vibration-control apparatus shall be the product of a single manufacturing source, where possible. Human exposure levels should be considered using ANSI S3.29 and NEBB-A.

Scheduled isolation mounting is in inches and is a minimum static deflection.

Spans referred to in Part 2, "Vibration-Isolation Systems Application," shall mean longest bay dimension.

Exact mounting sizes and number of isolators shall be determined by the isolator manufacturer based on equipment that will be installed. Equipment revolutions per minute (rpm) and spring deflections shall be checked to verify that resonance cannot occur.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Outline Drawings for Vibration Isolator Systems shall indicate overall physical features, dimensions, ratings, service requirements, and weights of equipment.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Mounting
Bases
Isolators
Floor-Mounted Piping
Vertical Piping

SD-05 Design Data

Equipment and Performance Data for Vibration Isolator Systems shall include 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.

SD-06 Test Reports

Test Reports shall be submitted for Deflection Tests in accordance with the paragraph entitled, "Tests and Reports," of this section. Reports shall include the following information:

Type of Isolator
Type of Base
Allowable Deflection
Measured Deflection

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for vibration isolation systems, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted for the vibration isolation systems.

PART 2 PRODUCTS

2.1 TYPE OF VIBRATION-ISOLATION PROVISIONS

Design for vibration isolation using NEBB-A, or ASHRAE-02, Chapter 42, as applicable to the following sections.

2.1.1 Materials

Rubber shall be natural rubber. Elastomer shall be chloroprene. Shore A durometer measurement of both materials shall range between 40 and 60.

Inorganic materials such as precompressed, high-density, fibrous glass encased in a resilient moisture-impervious membrane may be used in lieu of specified natural rubber and elastomers. Where this substitution is made, specified deflections shall be modified by the manufacturing source to accommodate physical characteristics of inorganic materials and to provide equal or better vibration isolation.

Weather-exposed metal vibration-isolator parts shall be corrosion protected. Springs shall be chloroprene coated.

2.1.2 Mountings

Mountings shall be one of the following types as indicated in this section, paragraph entitled "Vibration Isolation - Systems Application", for the type and location of the equipment.

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 shall not exceed 40 pounds per square inch (psi). Minimum overall thickness shall 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 shall 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 inchclearance maintained around springs, with adjustable limit stops, 0.25-inch thick Type A base elastomer pads, and accessories.

Type E: Pendulum-suspension configuration with free-standing stable spring with resilient horizontal and vertical restraints to allow maximum movements of 0.25 inch in each direction, 0.25-inch thick Type A base elastomer pads.

Type F: Combination spring and rubber-in-shear or elastomer-in-shear steel framed for hanger-rod mounting. Minimum total static deflection shall be 1 inch.

Type G: Air spring with body constructed of reinforced elastomer specifically suitable for application environment. Air spring shall be selected to provide a natural frequency equal to 5 inches of deflection of conventional specified steel springs. Facilities shall be provided for dead-level adjustment and height-control of supported equipment.

2.1.3 Bases

Bases shall be one of the following types as indicated in this section, paragraph entitled "Vibration-Isolation Systems Application" for the type and location of the equipment.

Type U: Unit isolators without rails, structural-steel bases, or inertia blocks.

Type R: Rails, connected or disconnected mill-rolled structural steel, of sufficient dimension to preclude deflection at midpoint of unsupported span in excess of 1/1,440th of the span between isolators, power transmission, component misalignment, and any overhung weight. Where Type R bases are specified and the equipment proposed requires additional base support, a Type S base shall be used.

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 shall be sufficient to provide stiffness required to maintain equipment manufacturer's recommended alignment and duty efficiency of power-transmission components. Height of steel member shall not result in member deflection at midpoint of unsupported span of more than 1/1,440th of the span between isolators. Minimum height shall be 5 inches.

Type CIB: Concrete inertia blocks shall be common to the entire assembly, shall 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 shall be filled with 3,000 psi cured-strength concrete.

Configuration of inertia bases shall be rectangular to accommodate equipment supported.

Minimum thickness of inertia base, in addition to providing suitable mass, shall be sufficient to provide stiffness to maintain equipment manufacturer's recommended alignment and duty efficiency of power-transmission components. Minimum thickness shall 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, shall be 8 percent of the longest base dimension.

Pumps with flexible couplings shall have inertia bases not less than 8 inches thick.

Minimum mass of concrete inertia block shall be equal in weight to supported equipment.

2.2 VIBRATION-ISOLATION SYSTEMS APPLICATION

Vibration isolation design per NEBB-A or ASHRAE-02, Chapter 42.

2.2.1 Centrifugal Water Chiller Package Locations

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
Hermetic	A-U-0.25	B-U-0.50	D-S-1.75	D-S-2.5
Open Type	B-U-0.38	D-U-1.0	D-CIB-1.75	D-CIB-2.5

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

2.2.2 Reciprocating Water Chiller Package Locations

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
500 to 750 rpm	D-U-1.0	D-U-1.5	D-S-2.5	D-CIB-2.75
750 rpm and over	D-U-1.0	D-U-1.0	D-R-2.0	D-CIB-2.5

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

2.2.3 Absorption Water Chiller Package Locations

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
Standard	A-U-0.25	D-U-1.0	D-U-1.5	D-U-2.75

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

2.2.4 Reciprocating Compressor/Condenser Locations

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
500 to 750 rpm	D-U-1.0	D-U-1.5	D-U-2.5	D-CIB-2.75
750 to and over	D-U-1.0	D-U-1.0	D-U-2.0	D-CIB-2.5

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 40-FOOT FLOOR-SPAN PROVISIONS*

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

2.2.5 Reciprocating Refrigeration Compressor Locations

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
500 to 750 rpm	C-U-1.0	C-U-1.5	C-U-2.5	C-CIB-2.75
750 rpm and over	C-U-1.0	C-U-1.0	C-U-2.0	C-CIB-2.5

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

2.2.6 Centrifugal Pump Locations

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
Close-couple through 5 hp	None	-R-0.35	C-S-1.0	C-S-1.0
Bedplate-mounted through 5 hp	None	C-CIB-1.0	C-CIB-1.5	C-CIB-1.75
7-1/2 hp	None	C-CIB-1.0	C-CIB-1.75	C-CIB-2.5

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

2.2.7 Air-Cooled Condensing Unit Locations

TYPE EQUIPMENT	20-FOOT ROOF-SPAN PROVISIONS*	30-FOOT ROOF-SPAN PROVISIONS*	40-FOOT ROOF-SPAN PROVISIONS*
Through 5 hp over 900 rpm	B-U-0.5	D-U-1.0	D-U-1.75
Over 5 hp to 500 rpm	B-U-0.5	D-U-1.75	D-U-2.5
500 rpm and over	B-U-0.5	D-U-1.0	D-U-1.75

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

TYPE EQUIPMENT	20-FOOT ROOF-SPAN PROVISIONS*	30-FOOT ROOF-SPAN PROVISIONS*	40-FOOT ROOF-SPAN PROVISIONS*

2.2.8 Low-Pressure Suspended Air-Handling Unit (AHU) Locations

Vibration-isolation provisions apply to ceiling-suspended Air Moving and Conditioning Association Class A packaged central-station units.

TYPE EQUIPMENT	20-FOOT ROOF-SPAN PROVISIONS*	30-FOOT ROOF-SPAN PROVISIONS*	40-FOOT ROOF-SPAN PROVISIONS*
Through 5 hp	F-U-1.0	F-U-1.0	F-U-1.0
7-1/2 hp and over 250 to 500 rpm	F-U-1.75	F-U-1.75	F-U-1.75
500 rpm and over	F-U-1.0	F-U-1.25	F-U-1.55

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

2.2.9 Low-Pressure AHU Locations

Vibration-isolation provisions apply to floor-mounted Air Moving and Conditioning Association Class A packaged central-station units.

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
Through 5 hp	B-U-0.35	C-U-1.0	C-U-1.0	C-U-1.0
7-1/2 hp and over 250 to 500 rpm	B-U-0.35	C-U-1.75	C-U-1.75	C-U-1.75
500 rpm	B-U-0.35	C-U-1.0	C-U-1.5	

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

2.2.10 Medium- and High-Pressure AHU Locations

Vibration-isolation provisions apply to floor-mounted Air Moving and Conditioning Association Classes B and C packaged central-station units.

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
Through 20 hp 250 to 300 rpm	B-U-0.35	C-U-2.5	C-U-2.5	C-U-3.5

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
300 to 500 rpm	B-U-0.35	C-U-1.75	C-U-1.75	C-U-2.5
500 rpm and over	B-U-0.35	C-U-1.0	C-U-1.0	C-U-1.75
Over 20 hp 250 to 300 rpm	B-U-0.35	C-U-2.5	C-CIB-3.5	C-CIB-3.5
300 to 500 rpm	B-U-0.35	C-U-2.5	C-CIB-2.5	C-CIB-3.5
500 rpm and over	B-U-0.35	C-U-1.0	C-CIB-1.75	C-CIB-2.5

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

2.2.11 Air-Moving Device Locations

Vibration-isolation provisions apply to free-standing fans of any pressure rating.

TYPE EQUIPMENT	BASEMENT BELOW-GRADE PROVISIONS*	ON GRADE 20-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 30-FOOT FLOOR-SPAN PROVISIONS*	ON GRADE 40-FOOT FLOOR-SPAN PROVISIONS*
Through 20 hp 200 to 300 rpm	B-U-0.35	C-S-2.5	C-S-2.5	C-S-3.5
300 to 500 rpm	B-U-0.35	C-S-1.75	C-S-1.75	C-S-2.5
500 rpm and over	B-U-0.35	C-S-1.0	C-S-1.5	C-S-1.75
Over 20 hp 250 to 300 rpm	B-U-0.35	C-S-2.75	C-CIB-3.5	C-CIB-5.0
300 to 500 rpm	B-U-0.35	C-S-1.75	C-CIB-2.5	C-CIB-3.5
500 rpm and over	B-U-0.35	C-S-1.0	C-CIB-1.75	C-CIB-2.5

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

2.2.12 Cross-Flow Cooling Tower Locations

TYPE EQUIPMENT	20-FOOT ROOF-SPAN PROVISIONS*	30-FOOT ROOF-SPAN PROVISIONS*	40-FOOT ROOF-SPAN PROVISIONS*
Package under tower base to 500 rpm	B-U-0.35	D-U-2.0	D-U-2.5
500 rpm and over	B-U-0.35	D-U-1.0	D-U-1.75
Field erected under tower base; all rpm			
Under mechanical-equipment supporting frame to 500 rpm			
500 rpm and over			

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

2.2.13 Blow-Through Cooling Tower Locations

TYPE EQUIPMENT	20-FOOT ROOF-SPAN PROVISIONS*	30-FOOT ROOF-SPAN PROVISIONS*	40-FOOT ROOF-SPAN PROVISIONS*
Under tower base to 500 rpm	B-U-0.35	C-S-2.5	C-S-3.5
500 rpm and over	B-U-0.35	C-S-1.0	C-S-1.75

*TYPE OF MOUNTING, BASE, AND MINIMUM DEFLECTION IN INCHES

2.3 PIPE AND DUCT VIBRATION ISOLATION

Where indicated on drawings, provide vibration isolation for piping and ductwork as specified below.

Type G: Isolators shall be devices with in-series contained steel springs and preformed fibrous-glass or chloroprene-elastomer elements for connecting to building-structure attachments. Devices shall be loaded 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: Isolators shall be devices with contained chloroprene-elastomer elements for connecting to building-structure attachments. Devices shall be loaded by supported system during operating conditions to produce a minimum elastomer static deflection of 3/8 inch.

Type J: Isolators shall be devices with elastomers mounted on floor-supported columns or directly on the floor. Devices shall be loaded by supported system during operating conditions to produce a minimum elastomer static deflection of 3/8 inch.

2.3.1 Floor-Mounted Piping

Type K: Isolators shall be devices with springs mounted on floor-supported columns or directly on the floor. Devices shall be loaded by supported system during operating conditions to produce a minimum spring static deflection of 1 inch.

2.3.2 Vertical Piping

Type L: Isolators shall be pipe base-support devices with one or more contained steel springs. Devices shall be loaded by supported system during operating conditions to produce a minimum static deflection of 1 inch. Devices shall be equipped 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 shall be elastomer mounted baseplate and riser pipe-guide devices. Elastomer elements shall be contained double acting, and elastomers under rated load shall have a minimum static deflection of 3/8 inch. Isolator shall be sized to accommodate thermal insulation within the stationary guide ring.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed in accordance with manufacturer's recommendations.

Rails, structural steel bases, and concrete inertia blocks shall be raised not less than 1 inch above the floor and shall be level when equipment supported is under operating load.

Vibration-isolation installation and deflection testing after equipment start-up shall be directed by a competent representative of the manufacturer.

3.2 TESTS AND REPORTS

Vibration-isolation devices shall be deflection tested. Test reports shall be submitted in accordance with paragraph entitled, "Submittals," substantiating that all equipment has been isolated as specified and that minimum specified deflections have been met. All measurements shall be made in the presence of the Contracting Officer.

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SECTION 15083

DUCT INSULATION
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M	(2001) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 209	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C 1071	(1998) Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
ASTM C 411	(1997) Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation
ASTM C 534	(1999) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 552	(2000) Standard Specification for Cellular Glass Thermal Insulation
ASTM C 553	(1999) Standard Specification for Mineral Fiber Blanket and Felt Insulation (Industrial Type)
ASTM C 591	(2000) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Insulation
ASTM C 612	(2000) Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C 795	(1992; R 1998 Rev e1) Standard Specification for Wicking-Type Thermal Insulation for Use Over Austenitic Stainless Steel

ASTM C 916	(1996; Rev E1) Standard Specification for Adhesives for Duct Thermal Insulation
ASTM D 579	(1997) Standard Specification for Greige Woven Glass Fabrics
ASTM E 84	(2001) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 255	(2000) Standard Method of Test of Surface Burning Characteristics of Building Materials
NFPA 90A	(1999) Standard for the Installation of Air Conditioning and Ventilating Systems

1.2 SYSTEM DESCRIPTION

Section 15003, "General Mechanical Provisions," Section 15815, "HVAC Systems Ductwork," and Section 15818, "Special Application Ductwork," apply to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Adhesives
Coatings
Thermal-Insulation Materials
Jacketing Materials

PART 2 PRODUCTS

2.1 MATERIALS

Insulation conductances shall be maximum values, as tested at any point, not an average. Insulation conductance found by test to exceed the stipulated maximum shall either be replaced or augmented by an additional thickness to bring it to the required maximum conductance.

Thermal-insulation system materials shall be noncombustible, as defined by NFPA 90A. Adhesives, coatings, sealants, facings, jackets, and thermal-insulation materials shall have a maximum flame-spread index (FSI) of 25 and a maximum smoke-developed index (SDI) of 50. These maximum values shall be determined in accordance with ASTM E 84 or NFPA 255. Adhesives, coatings, and sealants shall be nonflammable in their wet state, except those for cellular elastomers.

Adhesives, coatings, sealants, facings, jackets and thermal-insulation

materials shall not flame, glow, smolder, or smoke when tested in accordance with similar test for pipe covering, ASTM C 411, temperature to which they are exposed in service. In no case shall the test temperature be below 250 degrees F.

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following.

2.1.1 Adhesives

2.1.1.1 Cloth Adhesives

Adhesives for adhering, sizing, and finishing open-weave glass cloth shall be pigmented polyvinyl acetate emulsion and shall conform to the requirements of ASTM C 916, Type I.

2.1.1.2 Vapor Barrier Adhesives

Adhesives for attaching laps of vapor-barrier materials and presized glass cloth and for attaching insulation to itself, to metal, and to various other substrates, shall be the solvent-base synthetic-rubber type and shall conform to the requirements of ASTM C 916, Type I, for attaching fibrous-glass insulation to metal surfaces. Solvents shall be nonflammable.

2.1.1.3 Cellular Elastomer Adhesives

Adhesive for cellular elastomer insulation shall be a solvent cutback chloroprene elastomer conforming to ASTM C 916, Type II or III Class 1 and shall be a type approved by the manufacturer of the cellular elastomer for the intended use.

2.1.2 Coatings

2.1.2.1 Outdoor Vapor-Barrier Finishing

Coatings for outdoor vapor-barrier and weather-barrier finishing of insulation shall comply with manufacturer's recommendation for material compatibility, service life, and environment.

2.1.2.2 Indoor Vapor-Barrier Finishing

Coatings for indoor vapor-barrier finishing of insulation surfaces shall be pigmented resin and solvent compound.

2.1.2.3 Outdoor and Indoor Nonvapor-Barrier Finishing

Coatings for outdoor and indoor nonvapor-barrier finishing of insulation surfaces shall be pigmented polymer emulsion recommended by the insulation-material manufacturer for the surface to be coated and shall be applied to the specified dry-film thickness.

2.1.2.4 Cellular Elastomer Insulation Finishing

Finish coating for cellular elastomer insulation shall be a polyvinylchloride lacquer approved by the manufacturer of the cellular elastomer for the intended use.

2.1.2.5 Coating Color

Coating color shall be white, unless otherwise indicated.

2.1.3 Insulation Materials

2.1.3.1 Rigid Mineral Fiber Boards

Rigid boards shall be ASTM C 612, Type 1A (rated for use at temperatures up to, nonloadbearing. Thermal conductivity shall be not greater than at).

2.1.3.2 Flexible Blankets

Flexible blankets shall be ASTM C 553, Type III (rated for use at temperatures up to, with thermal conductivity (k) not greater than at).

2.1.3.3 Cellular Elastomer Sheets

Cellular elastomer shall conform to ASTM C 534, except that the water-vapor permeability shall not exceed 0.30 perm-inch per hour per inch mercury for 1 inch thickness.

2.1.4 Jacketing

2.1.4.1 Vapor Barrier Jacketing

Jacketing shall be a 3-ply laminate of 35-pound per cubic foot white-bleached kraft bonded to not less than 1-mil thick aluminum foil and reinforced with glass fiber. Fire-resistance classification shall be as follows:

	FOIL EXPOSED	KRAFT EXPOSED
FSC	5	25
SDC	0	15

Jacketing shall conform to ASTM 1136, Type II. Water-vapor permeance rating of the composite shall be not more than 0.02 perm or grain per hour per square foot per inch of mercury and puncture resistance shall be not less than 25 Beach units (29 metric units).

2.1.4.2 Sheetmetal Jacketing

Sheetmetal jacketing shall be minimum galvanized steel in conformance with ASTM A 653/A 653M or aluminum in conformance with ASTM B 209, having lock-forming corner bead and joint capability.

2.1.4.3 Glass Cloth

Glass reinforcing cloth shall be a leno weave, 26-end and 12-pick thread conservation, with a warp-and-fill tensile strength in pounds per inch of width of 45 and 30, respectively, and with a weight not less than 1.5 ounces per square yard. Style 191 leno-weave glass cloth conforming to ASTM D 579 may be provided.

2.2 DUCT INSULATION REQUIREMENTS

Ductwork insulation type and thickness shall be as indicated below for ductwork within the building, unless otherwise indicated on drawings. For any ductwork exposed to weather, other requirements shall be indicated on the drawings.

Ductwork in mechanical or electrical equipment rooms, and elsewhere as indicated:

Type T-13, Rigid Mineral Fiber w/ Vapor barrier Jacket. In addition provide Protection angles and glass cloth covering on surfaces 8 feet 2440 mm or less above floor, and elsewhere as indicated.

Other ductwork exposed to view:

Type T-13, Rigid Mineral Fiber w/ Vapor Barrier Jacket.

Concealed ductwork:

Type T-11 Flexible Mineral Fiber w/ Vapor Barrier Jacket.

Unless otherwise indicated, sheet metal plenums shall be insulated the same as ductwork, for the applicable service and location. Unless otherwise indicated, exhaust ductwork shall not be insulated. Lined ductwork shall not be externally insulated unless otherwise indicated.

Insulation thickness shall be as indicated below, for the location within the building and the service of the ductwork:

Location	Supply Air	Return Air	Outside Air
in unconditioned rooms,chases, or non-return-air ceiling plenums	1.5 inches	1 inch	
in return-air ceiling plenums	1 inch	none	
in conditioned spaces	none unless indicated on drawings	none	
from intake louver to heating coil or equipment casing			2 inch

PART 3 EXECUTION

3.1 INSTALLATION OF INSULATION SYSTEMS

Contours on exposed work shall be smooth and continuous. Cemented laps, flaps, bands, and tapes shall be smoothly and securely pasted down. Adhesives shall be applied on a 100-percent coverage basis. Departure from these requirements shall be a basis for rejection.

Joints shall be tight, with insulation lengths tightly butted against each other. Where lengths are cut, cuts shall be smooth and square and without

breakage of end surfaces. Where insulation terminates, ends shall be neatly tapered and effectively sealed or finished. Longitudinal seams of exposed insulation shall be directed away from normal view.

Surfaces shall be clean and free of all oil and grease before insulation adhesives or mastics are applied. Solvent cleaning required to bring metal surfaces to such condition shall be provided.

3.2 SYSTEM TYPES

3.2.1 Type T-11, Flexible Mineral Fiber with Jacket

Sheet metal ducts shall be covered with mineral-fiber duct insulation with factory-attached vapor-barrier jacket. Vapor seal shall be maintained. Jacket overlap shall be not less than 2 inches.

Insulation shall be adhered to sheet metal surfaces with vapor-barrier adhesive.

Insulation on all rectangular ducting with side- or bottom-surface dimensions over 30 inches shall, in addition to being adhered with adhesive, be impaled on pins secured to the duct surface and then locked by means of flush pin caps. Pins shall be clipped flush with face of cap. Pins shall be 12 inches on center placed not more than 2 inches from duct edges, and there shall be not less than two rows of pins per surface. Pins shall be sealed with outdoor vapor-barrier coating and vapor-barrier duct tape.

When insulation is in place, total thickness shall be reduced by not more than 25 percent of nominal thickness, and no condensation shall appear on any surface.

Jackets, jacket flaps, and bands shall be securely cemented in place with vapor-barrier adhesive. Jacketing bands for butt joints shall be not less than 4 inches wide. In lieu of jacketing bands, pressure-sensitive vapor-barrier tape not less than 3 inches wide shall be used to seal horizontal and transverse seams.

Duct insulation shall be Type T-3 rigid-board where penetrations through sleeves or prepared openings occur in locations not requiring fire dampers.

Duct insulation at fire dampers shall be provided in accordance with the damper manufacturer's instructions to maintain the listing of the fire damper assembly.

Duct insulation terminating at insulated or uninsulated sheet metal and equipment surfaces, supports, damper fittings, walls, and similar penetration and construction points shall be sealed with outdoor vapor-barrier coating and, where lengths exceeding 24 inches are involved, flashed with glass-cloth tape and sheet metal trimming. Glass-cloth tape shall be in two layers with not less than 3 inches of overlap imbedded in not less than 1/16 inch dry-film thickness of outdoor vapor-barrier coating.

3.2.2 Type T-13, Rigid Mineral Fiber with Jacket

Sheet metal ducts shall be covered with insulation with factory-applied vapor barrier and finished with field-applied glass-cloth jacket. Vapor seal shall be maintained. Jacket overlap shall be not less than 2 inches.

Insulation shall be adhered to sheet metal surfaces with vapor-barrier adhesive.

Insulation on sheet metal with side- or bottom-surface dimensions over 30 inches, in addition to being adhered with adhesive, shall be impaled on pins secured to the duct surface and then locked by means of flush pin caps clipped flush with face of cap. Pins shall be 12 inches on center placed not more than 2 inches from duct edges, and there shall be not less than two rows of pins per surface. Pins shall be sealed with outdoor vapor-barrier coating and vapor-barrier duct tape. Pinned area and other surfaces shall be level with adjoining insulated surface. Edges shall be square and straight without scallops; where necessary, areas shall be leveled with a mixture of finish insulating cement and nonvapor-barrier adhesive diluted with three parts water.

Vapor-barrier jackets, jacket flaps, and bands shall be securely cemented in place with vapor-barrier adhesive. Jacketing bands for butt joints shall be not less than 4 inches wide.

Duct insulation at fire dampers shall be provided in accordance with the damper manufacturer's instructions to maintain the listing of the fire damper assembly.

Insulation shall be brought tightly against raised-flange standing seams and sealed with vapor-barrier coating. A 3-inch wide strip of the insulation of adequate thickness to give 0.5 inch covering over flange shall be provided. Strip shall be routed out to accommodate the still-exposed portion of the seam or flange and shall be cemented in place over the seam or flange by use of vapor-barrier coating material.

Duct insulation terminating at insulated and uninsulated sheet-metal and equipment surfaces, supports, damper fittings, access doors, walls, and similar penetration and construction points shall be sealed with outdoor vapor-barrier coating. Where lengths exceeding 24 inches are involved, insulation shall be flashed with glass-cloth tape and sheet-metal trimming. Glass-cloth tape shall provide not less than 3-inch overlap, shall be in two layers, and shall be embedded in not less than 1/16 inch dry-film thickness of outdoor vapor-barrier coating. Sheet metal trimming shall be installed after glass-cloth jacket is in place.

Insulation shall be finished with not less than 6 mils dry-film thickness of nonvapor-barrier coating suitable for painting.

3.2.3 Type T-14, Rigid Mineral Fiber with Jacket, Protected

Materials and installation methods shall be the same as Type 13, except that additional protection against physical damage shall be provided.

Glass-cloth jacketing shall be applied over the insulation outer corner sheet-metal angles and securely cemented in place with nonvapor-barrier adhesive. Corner angles shall be not less than 3-gage galvanized sheet metal with leg dimensions equal to thickness of insulation. Glass cloth embedded in the adhesive shall be pulled tight and wrinkle-free and shall lap seams not less than 4 inches. The entire outer surface shall be given a flood coat of nonvapor-barrier adhesive while the first coat is still wet.

3.2.4 Type T-18, Cellular Elastomer

Surfaces shall be covered with 0.5 inch cellular-elastomer sheet

insulation. Vapor seal shall be maintained. Insulation shall be cemented into continuous material with a solvent cut-back chloroprene adhesive recommended by the manufacturer for the specific purpose. Adhesive shall be applied to both of the surfaces to be joined to a minimum thickness of 10 mils wet or 150 square feet per gallon of undiluted adhesive.

Duct stiffeners shall be covered with cellular elastomer insulation strips.

Surfaces exposed to weather, to view, or to ultraviolet light shall be finished with a 2-mil minimum dry-film thickness of a polyvinylchloride lacquer recommended by the manufacturer and applied in not less than two coats.

3.2.5 Acoustic Duct-Lining

Acoustic duct-lining shall be provided where indicated. Duct sizes indicated shall be interpreted to mean clear air space. Thickness of lining shall be as indicated on the drawings.

Acoustic duct-lining shall be fibrous glass conforming to ASTM C 1071, Type II, rated air velocity 4000 feet per minute. Liner composition shall be uniform density, graduated density, or dual density and deeply impregnated with chloroprene on the surface exposed to airstream. Acoustic liner shall conform to the fire-hazard requirements of NFPA 90A. Sound-absorption coefficient shall be not less than that required by ASTM C 1071 for Type II liner of the indicated thickness.

Lining shall be applied in cut-to-size pieces attached to the interior of the duct with fire-resistant adhesive conforming to ASTM C 916, Type I, for attaching fibrous-glass insulation to metal surfaces. Top and bottom pieces shall lap the side pieces and, in addition, shall be secured with pins and speed washers or cup-head pins 12 inches on center, maximum and within 2 inches of each edge. Pins and washers shall be flush with the surface of the duct-liner, and breaks and punctures of the duct-liner coating shall be sealed with fire-resistant adhesive conforming to ASTM C 916, Class 1. Exposed edges of the coated liner at the duct ends and at other joints where the lining will be subject to erosion shall be coated with a heavy brush-coat of fire-resistant adhesive and where necessary with metal nosing to prevent delamination of the glass fibers. Duct liner may also be applied to flat sheet metal with fire-resistant adhesive, ASTM C 916, Class 2, prior to forming duct through the sheet metal brake. The lining at the top and bottom surfaces of the duct shall be additionally secured by pins or adhered clips as specified for cut-to-size pieces.

Preformed round duct liner designed for insertion in round ducts shall be used in the sizes commercially available. Duct-liner sections shall be furnished with not less than 2 inch wide ship-lap joints. Joints shall be in accordance with the manufacturer's instructions. Fire-resistant adhesive shall be used to field-coat joints, when recommended by the manufacturer of the liner, to prevent delamination or erosion at the joints. Tubular sections of the duct liner shall fit the metal duct snugly and without gaps between duct-liner sections. Requirements specified previously for acoustic duct-lining shall apply to preformed round duct liner.

-- End of Section --

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SECTION 15085

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03/98

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SECTION 15085

PIPING INSULATION
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C 1136	(1995) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C 195	(1995) Mineral Fiber Thermal Insulating Cement
ASTM C 449/C 449M	(1995) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 533	(1995) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(1999) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	(1995) Mineral Fiber Preformed Pipe Insulation
ASTM C 552	(2000) Standard Specification for Cellular Glass Thermal Insulation
ASTM C 553	(1999) Standard Specification for Mineral Fiber Blanket and Felt Insulation (Industrial Type)
ASTM C 916	(1996; Rev E1) Standard Specification for Adhesives for Duct Thermal Insulation
ASTM C 921	(1989; R 1996) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM D 579	(1997) Standard Specification for Greige Woven Glass Fabrics

ASTM E 84	(2001) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E 96	(1995) Standard Test Methods for Water Vapor Transmission of Materials

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 220	(1999) Standard Types of Building Construction
NFPA 255	(2000) Standard Method of Test of Surface Burning Characteristics of Building Materials

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AMS 3779	(1990; Rev A) Tape Adhesive, Pressure Sensitive Thermal Radiation Resistant

1.2 SYSTEM DESCRIPTION

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Adhesives
Coatings
Insulating Cement
Insulating Materials
Jacketing
Tape Materials

PART 2 PRODUCTS

2.1 MATERIALS

Thermal-insulation system materials shall be noncombustible, as defined by NFPA 220. Adhesives, coatings, sealants, facings, jackets, and thermal-insulation materials, shall have a maximum flame-spread index of 25, and a maximum smoke-developed index of 50. These values shall be determined in accordance with ASTM E 84 or NFPA 255. Coatings and sealants shall be nonflammable in their wet state, except those for cellular elastomers.

Adhesives, coatings, and sealants shall have published or certified temperature ratings suitable for the entire range of working temperatures

normal for the surfaces to which they are to be applied.

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials shall be asbestos free and conform to the following.

2.1.1 Adhesives

2.1.1.1 Cloth Adhesives

Adhesives for adhering, sizing, and finishing lagging cloth, canvas, and open-weave glass cloth shall be a pigmented polyvinyl acetate emulsion and shall conform to the requirements of ASTM C 916, Type I.

2.1.1.2 Vapor-Barrier Material Adhesives

Adhesives for attaching laps of vapor-barrier materials and presized glass cloth and for attaching insulation to itself, to metal, and to various other substrates, shall be solvent-base, synthetic-rubber type and shall conform to the requirements of ASTM C 916, Type I, for attaching fibrous-glass insulation to metal surfaces. Solvent shall be nonflammable.

2.1.1.3 Cellular Elastomer Insulation Adhesive

Adhesive for cellular elastomer insulation shall be a solvent cutback chloroprene elastomer conforming to ASTM C 916, Type III, and shall be of a type approved by the manufacturer of the cellular elastomer for the intended use.

2.1.2 Coatings

2.1.2.1 Outdoor Vapor-Barrier Finishing

Coatings for outdoor vapor-barrier finishing of insulation surfaces such as fittings and elbows shall be a nonasphaltic, hydrocarbon polymer, solvent-base mastic containing a blend of nonflammable solvents.

2.1.2.2 Indoor Vapor-Barrier Finishing

Coatings for indoor vapor-barrier finishing of insulation surfaces shall be a pigmented resin and solvent compound.

2.1.2.3 Outdoor and Indoor Nonvapor-Barrier Finishing

Coatings for outdoor and indoor nonvapor-barrier finishing of insulation surfaces shall be pigmented polymer-emulsion type recommended by the insulation material manufacturer for the surface to be coated and shall be applied to specified dry-film thickness.

2.1.2.4 Cellular-Elastomer Insulation Coating

Finish coating for cellular-elastomer insulation shall be a polyvinylchloride lacquer approved by the manufacturer of the cellular elastomer.

2.1.2.5 Coating Color

Coating color shall be white unless otherwise indicated.

2.1.3 Insulating Cement

2.1.3.1 General Purpose Insulating Cement

General purpose insulating cement shall be mineral fiber and shall conform to ASTM C 195. Composite shall be rated for 1800 degrees F service and shall have a thermal-conductivity maximum of 0.85 Btu by inch per hour per square foot for each degree F temperature differential at 200 degrees F mean temperature.

2.1.3.2 Finishing Insulating Cement

Finishing insulating cement shall be mineral-fiber, hydraulic-setting type conforming to ASTM C 449/C 449M.

2.1.4 Corner Angles

Corner angle piping insulation shall be nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum shall be in accordance with ASTM B 209, Alloy 3003, 3105 or 5005.

2.1.5 Insulation Materials

Insulation conductances shall be maximum values, as tested at any point, not an average. Insulation conductance found by test to exceed the specified maximum shall either be replaced or augmented by an additional thickness to bring it to the required maximum conductance and a complete finishing system.

2.1.5.1 Mineral Fiber Pipe Insulation

Mineral fiber pipe insulation shall conform to ASTM C 547, Type I, molded, for surface temperatures up to 817 degrees F. Thermal conductivity shall be not greater than 0.26 Btu per hour per square foot square per degree F at 68 degrees F.

Pipe fitting insulation shall be molded pipe fitting covering, of materials with the same properties as the pipe insulation, or fittings shall be wrapped with flexible blanket.

Flexible mineral fiber blankets shall conform to ASTM C 553, Type III, for use at temperatures up to and including 418 degrees F. Thermal conductivity shall be not greater than at mean.

2.1.5.2 Cellular Elastomer

Cellular elastomer shall conform to ASTM C 534 Type ((tabular) or Type II (sheet). The water-vapor permeability shall not exceed 0.30 perms per foot per inch per hour per square foot. Thermal conductivity shall not exceed 0.0433 watt per meter per degree C at 24 degrees C.

2.1.5.3 Cellular Glass

Cellular glass shall conform to ASTM C 552, Type II, pipe covering. Substitutions for this material shall not be permitted.

2.1.5.4 Calcium Silicate

Calcium silicate shall conform to ASTM C 533, Type I, pipe insulation.

Thermal conductivity shall be not greater than at mean.

2.1.6 Jacketing

2.1.6.1 Aluminum Jackets

Aluminum sheet shall be in accordance with ASTM B 209 and shall be 0.016 inch thick with factory-applied vapor barrier on the insulation side. Aluminum shall be made from smooth, polished, Temper H14 or H16, Alloy 3003, 5005, or 3105. Straps shall be AISI 300 series corrosion-resistant steel, 15 mils thick, 1/2 inch wide, for pipe under 12-inch diameter and 3/4-inch wide for pipe over 12-inch diameter.

Elbow jackets shall be 0.016-inch thick, deep-drawn, die-shaped, two-piece components for long-radius, butt-weld elbows manufactured from the same materials as specified for jackets, with factory-attached vapor-seals on underside of the aluminum. Preinsulated, voidless, jacketed components conforming to these specifications shall be used. Preinsulated fittings shall have a 2-inch overlay beyond route for weld bead.

Vapor barrier shall be 30-60-30 laminated-asphalt paper or 60-pound per 100 square foot kraft paper with 10-pound per 100 square foot polyethylene coating.

Pipe jackets shall have not less than 2-inch longitudinal and circumferential lap.

Sealant for longitudinal and butt joints of aluminum jacketing shall be an aluminum-pigmented, butyl, polymer sealant with high-butyl solids.

2.1.6.2 Glass Cloth Jackets

Glass cloth shall be plain-weave glass cloth conforming to ASTM D 579, Style 141 and shall weigh not less than before sizing. Cloth shall be factory applied wherever possible.

Glass reinforcing cloth shall be a leno weave, 26-end and 12-pick thread conservation, with a warp and fill tensile strength of 45 and 30 pounds per inch of width, respectively, and with a weight of not less than 1.5 ounces per square yard. At the Contractor's option, Style 191 leno-weave glass cloth conforming to ASTM D 579 may be provided.

2.1.6.3 PVC Jackets

Polyvinylchloride (PVC) shall be a 0.010-inch thick, factory-premolded, one-piece fitting or pipe-barrel sheeting vapor-barrier jacketing.

Vapor barrier shall conform to ASTM C 1136, Type I, low-vapor transmission, high-puncture resistance for use on insulation for piping, ducts, and equipment. Permeability rating shall be not greater than 1.15 nanogram per pascal per second per square meter, determined in accordance with ASTM E 96. Vapor-barrier joint adhesive shall be the manufacturer's standard solvent-weld type.

2.1.6.4 3-Ply Laminate

Jacketing shall be a 3-ply laminate of 35-pound per 100 square foot white-bleached kraft, bonded to not less than 0.0007-inch thick aluminum foil and reinforced with glass fiber.

Vapor barrier shall conform to ASTM C 1136, Type I, low-vapor transmission, high-puncture resistance for use on insulation for piping, ducts, and equipment. Water-vapor permeance rating of the composite shall be 0.02 perm or grain per hour per square foot, per inch of mercury, determined in accordance with ASTM E 96.

2.1.7 Tape

Glass lagging shall be a knitted elastic cloth specifically suitable for continuous spiral wrapping of insulated pipe bends and fittings and shall produce a smooth, tight, wrinkle-free surface. Tape shall conform to requirements of SAE AMS 3779, ASTM D 579, and ASTM C 921, and shall weigh not less than 10 ounces per square yard.

2.2 PIPING SYSTEMS

Insulation thickness and pipe sizes are in nominal DN inches.

Requirements specified below are for aboveground piping, not exposed to weather. For any weather-exposed piping, additional requirements will be indicated in the task order.

2.2.1 Chilled Water Piping

Insulation shall be mineral fiber with vapor barrier jacket, Type T-1. Thickness shall be not less than that given in the following list. Aboveground pipes, valve bodies, fittings, unions, and flanges shall be insulated.

PIPE SIZE (INCH)	INSULATION THICKNESS (INCH)
Up to 1-1/4	1
1-1/4 to 3	1-1/2
3 and larger	2

2.2.2 Secondary (Dual-Temperature) Water Piping

Insulation shall be mineral fiber with vapor barrier jacket, Type T-1, except runouts as indicated may be celluar elastomer Type T-3. Thickness shall be not less than that given in the following list. Aboveground pipes, valve bodies, fittings, unions, and flanges shall be insulated.

PIPE SIZE	INSULATION THICKNESS

2.2.3 Hot-Water Piping (HVAC Service)

Insulation shall be mineral fiber with glass cloth jacket, Type T-2, except runouts as indicated may be cellular elastomer Type T-3. Thickness shall be not less than that given in the following list. Aboveground pipes, valve bodies, fittings, unions, flanges, and miscellaneous surfaces shall be insulated.

PIPE SIZE	INSULATION THICKNESS

2.2.4 Steam Piping, Low Pressure

Insulation shall be mineral fiber with glass cloth jacket, Type T-2. Thickness shall be not less than that given in the following list. Aboveground pipes, valve bodies, fittings, unions, flanges, and miscellaneous surfaces shall be insulated.

PIPE SIZE (INCH)	INSULATION THICKNESS (INCH)
Up to 2	1-1/2
over 2 to 6	2
over 6	3-1/2

2.2.5 Condensate-Return Piping, Low Pressure

Insulation shall be mineral fiber with glass cloth jacket, Type T-2. Thickness shall be not less than that given in the following list. Aboveground pipes, valve bodies, fittings, unions, flanges, and miscellaneous surfaces shall be insulated.

PIPE SIZE (INCH)	INSULATION THICKNESS (INCH)
all sizes	1-1/2

2.2.6 Steam Piping, High and Medium Pressure

Insulation shall be mineral fiber with glass cloth jacket, Type T-2. Thickness shall be not less than that given in the following list. Aboveground pipes, valve bodies, fittings, unions, flanges, and miscellaneous surfaces shall be insulated.

PIPE SIZE (INCH)	INSULATION THICKNESS (INCH)
Up to 1	2
Over 1 to 4	2-1/2
over 4	3-1/2

2.2.7 Condensate-Return Piping, High and Medium Pressure

Insulation shall be mineral fiber with glass cloth jacket, Type T-2. Thickness shall be not less than that given in the following list. Aboveground pipes, valve bodies, fittings, unions, flanges, and miscellaneous surfaces shall be insulated.

PIPE SIZE (INCH)	INSULATION THICKNESS (INCH)
Up to 1	2
Over 1 to 4	2-1/2
over 4	3-1/2

2.2.8 Cold-Water and Condensate-Drain Piping

Aboveground pipes, valve bodies, fittings, unions, flanges, and miscellaneous surfaces shall be insulated. Unless otherwise noted, make-up water lines to other mechanical systems or equipment, do not need to be insulated.

Insulation shall be cellular-elastomer, Type T-3, 1/2 inch thickness.

2.2.9 Refrigerant Suction Piping

Insulation shall be cellular-elastomer, Type T-3. Thickness shall be nominal 3/4 inch. Surfaces, including valve, fittings, unions, and flanges, shall be insulated.

2.2.10 Condenser Water Piping

Insulation shall be cellular-elastomer, Type T-3. Thickness shall be not less than that given in the following list. Aboveground pipes, valve bodies, fittings, unions, flanges, and miscellaneous surfaces shall be insulated.

PIPE SIZE (INCH)	INSULATION THICKNESS (INCH)
Up to 2	1/2
2 to 6	3/4
6 and larger	1

Thickness inside buildings shall be 3/8 inch for all pipe sizes.

Insulation shall be mineral fiber with aluminum jacket, Type T-6. Thickness shall be not less than that indicated. Aboveground pipes, valve bodies, fittings, unions, flanges, and miscellaneous surfaces shall be insulated.

2.2.11 Steam Pressure Reducing Stations

Insulation shall be calcium silicate with glass cloth jacket, Type T-5. Thickness shall be not less than indicated in following list.

PIPE SIZE (INCH)	INSULATION THICKNESS (INCH)
Up to 1	3-1/2
Over 1 to 4	4

PIPE SIZE (INCH)	INSULATION THICKNESS (INCH)
Over 4 to 8	4-1/2
Over 8	5

2.2.12 Hot Water or Secondary Water Heating Convertor

Insulation shall be calcium silicate with glass cloth jacket, Type T-7. Thickness shall be 1-1/2 inches.

2.2.13 Chilled-Water and Secondary Water Pumps

Insulation shall be cellular elastomer, Type T-9. Thickness shall be 1 inch. Surfaces subject to condensation shall be covered, and a vapor-barrier coating shall be supplied.

2.2.14 Hot Water Piping (Domestic or Laboratory)

Insulation for hot water supply (and return where applicable) shall be mineral fiber with all-servie-jacket Type T-2, or cellular elastomer Type T-3.

Thickness shall be not less than that given in the following list):

Pipe Size	Insulation Thickness

2.2.15 Cold Water Piping (Domestic, Laboratory, Make-up)

Insulation shall be mineral fiber with all-service-jacket and vapor barrier, Type T-1; or cellular elastomer with vapor-sealed joints, Type T-3. All aboveground pipes, fittings, valve bodies, unions, flanges and miscellaneous surfaces shall be insulated. Unless otherwise noted, thickness shall be not less than 19 millimeter for all pipe sizes.

PART 3 EXECUTION

3.1 INSTALLATION OF INSULATION SYSTEMS

Contours on exposed work shall be smooth and continuous. Cemented laps, flaps, bands, and tapes shall be smoothly and securely pasted down. Adhesives shall be applied on a full-coverage basis.

Insulation shall be applied only to system or component surfaces that have been tested and approved.

Joints shall be tight with insulation lengths tightly butted against each other. Where lengths are cut, cuts shall be smooth and square and without breakage of end surfaces. Where insulation terminates, ends shall be neatly tapered and effectively sealed, or finished as specified. Longitudinal seams of exposed insulation shall be directed away from normal view.

Materials shall be applied in conformance with the recommendations of the

manufacturer.

Surfaces shall be clean and free of oil and grease before insulation adhesives or mastics are applied. Solvent cleaning required to bring metal surfaces to such condition shall be provided.

3.2 SYSTEM TYPES

3.2.1 Type T-1, Mineral Fiber with Vapor-Barrier Jacket

Piping shall be covered with mineral-fiber pipe insulation with factory-and field-attached vapor-barrier jacket. Vapor seal shall be maintained. Jackets, jacket laps, flaps, and bands shall be securely cemented in place with vapor-barrier adhesive. Jacket overlap shall be not less than 1-1/2 inches. Jacketing bands for butt joints shall be 3 inches wide.

Exposed-to-view fittings and valve bodies shall be covered with preformed mineral-fiber pipe-fitting insulation of the same thickness as the pipe-barrel insulation. Fitting insulation shall be temporarily secured in place with light cord ties. A 60-mil coating of white indoor vapor-barrier coating shall be applied and, while still wet, wrapped with glass lagging tape with 50 percent overlap, and shall be smoothly blended into the adjacent jacketing. Additional coating shall be applied as needed and rubber-gloved to smooth fillet or contour coating, then allowed to fully cure before the finish coating is applied. On-the-job fabricated insulation for concealed fittings and special configurations shall be built up from mineral fiber and a special mastic consisting of a mixture of insulating cement and lagging adhesive diluted with 3 parts water. Where standard vapor-barrier jacketing cannot be used, the surfaces shall be made vapor tight by using coating and glass lagging cloth or tape as previously specified.

In lieu of materials and methods previously specified, fittings and valve bodies may be wrapped with a twine-secured, mineral-wool blanket to the required thickness and covered with premolded polyvinylchloride jackets. Seams shall be made vapor tight with a double bead of manufacturer's standard vapor-barrier adhesive applied in accordance with the manufacturer's instructions. All jacket ends shall be held in place with AISI 300 series corrosion-resistant steel straps, 15 mils thick by 1/2 inch wide.

Pipe insulation shall be set into an outdoor vapor-barrier coating for a minimum of 6 inches at maximum 12-foot spacing and the ends of the insulation sealed to the jacketing with the same material to provide an effective vapor-barrier stop.

Staples shall not be used in applying insulation. Vapor-barrier materials shall be continuous over all surfaces, including areas inside pipe sleeves, hangers, and other concealments.

Piping insulation at hangers shall consist of 13-pounds per cubic foot density, fibrous-glass inserts or expanded, rigid, closed-cell, polyvinylchloride. Junctions shall be sealed with vapor-barrier jacket where required, glass-cloth mesh tape, and vapor-barrier coating.

White-bleached kraft paper side of the jacketing shall be on the side exposed to view.

Exposed-to-view insulation shall be finished with not less than a dry-film

thickness of nonvapor-barrier coating suitable for painting.

3.2.2 Type T-2, Mineral Fiber with Glass Cloth Jacket

Piping shall be covered with a mineral-fiber, pipe insulation with factory-attached, presized, white, glass cloth. Jackets, jacket laps, flaps, and bands shall be securely cemented in place with vapor-barrier adhesive. Jacket overlap shall be not less than 1-1/2 inches. Jacketing bands for butt joints shall be 3 inches wide.

Exposed-to-view fittings shall be covered with preformed mineral-fiber fitting insulation of the same thickness as the pipe insulation and temporarily secured in place with light cord ties. Impregnated glass lagging tape shall be installed with indoor vapor-barrier on 50 percent overlap basis and the tape shall be blended smoothly into the adjacent jacketing. Additional coating shall be applied as needed, and rubber gloved to a smooth contour. Ends of insulation shall be taped to the pipe at valves 2 inches and smaller. On-the-job fabricated insulation for concealed fittings and special configurations shall be built up from mineral fiber and a mixture of insulating cement and lagging adhesive, diluted with 3 parts water. Surfaces shall be finished with glass cloth or tape lagging.

Valves 2-1/2 inches and larger and all flanges shall be covered with preformed insulation of the same thickness as the adjacent insulation.

Exposed-to-view insulation shall be finished with a minimum 6-mildry-film thickness of nonvapor-barrier coating suitable for painting.

In lieu of materials and methods specified above, fittings may be wrapped with a twine-secured, mineral-wool blanket to the required thickness and covered with premolded polyvinylchloride jackets. All jacket ends shall be held in place with ANSI 300 series corrosion-resistant steel straps, 15 mils thick by 1/2 inch wide. Fitting insulation shall be thermally equivalent to pipe-barrel insulation to preclude surface temperatures detrimental to polyvinylchloride.

3.2.3 Type T-3, Cellular Elastomer

Piping-system surfaces shall be covered with flexible cellular-elastomer sheet or preformed insulation. Vapor seal shall be maintained. Joints and seams shall be sealed with adhesive. Insulation shall be cemented into continuous material with a solvent cutback chloroprene adhesive recommended by the manufacturer for the specific purpose. Adhesive shall be applied to both of the surfaces on a 100-percent coverage basis to a minimum thickness of 10 mils wet or approximately 150 square feet per gallon of undiluted adhesive.

Insulation on cold piping shall be sealed to the pipe for a minimum of 6 inches at maximum intervals of 12 feet to form an effective vapor barrier. At piping supports, insulation shall be continuous through using outside-carrying type clevis hangers with insulation shield. Cork or wood dowel load-bearing inserts shall be installed between the pipe and insulation shields to prevent insulation compression.

Sweat fitting shall be insulated with miter-cut pieces of cellular elastomer insulation of the same nominal pipe size and thickness as the insulation on the adjacent piping or tubing. Miter-cut pieces shall be joined with approved adhesive. Covers shall be slit and snapped over the

fitting, and joints shall be sealed with approved adhesive.

Screwed fittings shall be insulated with sleeve-type covers formed from miter-cut pieces of cellular elastomer thermal insulation having an inside diameter large enough to overlap adjacent pipe insulation. Pipe insulation shall be butted against fittings. Overlap shall be not less than 1 inch. Adhesive shall be used to join cover pieces and cement the cover to the pipe insulation.

Surfaces exposed to view or ultraviolet light shall be finished with a 2-mil minimum dry-film thickness application of a polyvinylchloride lacquer recommended by the manufacturer, and applied in not less than two coats.

3.2.4 Type T-4, Cellular Glass with Vapor-Barrier Jacket

Piping shall be covered with cellular glass insulation and factory- and field-attached vapor-barrier jacket. Vapor seal shall be maintained. Jackets, jacket laps, flaps, and bands shall be securely cemented in place with vapor-barrier adhesive. Jacket overlap shall be not less than 1-1/2 inches . Jacket bands for butt joints shall be not less than 3 inches wide. Insulation shall be continuous through hangers. Insulation shall be bedded in an outdoor vapor-barrier coating applied to all piping surfaces.

Flanges, unions, valves, anchors, and fittings shall be insulated with factory premolded or prefabricated or field fabricated segments of insulation of the same material and thickness as the adjoining pipe insulation. When segments of insulation are used, elbows shall be provided with not less than three segments. For other fittings and valves, segments shall be cut to the required curvature or nesting size.

Segments of the insulation shall be secured in place with twine or copper wire. After the insulation segments are firmly in place, a vapor-barrier coating shall be applied over the insulation in two coats with glass tape imbedded between coats. First coat shall be tinted, the second shall be white to ensure application two coats. Coating shall be applied to a total dry-film thickness of 1/16 inch minimum. Glass tape seams shall overlap not less than 1 inch and the tape end not less than 4 inches .

In lieu of materials and methods specified above, fittings may be wrapped with 3/8-inch thick, vapor-barrier, adhesive-coated strips of cellular elastomer insulation. Insulation shall be under tension, compressed to 25 percent of original thickness, and wrapped until overall thickness is equal to adjacent insulation. Cellular elastomer shall be secured in place with twine and sealed with vapor-barrier coating applied to produce not less than 1/16 inch dry-film thickness. Fittings shall then be covered with premolded polyvinylchloride jackets. Seams shall be made vapor-tight with a double bead of manufacturer's standard vapor-barrier adhesive applied in accordance with the manufacturer's instructions. Jacket ends shall be held in place with AISI 300 series corrosion-resistant steel straps, 15 mils thick by 1/2-inch wide.

Anchors secured directly to piping shall be insulated, to prevent condensation, for not less than 6 inches from the surface of the pipe insulation.

White-bleached kraft paper side of jacketing shall be on the side exposed to view. Exposed-to-view insulation shall be finished with not less than a 6-mil dry-film thickness of nonvapor-barrier coating suitable for painting.

3.2.5 Type T-5, Calcium Silicate with Glass Cloth Jacket (Piping)

Piping shall be covered with a calcium-silicate pipe insulation with factory attached and presized, white, glass cloth. Jackets shall be field applied when required. Jackets, jacket laps, flaps, and bands shall be securely cemented in place with vapor-barrier adhesive. Jacket overlap shall be not less than 1-1/2 inches. Jacketing bands for butt joints shall be 4-inches wide. Fittings shall be fabricated from segmented pipe barrel sections bedded in general purpose insulating cement and wired in place. Voids shall be filled with general purpose insulating cement with not less than 1/4-inch thick, final coating. Glass lagging tape shall be impregnated with lagging adhesive, wrapped with a 50-percent overlap, and be blended smoothly into adjacent jacketing. Additional adhesive shall be applied as needed and rubber-gloved to a smooth contour.

3.2.6 Type T-6, Mineral Fiber with Aluminum Jacket

Piping shall be covered with mineral-fiber pipe insulation with factory-attached or field-applied aluminum jacketing.

Fittings and valve bodies shall be covered with preformed mineral-fiber pipe-fitting insulation of the same thickness as the pipe-barrel insulation. Fitting insulation shall be secured temporarily in place with light cord ties. A 60-mil coating of vapor-barrier mastic shall be applied, and while still tacky, wrapped with glass lagging tape.

Additional mastic shall be applied as needed and rubber-gloved to smooth fillets or contours. On-the-job fabricated insulation for special configurations shall be built up from mineral fiber and a mixture of insulating cement and lagging adhesive diluted with 3 parts water. Only where standard aluminum jacketing cannot be used, the surfaces shall be made vapor-tight by using mastic and glass lagging cloth or tape as specified above with an added finish coat of mastic.

Pipe insulation shall be set into outdoor vapor-barrier coating for a minimum of 6 inches at maximum 12-foot spacing. Ends of the insulation shall be sealed to the jacketing with the same material to provide effective vapor barrier stops.

Vapor barrier shall be continuous over all surfaces, including areas inside pipe sleeves, hangers, and other concealment.

Piping insulation shall be applied to both sides of pipe hangers. Junctions shall be insulated with a special mastic mixture, glass cloth mesh tape, and mastic as previously specified.

Jacket laps, flaps, and bands shall be securely cemented in place with aluminum jacket sealant. Jacketing bands for butt joints shall be 6 inches wide.

Joints, wherever possible, shall be lapped against the weather so that the water will run off the lower edge. Laps shall be in accordance with the pipe drainage pitch. Longitudinal laps on horizontal lines shall be located 45 degrees below the horizontal centerline and alternately staggered 1 inch. Jacketing material shall be lapped a minimum of 2 inches, circumferentially sealed with mastic, and strapped to provide a waterproof covering throughout. Straps shall be located 8 inches on center and shall be pulled up tight to hold jacketing securely in place. Screws shall be used in addition to straps when necessary to obtain a waterproof covering.

Extra straps shall be placed on each side of supporting devices and at openings. Where flanging access occurs, a chamfer sheet shall be strapped to the pipe at jacketing.

Exposed longitudinal edges of aluminum jacketing shall be stiffened by bending a 1-inch hem on one edge.

Expansion joints shall provide for maximum and minimum dimensional fluctuations.

To prevent corrosion, the aluminum jacketing shall not come in direct contact with other types of metal.

At openings in jacket, an outdoor vapor-barrier coating shall be applied for 2 inches in all directions. Jacketing shall be applied while waterproofing is tacky.

Screws shall be used at each corner of each sheet, at fitting jackets, and as necessary for the service. Number 7, 3/8-inch long, binding-head aluminum sheet metal screws shall be placed through the mastic seal.

3.2.7 Type T-7, Calcium Silicate with Glass Cloth Jacket (Surfaces)

Surfaces shall be covered with insulation block bedded in an insulating cement and covered with glass cloth jacketing.

Surfaces shall be cleaned with a chlorinated solvent. General purpose insulating cement shall be mixed with 3 parts water to 1 part nonvapor-barrier adhesive to bring to application consistency. Block shall be set into bedding and joints and spaces shall be filled with a bedding mix and wrapped with galvanized chicken wire mesh well laced into an envelope. A 3/8-inch thick coating of bedding mix jacket shall be troweled on with nonvapor-barrier adhesive and glass cloth. Surfaces shall be finished with not less than a 6-mil dry-film thickness of nonvapor-barrier coating.

3.2.8 Type T-9, Cellular Elastomer (Surfaces)

Pump surfaces shall be solvent cleaned. Not less than 1 inch of general purpose insulating cement shall be applied, mixed with nonvapor-barrier adhesive diluted with 3 parts water, to achieve smooth surface and configuration contours. After all water has been removed, surfaces shall be covered with 1/2-inch thick cellular elastomer insulation attached and joined into a continuous sheet with an outdoor vapor-barrier coating recommended by the insulation manufacturer for the specific purpose. Coating shall be applied to both of the surfaces on a 100-percent coverage basis with a minimum thickness of 10 mils wet, or approximately 150 square feet per gallon of undiluted coating. Coating shall be blended into the adjacent flange insulation and the joint covered with a band of cellular elastomer equal to the flange assembly width. Same coating shall be used to seal insulation to the casing at penetrations and terminations. Pumps shall be insulated in a manner that will permit insulation to be removed to repair or replace pumps.

Insulation shall be finished with a 2-mil minimum dry-film application of a polyvinylchloride lacquer coating recommended by the manufacturer and applied in not less than two coats.

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SECTION 15102

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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22	(1999) Relief Valves for Hot Water Supply Systems

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(1990) Atmospheric Type Vacuum Breakers
ASSE 1010	(1996) Water Hammer Arresters
ASSE 1013	(1999) Reduced Pressure Principle Backflow Preventers and Reduced Pressure Priniciple Fire Protection Backflow Preventers
ASSE 1015	(1999) Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies
ASSE 1020	(1990) Pressure Vacuum Breaker Assembly

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.18.1	(2000) Plumbing Fixture Fittings
ASME A112.1.2	(1991; R 1998) Air Gaps in Plumbing Systems
ASME B1.20.7	(1991; R 1998) Hose Coupling Screw Threads (Inch)
ASME B1.21M	(1997) Metric Screw Threads - MJ Profile

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C510	(1997) Double Check Valve Backflow-Prevention Assembly (Second Edition)
AWWA C511	(1997) Reduced Pressure Principle Backflow-Prevention Assembly (First Edition)
AWWA C651	(1999) Disinfecting Water Mains
AWWA C700	(1995) Cold Water Meters - Displacement

Type, Bronze Main Case

CODE OF FEDERAL REGULATIONS (CFR)

10 CFR 430 (1999) Energy Conservation Program for Consumer Products

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCHR)

FCCHR-01 (1993; 9th Ed) Manual of Cross-Connection Control

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5 (2000) American National Standard for Centrifugal Pumps for Nomenclature, Definitions, Application and Operation

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC (2000) International Plumbing Code

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA 250 (1997) Enclosures for Electric Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (1999) National Fuel Gas Code

NATIONAL SANITATION FOUNDATION (NSF)

NSF 5 (2000) Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment

NSF 61 (2000; Rev A) Drinking Water System Components - Health Effects

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (1983) Water Hammer Arrestors Standard

1.2 DESIGN REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

Plumbing systems shall be provided and shall include the water supply system, the waste and vent system, and all required plumbing fixtures and fittings. Plumbing and drain fixtures shall be as specified in Section 15410, "Plumbing Fixtures". All installation or modification of piping and components defined as pressure vessels and pressurized systems (PV/S) in Section 15055, "Welding and Pressure Vessels/Systems", shall comply with applicable requirements of that section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items, including material certification, standards compliance, detailed drawings and performance data:

Vacuum Relief Valves
Pressure-Temperature Relief Valves
Backflow Prevention Devices
Water Heaters
Water-Hammer Arresters
Wall Hydrants
Water Filters
Water Meters
Pumps

SD-06 Test Reports

Test Reports shall be submitted for all tests conducted in accordance with paragraphs entitled, "Tests," and "Operational Test" of this section.

SD-07 Certificates

Copies of Current WSSC Certification as a Backflow Preventer Mechanic shall be submitted for personnel performing testing of backflow preventers.

SD-08 Manufacturer's Instructions

Installation Instructions and Drawings for the following items shall be in accordance with the manufacturer's recommended instructions and methods.

Pumps
Backflow Prevention Devices
Water Heaters
Vacuum Relief Valves
Pressure-Temperature Relief Valves

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted for the following items:

Pumps
Backflow Prevention Devices
Vacuum Relief Valves
Pressure-Temperature Relief Valves

SD-11 Closeout Submittals

PV/S Certification Records shall be submitted for PV/S piping and

components, for approval and Certification prior to pressurization and operation. Pressure vessels and pressurized systems (PV/S), and the required contents of the PV/S Certification Records, shall be as defined in Section 15055, "Welding and Pressure Vessels/Systems"

1.4 GENERAL REQUIREMENTS

Section 15055, "Welding Mechanical," applies to work specified in this section.

PART 2 PRODUCTS

2.1 WATER SYSTEMS

Water systems shall include: domestic cold water, hot water supply, hot water return; laboratory cold water, hot water, hot water return; and water supply to other systems such as fire protection, HVAC or process heating/cooling systems. All water system piping, components and equipment shall comply with the requirements of NSF 61.

2.1.1 Pipe and Fittings

Pipe and fittings shall be of the type(s) indicated below, as specified in Section 15050, "Basic Mechanical Materials and Methods".

Above ground copper tubing shall be Type CPR-AG.

Underground copper tubing shall be Type CPR-UG.

Underground piping 8 inch and above shall be ductile iron as specified in Section 02515, "Water Systems".

2.1.2 Insulation

2.1.2.1 Hot Water

Domestic or Laboratory Hot Water Piping: Insulation for hot water supply (and return where applicable) shall be mineral fiber with all-service jacket Type T-2, or cellular elastomer Type T-9, as specified in Section 15085, "Piping Insulation". Thickness shall be not less than that given in the following:

Pipe Size (inches)	Insulation Thickness (inches)
Run-outs to fixtures or equipment, 2 inches and smaller, and no longer than 13 feet	1/2 (Type T-9, cellular elastomer, only)
4 and smaller	1
over 4	1-1/2

2.1.2.2 Cold Water

Cold Water (Domestic, Laboratory, Make-Up): Insulation shall be mineral

fiber with all-service jacket and vapor barrier, Type T-1; or cellular elastomer with vapor-sealed joints, Type T-9, as specified in Section 15085, "Piping Insulation". All aboveground pipes, fittings, valve bodies, unions, flanges, and miscellaneous surfaces shall be insulated. Unless otherwise noted, thickness shall be not less than 3/4 inch for all pipe sizes.

2.1.3 Valves and Specialties

2.1.3.1 Ball Valves and Gate Valves

Ball valves shall be Type BAV as specified in Section 15050, "Basic Mechanical Materials and Methods" 2-inch and smaller, other sizes Gate Type GAV.

2.1.3.2 Vacuum and Relief Valves

Vacuum and relief valves shall be size and type to relieve pressure and prevent the formation of a vacuum. Valves shall automatically remove air from the lines when the lines are being filled and admit air into the lines when water is being withdrawn in excess of the inflow.

2.1.3.3 Hose Faucets

Hose faucets shall be constructed with 1/2-inch male inlet threads, hexagon shoulder, and 3/4-inch hose connection, conforming to ASME A112.18.1. Hose-coupling screw threads shall conform to ASME B1.20.7.

Vandalproof, atmospheric-type vacuum breaker shall be provided on discharge, unless faucet is on a laboratory or non-potable line isolated from the domestic water system by backflow prevention devices.

2.1.3.4 Globe Valves

Globe valves shall be type GLV as specified in Section 15050, "Basic Mechanical Materials and Methods".

2.1.3.5 Check Valves

Check valves shall be standard check valves, type SCV, except on pump discharges 2-inch and larger shall be nonslam check valves type NSV, as specified in Section 15050, "Basic Mechanical Materials and Methods".

2.1.3.6 Backflow Prevention Devices

Devices 2 inches ips and smaller with moving components defined in AWWA C511, shall be constructed of nonferrous metals. Nonmetal components of such devices shall be rated for the applicable service temperature.

Bodies of devices 2-1/2 inches and larger shall be corrosion-resistant ferrous material or bronze, with flanged connections. Metallic operating components and trim shall be nonferrous. Nonmetallic parts shall be rated for the applicable service temperature.

External surfaces of devices used in conjunction with equipment with polished or chrome-plated surfaces shall be similarly finished.

External surfaces of devices may be rough castings where these devices are used outside of the building, in concealed locations, or in equipment rooms. Devices shall be protected from freezing and shall be installed,

tested, and used in strict conformance with the manufacturer's instructions.

Air gaps shall be at least two times the supply pipe diameter, but not less than 1 inch, as measured vertically, from the flood rim of the supplied device. There shall be no provision for a temporary bypass line around the air gap or water supply tank and pump. Air gaps shall conform to the requirements of ASME A112.1.2.

Atmospheric Vacuum Breakers (AVB) shall be used only where no back-pressure may occur. Atmospheric vacuum breakers will only provide protection against back-siphonage of nontoxic pollutants. AVB shall be installed downstream of the last shutoff valve and at least 18 inches above the highest sprinkler head or outlet. Under no circumstances shall the AVB be installed where it will be under continuous pressure for more than 12 hours in any 24-hour period. AVB shall be installed in an accessible location, and shall comply with ASSE 1001.

Type PVB pressure vacuum breaker devices used only where there is no possibility of back-pressure. PVB shall be installed in an accessible location to facilitate inspection and servicing. PVB shall be installed a minimum of 18 inches above the highest outlet, shall conform to ASSE 1020, and shall have tightly closing shutoff valves on each end, and be fitted with properly located test cocks. PVB devices may have pressure on downstream side and may be used for back-siphonage only, against pollutants or contaminants.

Type DC double check valve backflow devices or assemblies are used for low degree of hazard nonpollutants or contaminants. This device shall conform to AWWA C510 or ASSE 1015, and FCCHR-01 standard. This unit shall be installed a minimum of 18 inches above the ground or flood level. When installed in a pit, a drain must be provided. This assembly device must be furnished with tightly closing shutoff resilient seated valves on each end and be fitted with properly located test cocks. Outside locations shall include protection against freezing. Critical facility potable water systems and 2-1/2 inch and larger shall have dual-parallel installation which should be installed in accessible locations. When DC backflow assemblies are used on fire suppression water systems, the shutoff valves must be OS&Y resilient seated gate valves.

Reduced pressure principle devices shall conform to ASSE 1013 or AWWA C511 and FCCHR-01. This unit shall be installed a minimum of 18 inches above ground or flood level. This unit shall include tightly closing shut-off valves on each end and be fitted with properly located test cocks. Indoor installations shall include an airgap-equipped drain adequate for relief valve discharge. Outside installations shall include protection against freezing. Critical water supplies shall have dual-parallel installations which should be installed in accessible locations.

2.1.3.7 Water Meters

Positive displacement disk meters shall conform to AWWA C700, except as otherwise noted. Parts wetted by water shall be bronze or plastic. Casing shall be flanged in sizes 2-1/2 inches and larger. Registers shall be magnetic drive, straight reading. Maximum pressure drop at maximum capacity shall not exceed 10 psi for meters sized 1-1/2 inches and smaller; and 15 psi for meters 2 inches and larger.

2.1.3.8 Water Filters

Provide water filters for supply to lab or photo areas where indicated. Filter assembly shall be duplex with nonferrous 3-way ported ball valves on inlet and outlet sides for inservice filter selection. Metal parts that are wetted in service shall be brass, bronze or AISI Type 304 or 316 corrosion-resistant steel. Nonmetallic parts shall be ceramic, plastic, or fiber suitable for providing noncontaminating service with distilled or demineralized water. Filter shall be capable of retaining all particulate matter larger than 1 micrometer. Maximum pressure drop at maximum indicated flow rate with 50 percent dirty cartridge(s) shall not exceed 10 psi.

2.1.3.9 Water-Hammer Arresters

Water-hammer arresters shall be commercially manufactured products consisting of bellows arranged to absorb the energy of pressure waves generated by valve closure in a line in which water is flowing. Arresters shall be nonferrous construction, shall be rated as to capacity, and shall be certified in accordance with PDI WH 201, or ASSE 1010.

2.1.3.10 Wall Hydrants

Wall hydrants shall have brass wall-boxes with nozzles and detachable T-handles and shall be provided with vandalproof type BAT vacuum breakers. Exterior surfaces shall be chrome-plated.

2.1.4 Water Heaters

All water heaters shall comply with applicable requirements of NSF 5.

Storage-type water heaters shall be steam convertor, gas-fired, or electric type, as indicated. Gas-fired water heaters shall be installed in accordance with NFPA 54. Electric water heaters shall be UL listed. Steam convertors shall be as specified, for Hot Water and Secondary Water Converters, in Section 15625, "Hydronic Water Systems", and in addition shall have double-wall coils that separate the steam from the potable water, with an air-space vented to the atmosphere in accordance with ICC IPC.

Water heaters shall be commercially available models. Model selected shall be of the energy efficient type. Energy Factor rating, based on DOE test procedure 10 CFR 430 shall be not less than 0.61 for gas water heaters. All steam hot water convertors and unfired hot water storage tanks shall be insulated to an R value of not less than 12.5 (square-feet-hour-degree Fahrenheit per BTU)

Temperature- and pressure-relief valves shall conform to ANSI Z21.22. Combination pressure- and temperature-relief valves shall be installed on all water heaters or storage tanks set at a maximum 150 psig and 210 degrees F, with rating not less than the input rating of the water heater. Outlet of relief valve shall be piped to drain with type CPR-DWV, full size of outlet, with no dips or traps, and terminate with air gap at floor drain. Vacuum-relief valves shall be installed on each cold-water branch connection on the bottom of the water heaters at an elevation above the top of the heater. Vacuum relief valve shall be designed to prevent water heater damage from a reverse flow vacuum, and shall comply with ANSI Z21.22.

2.2 SANITARY DRAIN, WASTE, AND VENT SYSTEM (DWV)

Sanitary drains and accessories shall be as specified in Section 15410, "Plumbing Fixtures".

Underground pipe and fittings shall be provided in accordance with Section 02536, "Sanitary Sewerage Systems".

Aboveground pipe and fittings shall be either type CISP-DWV, type CPR-DWV, or type PVC-DWV, as specified in Section 15050, "Basic Mechanical Material and Methods".

Minimum slope of sanitary piping shall be 2 percent.

2.3 ROOF DRAIN SYSTEM

Roof drains and accessories shall be specified in Section 15410, "Plumbing Fixtures".

Underground piping shall be provided in accordance with Section 02635, "Storm Sewerage"

Aboveground pipe and fittings shall be type CISP-DWV as specified in Section 15050, "Basic Mechanical Materials and Methods", with hubless joints and fittings.

Underside of roof drains, all horizontal piping above ground, and vertical piping where indicated, shall be insulated. Insulation shall be type T-1 (mineral fiber with vapor barrier jacket) as specified in Section 15085, "Piping Insulation", 1 inch thickness.

Minimum slope of roof drain piping shall be 2 percent.

2.4 DEIONIZED WATER OR SPECIAL SERVICE SYSTEM

Piping for deionized water system (or other special service piping as indicated on drawings) shall be:

> Type PVC or type CPVC, schedule 40 or schedule 80, as indicated on drawings, as specified in Section 15050, "Basic Mechanical Materials and Methods".

Valves, strainers, unions and other appurtenances shall be of the same material as the piping, and shall be as recommended by the manufacturer for the service. Unless otherwise indicate, valves shall be type PVC or CPVC as specified in Section 15050, "Basic Mechanical Materials and Methods".

PVC and CPVC piping shall not be insulated unless specified on the drawings.

System design operating pressure and temperature shall be as indicated on drawings.

2.5 PUMPS

2.5.1 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump capacities, efficiencies, motor sizes, speeds, and impeller

types shall be as shown. Pump and motor shall be integrally mounted on a cast-iron or steel subbase. 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 power for the service required. Pump shall conform to HI 1.1-1.5. 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. Pump motors smaller than Fractional horsepower pump motors shall have integral thermal overload protection. All motors shall comply with Section 16225, "Motors".

2.5.2 Booster Pumps

Booster pumps shall be of the type and capacity indicated and shall comply with Section 15135, "Centrifugal Pumps".

2.6 SUPPORTING ELEMENTS

Necessary 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; anchors; and variable and constant supports. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures, and natural and other external forces.

Supporting elements shall be as specified in Section 15050, "Basic Mechanical Materials and Methods", and requirements specified herein.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

Excavation and backfill operations shall performed in accordance with Section 02300, "Earthwork."

3.2 PIPE INSTALLATION

Piping systems shall be fabricated and installed in accordance with ICC IPC, and as specified in Section 15050, "Basic Mechanical Materials and Methods.

Final connections to equipment shall be made with unions or flanges.

3.3 VALVES

Valves shall be provided as indicated on the drawings.

Valves shall be provided to permit isolation of 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.

Valves unavoidably located in furred or other normally inaccessible places shall be provided with adequately sized access panels approved for the location.

3.4 SUPPORTING ELEMENTS INSTALLATION

Supporting elements shall be provided as specified in section 15050, "Basic Mechanical Materials and Methods".

Piping shall be supported from building structure only. Piping shall not be supported from roof deck or from other pipe.

3.5 UNDERGROUND PIPING INSTALLATION

Underground piping shall be installed in accordance with Section 02515, "Water Systems"; Section 02536, "Sanitary Sewerage Systems"; and Section 02635, "Storm Sewerage".

3.6 PRESSURE VESSELS/SYSTEMS (PV/S) CERTIFICATION

All installation or modification of PV/S piping and components shall comply with the requirements of Section 15055, "Welding and Pressure Vessels/Systems", and PV/S Certification Records shall be prepared as indicated in that section. This data shall be submitted and approved, and the system or components Certified by the Government, prior to pressurization and operation.

3.7 TESTS

Plumbing systems shall be tested to prove tightness of piping and connections and proper operation of equipment and fixtures. Testing of any section of piping shall be completed successfully prior to installing any insulation.

3.7.1 Water Piping

Hydrostatic tests shall be performed by completely filling the piping system with water and eliminating accumulation of air so that any leakage will be immediately apparent.

Aboveground copper water piping shall be tested hydrostatically at 860 kilopascal for not less than 2 hours with no loss of pressure. PVC and CPVC water piping shall be tested hydrostatically at 1.5 times the system operating pressure for 2 hours with no loss of pressure.

Underground water piping shall be tested hydrostatically at 860 kilopascal pressure for not less than 8 hours with no loss of pressure. Leaks shall be eliminated by replacing the pipe or fitting in question at no additional cost to the Government. Underground water piping shall be tested before backfilling.

3.7.2 Drain and Vent Piping

Drainage and venting piping shall be tested before the fixtures are installed, except that floor drains, roof drains, and cleanouts shall be installed and tested along with the piping. Underground soil and waste piping shall be tested before backfilling. Testing shall be applied to the system in its entirety or in sections. Underground drain and vent piping shall be tested before backfilling.

When the entire system is tested, openings in the pipes shall be tightly closed except the highest opening, and the system shall be filled with water to the point of overflow.

When the system is tested in sections, each opening except the highest opening of the section under test shall be tightly plugged, and each section shall be filled with water and tested with at least of water). In testing successive sections, at least the upper of the next preceding section shall be tested so that each joint or pipe except the uppermost of the system has been submitted to a test of at least

Water shall be kept in the system or in the portion under test for at least 2 hours before the inspection starts. System shall be proved tight at all joints.

3.7.3 Backflow Preventers

Testing of backflow preventers shall be performed in accordance with the manufacturers instructions, by a WSSC-certified Backflow Preventer Mechanic.

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with FCCHR-01. Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.8 FLUSHING AND DISINFECTION

Water piping shall be flushed with clean potable water until no dirt, foreign materials, or discoloration appears at the outlet. After flushing, water piping, including valves, fittings, and other devices, shall be disinfected with a solution of chlorine and water, and tested according to AWWA C651. Solution shall contain not less than 50 parts per million (ppm) of available chlorine, and solution shall be held for a period of not less than 24 hours, or solution shall contain not less than 200 parts per million (ppm) of available chlorine and shall be held for a period of not less than 3 hours. After successful disinfection, the piping shall be flushed with clean potable water until the chlorine residual in the water leaving the system does not exceed that of the flushing water, before placing into service. Water for disinfection will be furnished by the Government, but disposal shall be the responsibility of the Contractor.

3.9 OPERATIONAL TEST

After flushing and disinfection, and prior to acceptance of the installation, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall be witnessed by the Government and shall include the following information (as applicable to the task order scope) in a report with conclusion as to the adequacy of the system:

a. Time, date, and duration of test.

b. Water pressures at the most remote and the highest fixtures.

c. Operation of each fixture and fixture trim.

d. Operation of each valve, hydrant, and faucet.

e. Pump suction and discharge pressures.

f. Temperature of each domestic hot-water supply.

g. Operation of each floor and roof drain by flooding with water.

h. Operation of each vacuum breaker and backflow preventer.

i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.

j. Operation of each hot water recirculation system, including circulating pump and bypass valve(s).

Operational Testing of pumps and water heaters or other equipment shall be coordinated with Section 15902, "Non-UCS Control Systems", or coordinated with UCS Contractor in accordance with Section 15900, "UCS Controls", when the associated controls are furnished under either of those sections.

All Operational Tests shall be completed prior to conducting the Operational Readiness Review.

3.10 OPERATIONAL READINESS REVIEW (ORR)

Provide an operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for each plumbing system as a whole. The ORR shall include a walkthrough of the systems indicating piping arrangement, location of fixtures, pumps, water heaters, valves, specialties and other components. Include locations of control devices, and a complete demonstration of all control sequences for pumps and water heaters or other equipment. Demonstration shall be coordinated with Section 15902, "Non-UCS Control Systems", or coordinated with UCS Contractor in accordance with Section 15900, "UCS Controls", when the associated controls are furnished under either of those sections. For delivery orders which involve replacement or modification of only a portion of the plumbing system, the ORR shall cover only the replaced or modified components.

-- End of Section --

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SECTION 15119

SELF-CONTAINED CONTROL AND RELIEF VALVES

09/98

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SECTION 15119

SELF-CONTAINED CONTROL AND RELIEF VALVES
09/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 126	(1995) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 463/A 463M	(1999; Rev A) Standard Specification for Steel Sheet, Cold-Rolled, Aluminum-Coated, Type 1 and Type 2
ASTM A 48	(1994; Rev E1) Standard Specification for Gray Iron Castings
ASTM B 61	(1993) Standard Specification for Steam or Valve Bronze Castings
ASTM F 1508	(1996) Standard Specification for Angle Style, Pressure Relief Valves for Steam, Gas and Liquid Services

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels, Division 1, Basic Coverage
ASME B16.34	(1996) Valves - Flanged, Threaded, and Welding End
ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME BPV IV	(1998) Boiler and Pressure Vessel Code; Section IV, Rules for Construction of Heating Boilers

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1003	(1993) Water Pressure Reducing Valves

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 4126	(1981) Safety Valves - General Requirements
ISO 5209	(1977) General Purpose Industrial Valves -

	Marking
ISO 5752	(1982) Metal Valves for Use in Flanged Pipe Systems - Face to Face and Center to Center Dimensions
ISO 7005-2	(1988) Metallic Flanges Part 2: Cast Iron Flanges

MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-86	(1997) Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings shall be submitted for Self-Contained Control and Relief Valves, including part numbers and exploded views.

SD-03 Product Data

Manufacturer's Data shall be submitted for Self-Contained Control and Relief Valves. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

SD-05 Design Data

Equipment Schedules shall be submitted for Self-Contained Control and Relief Valves. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for Self-Contained Control and Relief Valves, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for Self-Contained Control and Relief Valves, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and

repair instructions, spare parts lists.

SD-11 Closeout Submittals

PV/S Certification Records shall be submitted for PV/S piping and components, for approval and Certification prior to pressurization and operation. Pressure vessels and pressurized systems (PV/S), and the required contents of the PV/S Certification Records, shall be as defined in Section 15055, "Welding and Pressure Vessels/Systems"

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

PART 2 PRODUCTS

2.1 SELF-CONTAINED TEMPERATURE CONTROL VALVES

Self-contained temperature-control valves shall conform to MSS SP-86 and to the following requirements, Type I or Type II as indicated on drawings.

Control valves shall be Type I, Class II (integral temperature-sensing units for very hot water).

Control valves shall be Type II, Class 2, Style A (remote temperature-sensing units for very hot water with a single temperature-sensing control element).

Set-point adjustment shall be mounted on the cabinet of the convector; the control knob shall be accessible on the cabinet surface.

Set-point adjustment and thermostat for finned-tube radiation shall be wall-mounted. Thermostat surfaces shall be nickel-plated brass.

Capillary tubing shall be installed and shall be armored. Remote element shall be not less than 18 inches long and contained within a guard.

Valve disks shall be renewable.

2.2 SELF-CONTAINED TEMPERATURE-REGULATOR VALVES

Valve shall be direct-operated, self-contained type. The valve body shall be ASTM B 61, (bronze) or ASTM A 126 (cast iron) and rated not less than 125-pounds per square inch (psi) saturated working steam-pressure. Body end connections shall be screwed. Trim shall be corrosion-resistant AISI Type 300 Series steel. Replaceable seat and plug shall be hardened or faced with a cobalt-chromium-tungsten alloy to produce a surface with resistance to impact, wire-drawing, and with a Brinell hardness of not less than 450. Packed steam valves shall be fitted with tetrafluoroethylene packing and shall be spring-loaded and self-adjusting. Valve shall be single-seated, suitable for dead-end service, and shall be fail-safe. Remote Class I or Class III filled-bulb element shall be mounted in a nonferrous separable socket. Valve shall maintain set-point temperature, plus or minus 5 degrees F, with the set point at or near midpoint of the adjustable element range.

2.3 RATE-OF-FLOW CONTROLLER

Rate-of-flow controller shall be a hydraulically operated, pilot-controlled diaphragm-type globe valve. Pilot control shall be actuated by differential pressure produced across an orifice installed at the inlet. Rate of flow shall be adjusted by varying spring loading on the pilot. Valve body shall be cast iron conforming to ASTM A 48, with 125-pound ASME B16.1 flanges. Valve trim shall be manufacturer's standard bronze or AISI 18-8 corrosion-resistant steel. Orifice plate shall be AISI Type 303 corrosion-resistant steel. Diaphragm and seal material shall be Buna-N. Maximum-service-pressure rating shall be not less than 175 psi at 180 degrees F.

2.4 NONMODULATING FLOAT VALVE

Nonmodulating float valve shall be pilot-controlled, diaphragm-actuated, spring-loaded, single-seated, hydraulically operated type. Pilot valve shall be mounted on the main valve or remotely mounted within the cooling tower basin. Main valve body shall be cast iron conforming to ASTM A 48 with screwed ends for sizes smaller than 2-inch iron pipe size (ips) and flanges conforming to ASME B16.1, for sizes 2-inch ips and larger. Pilot valve body shall be brass or bronze. Main and pilot valve trim, including linkage and float, shall be the manufacturer's standard bronze-copper or AISI Type 300 series corrosion-resistant steel. Diaphragm materials and seals shall be Buna-N. Maximum-service-pressure rating shall be not less than 175 psi at 180 degrees F. Valve operation shall be nonslam.

2.5 WATER PRESSURE-REGULATING VALVE

Pressure-regulating valve shall conform to ASSE 1003, direct acting.

Pressure-regulating valve shall not stick or allow pressure to build up on the low side. Valve shall be set to maintain a terminal pressure of approximately 5 psi in excess of the static head on the system and shall operate within a 2-pound maximum variation regardless of initial pressure fluctuation, and without objectionable noise under any condition of operation.

2.6 WATER PRESSURE-RELIEF VALVE

Pressure-relief valve shall be constructed, labeled, and installed in accordance with ASME BPV IV. Relieving capacity shall be as specified by the referenced publication. Valves shall be of nonferrous construction, complete with test lever.

2.7 PILOT-OPERATED PRESSURE-RELIEF VALVE

Pilot-operated pressure-relief valve shall be hydraulically operated, pilot-controlled modulating, with adjustable set point over the indicated range. Valve body shall be cast iron conforming to ASTM A 48, with 125-psi ASME B16.1 flanges. Valve trim shall be manufacturer's standard brass, bronze, or corrosion-resistant steel. Pilot control shall have AISI Type 303 or 304 corrosion-resistant steel trim. Diaphragm and seal material shall be Buna-N. Maximum service-pressure rating shall be not less than 175 psi at 180 degrees F.

2.8 RELIEF VALVES FOR ELECTRIC WATER HEATERS

Temperature- and pressure-relief valves shall conform to ASTM A 463/A 463M.

Type I (combination pressure- and temperature-relief) valves shall be installed when the heat input is less than 100,000 Btu per hour and when the storage is less than 120 gallons. If either or both of the specified conditions will be reached or exceeded, Type II (temperature relief, water rated) or Type III (temperature relief, steam rated) valves shall be installed. Vacuum-relief valves shall be installed on each cold-water branch connection to electric water heaters at an elevation above the top of the heater. Vacuum relief shall be designed to prevent water heater damage from a reverse flow vacuum.

2.9 STEAM PRESSURE RELIEF VALVES

Steam pressure relief valves shall be furnished and installed where indicated on the drawings, specified, or required for a proper installation. Valves shall comply with ASTM F 1508, ASME B16.34, and shall be code rated and labeled to comply with the applicable section of ASME BPV VIII Div 1.

Safety valves shall be installed on the discharge header of each stage of the steam pressure reducing station. Valves shall be rated for the pressure of the high pressure side and sized for the full installed capacity of the pressure regulating station at the pressure of the low pressure side. Valve shall be set at not more than 20 percent above the low side operating pressure.Valves shall be of a design that will permit seat and disc maintenance without disassembly of valve piping.

All safety relief devices shall be piped to a location that will prevent the exposure of personnel to a hazard. Each safety valve shall have a separate vent pipe, one nominal pipe size larger than the discharge outlet of the valve, exhausting outdoors above the roof level unless otherwise indicated. Multiple valves shall not discharge through a single vent pipe. Each vent riser shall have a drip pan elbow to prevent the accumulation of water on the valve, and a suitable slip joint or flexible metal hose between the drip pan elbow and the riser to prevent stress on the vent pipe due to thermal expansion. Vent piping shall be as specified for low pressure steam system in Section 15183, "Steam and Condensate Systems". Vent shall be as short and straight as possible, and any horizontal section shall be sloped to drain back to the drip pan elbow. The drip pan drain outlet shall be piped to the nearest drain with copper tubing the full size of the outlet.

PART 3 EXECUTION

3.1 INSTALLATION

Valves shall be installed in accordance with the manufacturer's recommendations, and Section 15050, "Basic Mechanical Materials and Methods."

3.2 PRESSURE VESSELS/SYSTEMS (PV/S) CERTIFICATION

All installation or modification of PV/S piping and components shall comply with the requirements of Section 15055, "Welding and Pressure Vessels/Systems", and PV/S Certification Records shall be prepared as indicated in that section. This data shall be submitted and approved, and the system or components Certified by the Code 540 RECERT Group, prior to pressurization and operation.

3.3 OPERATIONAL READINESS REVIEW (ORR)

Operational testing, and Operational Readiness Review (ORR), of valves shall be conducted as part of the operational test and ORR for the associated equipment or system.

-- End of Section --

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DIVISION 15 - MECHANICAL

SECTION 15125

STEAM TRAPS

06/96

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3.3 OPERATIONAL READINESS REVIEW (ORR)

-- End of Section Table of Contents --

SECTION 15125

STEAM TRAPS
06/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 278	(1993) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 Degrees F
ASTM A 278M	(1993; Rev E1) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 345 Degrees C (Metric)
ASTM F 1139	(1988; R 1998) Standard Specification for Steam Traps and Drains

1.2 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section. Medium pressure and high pressure traps, with operating pressure greater than 15 psig, shall comply with the applicable requirements of Section 15055, " Welding and Pressure Vessels/Systems".

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Data shall be submitted for steam traps. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

SD-05 Design Data

Equipment Schedules shall be submitted for steam traps. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for steam traps, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted steam traps, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

SD-11 Closeout Submittals

PV/S Certification Records shall be submitted for medium and high pressure traps, for approval and Certification prior to pressurization and operation. Pressure vessels and pressurized systems (PV/S), and the required contents of the PV/S Certification Records, shall be as defined in Section 15055, "Welding and Pressure Vessels/Systems"

PART 2 PRODUCTS

2.1 MATERIALS

Traps exposed to weather shall be freezeproof.

2.2 TRAP APPLICATION

SERVICE	TRAP TYPE
Steam mains, risers, branches	Type IB, inverted bucket with thermostatic air vent where necessary
Steam mains, underground distribution system, weather-exposed and subject to freezing	Type TD, thermodynamic
Steam coils associated with fans	Type F&T, float and thermo-static
Steam coils not associated with fans and not subject to freezing	Type T, thermostatic
Hot-water converter	Type F&T, float and thermo-static
Flash tank	Type IB, inverted bucket

2.3 TRAP-SIZING CRITERIA

Traps in steam mains, risers, and branches shall be sized to provide an actual capacity, under normal operating conditions, of not less than three

times the normal condensing rate.

Traps draining underground steam mains shall be sized to provide an actual capacity, under normal operating conditions, of not less than four times the normal condensing rate.

Traps in steam mains, risers, and branches, weather-exposed and subject to freezing, shall be sized to provide an actual capacity, under normal operating conditions, of two times normal condensing rate and shall be duplexed. Two identical traps shall be provided, sized appropriately at each drainage point.

Traps draining steam coils under modulating control shall be sized to provide an actual capacity, under conditions normal to the system and including 1/2-pound per square inch (psi) coil pressure, of two times normal condensing rate and shall be capable of opening at maximum coil steam pressure.

Traps in all other services shall be sized to provide an actual capacity, under normal operating conditions, of three times normal condensing rate.

Trap safety factors are minimal and shall be increased where necessary to ensure proper system drainage for a given application but shall not be decreased without written approval.

2.4 TRAP TYPE, CONSTRUCTION, AND MATERIALS

Trap bodies and components shall have a primary working steam pressure (wsp)-rating equal to or in excess of the maximum wsp of the steam system to which applied. Traps shall comply with ASTM F 1139.

Trap bodies for pressures 125-psi wsp and under shall be cast iron in accordance with ASTM A 278, Class 30.

Traps shall have permanent external identification of service rating and orifice size.

2.4.1 Type IB

Inverted bucket traps shall have AISI 300 Series corrosion-resistant steel floats and operating mechanisms and hardened, 13 percent chrome corrosion-resistant steel seats and valves.

Thermostatic elements shall be bimetallic type.

Traps shall be designed to permit removal and replacement of all operating and wearing parts without disturbing piping connections to trap body.

Strainers shall be provided as an integral part of the body.

Bodies shall be provided with plugged priming and draining openings.

Test cocks shall be provided.

2.4.2 Type F&T

Float and thermostatic traps shall have AISI 300 series corrosion-resistant steel, heliarc-welded floats and operating mechanisms, and hardened, 13 percent chrome corrosion-resistant steel seats and valves.

Thermostatic elements shall be balanced pressure type, with corrosion-resistant alloy bellows charged with a fluid that will provide most rapid response to changes in temperature.

Bellows shall be suitable for service with condensate having a pH of 6.0.

Traps shall be designed to permit removal and replacement of all operating and wearing parts without disturbing piping connections to trap body.

Bellows shall be designed to permit removal while hot without overexpansion and shall be shielded from direct blast of steam and condensate.

Bodies shall be fitted with drain plug.

2.4.3 Type T

Thermostatic traps shall be balanced pressure type, with corrosion-resistant alloy bellows charged with a fluid that will provide most rapid response to change in temperature.

Bellows shall be suitable for service with a condensate having a pH of 6.0. Bellows shall be shielded from direct blast of steam and condensate and shall be designed to permit removal while hot without overexpansion.

Valves and valve seats shall be hardened, 13 percent chrome corrosion-resistant steel.

Traps shall be designed to permit removal and replacement of all operating and wearing parts without disturbing piping connections.

2.4.4 Type TD

Thermodynamic traps shall have stainless steel body and cap with integral stainless steel strainer and blowdown connection. Disc and seating surfaces shall be hardened stainless steel.

Traps shall be designed to permit removal and replacement of all operating and wearing parts without disturbing piping connections to body.

PART 3 EXECUTION

3.1 TRAP INSTALLATION

Traps shall be installed in accordance with the manufacturer's instructions and as specified in Section 15183, "Steam and Condensate Systems".

3.2 PRESSURE VESSELS/SYSTEMS (PV/S) CERTIFICATION

All installation or modification of PV/S piping and components shall comply with the requirements of Section 15055, "Welding and Pressure Vessels/Systems", and PV/S Certification Records shall be prepared as indicated in that section. This data shall be submitted and approved, and the system or components Certified by the Code 540 RECERT Group, prior to pressurization and operation.

3.3 OPERATIONAL READINESS REVIEW (ORR)

Steam traps shall be included as part of the Operational Readiness Review

for the associated steam and condensate piping or the associated equipment, including location and type of all traps..

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SECTION 15135

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09/96

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SECTION 15135

CENTRIFUGAL PUMPS
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABEMA)

ABEMA 11	(1990) Load Ratings and Fatigue Life for Roller Bearings
ABEMA 9	(1990) Load Ratings and Fatigue Life for Ball Bearings

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5	(2000) American National Standard for Centrifugal Pumps for Nomenclature, Definitions, Application and Operation

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 1940-1	(1986) Mechanical vibration - Balance quality requirements of rigid rotors - Part 1: Determination of permissible residual unbalance
ISO 2858	(1975) End Suction Centrifugal Pump (Rating 16 Bar) Designation Nominal Duty Point and Dimensions
ISO 5199	(1986) Technical Specifications for Centrifugal Pumps, Class II
ISO 7005-2	(1988) Metallic Flanges Part 2: Cast Iron Flanges

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP 51	(2000) Class 150 LW Corrosion Resistant Cast Flanges and Flanged Fittings
MSS SP-86	(1997) Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators

1.2 DESIGN REQUIREMENTS

Pumps shall be designed using hydraulic criteria based upon actual model developmental test data. Manufacturer shall certify that pumps have been hydraulically tested at the factory.

Pumps shall be selected at a point within the maximum efficiency for a given impeller casing combination. Deviations within 3 percent of maximum efficiency are permissible, provided the lesser efficiency is not less than the scheduled efficiency.

Pumps having impeller diameters larger than 90 percent of the published maximum diameter of the casing or less than 15 percent larger than the published minimum diameter of the casing will be rejected.

Acceptable maximum impeller diameter calculations shall not be based on percentage of impeller diameter range for a given casing. Shop drawings will be approved only if complete performance curves for all impeller sizes for a given casing are included in the submittal.

Where parallel-pump operation is indicated, pumps selected shall have characteristics specifically suitable for the service without unstable operation.

When Net Positive Suction Head (NPSH) calculations are made, inlet-storage head shall be considered at empty point and the centerline pump location shall include not less than a 6-inch concrete base.

Pumps shall be suitable for operation at indicated temperature without vapor binding and without cavitation under any system operating condition. The only acceptable means of rectification of cavitation shall be replacement of entire pump assembly.

Available Net Positive Suction Head (NPSH) shall exceed required NPSH by not less than 1-1/2 feet.

Pumps of the same duty condition, classification, and accessories, or with specified accessory deviation, shall be identical and the product of one manufacturing source.

Pumps from more than one manufacturing source shall be provided only when a single manufacturing source is unable to meet all specification requirements.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Data shall be submitted forCentrifugal Pumps. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance curves. Curves shall include volume,

head, NPSH, input power, and efficiency at rated speed. Pumps for variable speed service shall include multiple curves indicating performance from minimum to maximum speed.

SD-05 Design Data

Design Analysis and Calculations shall show NPSH (net positive suction head) calculations for Centrifugal Pumps.

SD-05 Design Data

Equipment Schedules shall be submitted for the Centrifugal Pumps. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

SD-06 Test Reports

Manufacturer's Test Reports shall be submitted for the items listed below. Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the manufacturer, by an authorized official of the testing laboratory or agency (if applicable), and by the Government's witness (if applicable).

Hydrostatic Tests
Balancing
Performance Tests

SD-06 Test Reports

Field Test Reports shall be submitted for the items listed below. Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the contractor, by an authorized official of the testing laboratory or agency (if applicable), and by the Government inspector who witnessed the test.

Alignment
Flow Capacity and Operational Test

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the Centrifugal Pumps, describing recommended methods for installation, including mounting and foundation data, special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for Centrifugal Pumps, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

1.4 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

Section 15072, "Vibration Isolation for Air Conditioning Equipment," applies to work specified in this section.

PART 2 PRODUCTS

2.1 GENERAL PUMP REQUIREMENTS

This specification includes design, construction, installation, and performance features of centrifugal water pumps. Pumps provided shall conform to HI 1.1-1.5 standards for centrifugal pumps, and to requirements specified herein.

2.1.1 Classification

Class ADS: Axially (horizontally) split-case, single-stage, double-suction, single- or double-volute centrifugal type

Class FES: Radially or vertically split-case, single-stage, frame-mounted distance piece or back pullout end suction, single- or double-volute centrifugal type

Class CES: Radially or vertically split-case, single-stage, close-coupled, distance piece end-suction, single- or double-volute centrifugal type

2.1.2 Casing

Pump casings shall be bronze-fitted, seasoned cast iron with a design working pressure of not less than 185 pounds per square inch gage (psig) at 100 degrees F. Casings shall be single or double volute with flanged piping connections conforming to ASME B16.1, MSS SP 51, Class 125 unless otherwise indicated or required to match system piping. Casing shall be hydrostatically tested at not less than 1.5 times working pressure. Direction of shaft rotation shall be conspicuously indicated. Casing shall have tapped openings for air venting, priming, draining, and suction and discharge gages. A brass or bronze umbrella or vent cock shall be furnished for venting except where automatic air vents are indicated. Drain openings in the volute, intake, or other passages capable of retaining trapped water shall be located in the low point of such passages.

Casing construction shall be such that packing seals may be substituted in the field for mechanical seals without machining.

Packing-box depth shall accommodate not less than four rings of square packing, lantern ring, and throttling bushing.

2.1.3 Distance Piece

A suction end distance piece shall be provided with each end suction pump as a part of the pump or piping system.

2.1.4 Impellers

Impellers shall be enclosed cast bronze or corrosion-resistant steel, machined and polished. Waterways shall be machine- or hand-finished. Impellers shall meet maximum and minimum diameter requirements.

2.1.5 Balancing

Pumps driven by motors rated 7.5 hp 5.6 kilowatt or over shall be factory balanced to Balance Grade G2.5 (except where a different grade is indicated) in accordance with ISO 1940-1. Factory test reports shall be submitted including:

Balance instrumentation make and model
Balance method (single plane or two plane) and correction plane location(s)
Type of rotor (overhung or between centers
Operating speed of rotor
Balance Quality Grade required
Calculated permissible residual unbalance
Measured residual unbalance in each correction plane

2.1.6 Wearing Rings

Wearing rings shall be dissimilar bronze composition for nongalling service. Wearing rings shall be provided in every pump case and on all impellers larger than 7 inches in diameter. On pumps with impellers larger than 6-7/8 inch in diameter wearing rings shall be attached with setscrews.

2.1.7 Shaft

Shafts for convertible packed or mechanical seal service shall be solid sleeveless AISI 400 series corrosion-resistant steel hardened to 425 Brinell in packing area, or sleeved type with AISI 300 series corrosion-resistant steel shaft and AISI 400 series corrosion-resistant steel sleeves hardened to 425 Brinell.

Shafts for packed seal service shall be sleeved and all materials shall be AISI Type 304 corrosion-resistant steel. Surfaces in packing area shall be plasma-spray-coated alumina ceramic with a coefficient of expansion compatible with the substrate. Surface hardness shall be 900 Brinell.

Shafts for mechanical-seal service shall be solid or sleeved and all materials shall be AISI Type 304 or 316 corrosion-resistant steel.

Press-fitted sleeves are not acceptable.

Shaft construction shall be substantial to prevent seal or bearing failure due to vibration. Total shaft peak-to-peak dynamic deflection measured by vibrometer at pump-seal face shall not exceed 2.0 mils under shutoff-head operating conditions. Flow from 1/4-inch iron pipe size (ips) pipe shall be provided during testing.

Shaft shall be equipped with bronze or nylon water slingers at each bearing

and shall be sealed at the casing interface with a bronze throttling bushing.

2.1.8 Packing Seals

Packing shall be soft woven non-asbestos material with not less than 25 percent by weight of tetrafluoroethylene resin. Pump shall be shipped to the site without the packing inserted and shall be packed on site in the presence of the pump or packing manufacturer's representative. At no time during startup or run-in shall the gland drip less water than 80 drops per minute. After a minimum of 40 operating hours and upon permission of the Contracting Officer, leakage rate may be reduced to 50 drops per minute or to the rate recommended by packing manufacturer.

Gland shall be split-bronze type with AISI 18-8 corrosion-resistant steel eyebolts and pins or studs. Hex-nuts shall be bronze or nongalling corrosion-resistant steel.

Stuffing boxes exposed to below atmospheric pressure at any operating condition, including starting, shall be provided with a water seal. Water seal shall consist of nonferrous lantern ring or a seal cage and required connections to the pump case.

2.1.9 Mechanical Seals

Mechanical seals shall be balanced or unbalanced, as necessary to conform to specified service requirements. Mechanical seals shall be constructed in a manner and of materials particularly suitable for the temperature service range and chemical analysis of water being pumped.

Cooling-water characteristics for seal construction purposes are as follows: makeup total dissolved solids of 200 parts per million (ppm) cycled up to five times, containing not more than 600 ppm of hexavalent chromate, and pH not less than 6.0.

Seal construction shall not require external source cooling for pumped-fluid service temperatures up to 250 degrees F.

Seal pressure rating shall be suitable for maximum system hydraulic conditions.

Materials of construction shall include AISI 300 series corrosion-resistant steel, solid tungsten-carbide rotating-seal face, and Buna-N vinylidene-fluoride-hexafluoropropylene, EPT, or tetrafluoroethylene seals.

Bypass flushing water supply shall be free of iron rust products and other abrasive materials and shall be directed onto face of seal without dead ending. All piping and accessories shall be provided.

Throttling bushing shall have clearances to minimize leakage in case of complete seal failure without restriction of flushing water.

Mechanical seals shall not be subjected to hydrostatic test pressures in excess of the manufacturer's recommendations.

Mechanical-seal manufacturer's representative shall direct on-site seal installation, testing, adjustment, and placing-into-service operations and shall instruct facility personnel as scheduled by the Contracting Officer.

2.1.10 Centrifugal Abrasive-Separators

Pump seals shall be flushed with pump discharge water cleansed by centrifugal force in a cyclone abrasive-separator. Separator shall be constructed of AISI Type 316 corrosion-resistant steel. Underflow shall be piped to waste.

2.1.11 Bearings and Lubrication

Bearings shall be heavy-duty ball or roller type with full provisions for the mechanical and hydraulic radial and thrust loads imposed by any normal service condition. Bearings shall be manufactured from vacuum-degassed or processed-alloy steel. Bearings shall have an L-10 rated life of not less than 30,000 hours or an average life of 150,000 hours in accordance with ABEMA 9 or ABEMA 11. Shop drawings shall bear manufacturer's certification of bearing life.

Bearings shall be grease lubricated and shall be provided with grease supply and relief fittings located at bottom of bearings.

Bearing housings shall be cast iron, self-aligning on metal-to-metal surfaces and shall totally enclose bearings.

2.1.12 Flexible Coupling

Pump shaft shall be connected to the motor shaft through a flexible coupling. Flexible member shall be a tire shape in shear, or a solid-mass serrated-edge disk shape made of chloroprene materials and retained by fixed flanges. Flexible coupling shall act as a dielectric connector and shall not transmit sound, vibration, or end thrust.

2.1.13 Bedplate

Pump and driver shall be mounted on a common bedplate, hollow cast iron, multiribbed for maximum rigidity, with adequate number of grout holes and grout air vents, and with drip rim and drain tapping.

Contractor shall submit for approval, when specified, a fabricated steel base constructed of a rolled structural-steel perimeter frame, reinforced and cross-braced internally with pipe or rolled structural members, capped with 1/4 inch steel plate, and provided with adequate grout holes, grout air vents, drip rim, and drain tapping. Formed or bent steel bedplates are not acceptable.

2.2 LINE-MOUNTED PUMPS

Line-mounted pumps shall not be used where the required motor size exceeds 1 horsepower.

Pump shall be the capacity indicated.

Design, construction balancing, and vibration-isolation provisions shall conform to HI 1.1-1.5 standards specifically for quiet waterside operation.

Pump casing and seal shall be suitable for operation at pressures up to 125 pounds per square inch at temperatures to 250 degrees F.

Pump casing shall be cast bronze.

Pump shall be single-stage, single-suction centrifugal-type, bronze, fitted with mechanical seal. Pump shaft shall be AISI 300 series corrosion-resistant steel or the manufacturer's standard alloy steel with nonferrous-metal-protected wetted surfaces. Coupling shall be elastomer-in-shear or four-spring type. Mechanical seal shall be designed for service with makeup water normal to the site and for 300 ppm of hexavalent chromate in the recirculating system. Pump bearings shall be oil-lubricated sleeve type, with oil reservoirs for extended periods of service without requiring added lubricant.

Motor shall have oil-lubricated sleeve bearings with oil reservoirs for extended periods of service, without requiring added lubricant, and shall be resiliently mounted.

PART 3 EXECUTION

3.1 PUMP PROTECTION

Before any pump is operated, sumps and piping systems shall be cleaned to remove all particles larger than 1,000 micrometer 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.

Mechanical-seal flushing water shall be provided with centrifugal separator or 10-micrometer filter element where loose rust may be present at startup.

Pump motors shall be checked for current direction of rotation only after pumps have been primed and approved by the manufacturer's representative and the Contracting Officer.

3.2 INSTALLATION AND ALIGNMENT

Pump shall be installed and aligned in accordance with Section 01750, "Equipment Alignment and Balancing for RCM", and alignment reports shall be submitted as indicated in that section prior to pump operation.

3.3 PUMP ACCEPTANCE

Pump shall be operated and demonstrated to be nonoverloading at any operating point and that the flow capacity is as specified.

Water Balancing shall be performed in accordance with Section 15950, "Testing, Adjusting and Balancing" prior to conducting the Operational Readiness Review. Operational Testing of the pump and associated controls shall be performed in accordance with Section 15902, "Non-UCS Control Systems", or coordinated with UCS Contractor in accordance with Section 15900, "UCS Controls", prior to conducting the Operational Readiness Review.

3.4 OPERATIONAL READINESS REVIEW (ORR)

Provide an operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for the pump and the related system as a whole. The system ORR shall include the pump and auxiliary components such as couplings and seals, along with associated heat exchangers, piping arrangement, location and operation of balancing valves, isolation valves, control valves, strainers, expansion tanks, air separators and other components. Include locations of control devices, and a complete

demonstration of all control sequences, for controls provided under Section 15902, "Non-UCS Control Systems"; or coordinate ORR with such demonstration by the UCS Contractor in accordance with Section 15900, "UCS Controls". For task orders which involve replacement or modification of only the pump, or only a portion of the system, the ORR shall cover only the replaced or modified components.

-- End of Section --

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SECTION 15183

STEAM AND CONDENSATE SYSTEMS
03/98

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 in the text by the basic designation only.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME B31.1	(1998) Power Piping
ASME B31.9	(1996) Building Services Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels, Division 1, Basic Coverage

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-50494	(1990) Exhaust Head, Steam
CID A-A-50558	(1996) Valves, Pressure Regulating, Steam
CID A-A-50568	(1997) Gages, Liquid Level Measuring, Tank
CID F-V-2906	(1997) Valves, Air Venting, Steam

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-45	(1998) Bypass and Drain Connection Standard
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application

1.2 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions" and Section 15050, "Basic

Mechanical Materials and Methods," apply to this section, with the additions and modifications specified herein.

This section includes steam and condensate piping within the building.

All installation or modification of high pressure and medium pressure steam and condensate systems shall comply with the requirements of Section 15055, "Welding and Pressure Vessels/Systems".

1.2.1 Classes and Maximum Working Pressures

Equipment, piping, and piping components shall be suitable for use under the maximum working pressure indicated. Except as modified herein, the pressure temperature limitations shall be as specified in the referenced standards and specifications.

1.2.2 Welding

Welding shall be performed in accordance with Section 15055, "Welding and Pressure Vessels/Systems".

1.2.3 Definitions

1.2.3.1 High Pressure Steam or Condensate Piping System

A system whose design working pressure is 100psig.

1.2.3.2 Medium Pressure Steam or Condensate Piping System

A system whose design working pressure is 60 psig.

1.2.3.3 Low Pressure Steam or Condensate Piping System

A system whose design working pressure is 15 psig or less.

1.2.3.4 Piping and Piping System

Includes pipe, tubing, flanges, bolting, gaskets, valves, safety valves, fittings, and pressure containing parts of other piping components, hangers, supports, guides, expansion joints, anchors, and other equipment items necessary to prevent overstressing the pressure containing parts.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittals."

SD-02 Shop Drawings

Submit fully detailed fabrication and installation drawings for steam pressure reducing stations and flash tanks.

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as

applicable.

Pressure Reducing Valves
Convertors
Valves
Traps
Instrumentation
Flash Tanks
Safety Valves

SD-06 Test Reports

Field Test Reports shall be submitted for the items listed below. Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the contractor, by an authorized official of the testing laboratory or agency (if applicable), and by the Government inspector who witnessed the test.

Steam and condensate piping tests
Steam and condensate system startup and operation tests

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the items listed below, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

Pressure Reducing Valves
Convertors
Traps
Safety Valves

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the following items, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

Steam Pressure Reducing Stations
Converters
Traps
Flash Tanks
Safety Valves

SD-11 Closeout Submittals

PV/S Certification Records, as defined in 15055, "Welding and Pressure Vessels/Systems" shall be submitted for high and medium pressure systems and components, for approval and Certification prior to pressurization and operation.

PART 2 PRODUCTS

2.1 PIPE AND PIPE SYSTEM

2.1.1 High and Medium Pressure Steam Piping System

High pressure system operating pressure is 100 psig at 338 degrees F.

Medium pressure system operating pressure is 60 psig at 308 degrees F.

High and medium pressure steam piping and fittings shall be type BCS-150, Schedule 40, as specified in Section 15050, "Basic Mechanical Materials and Methods".

2.1.2 Low Pressure Steam Piping System

Low pressure system operating pressure is 15 psig at 250 degrees F.

Low pressure steam piping and fittings shall be type BCS-125, Schedule 40, as specified in Section 15050, "Basic Mechanical Materials and Methods".

2.1.3 High and Medium Pressure Condensate Return Piping

High and medium pressure condensate return piping and fittings shall be type Type BCS-150, Schedule 80, as specified in Section 15050, "Basic Mechanical Materials and Methods".

2.1.4 Low Pressure Condensate Return Piping

Low pressure condensate return piping and fittings shall be Type BCS-125, Schedule 80, as specified in Section 15050, "Basic Mechanical Materials and Methods".

2.1.5 Valves

Shall conform to the following paragraphs. End connections shall conform to specified pipe and fitting type. Valves shall be of the types indicated below, as specified in Section 15050, "Basic Mechanical Materials and Methods".

2.1.5.1 Gate Valves

High and Medium Pressure Steam and Condensate: Type GAV-150.

Low Pressure Steam and Condensate: Type GAV.

2.1.5.2 Globe and Angle Valves

High and Medium Pressure Steam and Condensate: Type GLV-150 and ANV-150.

Low Pressure Steam and Condensate: Type GLV and AVN.

2.1.5.3 Check Valves

High and Medium Pressure Steam and Condensate: Type CV-150.

Low Pressure Steam and Condensate: Type SCV.

2.1.5.4 Steam Pressure Reducing Valves

Pressure reducing stations shall be the two stage, parallel type. Each stage shall include two reducing valves piped in parallel between common headers, one sized for approximately two-thirds of the total design flow, and the second valve sized for approximately one-third. Flow capacity in grams per second shall be as indicated on the drawings.

Steam pressure reducing valves shall be in accordance with CID A-A-50558 and shall be Type IV, pilot operated through external pressure sensing tube, Class 150, single-seated, metal diaphragm operator,

High pressure stage valves shall operate from an inlet pressure of 100 psig and provide an outlet pressure of 60 psig, with an accuracy of regulation within 2 percent. Medium pressure stage valves shall operate from an inlet pressure of 60 psig and provide an outlet pressure of 15 psig, with an accuracy of regulation within 0.5 psig.

Metal diaphragm shall be phosphor bronze, monel or stainless steel, treated to prevent work hardening. Each valve shall be equipped with a separate pilot valve, similar to the main valve in construction, diaphragm and trim materials. Valves of size DN 50 and less shall have either threaded or flanged ends, and larger valves shall have flanged ends, complying with ASME B16.1 and ASME B16.5.

Valves shall have removable, threaded seats and plugs replaceable without removing valve body form piping, made of heat treated stainless steel or high chromium steel with minimum Brinell hardness of 450 and guaranteed by manufacturer to resist wire-drawing and erosion.

Valves shall be designed and selected for quiet operation, and sized for a minimum of excess capacity to minimize noise when operating at low loads. Inlet velocity shall not exceed 9,000 feet per minute and outlet velocity shall not exceed 50,000 feet per minute, at indicated capacity, based on schedule 80 pipe of the same nominal size as the valve inlet and outlet.

2.1.5.5 Control Valves

Control valves shall be furnished by the UCS contractor, for installation under this contract, unless otherwise indicated.

2.1.5.6 Air Vent Valves

CID F-V-2906, with vacuum holding device, pressure rated for the intended service, and with a capacity based on manufacturer's standard for the connection size, cast iron prohibited.

2.1.5.7 Vacuum Breaker Valves

Vacuum breaker valves shall be 3/4 inch NPT spring loaded vacuum breaker, opening at less than 1/2 inch of vacuum, suitable for steam at 15 psig and 250 degree F.

2.1.5.8 Safety Valves

Pressure relief valves shall be in accordance with Section 15119, "Self-Contained Control and Relief Valves".

2.1.6 Instrumentation

2.1.6.1 Pressure and Vacuum Gauges

Gauges shall be as specified in Section 15050, "Basic Mechanical Materials and Methods", and located as indicated.

2.1.6.2 Tank Gages

CID A-A-50568, locate as indicated. Gauges shall have dual scales with both English (inches) and Metric (millimeters) units.

2.1.7 Miscellaneous Pipeline Components

2.1.7.1 Steam Traps

Steam traps shall be in accordance with Section 15125, "Steam Traps".

2.1.7.2 Strainers

Strainers shall be the type indicated below as specified in Section 15050, "Basic Mechanical Materials and Methods".

High and Medium Pressure Steam and Condensate: Type HTP

Low Pressure Steam and Condensate: Type LTP

2.1.7.3 Exhaust Heads

CID A-A-50494, for atmospheric discharge of exhaust steam.

2.1.7.4 Hangers, Supports, Spacing Requirements, and Attachments

Supporting elements shall be in accordance with Section 15050, "Basic Mechanical Materials and Methods".

MSS SP-58 and ASME B31.1 for materials, design, and manufacture. MSS SP-69 for selection and application.

2.1.7.5 Flash Tanks

Construct of steel for a minimum working pressure of 125 psig. Provide the tank with a vent, hand hole, taps for condensate piping as indicated, and valved drain. Tank shall be constructed and stamped in accordance with ASME BPV VIII Div 1, and shall be the size and capacity indicated on drawings.

2.2 INSULATION

Steam and condensate piping systems and equipment shall be insulated in accordance with Section 15085, "Piping Insulation".

2.3 CONVERTORS

Steam to hot water convertors, with capacity as indicated, shall be provided in accordance with Section 15625, "Hydronic Water Systems", for HVAC service, or Section 15102, "Plumbing", for domestic hot water service.

Converter shall be constructed and stamped in accordance with ASME BPV VIII Div 1 and the requirements of Section 15055, "Welding and Pressure Vessels/Systems".

2.4 CONDENSATE RETURN UNITS

Condensate return units shall be as specified in Section 15186, "Condensate Pumps".

PART 3 EXECUTION

3.1 INSTALLATION

Work material and equipment into a complete, convenient, and economical system or systems; and provide apparatus, parts, materials, and accessories which are necessary to accomplish this result.

3.1.1 Piping

Fabricate, assemble, weld, solder, braze, and install piping and pipe system in accordance with Section 15050, "Basic Mechanical Materials and Methods", and ASME B31.9 and as further qualified herein. Piping shall follow the general arrangement shown.

Provide adequate clearances from walls, ceilings, and floors to permit the welding of joints; at least 6 inches for pipe sizes 4 inches and smaller, 10 inches for pipe sizes larger than 4 inches, and in corners provide sufficient clearance to permit the welder to work between the pipe and one wall. Make provision for expansion and contraction of pipe lines. Do not bury, conceal, or insulate piping until it has been inspected, tested, and approved. Do not conceal piping in walls, partitions, underground, or under the floor except as indicated. Where pipe passes through building structure, do not conceal pipe joints, but locate where they may be readily inspected and not weaken building structure. Run insulated pipe as shown and as required with sufficient clearance to permit application of insulation.

Use long radius ells wherever possible to reduce pressure drops. Pipe bends may be used in lieu of welding fittings where space permits. Pipe bends shall have a uniform radius of at least five times the pipe diameter and shall be free from any appreciable flattening, wrinkling, or thinning of the pipe. Mitering of pipe to form elbows, notching straight runs to form full sized tees, or any similar construction shall not be used. Make branch connections to the top of mains with welding tees except factory made forged welding branch outlets or nozzles having integral reinforcements conforming to ASME B31.9 may be used, provided the nominal diameter of the branch is at least one pipe size less than the nominal diameter of the run.

Install piping connected to equipment to provide flexibility for thermal stresses and for vibration. Support and anchor pipe so that strain from weight and thermal movement of piping is not imposed on the equipment.

3.1.1.1 Welding, Brazing and Soldering

a. Welding, Brazing and Soldering of Piping: Welding of joints in piping, butt welds, fillet welds, bends, loops, offsets, and preparation and cleaning of pipe for welding, brazing, or soldering, shall be in accordance with ASME B31.9 and the

requirements of Section 15055, "Welding and Pressure Vessels/Systems".

3.1.1.2 Hangers and Supports

Horizontal and vertical piping attachments shall conform to Section 15050, "Basic Materials and Methods", ASME B31.9, and MSS SP-58.

3.1.1.3 Grading and Venting of Pipe Lines

Unless otherwise indicated, install horizontal lines of steam and condensate return piping to grade down in the direction of flow with a pitch of not less than 2 mm per meter (0.2%) for steam, and 4mm per meter (0.4% for condensate. When counterflow of condensate within the steam pipe occurs in a portion of a pipeline, pitch up in the direction of steam flow a minimum of 6 inches per 100 feet (0.5%) and increase pipe diameters by one standard pipe size or as indicated on drawings. Branch lines less than 3 meters in length may be sloped back to the main at 5 mm per meter (0.5%) without increasing size. Eccentric reducers shall be used in all horizontal piping to maintain a constant pitch. Air vents shall be provided at the highest point of any vertical riser.

3.1.1.4 Penetrations

Piping penetrations through floors, walls, roofs, and partitions shall be in accordance with Section 15050, "Basic Mechanical Materials and Methods".

3.1.1.5 Unions and Flanges

Provide unions and flanges where necessary to permit easy disconnection of piping and apparatus, and as indicated. Provide a union for each threaded end valve. Use unions on piping smaller than 2 inches in diameter, and use flanges on piping 2 inches and larger in diameter. Provide dielectric unions or flanges between ferrous and non-ferrous piping, equipment, and fittings; except that bronze valves and fittings may be used without dielectric couplings for ferrous-to-ferrous or non-ferrous to non-ferrous connections. Dielectric fittings shall utilize a non-metallic filler which will prevent current flow. The spacer shall be suitable for the pressure and temperature of the service.

3.1.1.6 Traps and Connections

Traps shall be of the type and capacity for the service as specified in Section 15125, "Steam Traps", and shall be properly supported and connected. Install traps with a dirt pocket and strainer between it and the piping or apparatus it drains, and a gate valve and union on each side. Where indicated, to maintain in continuous service apparatus or piping which is to be drained, provide a three-valve bypass so that the trap may be removed and repaired and condensate may drain through the throttled bypass valve. Provide a check valve on the discharge side of the trap whenever the trap is installed for lift or operating against a back pressure, or discharges into a common return line. When a thermodynamic trap is used, a check valve is not required or recommended. Provide test connections on the discharge side of the high and medium pressure traps. The test connection shall include a 1/2 inch globe valve with uncapped nipple. At all low points of steam piping provide full-size drip leg with blowdown valve and trap. Minimum length of drip leg (from bottom of main to level of trap) shall be .

3.1.1.7 Connections for Future Equipment

Install control valves, isolation valves and strainers in accordance with Section 15900, "UCS Controls", or Section 15902, "Non UCS Control Systems".

Locate capped or plugged outlets for connections to future equipment as indicated. Provide a pressure gauge to indicate steam pressure entering each piece of connected equipment.

3.1.1.8 Trap Installation

Piping from equipment outlet to trap shall be equipped with a vacuum breaker, and shall include a vertical section, the full size of the outlet connection, with the trap inlet located a minimum of 360 mm below the equipment outlet unless otherwise indicated, and the bottom of the vertical pipe capped or plugged to form a dirt pocket a minimum of 150 mm deep below the trap connection. Trap shall be installed with strainer, valves and unions as described above.

3.1.2 Valves

3.1.2.1 General

Install valves in conformance with ASME B31.9, ASME BPV VIII Div 1, and as required herein, at the locations indicated and elsewhere as required for the proper functioning of the system. Use gate valves unless otherwise directed. Install stop valves in the supply lines equipped or located so as to permit operation from floor level, or provided with safe access in the form of walkways or ladders. Install valves in positions accessible for operation and repair. Provide gate valves 8 inches and larger with globe-valved bypass in accordance with MSS SP-45.

3.1.2.2 Globe Valves

Install globe valves so that the pressure shall be below the disk. Install globe valves with the stems horizontal on steam and exhaust lines.

3.1.3 Pressure Gages

Install a shutoff valve or petcock between each pressure gage and the line, and gages on steam lines shall have a syphon installed ahead of the gage.

3.1.4 Steam Pressure Reducing Stations

Pressure reducing stations shall be installed in location indicated, and arranged to permit ample space for access to all devices. Unless otherwise indicated station shall be arranged with vertical high pressure, medium pressure, and low pressure headers, with the pressure reducing valves in horizontal lines between headers. All piping, valves, strainers and accessories in the station shall be as specified for high pressure steam system.

Provide a strainer between the header and each pressure reducing valve. Each pressure reducing valve shall be installed with gate valves and unions on each side, except unions are not required if valve is flanged. Provide a bypass for each reducing valve, of two pipe sizes smaller than the valve inlet, with angle globe valve and union. Pressure sensing line shall be installed in accordance with the manufacturer's instructions, but connection to valve outlet steam piping shall be not less than 10 pipe

diameters downstream of reducing valve. Sensing line shall be equipped with union and globe valve

Provide pressure gauges, with stop cocks and siphons, on high pressure, medium pressure, and low pressure headers. Provide each header with main drip and trap assembly in accordance with Section 15125, "Steam Traps", with condensate piping routed to flash tank (high and medium pressure) or to the condensate pump receiver (low pressure) as indicated on drawings. Provide each header with an appropriately sized and rated pressure relief valve, in accordance with Section 15119, "Self-Contained Safety and Relief Valves", with discharge piped to the outside of the building as indicated on drawings

3.1.5 Steam Flowmeters

Flowmeters, and installation accessories as indicated below, will be furnished by the UCS Contractor, for installation under this contract as indicated below. Coordinate scheduling and installation with UCS Contractor in accordance with Section 15900, "UCS Control Systems".

3.1.5.1 Reduced Size Pipe Run

If drawings indicate a reduced size pipe run for metering, provide portion of steam main of reduced size as indicated, with minimum length as required to satisfy the minimum upstream and downstream straight run indicated. For horizontal piping, provide eccentric reducers and maintain slope of reduced size piping to permit condensate drainage in direction of slope of main.

3.1.5.2 Insertion Type Meters

UCS Contractor will furnish meter, with 2-inch weld-o-let, flange and gate valve for installation. Install weld-o-let, flange and gate valve on steam main where indicated, with the indicated minimum straight piping upstream and downstream, and in accordance with meter manufacturer's instructions. Insert meter through valve into piping and adjust to proper insertion depth for the pipe size. UCS Contractor will provide control wiring, conduit, connections to meter, set-up and testing.

3.1.5.3 In-Line Type Meters

UCS Contractor will furnish meter (Class 150 flanged) for installation. Furnish and install matching pipe flanges on steam line, and install meter where indicated, with the indicated minimum straight piping upstream and downstream, and in accordance with meter manufacturer's instructions. UCS Contractor will provide control wiring, conduit, connections to meter, set-up and testing.

3.1.6 Strainers

Provide strainers with meshes suitable for the services where indicated, and where dirt might interfere with the proper operation of valve parts, orifices, and moving parts of equipment. Provide globe valves for blowdown.

3.1.7 Equipment Foundations

Design equipment foundations of sufficient size and weight to provide isolation and to preclude shifting of equipment under operating conditions. Foundations shall meet the requirements of the equipment manufacturer. When

required by the Contracting Officer, the equipment manufacturer's approval of the foundation design and construction for the equipment involved shall be obtained.

3.1.8 Equipment Installation

Install equipment as specified and in accordance with the manufacturer's installation instructions. Grout equipment mounted on concrete foundations before piping is installed. Install piping in such a manner as not to place a strain on any of the equipment. Do not bolt flanged joints tight unless they match. Adequately extend expansion bends before installation. Grade, anchor, guide, and support piping without low pockets.

3.1.9 Cleaning of System

As installations of the various system components are completed, clean before final closing. Remove foreign matter from equipment and surrounding areas. Preliminary or final tests shall not be performed until the cleaning is approved.

Thoroughly clean each section of pipe, fittings, and valves of foreign matter before erection. Before placing in position, clean the inside of black steel pipe by rapping along its full length to loosen sand, mill scale, and other foreign matter; pipe 2 inches and larger shall have a wire brush of a diameter larger than that of the inside of the pipe drawn through its entire length several times. Before final connections are made to the apparatus, thoroughly wash out the piping interior with water. Blow out steam piping with high-pressure steam, if available, or compressed air, removing rust, oil, chips, sand, and other material. Plug or cap open ends of mains during shutdown periods. Do not leave lines open at any place where any foreign matter might accidentally enter pipe.

3.2 PRESSURE VESSELS AND PRESSURIZED SYSTEMS (PV/S) CERTIFICATION

All installation or modification of high pressure and medium pressure steam and condensate systems shall comply with the requirements of Section 15055, "Welding and Pressure Vessels/Systems", and PV/S Certification Records shall be prepared as indicated in that section. This data must be submitted and approved, and the system or components Certified by the Government, prior to pressurization and operation.

3.3 FIELD TESTS AND INSPECTIONS

3.3.1 Field Inspections

Inspect piping system prior to initial operation, for conformance to drawings, specifications, and ASME B31.9. Equipment, material, or work rejected because of defects or non-conformance with drawings, specifications, and ASME B31.9 shall be replaced or corrected by the Contractor, as directed by the Contracting Officer.

3.3.2 Field Tests

Conduct the following tests after completion of the piping installation and prior to installing insulation, or initial operation.

3.3.2.1 Piping System

Test piping system hydrostatically using water not exceeding 100 degrees F.

Conduct tests in accordance with the requirements of ASME B31.1 and as follows. Test the piping system after the lines have been cleaned as herein specified and before any insulation covering has been applied. Test piping system at 1 1/2 times the system pressure or 50 psig whichever is greater. Before performing tests, remove or valve off from the system, gages, traps, and other apparatus which may be damaged by the test pressure. Install a calibrated test pressure gage in the system to observe any loss in pressure. Maintain the required test pressure for not less than 8 hours with no loss of pressure. Leaks shall be corrected and re-tested.

3.3.2.2 Start-Up and Operational Test

Start-up the system and initially operate with components operating. During the test, periodically clean the various strainers until no further accumulation of foreign material occurs. Exercise care so that minimum loss of water and steam occur when strainers are cleaned. Adjust safety and automatic control instruments as necessary to place them in proper operation and sequence.

3.3.2.3 Extent of Field Tests

After installation and before acceptance, coordinate as required, the work of this section with the necessary field tests, including those herein specified, and in Sections 15950, "Testing, Adjusting and Balancing," 15900, "UCS Controls", and 15902, "Non-UCS Control Systems."

3.4 OPERATIONAL READINESS REVIEW (ORR)

Provide Operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for system including new valves, traps, pumps, converters, and controls.

ORR shall include a complete walk-through of the system, identifying locations of all items listed above, and all connected equipment.

-- End of Section --

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DIVISION 15 - MECHANICAL

SECTION 15185

REFRIGERATION PIPING AND SPECIALTIES

03/98

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SECTION 15185

REFRIGERATION PIPING AND SPECIALTIES
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 495	(1999) Refrigerant Liquid Receivers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 278	(1993) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 Degrees F
ASTM A 278M	(1993; Rev E1) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 345 Degrees C (Metric)
ASTM B 280	(1999) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 62	(1993) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM F 104	(1995) Standard Classification System for Nonmetallic Gasket Materials

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15	(1994) Safety Code for Mechanical Refrigeration
ASHRAE-04	(1997) Handbook, Fundamentals (SI Edition)
ASHRAE-05	(1999) Handbook, HVAC Applications (SI Edition)
ASHRAE-06	(1996) Handbook, HVAC Systems and Equipment (IP Edition)
ASHRAE-07	(1996) Handbook, HVAC Systems and Equipment (SI Edition)
ASHRAE-08	(1998) Handbook, Refrigeration (SI Edition)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B31.5	(2000) Refrigeration Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV VII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels, Division 1, Basic Coverage

FEDERAL SPECIFICATIONS (FS)

FS BB-N-411	(Rev C) Nitrogen, Technical

MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-104	(1995) Wrought Copper Solder Joint Pressure Fittings
MSS SP-86	(1997) Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators

MILITARY SPECIFICATIONS (MS)

MS MIL-F-1183/GEN	(Rev J; Supple 1A) Fittings, Pipe, Cast Bronze, Silver-Brazing, General Specification for

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE J513	(1999) Refrigeration Tube Fittings - General Specifications Standards

1.2 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section. All installation or modification of piping and components defined as pressure vessels and pressurized systems (PV/S) in Section 15055, "Welding and Pressure Vessels/Systems", shall comply with applicable requirements of that section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification: For items defined as "V/S, submit additional items as specified in Section 15055, " Welding and Pressure Vessels/Systems".

SD-02 Shop Drawings

Connection Diagrams shall be submitted indicating the relations and connections, and the general physical layout of all piping, valves, components and associated equipment in the system..

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

Components
Valves

SD-05 Design Data

Equipment Schedules shall be submitted for the items listed below. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

Components
Valves

SD-06 Test Reports

Test Reports shall be submitted in accordance with the paragraph entitled, "Testing," of this section.

SD-07 Certificates

Certificates of Compliance shall be submitted for the items listed below. Certificates shall be signed by responsible officials of the manufacturer or supplier, attesting that the product, system or material complies with the specified standards, shall list the issuing organization(s) and standard number(s) which are applicable, and additional specified requirements such as type, grade, or specific materials.

Piping Materials
Piping System Supports

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the items listed below, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

Components
Valves

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the following items, in accordance with Section 01770, "Task Order Closeout", and shall be incorporated into the manuals for the

associated equipment. Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

Components
Valves

PART 2 PRODUCTS

2.1 GENERAL

All system materials shall comply with applicable requirements of ASHRAE 15 and ASME B31.5, and shall be compatible with the indicated refrigerant type..

2.2 REFRIGERANT

Refrigerant type shall be as indicated in the specification section for the equipment.

CFC refrigerant shall not be used.

2.3 PIPING MATERIALS

2.3.1 Purging and Testing Nitrogen Gas

Gaseous nitrogen shall be dry, conforming to FS BB-N-411, Grade A (99.95 percent pure), Type I (gaseous), with minus 70-degree F dewpoint.

2.3.2 Brazing Rod

Brazing material shall be AWS Type BCuP-5.

2.3.3 Gaskets

Gaskets shall be formed from compressed non-asbestos fiber material sheet conforming to ASTM F 104, both sides shall be free of any lubricant and shall contain not less than 75 percent non-asbestos fiber material.

2.3.4 Piping

Type CPR-ACR-Copper air-conditioning refrigeration piping shall be as follows:

Tubing:

To 7/8-inch outside diameter (od)	Annealed Type K, conforming to ASTM B 280, where bending or flare connection is required
Over 7/8-inch od	Hard-drawn, seamless-copper tubing conforming to ASTM B 280, Type K

Fittings:

To 7/8-inch od	Flared-type, conforming to SAE J513
Over 7/8-	150-pound per square inch, gage (psig),

inch od	wrought-copper socket-joint, conforming to ASME B16.22
	All fitting cup depths and tolerances shall conform to MS MIL-F-1183/GEN.

Flexible connectors:

All sizes: Flexible connections for reciprocating equipment shall be the seamless, corrugated, all nonferrous-metal type with external nonferrous metal reinforcing braid. Flexible connections shall be installed in pairs, one at right angle to the other, whether shown or not. Working pressure rating shall have 4 to 1 safety factor at minimum.

2.4 COMPONENTS

2.4.1 Liquid Refrigerant Receiver

Refrigerant liquid receiver shall have all necessary openings, accessories, and support provisions.

Receiver shall conform to ARI 495, ASHRAE-06 and ASME BPV VII Div 1.

Pump-down capacity of receiver shall be 80 percent of the internal volume of the receiver.

Receiver shall be equipped with inlet-outlet drop pipe, drain plug, purging valve, relief valves of capacity and setting required by ASHRAE 15, and two bull's-eye liquid-level sight glasses. Sight glasses shall be in the same vertical plane, 90 degrees apart, perpendicular to the axis of the receiver, and not over 3 inches horizontally from the drop pipe, measured along the axis of the receiver. In lieu of bull's-eye sight glass, external gage glass with metal glass guard and automatic-closing stop valves may be provided.

2.4.2 Pressure Gages

Refrigerant pressure gages shall conform to requirements specified under Section 15050, "Basic Mechanical Materials and Methods," except that gages shall be in conformance with ASME B40.1, Class 1, Style X, Type III, minimum 3-1/2 inch size. Gauges shall indicate both English and Metric units.

2.4.3 Thermometers

Thermometers shall conform to the requirements specified under Section 15050, "Basic Mechanical Materials and Methods." Dial, remote or direct-bulb adjustable-angle type, is acceptable provided case is corrosion resistant steel, not less than 3-1/2 inches in diameter, and accuracy is plus or minus 1 degree, graduated in 2-degree increments. Dial face shall be white with black digits. Thermometers shall be installed in copper wells. Thermometers shall indicate both English and Metric units.

2.4.4 Evaporator Pressure Regulators

Evaporator pressure regulators shall have a maximum pressure drop at design conditions of 3 psi with refrigerants R-22 or R-502. Regulators shall be installed with valved gages upstream and downstream and shall be fully

adjustable, both for setting and for throttling range from open to closed.

2.4.5 Filters/Dryers

Filter/dryers, in sizes 1/2 inch and larger shall be the full-flow, replaceable-core type. Sizes smaller than 1/2 inch shall be the sealed type. Cores shall be of a suitable desiccant that will not plug, cake, dust, channel, or break down but shall remove water, acid, and foreign material from the refrigerant. Dryer shall be constructed so that no desiccant will pass into the refrigerant lines. A filter/dryer shall be provided in the liquid line to each evaporator and shall be piped with a three-valve bypass. Pressure drop through the dryer shall not exceed 2 psi when operating at full connected evaporator capacity.

2.4.6 Liquid Sight Glasses

Sight glasses shall be double glass, see-through type, with cover cap on each side. Sight glass shall be provided in liquid line immediately preceding each expansion valve. Glass shall be furnished with a color-change-type moisture indicator.

2.4.7 Moisture Indicators

Color-change moisture indicators shall be provided downstream from each filter/dryer and bypass or combined as a single unit in the liquid sight glasses.

2.4.8 Discharge-Line Oil Separator

Discharge-line oil separator of rated capacity equal to or greater than the compressor capacity shall be provided in the discharge line from each compressor when recommended by the compressor manufacturer for the specific installation. Separator shall be provided with an oil float-valve assembly or needle valve and orifice assembly, drain-line shutoff valve, and sight glass. Oil-return line shall be connected to the compressor as recommended by the compressor manufacturer.

2.4.9 Liquid-Suction Interchangers

Liquid-suction interchangers shall be provided to increase system efficiency to subcool liquid refrigerant or to prevent liquid refrigerant from entering the compressor.

2.4.10 Line Strainers

Strainers shall be Y-type with removable basket. Strainers in sizes 2-inch and smaller shall have solder ends; in sizes 2-1/2-inch and larger, strainers shall have flanged ends. Minimum body working-pressure rating shall be 250 psig. Body shall have cast-in arrows to indicate direction of flow. All strainer bodies fitted with screwed screen retainers shall have straight threads and shall be gasketed with nonferrous metal. Strainer bodies fitted with bolted-on screen retainers shall have offset blowdown holes. Body material shall be cast bronze, conforming to ASTM B 62, in sizes 2-inch and smaller, and cast bronze or cast iron conforming to ASTM A 278, Class 30, in sizes 2-1/2-inch and larger.

Minimum free-hole area of strainer element shall be equal to not less than 5 times the internal area of connecting piping. Strainer screens for liquid service shall have perforations not to exceed 0.010 inch (or

equivalent wire mesh). Strainer screens for vapor or gas service shall have perforations not to exceed 0.02 inch 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 or 316 corrosion resistant steel or Monel metal.

2.4.11 Mufflers

A muffler shall be provided in hot-gas discharge line.

2.5 VALVES

2.5.1 Shutoff and Check Valves

Valves shall conform to ASHRAE-06, Chapter 42. Shutoff valves shall be packless diaphragm (in sizes commercially available), with packed, ground-finish stem, key operated, back seating, sealed-cap type; otherwise, angle pattern valves shall be used whenever possible. Check valves shall be lift type for gases and vapors and swing-check type for liquids.

Valves connected to copper tubing shall have flared end connections up to 7/8-inch and socket type ends or flanged ends with flange adapters for all other sizes.

2.5.2 Solenoid Valves

Valves shall be brass or steel body, packless type, with corrosion resistant steel trim, rated for continuous-duty service, direct or pilot operated, provided with manual lift stems, and designed for use with type of refrigerant used. Valve capacities shall be sufficient for the requirements of the installation at a pressure drop not in excess of 2 pounds per square inch (psi). Valves in suction lines shall be sized in accordance with temperature rise and superheat normal to the system.

Valves connected to copper tubing shall have flared-end connections up to 7/8-inch and socket type ends or flanged ends with socket flange adapters for all other sizes.

2.5.3 Expansion Valves

Valves shall be thermal-expansion type to suit specific system refrigerant, designed to fit coil distributors, and capable of operating from 40 to 100 percent of full load at system head pressure without hunting or liquid hammer. Valves shall have external equalizer connections and external superheat adjustments with seal caps. Joint connections shall be mechanical threaded or flanged type. Valves shall require not over 4 degrees F superheat change to move from fully open to fully closed position. Superheat setting shall be 10 degrees F at full load.

Expansion valves shall be balanced double-seated or pilot-operated, capable of stable operation at 15 percent design load.

Each valve shall be provided with external strainer.

Manual-angle, globe body expansion valves shall be provided in three shutoff-valve bypasses to facilitate automatic valve maintenance.

2.6 PIPING SYSTEMS SUPPORTS

Piping systems support materials shall conform to requirements specified under Section 15050, "Basic Mechanical Materials and Methods," requirements specified herein, and the requirements of ASHRAE 15 and ASME B31.5.

Supports for uninsulated copper tubing shall have wide copper-plated bearing surfaces with lead sheet liners between the tube and the support in the contact area, which shall be secured to the support by turned-under edges.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed in accordance with ASHRAE 15, ASME B31.5, manufacturer's recommendations and in accordance with Section 15050, "Basic Mechanical Materials and Methods."

3.2 TESTING

Testing of refrigerant piping, as well as operational tests and air/water balancing of the associated equipment, shall be performed in accordance with manufacturer's recommendations and Section 15950, "Testing, Adjusting and Balancing", and shall be completed prior to conducting an Operational readiness Review (ORR).

Operational Testing of the associated controls shall be performed in accordance with Section 15902, "Non-UCS Control Systems", or coordinated with UCS Contractor in accordance with Section 15900, "UCS Controls", prior to conducting the Operational Readiness Review.

3.3 OPERATIONAL READINESS REVIEW (ORR)

Provide an operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for the refrigerant piping, and the related equipment and controls, as a whole system. This system ORR shall include a complete walk-through indicating the location and operation of all piping, valves and components specified in this section. For task orders which involve replacement or modification of only a portion of the system, the ORR shall cover only the replaced or modified piping, valves and components.

-- End of Section --

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SECTION 15186

CONDENSATE PUMPS

09/96

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-- End of Section Table of Contents --

SECTION 15186

CONDENSATE PUMPS
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels, Division 1, Basic Coverage

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5	(2000) American National Standard for Centrifugal Pumps for Nomenclature, Definitions, Application and Operation

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 1940-1	(1986) Mechanical vibration - Balance quality requirements of rigid rotors - Part 1: Determination of permissible residual unbalance
ISO 2858	(1975) End Suction Centrifugal Pump (Rating 16 Bar) Designation Nominal Duty Point and Dimensions
ISO 5199	(1986) Technical Specifications for Centrifugal Pumps, Class II

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Control Diagrams shall be submitted for Condensate Pumps showing motor starters, relays, or any other component necessary for safe operation.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for Condensate Pumps showing Equipment Foundation Data and Equipment and Performance Data including performance curves and indicating brake power, head (gpm), NPSH, size, type, and efficiency rating.

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for condensate pumps, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for condensate pumps, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

Section 15072, "Vibration Isolation for Air Conditioning Equipment," applies to work specified in this section.

PART 2 PRODUCTS

2.1 CONDENSATE-RETURN PUMP UNITS

Condensate-return pump units shall be factory assembled and shall include condensate receivers, motor-driven pump(s), manual and automatic liquid-level controls, and other accessories as specified herein or which may be necessary for complete and satisfactorily operating units(s).

Pump(s) and all accessories mounted on the receiver and unit(s) shall be complete with all intercomponent piping and wiring. Receiver and unit(s) shall be complete with all intercomponent piping and wiring. Receiver shall have integral cast lugs for securing to mounting surface. Pump suction piping shall contain a shutoff valve for pump servicing.

Condensate-return pump units shall be duplex type.

Condensate-return pump unit shall be factory tested for capacity and pressure.

2.1.1 Electric Condensate Pumps

Pumps shall be close coupled or flexible coupled with guard centrifugal volute vertically or horizontally mounted on or next to receiver. Pumps shall conform to applicable requirements of HI 1.1-1.5 standards and shall be bronze mounted. Casing shall be close-grained cast iron with renewable wearing ring. Tapped openings shall be provided for automatic venting, draining, and pressure-gage connection. Pump shaft shall be AISI Type 300 series corrosion-resistant steel. Pump seal shall be manufacturer's standard for continuous service at 250 degrees F, minimum, at seal rotating and stationary members interface and 209-degree F pumped fluid. Pumps shall be capable of handling 209-degree F condensate without cavitation or vapor binding while delivering specified capacity.

Pumps driven by motors rated 7.5 hp 5.6 kilowatt or over shall be factory balanced to Balance Grade G2.5 (except where a different grade is

indicated) in accordance with ISO 1940-1. Factory test reports shall be submitted including:

Balance instrumentation make and model
Balance method (single plane or two plane) and correction plane location(s)
Type of rotor (overhung or between centers
Operating speed of rotor
Balance Quality Grade required
Calculated permissible residual unbalance
Measured residual unbalance in each correction plane

2.1.2 Motor Requirements

Motors shall be vertical or horizontal and shall conform to requirements specified under the electrical sections of the specifications and to the following additional requirements.

Motor insulation shall be Class H or manufacturer's standard and shall be suitable for satisfactory operation under the following conditions:

Still air at 65 percent relative humidity, with service-location temperatures to 122 degrees F

Thermal conduction along motor shaft immersed in 209-degree F water

Proximity of motor to receiver surfaces at 209 degrees F

Lubricants shall be specifically suitable for high-temperature service.

2.1.3 Receiver

Condensate receiver shall be a single tank constructed of close-grained cast iron with a minimum receiver wall thickness of 5/16 inch or steel with a rust-resistant interior coating.

Each receiver shall be fitted with:

Redline borosilicate gage glass and nonferrous shutoff valve assembly for use in case of glass breakage

External inlet strainer with removable basket for pump protection

Thermometer with separable well conforming to requirements specified in Section 15050, "Basic Mechanical Materials and Methods"

Receiver top-vent connection and drain at lowest point. Drain closures shall be assembled with tetrafluoroethylene tape.

2.1.4 Controls

Simplex-unit control shall consist of a float-operated switch UL rated for the load imposed and wired to the motor. Float and float arm shall be AISI Type 304 or 316 corrosion-resistant steel. Copper float mechanisms are not acceptable.

Duplex-unit control shall consist of a float-operated automatic mechanical alternator controlling at two levels with double-pole alternating switches and operated by a single float. Control shall automatically alternate

operation of two pumps to deliver total capacity of two pumps under peak-load conditions, and automatically operate second pump should on-line pump fail. Switch shall be UL rated for the load imposed and shall be wired to motors. Float and float arm shall be AISI Type 304 or 316 corrosion-resistant steel. Copper float mechanisms are not acceptable.

Duplex unit control shall consist of an automatic electric sequence controller used in conjunction with two motor controllers, two selector switches, and two float switches, complete with intercomponent wiring, installed in a NEMA Type 1 enclosure mounted on the receiver. Selector switches shall provide automatic OFF positions. A momentary-contact test pushbutton shall be provided. One float switch shall control the alternator to provide automatic alternation of the two pumps. Second float switch shall provide simultaneous operation of two pumps to deliver total capacity of two pumps under peak-load conditions and automatically operate second pump should on-line pump fail. Switches shall be UL rated for the load imposed. Floats and float arms shall be AISI Type 304 or 316 corrosion-resistant steel. Copper float mechanisms are not acceptable.

2.2 CONDENSATE RECEIVER

Receiver shall be designed and constructed in accordance with ASME BPV VIII Div 1 for operation under atmospheric conditions but certified as hydrostatically tested at 100 pounds per square inch, gage.

Receiver shall be manufacturer's standard vessel.

2.2.1 Materials and Construction

Receiver shall be constructed of either cast iron or galvanized steel and be a standard item of the manufacturer with dished heads, indicated openings including those for vent, inlets, discharge, drain, gage-glass connections, and level-control devices. Minimum tank opening shall be 1-inch iron pipe size. Couplings shall be forged carbon steel. Nozzle-piping weight shall be Schedule 80. Piping, flanges, and fittings shall conform to specifications for connecting condensate piping system.

Receiver shall be mounted as indicated.

One 11- by 15-inch gasketed manhole shall be provided at a point in the head or shell for access when receiver is in place.

Receiver internal surfaces, including nozzles, shall be sandblasted to white metal, to a profile required by the coating manufacturer. Internal surfaces shall be coated with a multiple-coat baked or air-dry phenolic system to produce, in not less than three coats, a dry-film thickness of not less than 7 mils. Coating shall be certified as suitable for continuous service when immersed in condensate at a temperature not less than 300 degrees F.

2.2.2 Accessories

Receiver shall be provided with a shutoff-valve-equipped gage-glass assembly to indicate liquid level over not less than 80 percent of receiver diameter from the bottom. Gage glass shall be red-lined borosilicate glass and shall be fitted with wire or sheet-metal guards.

2.3 STEAM POWERED CONDENSATE PUMP

Steam powered condensate pump shall be cast iron body, with stainless steel float, steam inlet and outlet valves, and linkage. Capacity shall be as indicated, with indicated steam supply pressure and condensate back-pressure. Condensate inlet and outlet check valves shall be furnished by the pump manufacturer. Pump shall be equipped with gage glass and cycle counter. Steam consumption shall not be more than 3 pounds per 1000 pounds of pumped liquid.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed in accordance with manufacturer's recommendations.

3.2 TESTING

Pump shall be operated and the demonstration shall verify that the pump is nonoverloading at any operating point and that the flow capacity is as specified.

3.3 OPERATIONAL READINESS REVIEW (ORR)

Provide an Operational Readiness Review in accordance with Section 01770, "Task Order Closeout", including location and function of control deices, and demonstration of all operating modes.

-- End of Section --

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SECTION 15195

NATURAL GAS SYSTEMS

03/97

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SECTION 15195

NATURAL GAS SYSTEMS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 105/A 105M	(1998) Standard Specification for Forgings, Carbon Steel, for Piping Components
ASTM A 197/A 197M	(2000) Standard Specification for Cupola Malleable Iron
ASTM A 234/A 234M	(1999) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 278	(1993) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 Degrees F
ASTM A 278M	(1993; Rev E1) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 345 Degrees C (Metric)
ASTM A 53/A 53M	(2001) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 666	(2000) Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM A 694/A 694M	(2000) Standard Specification for Forgings, Carbon and Alloy Steel, for Pipe Flanges, Fittings, Valves and Parts for High Pressure Transmission Service
ASTM B 280	(1999) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 62	(1993) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 88	(1999) Standard Specification for Seamless Copper Water Tube

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.3	(1999) Malleable-Iron Threaded Fittings, Classes 150 and 300
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions, Classes 150, 250, and 300
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(1998) Power Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Specification for Filler Metals for Brazing
AWS-02	(1990) Welding Handbook; Eighth Ed; Vol Two - Welding Process

FEDERAL SPECIFICATIONS (FS)

FS L-C-530	(1987 Rev C) Coating, Pipe, Thermoplastic Resin
FS QQ-B-654	(Rev A; Notice 1) Brazing Alloys, Silver

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 7005-2	(1988) Metallic Flanges Part 2: Cast Iron Flanges

MILITARY SPECIFICATIONS (MS)

MS MIL-F-1183/GEN	(Rev J; Supple 1A) Fittings, Pipe, Cast Bronze, Silver-Brazing, General Specification for
MS MIL-L-25567	(Rev D; Am 1) Leak Detection Compound, Oxygen Systems (Metric)
MS MIL-V-12003	(Rev F; Am 1) Valves, Plug: Cast-Iron or Steel, Manually Operated

MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-83	(1995) Steel Pipe Unions Socket-Welding and Threaded
MSS SP-86	(1997) Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(1999) National Fuel Gas Code
NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 842	(1997; 8th Ed) UL Standard for Safety Valves for Flammable Fluids
UL 860	(1993; 6th Ed) UL Standard for Safety Pipe Unions for Flammable and Combustible Fluids and Fire-Protection Service

1.2 SCOPE OF WORK

This section applies only to natural gas piping within buildings. All underground gas distribution piping up to building, and gas meters, will be provided by Washington Gas or their approved contractor, not as part of this contract.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification: For items defined as "V/S, submit additional items as specified in Section 15055, " Welding and Pressure Vessels/Systems".

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

Piping Materials
Valves
Piping Specialties

SD-05 Design Data

Equipment Schedules shall be submitted for the items listed below.

Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

Valves
Piping Specialties

SD-06 Test Reports

Field Test Reports shall be submitted for the items listed below. Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the contractor, by an authorized official of the testing laboratory or agency (if applicable), and by the Government inspector who witnessed the test.

Pneumatic Testing
Pressure Testing

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the items listed below, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

Valves
Piping Specialties

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the following items, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

Valves
Piping Specialties

1.4 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions, Section 15050, "Basic Mechanical Materials and Methods". All installation or modification of piping and components defined as pressure vessels and pressurized systems (PV/S) in Section 15055, "Welding and Pressure Vessels/Systems", shall comply with applicable requirements of that section.

PART 2 PRODUCTS

2.1 ABOVEGROUND PIPING MATERIALS

Type BCS-NG: Black carbon steel

Pipe (1/8 inch through 10 inches and where indicated): Schedule 40 seamless or electric resistance welded black carbon steel, conforming to ASTM A 53/A 53M, Grade B, Type E or S.

Fittings (1 inch and under): Class 150 banded black malleable iron screwed, conforming to ASTM A 197/A 197M, ASME B16.3 and ASTM A 234/A 234M

Unions (1 inch and under): Class 250 female, screwed, black malleable iron with brass to iron seat and ground joint, conforming to ASME B16.39 and UL 860

Couplings (1 inch and under): Heavyweight screwed black carbon steel

Fittings (1-1/4 inches and over): Steel butt weld, conforming to ASTM A 234/A 234M and ASME B16.9 to match pipe wall thickness, or steel socket weld, conforming to ASTM A 105/A 105M and ASME B16.11 rated at 2,000 psi wog

Flanges (1-1/4 inches and over): Class 150 forged steel socket or welding neck to match pipe wall thickness, and conforming to ASME B16.5 and ASTM A 694/A 694M

Type CPR-NG: Copper; natural gas vent and control and instrumentation system tubing; 30 psig and less

Tubing 1/4-inch: Hard drawn or annealed seamless copper conforming to ASTM B 280.

Fittings 1/4 inch: Socket joint wrought copper, conforming to ASME B16.11. All fitting cup depths and tolerances shall conform to MS MIL-F-1183/GEN.

Brazing rod	Type 3, conforming to FS QQ-B-654
Silver Solder	Type BCuP-5 conforming to AWS A5.8

2.2 PIPING SPECIALTIES

2.2.1 Appliance Connectors

Connectors shall be corrugated bronze metal with brazed inverted flare-type brass fittings complete with transition for ips connection. Maximum length shall be 6 feet. Connectors shall be AGA-approved type.

2.2.2 Pressure Gages

Pressure gages shall conform to ASME B40.1, Type I, Class 1. Pressure-gage size shall be 3-1/2-inch nominal diameter. Case shall be corrosion-resistant steel conforming to any of the AISI 300 series of ASTM A 666, with a No. 4 standard commercial polish or better. All gages shall be equipped with adjustable red marking pointer and damper screw adjustment in inlet connection.

2.2.3 Line Strainers

Strainers shall be Y-type with removable basket. Strainers in sizes 2-inch ips and smaller shall have screwed ends; 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. All strainer

bodies fitted with screwed screen retainer shall have straight threads and shall be gasketed with nonferrous metal. Strainer bodies fitted with bolted-on screen retainers shall have offset blowdown holes. Body material shall be cast bronze conforming to ASTM B 62 or cast iron conforming to Class 30 ASTM A 278. Where system material is nonferrous, strainer body material shall be nonferrous.

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 for natural gas service shall have mesh cloth not to exceed 0.006 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 or 316 corrosion-resistant steel.

2.3 VALVES

2.3.1 Ball Valves (BAV-NG)

Ball valves shall be the fire-seal type, conforming to UL 842.

Valves shall be rated for service at not less than 200 psi at 200 degrees F.

Valve bodies in sizes 1-inch ips and smaller shall be screwed-end type constructed of carbon steel or cast steel.

Valve bodies in sizes 1-1/4-inch ips and larger shall be flanged-end type constructed of carbon steel or cast steel.

Valve bodies shall have socket weld ends or butt weld ends where indicated to be welded, and body shall be constructed of carbon steel or cast steel.

Balls and stems shall be Type 316 corrosion-resistant steel.

Valves shall be suitable for flow from either direction and shall seal tightly in either direction.

Valves shall have full pipe size flow areas where noted.

Valve seats and seals shall be tetrafluoroethylene; seats shall have secondary corrosion-resistant steel seating surfaces to effect shutoff should resin be burned out.

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 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.

2.3.2 Gage Cocks (GC)

Gage cocks shall be T-head or lever-handle ground key type with washer and screw, constructed of polished ASTM B 62 bronze, 125 psi. End connections shall suit the service, with or without union and nipple.

2.3.3 Gasket Material

Gasket material and type shall be in accordance with NFPA 54.

PART 3 EXECUTION

3.1 ABOVEGROUND PIPING SYSTEMS INSTALLATION

3.1.1 Aboveground Piping

Aboveground piping shall be fabricated and installed in accordance with NFPA 54, AWS-02, MSS SP-69.

Work shall be performed in the presence of the Contracting Officer who shall be notified 48 hours in advance of start of work.

Pipe shall be fabricated to measurements established on the job and shall be carefully worked into place without springing or forcing. Adequate provision shall be made for absorbing all expansion and contraction without stress in any part of the system.

Pipe, tubing, fittings, valves, equipment, and accessories shall be visibly clean and free of foreign material before being installed into the respective systems. Pipe shall be cleaned by hammering, shaking, or swabbing, or by a combination of methods. Lines shall be purged with dry, oil-free compressed air after erection, but purging out shall not be relied upon for removing all foreign matter. Purge velocity shall be equal to 1-1/2 times maximum normal flow velocity. During the progress of construction, open ends of pipe, fittings, and valves shall be properly protected at all times to prevent the admission of foreign matter. Plugs or caps shall be placed in the ends of installed work at all times when connecting work is not actually under way. Plugs shall be commercially manufactured products approved by the Contracting Officer. Outlets, including valve outlets, shall be securely closed gastight with a threaded plug or cap immediately after installation and shall be left closed until the gas equipment is connected thereto.

Piping shall be installed straight and true with approved offsets around obstructions and with expansion bends or fitting offsets essential to a satisfactory installation, and as may be necessary to increase headroom or to avoid interference with the building construction, electric conduit, or facilities equipment.

Natural gas piping smaller than 1/2-inch shall not be concealed.

When installing piping that is to be concealed, the following and similar connections shall not be concealed: unions, tubing fittings, running threads, right and left couplings, and swing joints made by combinations of fittings.

Standard long sweep pipe fittings shall be used for changes in direction; no mitered joints or unapproved pipe bends will be permitted.

Tee connections shall be made with screwed tee fittings or butt, or, where pipe is being welded, branch connections may be made with either butt or socket welding tees or forged branch outlet fittings, either being acceptable without size limitation. Branch outlet fittings, where used, shall be forged, flared for improved flow where attached to the run, reinforced against external strains, and designed to withstand full

pipe-bursting strength requirements.

Horizontal piping shall have a grade of 1 inch per 100 feet (0.08 percent).

Reducers shall be concentric or eccentric. Eccentric reducers shall be used where required to permit proper drainage of pipe lines. Bushings as reducers are not permitted. Drain valves shall be provided in all piping systems at low points.

Installation of piping shall be such as to prevent stresses and strains from being placed on connected equipment.

Dielectric connection shall be provided at inlet side to building pressure regulator.

Expansion bends in steel pipe shall be made from pipe sections and long radius welding elbows in sizes 1 inch and larger. Expansion U-bends shall be cold sprung and welded into the line, which shall be anchored before removing the spreader from the expansion U-bend. Amount of cold spring shall be as indicated.

3.1.2 Joints

Joints larger than 1-inch ips shall be welded.

Pipe ends shall be reamed before joint connections are made.

Screwed joints shall be made up with joint compound.

Joint compounds shall be applied to the male thread only, and care shall be exercised to prevent compound from reaching the interior of the pipe.

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.

Flanged joints shall be assembled with appropriate flanges, gaskets, and bolting. Clearance between flange faces shall be such that the connections can be gasketed and bolted tight without imposing undue strain on the piping system. Flange faces shall be parallel and the bores concentric. Gaskets shall be centered on the flange faces without projecting into the bore. Bolting shall be lubricated with oil and graphite before assembly to ensure uniform bolt stressing. Flange bolts shall be drawn up and tightened in staggered sequence in order to prevent unequal gasket compression and deformation of the flanges. Wherever a flange with a raised face is joined to a companion flange with a flat face, the raised face shall be machined down to a smooth matching surface and a full face gasket shall be used. After the piping system has been tested and is in service at its maximum temperature, bolting shall be retightened to achieve minimum gasket seating stress recommended by the gasket manufacturer. Only hex-head nuts and bolts shall be used.

Gasket material shall be fresh stock.

Uncoated metallic gaskets shall be assembled with specified compound.

Field-welded joints shall conform to the requirements of the AWS-02 and ASME B31.1.

Copper tubing for solder joints shall be cut square, and burrs shall be removed with approved cutting and reaming tools. Inside surfaces of fittings and outside surfaces of tubes in joint area shall be cleaned with steel wool before assembly of joint. Joint flux, solder, and heat source shall be applied in accordance with the manufacturer's instructions to provide proper capillary action to fill the socket space and to achieve 100 percent shear-line strength. Valves in copper piping shall have screwed ends with end adapters to suit mechanical connections, unless solder jointing is specified or indicated for a given application. Copper joints that fail pressure tests shall be remade with new materials, including pipe or tubing fittings and filler metal.

Copper tubing for mechanical joints shall be cut square, and burrs shall be removed with approved cutting and reaming tools. Care shall be exercised not to work-harden copper surfaces during flaring and, in case of doubt, tube ends shall be cut off and annealed by heating and air cooling in accordance with the manufacturer's instructions.

3.1.3 Piping Supports

Supporting elements for natural gas pipe and tubing shall be as specified in Section 15050, "Basic Mechanical Materials and Methods". Installation shall be as specified in that section, except that support spacing shall not exceed the maximum indicated below, to comply with NFPA 54.

Steel Pipe Nominal Size (inches)	Support Spacing (feet)	Copper Tubing Nominal Size (inches)	Support Spacing (feet)
up to 1/2	6	up to 1/2	4
3/4 or 1	8	over 1/2 up to 3/4	6
1-1/4 and up (horizontal)	10	over 3/4 up to 1	8
1-1/4 and up (vertical)	at each floor level		

3.1.4 General Service Valve Locations

Aboveground valves for natural gas service shall be ball valves, Type BAV-NG, unless otherwise indicated.

Valves shall be located to permit isolation of branch piping and each equipment item from the balance of the system and to allow safe and convenient access without moving equipment and with a minimum of piping and equipment disassembly.

Valves shall be provided in piping mains and branches and at equipment where indicated and where specified.

No valve shall be placed in an inaccessible space.

3.2 NATURAL GAS SYSTEMS TESTING

3.2.1 Tests

Prior to acceptance of the work, the Contractor shall test completed systems in the presence of the Contracting Officer.

Tests shall be pneumatic and shall utilize dry, oil-free nitrogen. Testing

shall be done in two stages, preliminary and acceptance.

Personnel not directly involved in pneumatic testing of ferrous piping in excess of 5 psi shall be evacuated from the area.

Testing of any system for any purpose shall include preliminary testing by the process of swabbing of all joints under test with standard high-film-strength soap solution conforming to MS MIL-L-25567, and the subsequent observation for bubbles at internal pressures not in excess of 5 psi.

When testing reveals that leakage exceeds specified limits, the leaks shall be isolated and repaired, defective materials shall be replaced where necessary, and the system shall be retested until specified requirements are met. Leaking gasket joints shall be remade with new gaskets and new flange bolting. Removed bolting and gaskets shall not be used again. Leaking tubing joints shall be remade with new fittings and new tube ends.

Only standard piping flanges, plugs, caps, and valves shall be used for sealing off piping for test purposes.

Components that could sustain damage due to test pressure shall be removed from piping systems during testing. Piping system components such as valves shall be checked for proper operation under system test pressure.

No test media shall be added to a system during a test for a period specified or determined by the Contracting Officer.

Duration of a test will be determined by the Contracting Officer and shall be for a minimum of 15 minutes with a maximum of 24 hours. Tests may be terminated by the Contracting Officer at any point during this period after it has been determined that the permissible leakage rate has not been exceeded.

Test material shall be retained in piping system after successful testing until purged by natural gas. No ambient air shall be permitted to enter piping system.

Records of piping systems tests shall be prepared and maintained. Records shall show Governmental and Contractor test personnel responsibilities, dates, test gage identification numbers, ambient temperatures, pressure ranges, rates of pressure drop, and leakage rates. Each acceptance test shall require the signature of the Contracting Officer.

3.2.2 Test Gages

Contractor's test gages shall have dial size 4-1/2 inches or larger with accuracy of plus or minus one-half of 1 percent of full-scale range. Dial graduations and pointer width shall be compatible with readability to one-half the accuracy extremes. Maximum permissible scale range for a given test shall be such that the pointer during a test shall have a starting point 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 days prior to the test, and shall show test gage number and the project number.

3.2.3 Acceptance Pressure Testing

Testing shall take place during steady ambient temperature conditions.

Ferrous piping systems shall be tested at 75 psig.

Any reduction of test pressures shall be deemed to indicate the presence of leaks which shall be corrected unless the pressure loss can otherwise be accounted for. A correction of plus or minus 0.3 psi will be allowed for each degree change between initial and final system temperature, plus for an increase in temperature and minus for a decrease.

Test duration shall be long enough to determine if there are any leaks but not less than 1 hour for each 500 cubic feet of pipe volume or fraction thereof, except that when testing a system having a volume of less than 10 cubic feet, the test duration may be reduced to 15 minutes. For piping systems having a volume of more than 24,000 cubic feet, the duration of the test shall be 24 hours.

Control and instrumentation tubing systems shall be tested at 30 psi and the test pressure shall be maintained for a period of not less than 24 hours with no pressure drop.

3.2.4 Purging of Piping

During construction, where necessary, purge valves shall be provided and located to ensure complete system purging with discharge exterior to the building.

3.2.5 Lighting of Pilot Lights

Equipment using natural gas under this Contract shall be lighted in the presence of the Contracting Officer.

3.3 ELECTRICAL WORK

3.3.1 Electrical Service

Available power is as indicated on the drawings. Contractor equipment with voltage requirements other than that specified shall have transformer equipment. Contractor shall refer to the electrical drawings and Division 16, "Electrical," of these specifications for specific information on the arrangement of electrical circuits and their effect on the equipment and work required.

3.3.2 Electrical Bonding and Grounding

Each aboveground portion of gas piping system upstream of the equipment shutoff valve shall be electrically continuous and bonded to any grounding electrode, in accordance with NFPA 70.

3.3.3 Electrical Circuits

Electrical circuits shall not utilize gas piping or components, except that low voltage (50 volts or less) control circuits, ignition circuits, and electronic flame detection device circuits may use piping or components for a part of an electrical circuit.

An electrically operated normally open safety control shall be provided to shut off the flow of gas if the power fails.

3.4 OPERATIONAL READINESS REVIEW (ORR)

Conduct an Operational Readiness Review (ORR) for piping system, in accordance with Section 01770, "Task Order Closeout", in conjunction with ORR for connected equipment.

Piping system ORR shall include location and operation of all valves, specialties, and controls.

-- End of Section --

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SECTION 15211

LOW-PRESSURE COMPRESSED AIR SYSTEMS

03/98

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SECTION 15211

LOW-PRESSURE COMPRESSED AIR SYSTEMS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 181/A 181M	(1995; Rev B) Standard Specification for Forgings, Carbon Steel, for General-Purpose Piping
ASTM A 234/A 234M	(1999) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
ASTM A 278M	(1993; Rev E1) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 345 Degrees C (Metric)
ASTM A 53/A 53M	(2001) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1999; Rev E1) Standard Specification for Ductile Iron Castings
ASTM B 280	(1999) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 62	(1993) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM D 1693	(2000) Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics
ASTM D 2239	(1999) Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR), Based on Controlled Inside Diameter
ASTM D 4080	(1996) Standard Specification for Trichloroethylene, Technical and Vapor-Degreasing Grade
ASTM E 1	(1998) Standard Specification for ASTM Thermometers

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B19.1	(1995) Safety Standard for Air Compressor Systems
ASME B31.9	(1996) Building Services Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels, Division 1, Basic Coverage

AMERICAN WELDING SOCIETY (AWS)

AWS-02	(1990) Welding Handbook; Eighth Ed; Vol Two - Welding Process

FEDERAL SPECIFICATIONS (FS)

FS L-C-530	(1987 Rev C) Coating, Pipe, Thermoplastic Resin

INSTRUMENT SOCIETY OF AMERICA (ISA)

ISA S7.0.01	(1996) Quality Standard for Instrument Air

MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application

1.2 GENERAL REQUIREMENTS

This section applies only to compressed air systems with operating pressures of 125 psig or less.

Section 15003, "General Mechanical Provisions," applies to work specified in this section. All installation or modification of piping and components defined as pressure vessels and pressurized systems (PV/S) in Section 15055, "Welding and Pressure Vessels/Systems", shall comply with applicable requirements of that section

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Control Diagrams shall be submitted for the following items:

Air Compressors
Air Dryers

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Underground Piping Materials
Aboveground Piping Materials
Piping Specialities
Supporting Elements
Air Compressors
Valves
Accessories
Vibration Isolation
Air Dryers
Air Filters
Pressure Reducing Valves
Pressure Relief Valves

SD-05 Design Data

Design Analysis and Calculations for low-pressure compressed air systems shall consist of the following items:

Flow Rates
Air Distribution
Pressure Requirements
Insulation Requirements

SD-05 Design Data

Equipment and Performance Data submitted for Piping Systemsshall show conformance with ASME Code.

SD-06 Test Reports

Test Reports shall be submitted for the following items in accordance with the paragraph entitled, "System Testing," of this section.

Preliminary Stage (Leakage) Test
Acceptance Stage (Pneumatic) Test

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the low-pressure compressed air systems, in accordance with Section

01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

SD-11 Closeout Submittals

PV/S Certification Records shall be submitted for compressed air PV/S piping and components, for approval and Certification prior to pressurization and operation. Pressure vessels and pressurized systems (PV/S), and the required contents of the PV/S Certification Records, shall be as defined in Section 15055, "Welding and Pressure Vessels/Systems"

1.4 GENERAL REQUIREMENTS

Section 15055, "Welding and Pressure Vessels/Systems" applies to work specified in this section.

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 A 53/A 53M, Type E or S, in sizes through 10-inch iron pipe size (ips). Pipe in size 12 inches and larger shall have Schedule 40 wall. Pipe wall shall be 0.375 inch thick.

Thermoplastic sheath shall conform to FS L-C-530. Sheath joints shall be made with thermally fitted shrinking sleeves applied with factory-approved shrinking devices. Taped fitting protection and repairs shall be made 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 long radius butt weld carbon steel conforming to ASTM A 234/A 234M and ASME B16.9 to match pipe wall thickness. Bending of pipe shall not be permitted. Aboveground terminal fittings shall be 150-pound forged steel weld neck flanges to match wall thickness, conforming to ASME B16.5 and ASTM A 181/A 181M Class 60.

2.1.3 Detectable Marking Tape

Detectable marking tape shall be acid and alkali resistant polyethylene film manufactured for marking and identifying underground utilities, 6 inches wide, 4 mils thick, continuously inscribed with utility name, with a metallic core, encased in a protective jacket for corrosion protection, detectable by a metal detector when tape is buried up to 30 inches deep. Color shall be blue.

2.2 ABOVE GROUND PIPING MATERIALS

2.2.1 Compressed Air Systems 125 Psig and Less

Pipe and fittings shall be Type BCS Black Carbon Steel as specified in

Section 15050, "Basic Mechanical Materials and Methods".

Lines DN25 and under may be Type CPR-AG, copper tubing, as specified in Section 15050, "Basic Mechanical Materials and Methods".

Provide dielectric couplings or unions at all joints between steel and copper.

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 (exposed) or annealed (concealed) seamless copper, conforming to ASTM B 280.

Fittings shall be solder joint wrought copper conforming to ASME B16.22.

Ball sleeve shall be of the compression type, forged brass, 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-02.

2.2.2.2 Polyethylene

Tubing shall be black virgin polyethylene, conforming to ASTM D 2239, Type I, Grade 2, Class C, conforming to stress-crack tests performed in accordance with ASTM D 1693. Multitube harness with polyester film barrier and vinyl jacket shall not be less than 0.062 inch thick.

Ball sleeve fittings shall be of the compression type, and shall be brass.

2.3 PIPING SPECIALTIES

2.3.1 Air Pressure Reducing Stations

Pressure reducing station shall be installed 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.

Pressure regulator body shall be constructed 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 nonferrous or suitable nonmetallic materials. Valves shall be of a balanced construction relieving type to automatically prevent excess pressure buildup.

Filters shall be constructed of zinc or 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. Bowl shall be equipped with manual drain cock. Liquid particles shall be separated by centrifugal and quiet zone action. Solid particles to 15-micrometer size shall be removed by filter elements of sintered bronze or corrosion-resistant steel mesh.

Pressure relief valves shall be rated for the pressure of the high-pressure side and sized for the full installed capacity of the pressure regulating station at the pressure of the low-pressure side. Valve shall be set at not more than 20 percent more than the correct low side pressure. Valve

shall be rated and labeled. 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. Such vessels shall be designed for the applicable working pressures and service in accordance with the ASME BPV VIII Div 1, and shall be labeled.

Receivers with tank-mounted compressors shall be factory-assembled, constructed, and labeled as a unit in accordance with ASME BPV VIII Div 1.

Vessels shall be complete with connections for drain, supports, and other required accessories.

2.3.4 Pressure Gauges

Pressure gauges shall be as specified in Section 15050, "Basic Mechanical Materials and Methods" for pressures indicated.

2.3.5 Thermometers

Thermometers shall be as specified in Section 15050, "Basic Mechanical Materials and Methods", with range as required for service.

2.3.6 Line Strainers

Strainers shall be Y-type 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. Strainer bodies fitted with screwed screen retainers shall have straight threads and shall be gasketed with nonferrous metal. Strainer bodies fitted with bolted-on screen retainers shall have offset blowdown holes. Strainers larger than 2-1/2-inches shall be fitted with manufacturer's standard blowdown valve. Body material shall be cast bronze conforming to ASTM B 62 or cast iron conforming to ASTM A 278 Class 30 or ductile iron conforming to ASTM A 536. Where system material is nonferrous, strainer body material shall be nonferrous.

Minimum free-hole area of strainer element shall be not less than 3.4 times the internal area of connecting piping. Strainer screens for air service shall have mesh cloth not to exceed 0.006 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 or 316 corrosion-resistant steel or Monel metal.

2.4 AIR COMPRESSOR

When indicated one or more air compressors of the oil-free piston type shall be provided complete with air tank, air dryer, filters, and other appurtenances. Where two compressors are indicated, provide two complete units, duplex compressors sharing tanks and other components are not acceptable. Compressor and installation shall conform to ASME B19.1. Compressor capacity shall be as indicated. Air dryers shall be of the mass refrigerated dryer type and shall maintain the air in the system with a dew point low enough to prevent condensation 13 degrees F at 18 psi main pressure. Air dryer shall be located at the outlet of the tank. Air delivered to the system shall conform to ISA S7.0.01, including filtration to 3 microns and hydrocarbon content not greater than 1 part per million.

2.5 VALVES

2.5.1 Ball Valves (BAV)

Ball valves shall be Type BAV as specified in Section 15050, "Basic Mechanical Materials and Methods", and shall be Class 150.

2.5.2 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.

2.5.3 Gauge Cocks (GC)

Gauge cocks shall be be as specified in Section 15050, "Basic Mechanical Materials and Methods".

2.5.4 Gate Valves (GAV)

Gate valves shall be Type GAV-150 as specified in Section 15050, "Basic Mechanical Materials and Methods".

2.5.5 Globe and Angle Valves (GLV and ANV)

Globe and angle valves shall be type GLV-150 and ANV-150 as specified in Section 15050, "Basic Mechanical Materials and Methods".

2.6 MISCELLANEOUS MATERIALS

Miscellaneous materials shall be as specified in Section 15050, "Basic Mechanical Materials and Methods".

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.

Supporting elements shall be FM-approved or UL-listed and shall conform to requirements of ASME B31.9, MSS SP-58, and MSS SP-69, except as otherwise noted, and shall be as specified in Section 15050, "Basic Mechanical Materials and Methods".

PART 3 EXECUTION

3.1 UNDERGROUND PIPING SYSTEM INSTALLATION

3.1.1 Compressed Air System Installation

Installation of compressed air systems shall be performed in accordance with the manufacturer's instructions. Installation shall be in the presence of the Contracting Officer who shall be notified by the Contractor 48 hours in advance of the work.

Excavations shall be in accordance with Section 02300, "Earthwork".

Piping shall be laid beginning at the low point of a system, and when in final position, shall be true to the grades and alignment with unbroken continuity of invert.

Blocking and wedging shall not be permitted.

Pipes passing through walls below grade and ground floor slab shall pass through pipe sleeves.

All repairs to concrete shall be in accordance with Section 03900, "Concrete Restoration and Cleaning."

In fill areas, pipe passing under or through building grade beams shall have a minimum of 4 inches clearance in all directions.

Where pipe penetrates earth or concrete grade, not less than 12 inches of polyethylene-coated Type BCS-PS pipe shall be exposed to view.

Type BCS-PS materials shall be installed in accordance with the applicable requirements for underground piping and aboveground piping. Pipe shall be palletized in padded pallets at the factory and shall be handled from pallet to final position with padded gear. Surfaces shall be protected from the sun with black polyethylene sheeting. Prior to being lowered into a trench, sheathing shall be checked for continuity with 10,000 volts applied by a continuity detector. In the trench, after joints and fittings are made, previously untested surfaces shall be checked for continuity. Where discontinuities in thermoplastic are found, not less than 12 inches of material upstream and downstream of fault shall be discarded.

After valves, valve operators, and valve boxes have been inspected and not less than 48 hours prior to being lowered into a trench, external surfaces 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, and shall result in a dry-film thickness of not less than 12 mils.

3.1.2 Valve Boxes

Valves and valve boxes shall be set plumb. Valve boxes shall be centered on the valves.

Concrete slabs 4 inches thick shall be provided to protect valve boxes.

3.1.3 Underground Marking Tape

Underground marking tape shall be installed above the piping during the

trench backfilling and shall be buried approximately 300 millimeters below final grade.

3.2 ABOVE GROUND PIPING SYSTEM INSTALLATION

3.2.1 Piping Systems

Welding, and installation of piping and components defined as PV/S in Section 15055, "Welding and Pressure Vessels/Systems", shall comply with the requirements of that section.

Piping systems shall be fabricated and installed in accordance with ASME B31.9, MSS SP-69, and applicable AWS requirements.

Pipe shall be fabricated to measurements established on the job and shall be carefully worked into place without springing or forcing.

Pipe, tubing, fittings, valves, equipment, and accessories shall be clean and free of all foreign material before being installed in their respective systems. Pipe shall be cleaned by a method approved by the Contracting Officer. Lines shall be purged with dry, oil-free compressed air after erection, but purging shall not be relied upon for removing all foreign matter. Lines shall be purged at a velocity equal to 1-1/2 times maximum normal flow velocity. During the progress of construction, open ends of pipe, fittings, and valves shall be protected at all times to prevent the admission of foreign matter. Except when connections are actually underway, plugs or caps shall be installed on all pipe and component openings. Plugs or caps shall be commercially manufactured products.

Piping shall be installed straight and true, with approved offsets around obstructions and with necessary expansion bends or fitting offsets essential to a satisfactory installation and as may be necessary to increase headroom or to avoid interference with the building construction, electric conduit, or facilities equipment.

Standard long sweep pipe fittings shall be used for changes in direction. No mitered joints or unapproved pipe bends shall be permitted.

Pipe bends in seamless pipe may be made with hydraulic benders in the field for pipe sizes to 4-inch ips, upon approval of the Contracting Officer. Radius of pipe bends shall be not less than five nominal pipe diameters.

Tee connections shall be made with screwed tee fittings or grooved tee fittings, or, where pipe is being welded, branch connections shall be made with either welding tees or forged branch outlet fittings, either being acceptable without size limitations. Branch outlet fittings shall be forged, flared for improved flow where attached to the run, reinforced against external strains, and designed to withstand full burst-pressure strength requirements. Tool space shall be provided between parallel piping runs whenever threaded unions or couplings are installed.

Horizontal piping shall have a grade of 1 inch per 100 feet.

Eccentric reducers shall be used where required to permit proper drainage of pipe lines. Bushings shall not be permitted for this purpose. Drain valves shall be provided in piping systems at low points. Pipe drains shall consist of 1/2-inch globe valves with renewable disks and 3/4-inch hose adapter.

Installation of piping shall be performed in a manner that will prevent stresses and strains from being imposed on connected equipment.

Expansion bends in steel pipe shall be made from pipe sections and long-radius welding elbows in sizes 1 inch and larger. Expansion U-bends shall be cold sprung and welded into the line. Line shall be anchored before removing the spreader from the expansion U-bend.

3.2.2 Penetrations

Piping penetrations through floors, walls, roofs and partitions shall be in accordance with Section 15050, "Basic Mechanical Materials and Methods".

3.2.3 General Service Valve Locations

Valves shall be provided 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.

Valves shall be provided in piping mains and branches at equipment and equipment items.

Riser and downcomer drains shall be provided above piping shutoff valves in piping 2-1/2 inches and larger. Shutoff valve body shall be tapped and fitted with a 1/2-inch plugged globe valve.

Three-valve bypass shall be provided around each pressure-regulating valve.

Valves unavoidably located in furred or other normally inaccessible places shall be provided with access panels.

3.2.4 Bypass Throttling Valves

Valves shall be globe type with composition disc.

3.2.5 Supporting Elements Installation

Supporting elements shall be provided in accordance with the requirements of ASME B31.9, MSS SP-58, MSS SP-69, and Section 15050, "Basic Mechanical Materials and Methods".

3.3 PRESSURE VESSELS/SYSTEMS (PV/S) CERTIFICATION

All installation or modification of compressed air PV/S piping and components shall comply with the requirements of Section 15055, "Welding and Pressure Vessels/Systems", and PV/S Certification Records shall be prepared as indicated in that section. This data shall be submitted and approved, and the system or components Certified by the Government, prior to pressurization and operation.

3.4 COMPRESSED AIR SYSTEMS TESTING

Prior to acceptance of the work, completed systems shall be pressure-tested in the presence of the Contracting Officer.

Testing shall be done in two stages: preliminary stage and acceptance stage, including gauge tests.

No testing shall be performed until personnel not directly involved in the test have been evacuated from the area.

Contractor may conduct tests for his own purposes, but preliminary testing and the acceptance test shall be conducted as specified.

When testing reveals that leakage exceeds specified limits, the leaks shall be isolated and repaired, defective materials shall be replaced where necessary, and the system shall be retested until specified limits are met. Leaking gasket joints shall be remade with new gaskets and new flange bolting, and used bolting and gaskets shall be discarded.

Other than standard piping flanges, plugs, caps and valves, only commercially manufactured expandable elastomer plugs shall be used for sealing off piping for test purposes. Published safe test pressure rating of any plug used shall be not less than three times the actual test pressure being applied. During pneumatic or hydrostatic testing, personnel shall be evacuated from areas where plugs are used.

Components that could be damaged by test pressure shall be removed from piping systems to be tested.

Piping system components, such as valves, shall be checked for proper operation under system test pressure.

Test records of all piping systems tests shall be prepared and maintained. Records shall show Governmental and Contractor test personnel responsibilities, dates, test gauge identification numbers, ambient temperatures, pressure ranges, rates of pressure drop, and leakage rates.

3.4.1 Preliminary Stage Tests

Tests shall be pneumatic and shall use dry, oil-free compressed air.

Testing of any system for any purpose shall include preliminary testing by swabbing joints under test with standard high-strength film soap solution and observing for bubbles at internal pressures not in excess of 5 psi. All visible leaks shall be repaired and the system retested prior to the acceptance tests.

3.4.2 Test Gauges

Contractor's test gauges shall conform to ASME B40.1 and shall have a dial size of 8 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 days prior to test use, test gauge number, and the project number, unless otherwise approved by the Contracting Officer.

3.4.3 Acceptance Pressure Testing

Testing shall take place during steady-state ambient temperature conditions.

Piping systems shall be tested at 1-1/2 times maximum operating pressure. Test pressure shall be maintained for a period of not less than 2 hours with an allowable pressure drop of 2 psi during that time unless otherwise approved by the Contracting Officer. No test media shall be added to a system during a test for the period specified.

3.5 COMPRESSED AIR SYSTEM CLEANING

Rust and dirt shall be removed from the bore and exterior surface of all piping and equipment. Pipeline strainers, temporary and permanent, shall be cleaned during purging operations, after startup, and immediately prior to final acceptance by the Government.

New steel piping shall be flushed with trichloroethylene conforming to ASTM D 4080, Type 1, until visible grease, dirt, and other contaminants have been removed.

3.6 OPERATIONAL READINESS REVIEW (ORR)

Provide an Operational Readiness Review (ORR), in accordance with Section 01770, Task Order Closeout". ORR shall include a complete walkthrough of the system identifying locations of all valves, controls and equipment. ORR for compressors, air dryers and controls shall include demonstration of all operating modes of the equipment.

-- End of Section --

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PLUMBING FIXTURES

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SECTION 15410

PLUMBING FIXTURES
08/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z358.1	(1990) Emergency Eyewash and Shower Equipment
ANSI Z535.1	(1991) Safety Color Code for Marking Physical Hazards

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 1010	(1994) Drinking Fountain and Self Contained, Mechanically Refrigerated Drinking Water Coolers

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.18.1	(2000) Plumbing Fixture Fittings
ASME A112.19.1M	(1994; R 1999) Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2M	(1998) Vitreous China Plumbing Fixtures
ASME A112.19.3M	(1987; R 1996) Stainless Steel Plumbing Fixtures Designed for Residential Use
ASME A112.21.1M	(1991; R 1998) Floor Drains
ASME A112.6.1M	(1997) Floor Affixed Supports for Off the Floor Plumbing Fixtures for Public Use
ASME B1.20.7	(1991; R 1998) Hose Coupling Screw Threads (Inch)
ASME B1.21M	(1997) Metric Screw Threads - MJ Profile

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 424	(2000) Standard Specification for Steel Sheet for Porcelain Enameling
ASTM A 74	(1998) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM B 43	(1991) Standard Specification for Seamless

	Red Brass Pipe, Standard Sizes
ASTM C 282	(1989) Acid Resistance of Porcelain Enamels (Citric Acid Spot Test)

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1016	(1996) Individual Thermal Static Pressure Balancing and Combination Control Valves for Bathing Facilities

FEDERAL STANDARDS (FED-STD)

FED-STD 795	(1988) Uniform Federal Accessibility Standards

INTERNATIONAL CODE COUNCIL (ICC)

ICC IPC	(2000) International Plumbing Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-86	(1997) Guidelines for Metric Data in Standards for Valves, Flanges, Fittings and Actuators

NATIONAL SANITATION FOUNDATION (NSF)

NSF 61	(2000; Rev A) Drinking Water System Components - Health Effects

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

Plumbing Fixtures and Trim
Sanitary Drain, Waste and Vent Fixtures

SD-05 Design Data

Equipment Schedules shall be submitted for the items listed below. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

Plumbing Fixtures and Trim
Sanitary Drain, Waste and Vent Fixtures

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the items listed below, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

Plumbing Fixtures and Trim

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the following items, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

Plumbing Fixtures and Trim

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to this section.

1.4 REGULATORY REQUIREMENTS

Comply with requirements of FED-STD 795 with regard to plumbing fixtures for physically handicapped people.

Comply with requirements of ICC IPC regarding plumbing fixture materials and installation.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver plumbing fixtures in manufacturer's protective packing, crating, and covering. Store plumbing fixtures on elevated platforms in dry locations.

PART 2 PRODUCTS

2.1 GENERAL

Provide fixtures of types defined herein and of the size and capacities indicated. All water supply fixtures and components shall be certified as complying with NSF 61.

2.2 PLUMBING FIXTURES AND TRIM

Provide fixtures with accessories for a complete installation, such as supply fittings, angle valves, escutcheons, couplings, nuts, drain fittings, and strainers, even if the accessories are not specifically called out herein. Rubber compression type connections are not acceptable and brass ferrule type fittings are required.

Obtain plumbing fixtures, faucets, and other components of each category from the same manufacturer, unless otherwise specified. Manufacturer shall

be a company of established reputation in the manufacture of plumbing fixtures and one that assembles the plumbing outfits and assumes responsibility for all products supplied.

Exposed traps and double-cone supply tubes for fixtures and equipment shall be connected to rough-piping at the wall, unless otherwise specified. Floor and wall plates shall be as specified herein or as covered by the outfit numbers. Exposed-to-view fixture trimmings, shut-off valves,fittings, and fasteners shall be chromium-plated or nickel-plated brass with polished, bright surfaces.

Exposed-to-view fixture supports shall be enameled iron to match the fixture.

Supplies and wastes for lavatories shall be to wall. Sleeves are not required at penetrations.

2.2.1 Fixture Supports

Wall-hung fixtures shall be supported by ferrous-metal carriers. Where specified, carriers shall be combination type with adjustable fittings. Water closets and urinals shall have supporting feet not less than 10 inches long, unless construction requires shorter feet or bases.

Lavatories shall be supported from the wall by wall carriers with concealed arms.

Lavatories shall be supported by carriers with concealed adjustable arms and supporting feet not less than 10 inches long.

Supporting arms of slab-type lavatories shall be concealed by secure deep-drawn, chrome-plated covers.

Supporting feet shall have not more than 1-1/2 inches of concrete topping over structural slab for effective concealment.

2.2.2 Lavatories

New lavatories shall be type L-C-CI unless otherwise indicated

Type L-S: Lavatories shall be slab type, wall hung, 20 by 18 inches. Inside opening shall be substantially rectangular. Lavatory shall be vitreous china and shall comply with ASME A112.19.2M, Figure 19, with concealed-arm carrier.

Type L-B: Lavatories shall be straight back, 20 by 18 inches. Inside opening shall be substantially rectangular. Lavatory shall be vitreous china and shall comply with ASME A112.19.2M, Figure 16, with concealed-arm carrier.

Type L-SS: Lavatories shall be countertop type, self-rimming with rounded rim corner and back ledge, front overflow, oval shaped, seamless, and mirror finish. Materials shall be 18-gage, corrosion-resistant steel conforming to ASTM A 424, AISI Class 302, A (annealed). Approximate internal size of the lavatory shall be 15-1/2 by 11-3/8 by 6 inches deep. Bowls shall be coated externally with sound deadening, nonmarring mastic. Lavatory shall be vitreous china and shall comply with ASME A112.19.3M

Type L-C-CI: Lavatories shall be countertop type, self-rimming with

rounded rim corner and back ledge, front overflow, oval shaped, white finish, enameled cast iron. Approximate internal size of the lavatory shall be 400 by 300 by 150 millimeter deep. Lavatory shall comply with ASME A112.19.1M.

Supply fittings shall conform to applicable requirements for faucets in ASME A112.18.1.

Supply fitting shall be a 4-inch centerset type with a vandalproof aerator. Maximum flow rate shall be 1.5 gallons per minute when tested in accordance with ASME A112.18.1 with a supply pressure of 60 pounds per square inch (gage).

Faucet shall be occupancy-sensor type, and shall include ADA-compliant infrared sensor-actuator with sensor on body, battery with low battery indicator on body, vandal-resistant aerator, inlet filter, and mechanical mixing valve with internal temperature adjustment. Flow cycle shall be factory pre-set for a cycle duration not less than 10 seconds, and shall deliver not more than 0.25 gallons per cycle. Faucets shall be "Z 6912" series (standard) or "Z 6920" series (gooseneck) by Zurn, or equal.

Standard supply fitting spout angle and length over the bowl shall provide a water-free back ledge. Horizontal distance from the centerline of the spoutless aerator to the centerline of the supply piping shall be not less than 4-3/8 inches, and the vertical distance between the centerline of the spout (less aerator) and the fitting base shall be not less than 2-1/2 inches.

Unless otherwise noted, provide one lavatory per restroom with a gooseneck type spout, in lieu of the standard spout described above.

All new lavatories shall be mounted so as to be "accessible" to comply with FED-STD 795. Height (to front of rim or to counter, as applicable) shall be set at 865 millimeter above finished floor, and there shall be a minimum 735 millimeter clearance from fixture bottom to finished floor.

Supply piping shall be chrome-plated brass, threaded in accordance with the requirements of ASME A112.18.1.

Drain fittings shall conform to ASME A112.18.1, strainer drain, unless otherwise specified, but with perforated removable strainer and 1-1/4-inch tailpiece. Adjustable P-trap, with cleanout, shall be Type I.

Corrosion-resistant steel lavatories shall be equipped with corrosion-resistant steel drain fittings.

2.2.3 Service Sinks

Service sinks and fittings shall conform to ASME A112.18.1. Maximum flow rate shall be limited to 2.5 gallons per minute at a supply pressure of 80 pounds per square inch (gage).

Type SS-W: Service sinks shall be single bowl, mounting trap standard with high nondrilled back, and without a finished apron. Supply fitting shall be a 10-inch chrome-plated spout, Type SS-W, single, compression, with vacuum breaker and 4-foot hose with holding bracket. Supplies shall be chrome-plated brass without valves.

Waste shall be to the wall. P-trap shall be cast iron with acid-resisting

enamel inside, brass clean-out plug, and strainer.

Type SS-F: Service sinks shall be single bowl, mounting floor with high nondrilled back, floor-corner mounted, curved or straight front, and molded fiberglass with rim guard. Approximate size of the sink shall be 28 by 28 inches overall, 13 inches back height from the floor, and 6 inches deep. Supply fitting shall be single, compression, with vacuum breaker and 4-foot hose with holding bracket. Drain fitting shall be 3 inches.

2.2.4 Urinals

Vitreous china urinals shall be wall-mounted low consumption type, siphon jet operation, comprised of flushing rim and extended sides, integral trap, and back connected. Rim height (to front center of rim) shall be set at 610 millimeter above finished floor for standard fixtures, or at 430 millimeter above finished floor for fixtures designated as "accessible" to comply with FED-STD 795. Urinals shall be "Trimbrook 1.0" by American Standard, or approved equal.

Flushometer valve shall be exposed, diaphragm operated with lever handle actuation and non-hold open feature. Valve construction shall consist of cast-brass body, brass or copper pipe or tubing inlet with wall flange and tail piece with spud, screw driver check stop and vacuum breaker. All exposed metal parts shall be polished chrome-plated.

Water consumption shall not exceed 1.0 gallons maximum per flushing cycle.

Piping connection between the flush valve and urinal shall be 1 inch, Schedule 40, red-brass pipe conforming to ASTM B 43, with fittings conforming to MSS SP-86. Fittings shall be brazed type wherever possible.

2.2.5 Wash Sinks

Wash sinks and fittings shall conform to ASTM A 424.

Type LS-SS: Laboratory sinks shall be single bowl, flat iron, beadless, self-rimming, ledge back, rounded-rim corner, with 2-1/2-inch (maximum) bowl-bottom radius, seamless, and a mirror finish. Material shall be 18-gage, corrosion-resistant steel conforming to Class AISI 316, annealed. Approximate size of the sink shall be 24 by 20 inches overall, 21 by 17 inches inside bowl, and 6-1/2 inches deep. Bowl shall be coated with sound-deadening, nonmarring mastic. Edge-back punchings shall be compatible with supply fitting. Location shall center the spout length over the bowl opening.

Bowl and waste fitting shall be suitable for front overflow.

Supply fitting shall conform to ASME A112.18.1. Maximum flow shall be restricted to 2.5 gallons per minute at a supply pressure of 80 pounds per square inch (gage)

Supply fitting shall be single-hole, deck-mounted type, with a 12-inch swing spout, universal-joint aerator, and heavy-duty lever.

Waste fitting shall be a cup strainer with drain plug fabricated from AISI 300 series corrosion-resistant steel.

P-traps shall be 1-1/2-inch corrosion-resistant steel or heavy-duty cast brass or cast bronze, adjustable, with cleanout.

2.2.6 Laboratory Sinks

Wash sinks and fittings shall conform to ASTM A 424.

Type WS-SS: Wash sinks shall be single bowl, flat iron, beadless, self-rimming, ledge back, rounded-rim corner, with 2-1/2-inch (maximum) bowl-bottom radius, seamless, and a mirror finish. Material shall be 18-gage, corrosion-resistant steel conforming to Class AISI 316, annealed. Approximate size of the sink shall be as indicated. Bowl shall be coated with sound-deadening, nonmarring mastic. Edge-back punchings shall be compatible with supply fitting. Location shall center the spout length over the bowl opening.

Bowl and waste fitting shall be suitable for front overflow.

Supply fitting shall conform to ASME A112.18.1. Maximum flow shall be restricted to 2.5 gallons per minute at a supply pressure of 80 pounds per square inch (gage)

Supply fitting shall be a gooseneck type with universal-joint aerator and single hole, deck mounted, and heavy-duty lever.

Provide hose faucet(s) as indicated. Hose faucets shall be constructed with 15 millimeter male inlet threads, hexagon shoulder, and 20 millimeter hose connection, confirming to ASME A112.18.1 Hose-coupling screw threads shall conform to ASME B1.20.7 and ASME B1.21M. Vandalproof, atmospheric-type vacuum breaker shall be provided on discharge unless faucet is on a laboratory or non-potable line isolated from the domestic water system by backflow prevention devices.

Waste fitting shall be a cup strainer with drain plug fabricated from AISI 300 series corrosion-resistant steel.

P-traps shall be 1-1/2-inch corrosion-resistant steel or heavy-duty cast brass or cast bronze, adjustable, with cleanout.

2.2.7 Water Closets

Vitreous china water closets shall be wall-mounted, elongated bowl type, syphon jet operation, white color, complying with ASME A112.19.2M. Water consumption shall not exceed 1.6 gallons per flushing cycle, factory set or field adjusted. Rim height (top of seat) shall be set at 450 millimeter above finished floor for standard fixtures, or at 485 millimeter above finished floor for fixtures designated as "accessible" to comply with FED-STD 795. Water closets shall be "Afwall EL 1.6" and "Afwall ADA Retrofit EL 1.6" by American Standard, or approved equal.

Flushometer valve shall be exposed, diaphragm operated with lever-handle actuation and non-hold-open feature. Valve construction shall be consist of cast-brass body, brass or copper pipe or tubing inlet with wall flange and tail piece with spud, screwdriver check stop, and vacuum breaker. Finish of exposed metal parts shall be polished, chrome-plated.

Seat shall be solid-plastic with open front without cover, commercial heavy-duty classification, and compatible with water closet. Seat shall be white in color and include bumpers and hinge.

2.2.8 Shower Fittings

Shower fittings shall conform to ASME A112.18.1 with concealed piping and pressure-balancing mixing valve complying with ASSE 1016. Vandalproof flow restrictor shall limit flow to a maximum of 2.2 gallons per minute.

2.2.9 Emergency Shower and Eyewash

Emergency shower, eyewash, and emergency shower/eyewash combination shall conform to ANSI Z358.1, with markings that conform to ANSI Z535.1.

2.2.10 Electric Water Cooler

All electric water coolers shall be handicapped accessible and shall be ARI 1010, wall-mounted bubbler style with ASME A112.6.1M concealed chair carrier, air-cooled condensing unit, 4.75 gallon per hour minimum capacity, stainless steel splash receptor, and all stainless steel cabinet, with 27-inch minimum 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. CFC refrigerants are not allowed.

2.3 SANITARY DRAIN, WASTE, AND VENT FIXTURES

Sanitary drain, waste, and vent fixtures shall be Type GCS-DWV, of galvanized carbon steel.

2.3.1 Floor Drains

Floor drains shall be complete with traps.

Floor drains located in slabs on earth shall have hub outlets; those in slabs not on earth shall have threaded outlets or hub outlets, as required to match piping used.

Floor drains shall have bottom outlets.

Floor drains shall have integral seepage pans and weep holes.

Floor drains fitted with membrane or metal pan waterproofing shall have clamping collar assemblies.

Hopper drains shall be provided with grates.

Ferrous floor drain surfaces, except the top of grates, shall be given a heavy coating of coal-tar enamel. Coating shall be applied either at the factory or in the field before installation and before rusting has occurred.

Hopper drain strainers and hoppers, where indicated, shall be coated with acid-resistant enamel in conformance with ASME A112.19.2M and ASTM C 282.

Equip floor drains with trap primers where indicated on drawings. Trap primers shall be all bronze with nonferrous trim floor. Drains shall be fitted with cast-iron primer adapters.

FD-1 General Duty, with sediment bucket, for finished floors: Floor drains shall conform to ASME A112.21.1M, shower-drain type with nonferrous sediment bucket, and to the requirements specified herein. Adjustable collar, strainer, and fasteners shall be nickel-bronze; exposed-to-view

surfaces shall be satin polished. Strainer holes shall be square and strainer diameter shall be nominal 5 inches. Strainer and body shall be capable of sustaining a platen load of not less than 2,000 pounds with not more than a 1/16-inch, nonpermanent deflection when load is applied within 5 seconds. Strainer free area shall be not less than 7 square inches.

FD-2 General Duty, without sediment bucket, for finished floors: Floor drains shall conform to ASME A112.21.1M, shower-drain type, and to the requirements specified herein. Adjustable collar, strainer, and fasteners shall be nickel-bronze; exposed-to-view surfaces shall be satin polished. Strainer holes shall be square and strainer diameter shall be nominal 5 inches. Strainer and body shall be capable of sustaining platen load of 2,000 pounds at 1/16 inch maximum nonpermanent deflection when load is applied within 5 seconds. Strainer free area shall be not less than 7 square inches.

FD-3 Extended Rim, with strainer, for open-sight drain: Floor drains shall conform to ASME A112.21.1M, shower-drain type, and to the requirements specified herein. Adjustable extended collar or rim, strainer, and fasteners shall be nickel-bronze; exposed-to-view surfaces shall be satin polished. Strainer diameter shall be a nominal 7 inches. Rim depth to the strainer shall be approximately 3/4 inch, and the free area shall be approximately 13 square inches.

FD-4 Funnel Type, with strainer, for open-sight drain: Floor drains shall conform to ASME A112.21.1M, shower-drain type, and to the requirements specified herein. Adjustable collar or rim, strainer, and fasteners shall be nickel-bronze; exposed-to-view surfaces shall be satin polished. Strainer diameter shall be a nominal 7 inches with an approximately 3-1/2-inchhigh, 4-inch top opening funnel. Free area shall be approximately 4-1/2 square inches.

FD-6 General Duty, for unfinished floors: Floor drains shall conform to ASME A112.21.1M, area-drain type, and the requirements specified herein. Strainer shall be deep flanged, tractor type. Strainer and body shall be capable of sustaining a platen load of not less than 8,000 pounds, applied within 3 seconds, before failure. Cracking of the strainer or body shall be considered as failure. Strainer free area shall be not less than 17 square inches.

FD-7 Heavy Duty for unfinished floors: Floor drains shall conform to ASME A112.21.1M, area-drain type, and the requirements specified herein. Strainer diameter shall be a nominal 10 inches with a free area not less than 26 square inches. Strainer and body shall be capable of sustaining a platen load of not less than 10,200 pounds, applied within 3.8 seconds, before failure. Cracking of the strainer or body shall be considered as failure. An identical pattern ductile-iron strainer may be provided in lieu of cast iron when so specified.

FD-8 Domed Strainer Type, for depressed areaways: Areaway drains shall conform to ASME A112.21.1M, area-drain type, plain pattern, bottom outlet, except that strainer shall be domed.

2.3.2 Roof Drains

Type RD-A: Roof drains shall be heavy pattern, all cast-iron construction with integral clamping surfaces not less than 2 inches wide, which includes a clamping ring and gravel guard where necessary. Beehive- or dome-shaped strainer diameter shall be approximately 12 inches and height shall be not

less than 5 inches. Open area of the strainer shall be not less than twice the area of the nominal drain outlet. Drain body and bolting shall be corrosion-protected with manufacturer's standard enamel and electrodeposited coating.

Roof drains shall have an integral expansion joint of proper size to receive the leader pipe. Expansion joint shall be heavy cast bronze, sleeve type, constructed to form a watertight, flexible joint. Metal of the sleeve shall have a nominal thickness of not less than 0.134 inch. Packing shall be of lubricated non-asbestos fiber materials, soft lead, or other similar, durable material, and shall not be located in the flow line of the drainage. Bronze wing nuts and bolts or other nonferrous metal devices shall be provided for tightening or replacing the packing without disturbing the leader-pipe connection to the drain. Roof integrity shall be protected by inline expansion joints and piping configuration indicated.

2.3.3 Drainage System Expansion Joints

Expansion joints shall be heavy cast-bronze sleeve type, constructed to form a watertight flexible joint. Metal of the sleeve shall have a nominal thickness of not less than 0.134 inch. Packing shall be of lubricated non-asbestos fiber materials, soft lead, or other similar durable material and shall not be located in the flow line of the drainage. Bronze wingnuts and bolts or other nonferrous metal devices shall be provided for tightening or replacing the packing without disturbing the leader-pipe connection to drain.

2.3.4 Cleanouts

Cleanouts shall be gastight and watertight and sized to provide quick and easy access for plug removal and rodding tools. Cleanouts shall be aesthetically located with respect to tile patterns, masonry bond, and alignment.

Cleanouts in ceramic tile, resilient tile flooring, and finished walls shall be rectangular.

No cleanout plug shall terminate in or above a finished floor or wall surface, except in stack bases and where indicated.

Access to foundation tile drainage lines in floors shall be as indicated.

Cleanouts shall have cast-brass raised-head plugs. Not less than two tools for each size and type plug shall be delivered to the Contracting Officer.

Cleanout plugs under pressure, and where specified, shall be lead gasketed.

Cleanouts in aboveground floors shall have integral seepage pans and weep holes.

Cleanouts fitted with membrane or metal-pan waterproofing shall have integral seepage pans and weep holes and clamping collar assemblies.

Cleanouts set outside of the building and cleanouts in building floors shall have adjustable housings.

Cast-iron bodies shall be coated with manufacturer's standard material.

Type CO-2 Heavy Duty, for unfinished floors: Cleanouts shall have a

cast-iron body and setscrew adjustable housing with deep set, tractor-type, polished nickel-brass or nickel-bronze, scoriated cover. Construction shall be heavy duty and suitable for AASHTO H-10 loading.

Type CO-3 General Duty for unfinished floors: Cleanouts shall have a cast-iron body and adjustable housing with polished nickel-brass or nickel-bronze heavy-duty frame, and scoriated, secured cover. Cover thickness shall be not less than 3/8 inch.

Type CO-4 General Duty, for tile floors: Cleanouts shall have a cast-iron body and adjustable housing with cover recessed to a depth to accommodate specified resilient flooring material. Surfaces and fasteners exposed to view shall be constructed of polished nickel-bronze or approved nickel-brass.

Type CO-5 General Duty, for terazzo floors: Cleanouts shall have cast-iron body and adjustable housing with 3/4-inch minimum recessed anchor cover. Surfaces and fasteners exposed to view shall be constructed of nickel bronze or approved nickel brass. Cover shall be fitted with a lifting screw.

Type CO-6 Exposed Type, for exposed pipes or concealed location with access door: Cleanouts shall have cast-iron cleanout tees with lead-gasketed plugs.

2.3.5 P-Traps

P-traps shall be extra-heavy cast iron conforming to ASTM A 74.

2.3.6 Pipe Insulation

Provide insulation for hot-water and drain piping located under lavatories and other hot-water-exposed supplies to fixtures. Insulation shall be white in color and made of fully molded flexible vinyl with nylon fasteners. Provide "Handi Lav-Guard Insulation Kits" manufactured by Truebro, Inc., or equal product approved by the Contracting Officer.

PART 3 EXECUTION

3.1 INSTALLATION

Materials, equipment, and fixtures shall be installed as indicated and specified and in accordance with the manufacturer's recommendations.

Installation of plumbing fixtures shall conform to the published or written instructions of the manufacturer for the specific project application, except as otherwise specified herein.

Fixtures shall be clean and free of deleterious material before being installed. Before connecting to water, waste, vent or trap service, the fixture lines shall be blown out with compressed air. During the progress of construction, open ends of fixtures shall be protected at all times to prevent the admission of foreign matter.

3.2 TESTS

Floor drains, roof drains and cleanouts shall be leak tested as part of the drain and vent piping tests specified in Section 15102, "Plumbing".

Fixtures shall be operationally tested as port of the Operational Test specified in Section 15102, "Plumbing".

Record of testing shall be maintained by the Contractor and shall be submitted to the Contracting Officer upon acceptance of the equipment by the Government.

3.3 PIPE INSULATION INSTALLATION

After tests have been completed and surfaces cleaned, install pipe insulation on hot-water and drain piping under lavatories and other hot-water-exposed supplies to fixtures in accordance with manufacturer's instructions.

3.4 OPERATIONAL READINESS REVIEW (ORR)

The Operational Readiness Review for plumbing fixtures shall be conducted as part of the plumbing systems ORR, as specified in Section 15102, "Plumbing".

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SECTION 15445

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09/96

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SECTION 15445

SUMP PUMPS
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M	(2001) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABEMA)

ABEMA 11	(1990) Load Ratings and Fatigue Life for Roller Bearings
ABEMA 9	(1990) Load Ratings and Fatigue Life for Ball Bearings

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5	(2000) American National Standard for Centrifugal Pumps for Nomenclature, Definitions, Application and Operation

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 1940-1	(1986) Mechanical vibration - Balance quality requirements of rigid rotors - Part 1: Determination of permissible residual unbalance
ISO 2858	(1975) End Suction Centrifugal Pump (Rating 16 Bar) Designation Nominal Duty Point and Dimensions
ISO 5199	(1986) Technical Specifications for Centrifugal Pumps, Class II

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electric Equipment (1000 Volts Maximum)

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Control Diagrams shall be submitted for Sump Pumps showing motor starters, relays, or any other component necessary for safe operation.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for Sump Pumps showing Equipment Foundation Data and Equipment and Performance Data including performance curves and indicating brake horsepower, head (gpm), and NPSH.

SD-06 Test Reports

Test Reports shall be submitted for the following tests in accordance with the paragraph entitled, "Tests," of this section.

Static Head and Tests
Pump Flow Capacity

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be provided.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with Section 01770, "Task Order Closeout", including approved maintenance and repair instructions, and spare parts lists.

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

Section 15072, "Vibration Isolation for Air Conditioning Equipment," applies to work specified in this section.

PART 2 PRODUCTS

2.1 WET-PIT SUMP PUMPS

This specification covers automatic, electric-motor-driven, centrifugal, wet-pit, suspended, sump pumps.

Pumps shall be constructed and furnished in accordance with the applicable requirements of HI 1.1-1.5 standards and those specified herein.

Pump shall be a duplex pump unit, including two individual, vertical, submerged, volute, centrifugal pumps mounted below a coverplate; vertical, flexible-connected, solid-shaft motors; motor and bearing-support housing attached to the coverplate; pump-support and shaft-housing pipes; discharge pipes; and automatic controls. Unit shall be designed to permit removal of one pump assembly without disturbing the operation of the other.

Requirements for each material designation shall be in accordance with the applicable definition listed in the centrifugal pump section of HI 1.1-1.5

standards. Materials for components and accessories not covered by these definitions shall be as specified herein.

Contact between dissimilar metals shall be avoided. Where such contact cannot be avoided, joints between dissimilar metals shall be protected against galvanic corrosion by plating, organic-insulation coatings, gaskets, or other suitable means.

2.1.1 Pump Selection

Where parallel pump operation is indicated, pumps shall be selected with characteristics specifically suited for the service without unstable operation.

Pumps shall be selected for service within 4 percent of maximum efficiency for a given casing and impeller series.

Pumps having impeller diameter larger than 90 percent of the published maximum diameter of the casing or less than 15 percent larger than the published minimum diameter of the casing will be rejected.

Pump duty conditions shall be as indicated.

A pump unit shall deliver, at rated speed, not less than the specified gallons per minute against the specified or indicated discharge head while the liquid level is not more than 1 foot above the datum elevation of the pump. Datum elevation shall be taken as the level of the entrance eye of the impeller. Discharge head, specified or indicated, shall include the friction head of the system piping external to the pump unit and the static head measured from a point of reference on the sump to the highest point in the system. Ratings shall be based on pumping clear, fresh water at a temperature of 68 degrees F.

2.1.2 Pump Casing

Pump casing shall be cast iron. Volute and discharge nozzle of the pump casing shall be cast in one piece. Casing shall be constructed with a bolted plate to permit inspection and removal of the impeller. Casing shall be designed to withstand a hydrostatic pressure of not less than 1-1/2 times the design shutoff head of the pump.

2.1.3 Impeller

Impeller shall be cast iron or bronze, enclosed or semi-open, with vanes on back shroud. Refer to the part entitled, "Bearings and Lubrication," in this section for additional requirements. Impeller shall be dynamically balanced.

Pumps driven by motors rated 7.5 hp 5.6 kilowatt or over shall be factory balanced to Balance Grade G2.5 (except where a different grade is indicated) in accordance with ISO 1940-1. Factory test reports shall be submitted including:

Balance instrumentation make and model
Balance method (single plane or two plane) and correction plane location(s)
Type of rotor (overhung or between centers
Operating speed of rotor
Balance Quality Grade required

Calculated permissible residual unbalance
Measured residual unbalance in each correction plane

2.1.4 Strainer

Intake shall be protected with a large cast-iron, slotted intake strainer with an effective free area sufficient to prevent cavitation and degradation of efficiency. Strainer shall have a free area of at least four times the cross-sectional area of the suction casing.

2.1.5 Pump Shaft

Pump shaft shall be constructed of ground and polished AISI Type 304 or 316 corrosion-resistant steel with hardened wearing surfaces at intermediate shaft-bearing locations. Hardened surfaces may be overlays of 500 Brinell Stellite, Wall Colmonoy, or similar proprietary metals, or plasma-spray-applied ceramic materials of not less than 900 Brinell hardness.

Mechanical properties and diameter of the shaft shall ensure that whip, deflection, or vibration will not be of sufficient magnitude to impose greater than design loads on the specified shaft bearings under normal operating conditions. Means shall be provided for external adjustment of the clearance between the impeller and the inner surfaces of the volute section.

2.1.6 Bearings and Lubrication

One or more antifriction ball- or roller-bearings shall be furnished in the motor and bearing support housing above the cover-plate surface, with full provision for the mechanical and hydraulic radial and thrust loads imposed. Bearings shall be sealed and grease-lubricated and shall have an L-10 rating of not less than 30,000 hours in accordance with ABEMA 9 or ABEMA 11. Shop drawings shall bear the manufacturer's certification of bearing life. Bearings shall be manufactured from vacuum-processed or degassed-alloy steels. Bearings shall be furnished with grease and pressure-relief fittings at bottom or opposite side the bearing where discharge may be viewed.

Intermediate shaft bearings shall be of the sleeve type. Center distance between any two bearings on the shaft shall not exceed 4 feet 6 inches for pumps operating between 1,700 and 1,800 revolutions per minute (rpm) or 5 feet for pumps operating at 1,200 rpm or less. Sleeve-bearing length shall be not less than 2 times the shaft diameter. A sleeve bearing located near the lower extremity of the shaft shall be provided.

Sleeve bearings shall be heavy-duty bronze- or corrosion-resistant steel-backed cutless-rubber type.

Sleeve bearings shall be heavy-duty bronze- or corrosion-resistant steel-backed cutless-rubber type with nonferrous piping and fittings provided for individual flushing of intermediate and lower bearings.

Potable water shall be supplied through a piping system containing a pressure regulator, a solenoid, and a backflow preventer. All wetted components shall be plastic, nonmetallic composition, elastomer, or nonferrous metal.

2.1.7 Flexible Couplings

Pump shaft shall be connected to the motor shaft through a flexible coupling. Flexible member shall be a tire shape or a solid-mass serrated-edge disk shape made of chloroprene material and retained by fixed flanges. Flexible coupling shall act as a dielectric connector, shall not transmit vibration or end thrust, and shall permit up to 4-degree misalignment under normal duty.

2.1.8 Support Pipe

A wrought-iron or steel support pipe concentric with the pump shaft shall connect the pump to the sump coverplate. Support-pipe flanges shall be machined and doweled to ensure proper alignment of the pump and shaft whenever the pipe is disassembled and reassembled in the field.

2.1.9 Discharge Pipe

A discharge pipe running from the pump-discharge outlet to the sump coverplate shall be furnished as an integral part of the pump unit. Discharge pipe shall be arranged to preclude discharge piping beyond the pump assembly from imposing loads which would tend to cause shaft misalignment. Pipe shall be black steel or wrought iron, with wall thickness not less than that specified in ASTM A 53/A 53M for Schedule 40 pipe. Discharge pipe shall be gastight through the sump coverplate. Discharge end of the pipe shall terminate in a screwed or flanged connection in accordance with the manufacturer's standard practice.

2.1.10 Liquid-Level Control

Duplex pump unit shall be furnished with the electrical and mechanical devices required to provide automatic operation of the pump unit when the liquid in the sump rises to a predetermined level. Controls shall automatically transfer the operating cycle from one pump to the other and shall operate both pumps simultaneously whenever the inflow to the sump exceeds the capacity of the operating pump. A means of adjustment such as float-rod stops shall be provided to allow for variations in the start and stop level-control points. Float and rod shall be AISI Type 304 or 316 corrosion-resistant steel, and all other parts of the fluid-level sensing mechanism below the cover shall be bronze, brass, or material of equivalent resistance to the corrosive effects of sewage.

Stilling tubes shall be provided where indicated.

Floatless electrode level controls may be submitted for approval, provided the electrodes are isolated from the fluid being sensed.

2.1.11 High-Water Alarm

A high-water alarm switch, complete with actuating mechanism, shall be provided for operation on an electrical circuit other than the motor circuit. Switch shall be designed to operate indicated alarm device(s) whenever a predetermined high-water level is reached in the sump because of failure of either pump or a fluid inflow that exceeds the combined capacity of both pumps. Controls shall be mounted on the sump coverplate.

2.1.12 Sump Tank and Coverplate

2.1.12.1 Tank

Concrete sump-tank interior surfaces shall be protected by not less than a two-coat, two-component system of amine-cured coal-tar epoxy totaling 15 mils in thickness.

2.1.12.2 Coverplate

Sump tank coverplate shall be cast iron or steel, of adequate strength to support the pumps without distortion, and of adequate strength to safely support maintenance personnel. Openings through the sump tank coverplate shall be gasketed, unless otherwise specified. A 2-inch ips or larger threaded outlet shall be provided to permit installation of a vent pipe. Sump coverplate shall provide either manhole or handhole access to the tank.

2.1.13 Painting

Equipment shall be treated and painted in accordance with the manufacturer's standard practice for the specified duty.

2.2 SUBMERSIBLE PUMPS

Pumps shall be constructed and furnished in accordance with the requirements of HI 1.1-1.5 standards and those specified herein.

Failure of operating switch shall not require breaking of pump-motor seals for repairs.

Pump shall be a duplex unit, including two submersible pumps, each with float level controls.

Requirements for each material designation shall be in accordance with the applicable definition listed in the centrifugal pump section of HI 1.1-1.5 standards. Materials for components and accessories not covered by these definitions shall be as specified herein.

Contact between dissimilar metals shall be avoided. Where such contact cannot be avoided, joints between dissimilar metals shall be protected against galvanic corrosion by plating, organic insulation coatings, gaskets, or other suitable means.

2.2.1 Pump Selection

Pumps shall be selected for the service within 4 percent of maximum efficiency for a given casing and impeller series.

Pump duty conditions shall be as indicated.

Pump seals, lubricant, and electrical insulation shall be suitable for service in liquids up to 140 degrees F.

2.2.2 Pump Housing

Pump housing shall enclose the pump motor and volute with its integrally cast feet. Pump housing shall be cast iron, watertight under all heads normal to the service, and constructed to permit inspection and repair. Volute shall be designed to withstand a hydrostatic pressure of not less

than 1-1/2 times the design shutoff head of the pump.

2.2.3 Impeller

Impeller material shall be bronze. Impeller shall be dynamically balanced and totally enclosed.

Pumps driven by motors rated 7.5 hp 5.6 kilowatt or over shall be factory balanced to Balance Grade G2.5 (except where a different grade is indicated) in accordance with ISO 1940-1. Factory test reports shall be submitted including:

Balance instrumentation make and model
Balance method (single plane or two plane) and correction plane location(s)
Type of rotor (overhung or between centers
Operating speed of rotor
Balance Quality Grade required
Calculated permissible residual unbalance
Measured residual unbalance in each correction plane

2.2.4 Pump Shaft

Pump shaft shall be an extension of the motor shaft and shall be constructed of ground and polished AISI Type 300 or 400 series corrosion-resistant steel with hard wearing surfaces (over 300 Brinell).

2.2.5 Mechanical Seal

Pump shaft seal shall be manufacturer's standard mechanical type specifically constructed for the service duty temperature and resistance to pumped fluid.

2.2.6 Bearings and Lubrication

Antifriction ball or roller bearings shall be furnished with full provision for the mechanical and hydraulic, radial, and thrust loads imposed. Bearings shall be sealed and permanently grease- or oil-lubricated.

2.2.7 Motor

Motor shall be manufacturer's standard construction for the service and shall be permanently sealed, oil-filled, and watertight. Motor space shall be fitted with watertight expansion provisions to accommodate temperature normal to specified duty. Motor seals shall remain watertight under any pressure developed in the volute and under a sump-level static head of not less than 30 feet of water; shop drawings shall so certify. Motor control for three-phase motor shall provide overload protection.

Single-phase motors shall have automatic-reset thermal-overload protection.

2.2.8 Liquid-Level Control

Duplex pump unit shall be furnished with the electrical and mechanical devices required to provide automatic operation of the pump unit when the liquid in the sump rises to predetermined level. Controls shall automatically transfer the operating cycle from one pump to the other, and shall operate both pumps simultaneously whenever the inflow to the sump exceeds the capacity of the operating pump. Means of adjustment such as

float-rod stops shall be provided to allow for variations in the start and stop level-control points. Float and rod shall be AISI Type 304 or 316 corrosion-resistant steel; all other wetted parts of the fluid-level sensing mechanism shall be bronze, brass, or material of equivalent resistance to the corrosive effects of the pumped fluid.

Control shall be pedestal mounted above the coverplate, and the enclosures shall be NEMA 250, Type 1, general purpose.

2.2.9 High-Water Alarm

A high-water alarm switch complete with actuating mechanism shall be provided for operation on an electrical circuit other than the motor circuit. Switch shall be designed to operate indicated alarm device(s) whenever a predetermined high-water level is reached in the sump because of failure of either pump or a fluid inflow that exceeds the capacity of both pumps. Switch enclosure shall be the same as that for the level-control switch.

2.2.10 Sump Tank and Coverplate

2.2.10.1 Tank

Concrete-sump interior surfaces shall be protected by not less than a two-coat, two-component system of amine-cured coal-tar epoxy totaling 15 mils in thickness.

2.2.10.2 Coverplate

Sump coverplate shall be cast iron or steel, of adequate strength to support not less than 200 pounds per square footwithout distortion. All openings through the sump cover shall be sealed to be gastight and watertight. A standard outlet shall be provided for a vent pipe. Sump cover shall provide either manhole or handhole access to the interior.

2.2.11 Painting

Equipment shall be treated and painted in accordance with the manufacturer's standard practice for specified duty.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed in accordance with manufacturer's recommendations, and Section 01750, "Equipment Alignment and Balancing for RCM".

3.2 TESTS

Tests, including operation of equipment, shall be performed in accordance with manufacturer's instructions.

Piping associated with pumps shall be tested in accordance with Section 15102, "Plumbing".

Pumps shall be operated against static heads indicated, and pump-flow capacity shall be verified.

3.3 OPERATIONAL READINESS REVIEW (ORR)

Provide an Operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for the pumps. Include locations of all control devices, and a complete demonstration of all operating modes.

-- End of Section --

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SECTION 15625

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03/98

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SECTION 15625

HYDRONIC WATER SYSTEMS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 278	(1993) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 650 Degrees F
ASTM A 278M	(1993; Rev E1) Standard Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures Up to 345 Degrees C (Metric)
ASTM B 395	(1995) U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes
ASTM B 395M	(1995) U-Bend Seamless Copper and Copper Alloy Heat Exchanger and Condenser Tubes (Metric)
ASTM B 62	(1993) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B 75	(1999) Seamless Copper Tube
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM D 1384	(1997 Rev A) Corrosion Test for Engine Coolants in Glassware
ASTM D 596	(1991; R 1995) Reporting Results of Analysis of Water

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.1	(1998) Power Piping
ASME B31.9	(1996) Building Services Piping
ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels, Division 1, Basic Coverage

TUBULAR EXCHANGER MANUFACTURERS ASSOCIATION (TEMA)

TEMA-01	(1999; 8th Ed) Standards of the Tubular Exchanger Manufacturers Association

1.2 SYSTEM DESCRIPTION

Contractor shall furnish labor, materials, equipment and services to construct, install, and test chilled water, hot water, and secondary water systems.

Pipe labeling and other general requirements shall be in accordance with Section 15003, "General Mechanical Provisions".

Pipe, fittings, valves, specialties, thermometers and pressure gauges shall be in accordance with Section 15050, "Basic Mechanical Materials and Methods", which defines the types referred to in this section.

All installation or modification of piping and components defined as Pressure Vessels and Pressurized Systems (PV/S) in Section 15055, "Welding and Pressure Vessels/Systems", shall comply with applicable requirements of that section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

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.

Converters
Compressor Tank
Air Separator
Water Treatment System
Heat Exchangers

SD-05 Design Data

Equipment Schedules shall be submitted for the items listed below. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

Valves and Specialties
Compressor Tank and Air Separator
Converters and Heat Exchangers

SD-06 Test Reports

Test Reports shall be submitted for the following tests in accordance with the paragraph entitled, "Tests," of this section.

Pressure Tests
Leakage Tests

SD-10 Operation and Maintenance Data

Contractor shall submit Operation and Maintenance Manuals for hydronic systems in accordance with Section 01770, "Task Order Closeout".

SD-11 Closeout Submittals

PV/S Certification Records shall be submitted for PV/S piping and components, for approval and Certification prior to pressurization and operation. Pressure vessels and pressurized systems (PV/S), and the required contents of the PV/S Certification Records, shall be as defined in Section 15055, "Welding and Pressure Vessels/Systems"

PART 2 PRODUCTS

2.1 PIPE, VALVES AND SPECIALTIES

2.1.1 Pipe

Piping shall be carbon steel, Type BCS, except that piping 2 inches and under may be copper, Type CPR-AG. Polyvinyl chloride, Type PVC piping may be used for drain piping.

2.1.1.1 Pipe Insulation

Pipe insulation system shall be mineral fiber with vapor barrier jacket Type T-1 as specified in Section 15085, "Piping Insulation", except that cellular elastomer Type T-3 as specified in Section 15085, "Piping Insulation", system may be used on cold water and condensate drain piping at the Contractor's option.

2.1.2 Valves

Valves 2-inch and smaller shall be ball valves, Type BAV.

Valve bodies, 2-inch iron pipe size (ips) and smaller, shall be bronze with soldered or screwed end connections. Valve bodies, 2-1/2-inch ips and larger, shall be cast iron with flanged end connections.

Valves 2-1/2-inch and larger shall be either gate valves conforming with Type GAV or butterfly valves conforming with Type BUV, as indicated.

Valves shall be single seated for dead-end service except where otherwise indicated or specified.

Drain, vent, and gage cocks shall be T-head or lever handle, ground key type, with washer and screw, constructed of polished ASTM B 62 bronze, and rated 125 psi working steam pressure (wsp). End connections shall suit the service, with or without union and nipple, as required.

Strainers shall be bronze, conforming to ASTM B 62, or cast iron, conforming to ASTM A 278, Class 30, with removable basket. Strainers larger than 2-inches shall be fitted with manufacturer's standard ball type blow down valve.

2.2 CONTROLS

Controls will be provided under this contract in accordance with Section 15902, "Non-UCS Control Systems" or by the UCS contractor, as

specified in Section 15900, "UCS Controls", as indicated on the drawings.

2.3 HEAT EXCHANGERS

Exchangers shall be constructed in accordance with ASME BPV VIII Div 1 and certified with ASME stamp secured to unit. Except as otherwise indicated, exchangers shall be constructed in accordance with the requirements of TEMA-01 for Class "C" Exchangers. U-tube bundles shall be completely removable for cleaning and tube replacement and shall be free to expand with shell. Shells shall be of seamless steel pipe or welded steel construction and tubes shall be seamless tubing as specified below unless otherwise indicated. Tube connections to plates shall be leakproof. Saddles or cradles shall be provided to mount shell and U-tube exchangers. Frames of plate and frame type exchangers shall be fabricated of carbon steel and finished with baked epoxy enamel. Design fouling factor shall be 0.00025 hr-sq-ft-deg-F per BTU.

2.3.1 Hot Water and Secondary Water Convertors

Exchangers shall operate with steam in shell and hot water or secondary water in tubes. Provide an impingement plate, or other means to protect the tube bundle against steam impingement, in accordance with TEMA-01. Shell and tube sides shall be designed for 150 psig working pressure and factory tested at 300 psig. Steam, water, condensate, and vacuum and pressure relief valve connections shall be located in accordance with the manufacturer's standard practice. Connections larger than 3 inches shall be ASME Class 150 flanged. Water pressure loss through clean tubes shall not exceed the amount indicated, and water velocity shall not exceed 6 fps unless otherwise indicated. Minimum water velocity in tubes shall be not less than 1 fps and assure turbulent flow. Tubes shall be seamless copper or copper alloy, (except where 90-10 copper-nickel or other tube material is indicated on the drawings), constructed in accordance with ASTM B 75 or ASTM B 395, suitable for the temperatures and pressures specified. Tubes shall be not less than 3/4 inch o.d. unless otherwise indicated. Transverse baffles or tube support plates shall be constructed of a material softer than the tubes. Unless otherwise indicated baffles shall be polypropylene suitable for service at temperatures up to 250 degrees F, or shall be brass suitable for service at temperatures over 250 degrees F, as appropriate for the service temperature. Maximum steam inlet nozzle velocity shall not exceed 6000 fpm. Heat transfer capacity, steam flow at 5 psig supply, and water flow, entering and leaving temperatures shall be as indicated on drawings.

2.3.2 Chilled Water Heat Exchangers, Shell and U-tube Type

Exchangers shall operate with plant chilled water in shell and building water in tubes. Shell and tube sides shall be designed for 150 psig working pressure and factory tested at 300 psig. Water and pressure relief connections shall be located in accordance with the manufacturer's standard practice. Water connections larger than 3 inches shall be ASME Class 150 flanged. Water pressure loss through clean tubes shall not exceed the amount indicated. Minimum water velocity in tubes shall be 1 fps and assure turbulent flow. Tubes shall be cupronickel or inhibited admiralty, constructed in accordance with ASTM B 395, suitable for the temperatures and pressures specified. Tubes shall be not less than 3/4 inch o.d. unless otherwise indicated. Heat transfer capacity, flow, and entering and leaving water temperatures shall be as indicated on the drawings.

2.3.3 Chilled Water Heat Exchangers, Plate and Frame Type

Plates, frames and gaskets shall be designed for a working pressure of 150 psig and factory tested at 300 psig. Plant chilled water, building chilled water, and pressure relief valve connections shall be located in accordance with the manufacturer's standard practice. Connections larger than 3 inches shall be ASME Class 150 flanged. Water pressure drop through clean plates and headers shall not exceed the amount indicated. Plates shall be designed to assure turbulent flow at the indicated flow. Plates shall be corrugated Type 304 stainless steel or Type 316 stainless steel. Plate thickness shall be not less than indicated. Heat transfer capacity, flow, and entering and leaving water temperatures shall be as indicated on drawings.

2.4 WATER TREATMENT AND GLYCOL SYSTEMS

When indicated,provide a water treatment system for closed hydronic systems.

The water treatment system shall be capable of manually feeding chemicals into the heating system to prevent corrosion and scale within the heat exchanger and piping system. All water treatment equipment and chemicals shall be furnished and installed by a water treatment company regularly engaged in the installation of water treatment equipment and the provision of water treatment chemicals based upon water condition analyses. The water treatment company shall provide a water sample analysis taken from the building site, each month for one year.

2.4.1 Chemical Shot Feeder

A shot feeder shall be provided as indicated. Size and capacity of feeder shall be based upon local requirements and water analysis. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping. All materials of construction shall be compatible with the chemicals being used.

2.4.2 Make Up Water Analysis

The make up water conditions reported per ASTM D 596 are as indicated on the drawings for the following measurements:

Date of Sample	
Temperature	degrees C
Silica (SiO2)	ppm (mg/L)
Insoluble	ppm (mg/L)
Iron and Aluminum Oxides	ppm (mg/L)
Calcium (Ca)	ppm (mg/L)
Magnesium (Mg)	ppm (mg/L)
Sodium and Potassium (Na and K)	ppm (mg/L)
Carbonate (HCO3)	ppm (mg/L)
Sulfate (SO4)	ppm (mg/L)
Chloride (C1)	ppm (mg/L)
Nitrate (NO3)	ppm (mg/L)
Turbidity	unit
pH	
Residual Chlorine	ppm (mg/L)
Total Alkalinity	ppm (meq/L)
Noncarbonate Hardness	epm (meq/L)
Total Hardness	epm (meq/L)
Dissolved Solids	ppm (mg/L)

Fluorine	ppm (mg/L)
Conductivity	microsiemens/cm

2.4.3 Chemicals

The chemical company shall provide pretreatment chemicals that will remove and permit flushing of mill scale, oil, grease, and other foreign matter from the water heating system. The chemical company shall also provide all treatment chemicals required for the initial fill of the system and for a period of one year of operation. The chemical company shall determine the correct chemicals and concentrations required for the water treatment. The chemicals shall not be proprietary and shall meet required federal, state, and local environmental regulations for the treatment of heating water systems and discharge to the sanitary sewer. The chemicals shall remain stable throughout the operating temperature range of the system, and shall be compatible with pump seals and other elements of the system.

2.4.4 Glycol Solutions

When indicated, provide glycol system for hydronics exposed to freezing.

The percent concentration by volume of industrial grade ethylene or propylene glycol shall be provided as indicated. The glycol shall be tested in accordance with ASTM D 1384 with less than 0.5 mils penetration per year for all system metals. The glycol shall contain corrosion inhibitors. Silicate based inhibitors shall not be used. The solution shall be compatible with pump seals, other elements of the system, and all water treatment chemicals used within the system.

2.4.5 Test Kits

All required test kits and reagents for determining the proper water conditions shall be provided.

2.5 COMPRESSION TANK AND AIR SEPARATOR

When indicated provide compression tank and air separator in accordance with Section 15050, "Basic Mechanical Materials and Methods", of the capacities shown on the drawings.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Except where shown in dimensional detail, exact locations of piping are not shown on design drawings. Materials, including offsets, bends, elbows, or other elements that may be required for the work shall be provided and installed by the Contractor, subject to approval by the Contracting Officer.

Contractor shall tie-in to existing hot water, chilled water, or secondary water where indicated. Tie-ins shall require 5 days prior notification to the Contracting Officer.

3.2 PIPE INSTALLATION

Installation of piping, supports, valves, and specialties shall be in accordance with Section 15050, "Basic Mechanical Materials and Methods", and as indicated below.

Connections between steel and copper piping shall be electrically isolated from each other with dielectric couplings (or unions), or flanged with gaskets rated for the service.

Final connections to equipment shall be made with unions or flanges.

Sleeves and penetrations shall be in accordance with Section 15050, "Basic Mechanical Materials and Methods" . Where piping penetrates fire-rated construction or smoke barriers, firestopping or smokestopping shall be provided in accordance with Section 07840, "Fire Stopping and Smoke Stopping".

3.3 INSULATION

Installation of insulation shall be in accordance with Section 15085, "Piping Insulation".

Insulation shall not be applied to system or component surfaces until they have been tested and approved.

Materials shall be applied in accordance with the recommendations of the manufacturer, except as otherwise specified.

Surfaces shall be clean and free of oil and grease before insulation adhesives or mastics are applied.

Contours on exposed work shall be smooth and continuous. Adhesives shall be applied for full coverage.

3.4 INSTRUMENTATION

Thermometers and pressure gauges shall be provided where indicated, and on the inlet and outlet of each convertor, coil or heat exchanger. On terminal devices (including unit heaters, convectors, fan coil units, VAV's), inlet and outlet pressure-temperature (P-T) plugs shall be provided.

3.5 VIBRATION ISOLATION

Only for portions of piping indicated on drawings, piping shall be vibration isolated from building structure using vibration isolators and from connecting equipment using flexible connectors, in accordance with Section 15072, "Vibration Isolation for Air Conditioning Equipment".

3.6 CONTROLS

Install control valves, flow meters, and other control devices in piping in accordance with Section 15902, "Non-UCS Control Systems". Such devices furnished by the UCS contractor (as indicated on drawings) shall be installed under this contract.

3.7 PRESSURE VESSELS/SYSTEMS (PV/S) CERTIFICATION

All installation or modification of PV/S piping and components shall comply with the requirements of Section 15055, "Welding and Pressure Vessels/Systems", and PV/S Certification Records shall be prepared as indicated in that section. This data shall be submitted and approved, and the system or components Certified by the Code 540 RECERT Group, prior to pressurization and operation.

3.8 FIELD TESTS

Inspect piping system prior to initial operation, for conformance to drawings, specifications, and ASME B31.9. Equipment, material, or work rejected because of defects or non-conformance with drawings, specifications, and ASME B31.9 shall be replaced or corrected by the Contractor, as directed by the Contracting Officer.

3.8.1 Field Tests

Conduct the following tests after completion of the piping installation and prior to installing insulation, or initial operation.

3.8.1.1 Piping System

Test piping system hydrostatically using water not exceeding 100 degrees F. Conduct tests in accordance with the requirements of ASME B31.1 and as follows. Test the piping system after the lines have been cleaned as herein specified and before any insulation covering has been applied. Test piping system at 1 1/2 times the system pressure or 50 psig whichever is greater. Before performing tests, remove or valve off from the system, gages, traps, and other apparatus which may be damaged by the test pressure. Install a calibrated test pressure gage in the system to observe any loss in pressure. Maintain the required test pressure for not less than 8 hours with no loss of pressure. Leaks shall be corrected and re-tested.

3.8.1.2 Start-Up and Operational Test

Start-up the system and initially operate with components operating. During the test, periodically clean the various strainers until no further accumulation of foreign material occurs. Exercise care so that minimum loss of water occur when strainers are cleaned. Adjust safety and automatic control instruments as necessary to place them in proper operation and sequence.

3.8.1.3 Extent of Field Tests

After installation and before acceptance, coordinate as required, the work of this section with the necessary field tests, including those herein specified, and in Sections 15950, "HVAC Testing, Adjusting and Balancing.," 15900, "UCS Controls", and 15902, "Non-UCS Control Systems."

3.9 OPERATIONAL READINESS REVIEW (ORR)

Provide Operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for system including new valves, heat exchangers, pumps, converters, and controls.

ORR shall include a complete walk-through of the system, identifying locations of all items listed above, and all connected equipment.

ORR for converters and heat exchangers shall be coordinated with ORR for pumps, controls and related equipment, to include demonstration of all operating modes as a system.

3.10 WATER TREATMENT TESTING

The heating water shall be analyzed prior to the acceptance of the facility

and a minimum of once a month for a period of one year by the water treatment company. The analysis shall include the following information recorded in accordance with ASTM D 596.

Date of Sample	
Temperature	degrees F
Silica (SiO2)	ppm (mg/L)
Insoluble	ppm (mg/L)
Iron and Aluminum Oxides	ppm (mg/L)
Calcium (Ca)	ppm (mg/L)
Magnesium (Mg)	ppm (mg/L)
Sodium and Potassium (Na and K)	ppm (mg/L)
Carbonate (HCO3)	ppm (mg/L)
Sulfate (SO4)	ppm (mg/L)
Chloride (C1)	ppm (mg/L)
Nitrate (NO3)	ppm (mg/L)
Turbidity	unit
pH	
Residual Chlorine	ppm (mg/L)
Total Alkalinity	ppm (meq/L)
Noncarbonate Hardness	epm (meq/L
Total Hardness	epm (meq/L)
Dissolved Solids	ppm (mg/L)
Fluorine	ppm (mg/L)
Conductivity	microsiemens/cm

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SECTION 15720

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SECTION 15720

AIR HANDLING UNITS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 430	(1999) Central-Station Air-Handling Units
ARI 640	(1996) Commercial and Industrial Humidifiers

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210	(1997) Laboratory Methods of Testing Fans for Rating
AMCA 211	(1994) Certified Ratings Program - Air Performance
AMCA 99	(1986; AMCA 99-0401) Standards Handbook

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 653/A 653M	(2001) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM A 90/A 90M	(2001) Standard Test Method for Weight (Mass) of Coating on Iron Steel Articles with Zinc or Zinc Alloy Coatings
ASTM B 117	(1997) Standard Test Method of Salt Spray (Fog) Testing

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 1940-1	(1986) Mechanical vibration - Balance quality requirements of rigid rotors - Part 1: Determination of permissible residual unbalance

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1999) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 998	(1993; Bul 1994) Humidifiers

1.2 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication/Erection Drawings for Field Assembled units shall be fully dimensioned and detailed to show relationship of various components, detail of unit casing and support fabrications, layout of particular elements, connections, and other relational aspects of the work.

Field Assembled Air Handling Units

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

Air Handling Units -- submittal shall include applicable data for all components, including those specified in detail in other specification sections, as a single package for each unit.

SD-05 Design Data

Equipment Schedules shall be submitted for the items listed below. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

Air Handling Units -- submittal shall include applicable data for all components, including those specified in detail in other specification sections, as a single package for each unit.

SD-06 Test Reports

Field Test Reports shall be submitted for the items listed below. Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the contractor, by an authorized official of the testing laboratory or agency (if applicable), and by the Government inspector who witnessed the test.

Fans with Motors rated 5.6 kW or greater -- Rotor Balance Report

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the items listed below, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

Air Handling Units -- submittal shall include applicable data for all components, including those specified in detail in other specification sections, as a single package for each unit.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the following items, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

Air Handling Units -- submittal shall include applicable data for all components, including those specified in detail in other Specification Sections, as a single package for each unit.

PART 2 PRODUCTS

2.1 GENERAL

Air Handling Unit and components shall be performance tested and rated in accordance with AMCA 211 and AMCA 210. Air Handling Unit ratings shall be certified in accordance with ARI 430.

Total static pressure and coil face area classification shall conform to AMCA 99.

Fans with enlarged outlets shall not be permitted.

Unless otherwise indicated, Air Handling Unit fan shall be double-width, double-inlet, centrifugal scroll type.

2.2 AIR HANDLING UNIT CABINET (FACTORY ASSEMBLED)

Air handling unit shall be central-station type, factory-fabricated, and sectionally or fully assembled. Cabinet shall be constructed in accordance

with AMCA 99 requirements for Class A, B or C, as indicated on the drawings and as applicable for the indicated operating pressure.

2.2.1 AMCA Class A & B Cabinets

Air Handling Unit cabinet shall be suitable for pressure class shown and shall have leaktight joints, closures, penetrations, and access provisions. Cabinet shall not expand or contract perceptibly during starting and stopping of fans and shall not pulsate during operation. Cabinet surfaces with deflections in excess of 0.004167 of unsupported span shall be reinforced prior to acceptance. Pulsating panels, which produce low frequency noise due to diaphragming of unstable panel walls, shall be stiffened to raise natural frequency to an easily attenuated level. Enclosure shall be fabricated from mill-galvanized or primed and painted carbon steel sheet of required thickness. Mill-galvanized sheet metal shall conform to ASTM A 653/A 653M and ASTM A 924/A 924M and shall be coated with not less than 1.25 ounces of zinc per square foot of two-sided surface. Mill-rolled structural steel shall be hot-dip galvanized or primed and painted. Cut edges, burns, and scratches in galvanized surfaces shall be corrosion protected. Primed and painted black carbon steel cabinet construction shall comply with this specification.

2.2.2 AMCA Class C Cabinets

Air Handling Unit cabinet shall be suitable for pressure class indicated and shall have leaktight joints, closures, penetrations, and access provisions. Cabinet shall not expand or contract perceptibly during starting and stopping of fans and shall not pulsate during operation. Cabinet surfaces with deflections in excess of 0.002778 of unsupported span shall be reinforced prior to acceptance by the Contracting Officer. Pulsating panels, which produce low frequency noise due to diaphragming of unstable panel walls, shall be stiffened to raise natural frequency to an easily attenuated level. Enclosure shall be fabricated from mill-galvanized or primed and painted carbon steel sheet of required thickness. Mill-galvanized sheet metal shall conform to ASTM A 653/A 653M and ASTM A 924/A 924M and shall be coated with not less than 1.25 ounces of zinc per square foot of two-sided surface. Mill-rolled structural steel shall be hot-dip galvanized or primed and painted. Cut edges, burns, and scratches in galvanized surfaces shall be corrosion protected. Primed and painted black carbon steel cabinet construction shall comply with this specification.

2.2.3 Cabinet Access

Where cabinet size is such that personnel access is possible, cabinet floor shall be strengthened to permit entry without damage to any component. Access doors and panels shall be hinged and latched at a spacing sufficiently close to preclude leaks caused by distortion, and shall be effectively gasketed.

2.2.4 Alternate Cabinet Construction

Black carbon steel cabinet construction shall be acceptable when the following conditions are met:

All interior and exterior surfaces, including lapped contacting surfaces, shall be coated with a corrosion-protective coating.

Coating shall be certified as passing a 500-hour exposure salt-spray fog test in accordance with ASTM B 117.

Immediately after completion of the test, the specimen shall show no signs of wrinkling, cracking or loss of adherence, and no signs of rust creepage beyond 1/8 inch on either side of the scratch mark.

After 11 months of service and prior to expiration of guarantee, cabinet shall pass inspection of interior and exterior surfaces for the same defects as the salt-spray fog test specimen.

Interior surfaces of cabinets constructed of intact mill-galvanized steel shall require no further protection.

Exterior surfaces of cabinets constructed of mill-galvanized steel shall be prepared by a phosphatizing treatment, and painted with two coats of manufacturer's standard enamel finish in color selected by the Contracting Officer.

2.3 AIR HANDLING UNIT CASING (FIELD ASSEMBLED)

Air handling unit shall be central station type of indicated configuration and shall include enclosure, centrifugal fans, guarded V-belt drives, motors, heating and cooling coils, filters, dampers, vibration isolation provisions, and indicated and specified accessories.

In addition to scheduled maximum system operating pressure and system testing pressure, the ceiling shall be capable of sustaining 35 pounds per square foot load without permanent deformation or damage. Material shall be hot-dip galvanized.

2.3.1 Enclosure

Enclosure surfaces shall consist of self-supporting ceiling and wall panels mounted on, and fastened to, a concrete curbing. Self-supporting shall be defined as free of building construction, except building floor.

2.3.2 Coil Supports

Coil supports shall be fabricated structural steel not less than 1/4 inch thick, hot-dip galvanized after fabrication. Hot-dip galvanizing shall conform to ASTM A 123 except that the amount of deposited zinc shall be not less than 2.3 ounces per square foot of single-side surface when tested in accordance with ASTM A 90/A 90M.

2.3.3 Access Doors and Panels

Access doors shall be not less than 24 by 60 inches and shall be constructed of 16-gage galvanized metal. Doors shall be provided with two heavy-duty hinges with removable pins and a like number of heavy-duty latch sets operable from either side. Latch sets shall be of cast iron or wrought steel construction with provisions for wear adjustment. Doors shall seal against mechanically retained expanded chloroprene elastomer gaskets.

2.4 FAN

Overall fan-section depth shall be equal to or greater than the manufacturer's free-standing fan.

Fans shall comply with Section 15725, "Air-Handling - Fans and Wall

Ventilators".

Fans shall be single-wheel, Type CSC-F, carbon steel centrifugal fan, unless otherwise indicated.

Location of fan inlet shall provide not less than one-half fan-wheel diameter clearance from cabinet wall or adjacent fan inlet where double wheels are permitted.

Motors shall be of the type, size, voltage, and phase characteristics indicated on drawings, and shall conform to all applicable requirements of Section 16225, "Motors".

Fan wheels shall be statically and dynamically balanced at the factory and after installation. Dynamic balancing shall be in two planes. For fans with motors rated 5.6 kW or greater, Balance Grade shall be G2.5 or better in accordance with ISO 1940-1, unless a different Balance Grade is indicated on the drawings.

Air Handling Unit motor and fan drive shall be mounted external to casing, unless internal mounting is indicated on the drawings. If mounted internally, an access door of adequate size for servicing motor and drive shall be provided. A belt guard shall be provided inside the cabinet.

Units with fans driven by motors rated 7.5 hp or over shall be furnished with access doors and other provisions necessary to permit field balancing of the rotating elements, addition of corrective weights, and measurements of residual unbalance in accordance with ISO 1940-1.

2.5 DRAIN PANS

Intermediate-coil, 3-inch deep drip pans shall be provided for each tiered coil bank.

Top pan shall extend 12 inches beyond face of coil, and bottom pan shall extend not less than 24 inches beyond face of coil. Where more than two pans are used, pan extension shall be proportional. Adequate supports shall be made from the same type material as pans or hot-dip galvanized angle iron with isolation at interface. Pan material shall be 22-gage AISI Type 304 corrosion-resistant steel with silver-soldered joints. Minimum side of drain opening shall be 1-1/4 inches. Pan shall be piped and sloped to drain.

Integral cabinet drain pan shall extend under all areas where condensate must be collected and shall be watertight with welded or brazed joints, piped to drain, corrosion protected in condensate collection area, and insulated against sweating. Sheet metal shall be minimum 14-gage, except that 16-gagedouble-drain-pan construction shall be acceptable.

Cooling coil ends shall be enclosed by cabinet and shall be factory insulated against sweating or shall drain to drain pan.

Unit arrangement and mounting shall be coordinated with the requirements in the paragraph entitled "Installation of Traps and Drains".

2.6 INSULATION

Unit shall be internally fitted with a sound-attenuating, thermal-insulating, fibrous-glass material not less than 1 inch thick and

shall have a surface deeply impregnated with chloroprene. Where indicated on drawings provide solid or perforated galvanized sheet metal over unit lining. Insulation effectiveness shall preclude condensation on any exterior cabinet surface under conditions normal to the unit's installed location. Acoustic treatment shall attenuate fan noise in compliance with specified noise criteria. Material shall be applied to the cabinet with adhesive on 100-percent coverage basis. Adhesive and insulating material shall be in accordance with NFPA 90A.

Plenums and bypasses shall be insulated in the same way as the rest of the unit.

2.7 PLENUMS

Plenums shall be provided in the following minimum widths:

6 inches for mounting temperature controls and to separate two or more coils of different size mounted in series

14 inches between face and bypass dampers and upstream accessories and at change in cross section

24 inches for access sections, including access downstream of all pre-heat coils.

2.8 HUMIDIFIERS

Factory-assembled, single or multiple units as required to obtain the capacities indicated. Units shall be tested and rated in accordance with ARI 640, and shall comply with UL 998.

Units shall inject steam directly into the air stream. Units shall be mounted in plenum with drain pan for draw-thru units or in diffuser section of blow-thru units, or as indicated.

Central plant steam injection units: equip each unit with provisions to trap out and reevaporate condensate and to supply dry steam for a single or multiple distribution grid. Provide modulating normally-closed pneumatic steam-control valve, steam-jacket with condensate drain, and condensate trap. Steam grid materials shall be copper or Type 300 Stainless Steel.

Electronic Electrode Steam Units: Self-contained, electronic steam generators with steam output as indicated and equipped with disposable tank. Provide each unit with a solid state energy saving control circuit to control steam output and compensate for changing water conditions without chemical additives. Include an integral control and monitoring panel, with a capacity meter, a "change cylinder (container)" indicator, a capacity adjustment control adjusting from 20 to 100 percent of rated output capacity, an on-off drain switch, and an on-auto push button with indicator light. Equip each unit with double-wall insulated steam supply hose, a steam distributor, an automatic fill with cleanable strainers, or an automatic drain valve.

2.9 OTHER COMPONENTS

Provide eliminators downstream of cooling coil where indicated on drawings. Eliminators shall be SMACNA three-break, hooked-edge design, constructed of reinforced 16-gage galvanized steel with assembled brazed joints.

Eliminator sections shall be easily removable for cleaning.

Provide heating and cooling coils, of the capacity and heating or cooling medium indicated on the drawings, in accordance with Section 15762, "Air Coils".

Provide vibration isolation in accordance with Section 15072, "Vibration Isolation for Air-Conditioning Equipment".

Multizone unit delivery dampers shall be part of the manufacturer's standard unit construction and shall meet the requirements specified under paragraph entitled, "Power-Operated Dampers," of Section 15902, "Control Systems."

Face and bypass dampers and multizone unit delivery dampers shall be part of the manufacturer's standard unit construction and shall meet the requirements specified under paragraph entitled, "Power-Operated Dampers," of Section 15902, "Control Systems."

A balancing plate shall be added to the heating coil when required to equalize resistance in airstreams of multizone units.

Blow-through Air Handling Unit shall be fitted with pressure equalizing baffles.

PART 3 EXECUTION

3.1 AIR HANDLING UNIT EQUIPMENT INSTALLATION

Equipment shall be installed in accordance with manufacturer's recommendations. Fan installation, alignment and rotor balance shall be performed prior to unit operation, in accordance with Section 01750, "Equipment Alignment and Balancing for RCM".

3.2 INSTALLATION OF TRAPS AND DRAINS

Drain lines from each section of the unit with a condensate drain pan shall include traps of the configuration indicated below. Coils shall be mounted in the air handler with sufficient height above the floor to permit the installation of traps and drain lines as indicated. If necessary, the unit shall be furnished with supplemental supports or installed on a thicker equipment pad to provide the height required for proper trapping of the condensate lines. Trap depth is defined as the distance from the bottom of the outlet pipe, to the top of the pipe forming the bottom of the U shape of the trap. Static pressure shall be the worst case under normal operation for the system, accounting for pressure drops at full air flow volume, and with fully loaded (dirty) filters.

Traps draining condensate from sections of a unit under positive pressure shall have a trap depth not less than the highest static pressure of the section, in inches or water (gage), plus 1/2 inch. In addition, the trap outlet shall be not less than 1/2 inch below the height of the trap inlet.

Traps draining condensate from sections of a unit under negative pressure shall have a trap depth not less than 1/2 of the highest (most negative) static pressure of the section, in inches of water (gage), plus 1/2 inch. In addition, the trap outlet shall be lower than the height of the trap inlet, by a distance not less than the highest (most negative) static pressure of the section, in inches of water (gage), plus 1 inch.

The inlet from the drain pan to the trap shall be made with a vertical tee, with a threaded plug on the top to serve as a vertical clean-out opening. Lines from the trap outlet to the drain shall be sloped a minimum of 1/4 inch per foot, or 2 percent}.

3.2.1 Provisions for Steam Traps

For air handling units equipped with steam coils or steam humidifiers, those devices shall be mounted in the air handler with sufficient height above the floor to permit the installation of steam traps, drip legs, and condensate drain lines as indicated in Section 15125, "Steam Traps". If necessary, the unit shall be furnished with supplemental supports or installed on a thicker equipment pad to provide the height required for proper trapping of the steam condensate.

3.3 AIR HANDLING UNIT TESTING

Fan alignment and balancing shall be performed in accordance with Section 01750, "Equipment Alignment and Balancing for RCM", prior to any operation of the unit.

Air and Water Balancing shall be performed in accordance with Section 15950, "Testing and Balancing" prior to conducting the Operational Readiness Review. Operational Testing of the air handling unit and its associated automatic temperature controls shall be performed in accordance with Section 15902, "Non-UCS Control Systems", or coordinated with UCS Contractor in accordance with Section 15900, "UCS Controls", prior to conducting the Operational Readiness Review.

3.4 OPERATIONAL READINESS REVIEW (ORR)

Provide an operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for the HVAC system as a whole. The HVAC system ORR shall include the Air Handling Unit, along with associated exhaust or return air fans, ductwork arrangement, location and operation of key balancing dampers, fire dampers, terminal units, and other components. Include locations of control devices, and a complete demonstration of all control sequences, for controls provided under Section 15902, "Non-UCS Control Systems"; or coordinate ORR with such demonstration by the UCS Contractor in accordance with Section 15900, "UCS Controls". For task orders which involve replacement or modification of only a portion of the HVAC system, the ORR shall cover only the replaced or modified components.

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SECTION 15725

AIR HANDLING - FANS AND WALL VENTILATORS

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SECTION 15725

AIR HANDLING - FANS AND WALL VENTILATORS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210	(1997) Laboratory Methods of Testing Fans for Rating
AMCA 211	(1994) Certified Ratings Program - Air Performance
AMCA 300	(1996) Test Code for Sound Rating Air Moving Devices
AMCA 301	(1990) Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 302	(1973) Application of Sone Loudness Ratings for Non Ducted Air Moving Devices
AMCA 311	(1990) Certified Sound Ratings Program for Air Moving Devices
AMCA 330	(1986) Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans
AMCA 99	(1986; AMCA 99-0401) Standards Handbook

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M	(2001) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM D 2563	(1994) Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts
ASTM D 2583	(1995) Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor
ASTM D 638	(1999) Standard Test Method for Tensile Properties of Plastics

ASTM D 790	(1999) Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B15.1	(1984) Safety Standard for Mechanical Power Transmission Apparatus

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABEMA)

ABEMA 11	(1990) Load Ratings and Fatigue Life for Roller Bearings
ABEMA 9	(1990) Load Ratings and Fatigue Life for Ball Bearings

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 1940-1	(1986) Mechanical vibration - Balance quality requirements of rigid rotors - Part 1: Determination of permissible residual unbalance

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings shall be submitted for Fans consisting of fabrication and assembly details to be performed in the factory.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for each fan. For each fan submitted catalog data shall include information on all specified components and accessories.

Power Wall Ventilators
Type TA-F Tubular Axial Fan
Type VA-F, Vane Axial Fan
Type TC-F Tubular Centrifugal Fan
Type CSC-F, Carbon-Steel Centrifugal Fan
Type CCSC-F, Coated Carbon Steel Centrifugal Fan
Type FRPC-F, Fibrous Glass-Reinforced Plastic Fan
Type C-F Cabinet Fans

SD-05 Design Data

Equipment and Performance Data shall be submitted for Fans

consisting of: Curves indicating tested and certified equipment response and performance characteristics shall also be submitted, including fan speed, air volume static pressure, power and efficiency. Where sound ratings are indicated, data shall also include certified sound power level or sone ratings.

SD-08 Manufacturer's Instructions

Installation Instructions shall be submitted for Fans including manufacturer's recommendations for the installation and start-up of the equipment.

SD-10 Operation and Maintenance Data

Contractor shall submit 4 copies of the Operation and Maintenance Manuals 30 days prior to testing the Fan Assemblies. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

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.

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

Section 15072, "Vibration Isolation for Air Conditioning Equipment," applies to work specified in this section.

PART 2 PRODUCTS

2.1 GENERAL FAN REQUIREMENTS

Fans shall be of the type indicated on the drawings, and of specific materials where indicated. Fans shall be selected to meet the minimum airflow and pressure, and the maximum power, indicated on the drawings. Fans shall not exceed the sound power level or sone ratings, if indicated on drawings.

2.1.1 General

Air performance data for all fans shall be determined in accordance with the provisions of AMCA 210.

Sound pressure level ratings of all fans shall comply with AMCA 301 and shall be the result of tests made in accordance with AMCA 300 or AMCA 330.

Unit construction shall conform to applicable standards contained in AMCA 99 and to requirements specified. Fans shall be licensed to bear the AMCA certified air and sound rating seal in accordance with AMCA 211 and AMCA 311. Sound-power spectrum of fan shall be a smooth curve without peak disturbances. Excessive decibel levels in the critical 125-, 250-, and 500-hertz bands will be sufficient cause for disapproval of fan proposed.

Safety provisions for power transmission equipment and nonducted inlets and outlets shall include guards and screens, unless other provisions are

required, and shall be constructed in accordance with applicable provisions of ASME B15.1. Installation shall be such that fan vibration-isolation provisions are not negated.

Fan wheels shall be statically and dynamically balanced at the factory and after installation. Dynamic balancing shall be in two planes. For fans with motors rated 5.6 kW or greater, Balance Grade shall be G2.5 or better in accordance with ISO 1940-1, unless a different Balance Grade is indicated on the drawings..

Fans driven by motors rated 5.6 kW or over shall be furnished with access doors and other provisions necessary to permit field balancing of the rotating elements, addition of corrective weights, and measurements of residual unbalance in accordance with ISO 1940-1.

2.1.2 Bearings

Bearings shall be antifriction ball or roller type, unless otherwise specified, with provisions for self-alignment and thrust-load requirements that may be imposed by the service. Bearings shall be constructed of vacuum degassed or processed steel alloys and shall have a certified ABEMA 9 or ABEMA 11, L-10 minimum life expectancy rating of 40,000 hours under load conditions the service will impose. Bearings shall have dusttight seals suitable for lubricant pressures encountered. Housings shall be cast iron unless otherwise specified or approved.

Bearings shall be grease lubricated. Lubrication provisions shall preclude overheating due to excess lubricant. Grease supply fittings shall be surface ball check type. Where necessary, manual or automatic grease pressure relief fittings shall be provided. Bearing and seal construction permitting, relief fittings shall be located on the side opposite the supply fitting. Relief fittings shall be visible from normal maintenance locations. Lubrication provisions shall include extension tubes where necessary.

Bearings shall be dowelled in place with AISI 18-8 corrosion-resistant steel spiral wrapped or split pins, unless otherwise specified or approved. Taper pins are not acceptable.

Factory sealed antifriction bearings which conform to above specified materials and ABEMA 9, L-10 life expectancy requirements shall be provided for fans driven by motors smaller than 1/2 horsepower.

Sleeve-type bearings shall be provided where indicated. Bearings shall be premounted, self-aligning, continuous-oil supply, single- or double-ring lubricated, insert type, with suitable provisions for shaft expansion and for such thrust as may be imposed by service loads. Maximum shaft surface speed shall not exceed 1,200 feet per minute (fpm) without water cooling, and bearing loading pressure shall not exceed 70 pounds per square inch (psi) based on effective bearing area. Each sleeve bearing shall be provided with approximately 16-ounce capacity constant-level oiler and oil-level gauge.

2.1.3 Belt Drives

Fan drives shall be V-belt type, except when direct drive type fans are indicated.

V-belt drive application shall conform to the manufacturer's published

recommendations.

Horsepower rating of drive shall be based on maximum pitch diameter of sheave.

Drives with motors up to and including 40 horsepower shall be standard section, fixed-sheave type, with a service factor of not less than 1.5.

Drives with motors over 40 horsepower shall be fixed-sheave, high-capacity, supertype, with a service factor of not less than 1.5.

Belt drives shall be located outboard of bearings.

High capacity, supertype belt drives shall be prominently identified with an identification plate containing all necessary replacement part data. Identification plate shall be stamped nonferrous metal or engraved plastic, mechanically and conspicuously attached to drive guard or equipment.

2.1.4 Sheaves

Sheaves shall be machined cast iron or carbon steel, bushing type of fixed bore, and shall be secured to the shaft by key and keyway.

Standard fixed-pitch spacing shall be used, unless otherwise specified, for all two- and three-groove drives with center-to-center distances equal to or exceeding the following:

BELTS	DISTANCE (INCHES)
A and B	20
C	28
D	36

2.1.5 Belts

Belts shall be endless, of Dacron-reinforced elastomer construction, with cross section to suit sheave grooves.

Belts shall be matched and measured on a belt-matching machine at the factory or by a factory-authorized distributor. Selection by code numbers, sag numbers, or match numbers is not acceptable. Each belt set shall be bound with wire and tagged with equipment identification.

2.1.6 Motor Bases

Motors shall be provided with adjustable motor bases, except as otherwise specified. Motor bases shall be adjustable in two planes (i.e. back/forward and left/right).

Motors over 7-1/2 horsepower with fixed-sheave standard belt section drives shall be provided with adjustable, pivoted motor bases wherever equipment configuration permits proper installation.

2.1.7 Air Balancing Provisions

All necessary facilities shall be provided for the adjustment of fan speed for each air-handling system during air-quantity balancing operations.

Facilities provided shall be one of the following:

A variable-pitch drive with variable range to produce the fan speed necessary for proper air balance. After completion of air balancing, variable pitch sheave shall be replaced by fixed pitch sheave by the Contractor.

A series of fixed-pitch pulleys that can be interchanged until the proper fan speed has been determined

2.1.8 Motor Requirements

Motors shall conform to Section 16225, "Motors," and the following requirements. Motors shall be single-phase or three-phase as indicated, and rated for the voltage indicated on drawings.

Where indicated, provide explosion-proof motors rated in accordance with NFPA 70 for hazardous location Class I, Group A, B, C, or D as indicated

Motors located in unfiltered airstreams shall be totally enclosed.

Air-over-motor units shall be provided with NEMA-rated Class H insulation for all services where airstream temperature exceeds 100 degrees F. Air velocity over motor surfaces shall be sufficient to maintain insulation temperatures within NEMA standards at maximum fan horsepower.

2.1.9 Spark Resistant Construction

Where indicated on drawings, provide fans with spark resistant construction of the indicated type in accordance with AMCA 99:

Type A - All parts of fan in contact with the air or gas being handled shall be made of nonferrous material.

Type B - Fan shall have an entirely nonferrous wheel and a nonferrous ring about the opening through which the shaft passes.

Type C - Fan shall be constructed so that a shift of the wheel will not permit ferrous parts of the fan to rub or strike other ferrous parts.

Materials shall be selected from those specified elsewhere in this section for the type of fan, to comply with the indicated spark-resistant construction type.

2.2 POWER WALL VENTILATORS

Bearing housings shall be manufacturer's standard, unless otherwise specified.

2.2.1 Type CWV-F

Centrifugal wall ventilator shall be provided, with direct drive and nonoverloading, backward-inclined wheel. Drive shall be vibration-isolated with elastomer.

Weather-exposed housing materials shall be Aluminum Association Alloy 3003 with 2-mil dry-film coating of clear acrylic for salt-air service or high-impact plastic with fiberglass reinforcement. All metal surfaces exposed to airstream shall be aluminum, corrosion-resistant steel,

mill-galvanized steel, or cadmium- or zinc-plated carbon steel. Discharge shall be away from building wall. Wheel inlet shall be venturi type. Conduit connection shall be run through housing or through wiring post to permit within-wall electrical connections. Housing shall be removable for external access to fan assembly and other components. An elastomer calk shall be provided around periphery of housing for watertight construction.

2.2.2 Type PWV-F

Propeller wall ventilator shall be provided, with square panel and direct drive.

Panel shall be painted steel with venturi inlet to wheel. Wheel shall have wide-faced blades. Relationship between drive supports, wheel speed, and number of blades shall be such that fundamental blade frequency is avoided. Drive shall be vibration-isolated with elastomers. A wire backguard constructed of 3/16-inch wire with not more than 1-1/2-inch spacing, and with a bright plated or enamel finish, shall be provided.

2.2.3 Type PWVB-F

Propeller wall ventilator shall be provided, with square panel and panel-mounted V-belt drive.

Panel shall be painted steel with venturi inlet to wheel. Panel shall be a minimum of 16-gauge for wheel diameters to 40 inches, 14-gauge for wheel diameters to 50 inches, or 12-gauge for wheel diameters through 60 inches. Flanging and reinforcement shall be provided to stiffen panel. Corners shall be welded. Panel and supports shall be phosphatized and finished with high-gloss enamel.

Wheel shall have wide-faced, fabricated, heavy-duty, corrosion-protected blades.

Wheel shall have airfoil-shaped, cast-aluminum, fixed- or adjustable-pitch blades.

Bearing housing of units over 1 horsepower shall be cast iron.

Relationship between fan-drive supports, wheel speed, and number of blades shall be such that fundamental blade frequency is avoided.

Selection proposed at indicated system resistance shall be such that there is no danger of stalling due to slight system pressure variance.

A wire backguard constructed of 3/16-inch steel wire with not more than 1-1/2-inch spacing and with bright plated or enamel finish shall be provided, with hinges and latch to enable fan motor servicing.

2.3 TYPE TA-F TUBULAR AXIAL FAN

Fan shall have a flanged, cylindrical casing with provisions for support requirements indicated.

Unit shall be direct drive type or V-belt drive type with a sealed enclosure that houses drive components as indicated.

Weather-exposed motor shall be provided with weatherproof housing.

Motor pulley and belts shall be guarded.

2.3.1 Fan Casing

Casing shall be constructed of not less than 8-gauge welded or fabricated aluminum; or casing shall be constructed of not less than 10-gauge welded carbon steel.

Casing shall be fitted with two large hinged and gasketed access doors secured with quick-acting lug-type closure devices. Wheel, shaft, and bearings shall be removable as a unit from the removable, gasketed, inner drive enclosure.

2.3.2 Fan Inlet

Casing shall be fitted with efficient inlet and outlet cones, inlet bell, or vortex breaker, as indicated.

Fan inlet shall be fitted with a heavy-duty galvanized inlet screen.

Fan shall be fitted with variable-inlet vanes, manually adjustable, and with provisions for positive position lock, where indicated.

2.3.3 Fan Wheel

Wheel shall be constructed of high-strength cast aluminum and shall have airfoil blades for type B fans.

Wheel shall be constructed of carbon steel with bronze blade tips, or entirely of high-strength cast aluminum with airfoil blades.

Wheel shall be fixed-pitch or manually adjustable pitch type, constructed of high-strength cast aluminum with airfoil blades.

Wheel shall be statically and dynamically balanced. Relationship between drive supports, wheel speed, and number of blades shall be such that fundamental blade frequency is avoided. Wheel hub shall be streamlined, and shaft shall be sealed at drive-enclosure penetration to prevent the entry of particulate matter. Wheel shall be keyed to shaft.

2.4 TYPE VA-F, VANE AXIAL FAN

Fan shall have a flanged, cylindrical casing with provisions for support requirements indicated.

Unit shall be direct-drive type or V-belt type with an enclosure covering the drive components as indicated.

Weather-exposed motor shall be provided with weatherproof housing.

Motor pulley and belts shall be guarded.

2.4.1 Fan Casing

Casing shall be constructed of not less than 8-gauge welded or fabricated aluminum; or casing shall be constructed of not less than 10-gauge welded carbon steel.

Stationary, airfoil-shaped, securely attached guide vanes shall be provided

behind fan wheel.

Casing shall be fitted with two hinged and gasketed access doors secured with quick-acting lug-type closure devices. Wheel, shaft and bearings shall be removable as a unit from removable, gasketed, inner drive enclosure.

2.4.2 Fan Inlet

Casing shall be fitted with an efficient inlet bell, inlet and outlet cones or vortex breaker as indicated.

Fan shall be fitted with variable inlet vanes, manually adjustable, and with provisions for positive position lock, where indicated.

2.4.3 Fan Wheel

Wheel shall be constructed of high-strength cast aluminum and shall have airfoil blades; or wheel shall be constructed of carbon steel with bronze blade tips, or entirely of high-strength cast aluminum with airfoil blades.

Wheel shall be fixed-pitch or manually adjustable pitch type, where indicated.

Adjustable pitch wheels shall have blade angles factory preset to match system characteristics.

Wheel shall be statically and dynamically balanced. Relationship between drive supports, wheel speed, and number of blades shall be such that fundamental blade frequency is avoided. Wheel hub shall be streamlined, and shaft shall be sealed at drive-enclosure penetration to prevent the entry of particulate matter. Wheel shall be keyed to shaft.

2.5 TYPE TC-F TUBULAR CENTRIFUGAL FAN

Fan shall have a flanged cylindrical casing with provisions for support requirements indicated.

Unit shall be direct drive type or V-belt drive type with an enclosure that houses all drive components as indicated.

Weather-exposed motor shall be provided with weatherproof housing.

Motor pulley and belts shall be guarded.

2.5.1 Fan Casing

Casing shall be constructed of not less than 8-gauge welded or fabricated aluminum, or casing shall be constructed of not less than 10-gauge welded carbon steel. Stationary, airfoil-shaped, securely attached guide vanes shall be provided behind fan wheel.

Casing shall be fitted with two hinged and gasketed access doors secured with quick-acting lug-type closure devices. Wheel, shaft, and bearings shall be removed as a unit from removable, gasketed, inner drive enclosure.

2.5.2 Fan Inlet

Casing shall be fitted with an efficient inlet bell.

Fan inlet shall be fitted with a heavy-duty galvanized inlet screen.

Fan shall be fitted with variable-inlet vanes, manually adjustable, and with provisions for positive position lock, where indicated..

2.5.3 Fan Wheel

Wheel shall be backward inclined or airfoil blade construction.

Wheel shall be fabricated from high-strength all-welded aluminum, or wheel shall be fabricated from carbon steel, with high-strength aluminum blade tips.

Fans with carbon-steel wheels shall be fitted with aluminum rub ring in inlet bell.

Wheels shall be statically and dynamically balanced. Shaft shall be sealed at drive-enclosure penetration to prevent the entry of particulate matter. Wheel shall be keyed to shaft.

2.6 TYPE CSC-F, CARBON-STEEL CENTRIFUGAL FAN

Duty point of each fan shall be not less than 3 percent to the right of the maximum static efficiency.

Duty point of centrifugal scroll fans provided shall be within the following requirements:

TYPE FAN WHEEL	PERCENT VOLUMETRIC CAPACITY
Forward curve	50 to 60
Nonoverloading	65 to 75

Shaft first critical speed shall be not less than 20 percent higher than the specified operating fan speed.

Wheels shall be keyed in place. Bearings shall be removable without dismantling fan. Fan inlets shall be streamlined orifice type, bolted to scroll. Scrolls and wheels shall be factory primed and painted, unless otherwise specified. Scrolls containing wheels with diameters 14 inches and larger shall be fitted with bolted cleanout doors, and all scrolls with wheels 12 inches in diameter and larger shall be fitted with iron pipe size (ips) threaded and plugged drains.

Automatic, variable inlet vane control shall be provided where indicated.

2.7 TYPE FRPC-F, FIBROUS GLASS-REINFORCED PLASTIC FAN

Fans shall be nonoverloading type, with backward curved or airfoil blade construction. Each fan shall bear an AMCA certified rating seal.

Laminates of fans with duty-point operating speeds that do not exceed the wheel diameter and rpm relationship tabulated hereunder shall be classed as standard design and shall be tested and inspected in accordance with the manufacturer's standard procedures. Directly proportional interpolation for different wheel sizes is permissible.

2.7.1 FRP Laminate Requirements

Fan scroll and wheel shall be solid fibrous glass-reinforced plastic (FRP).

Fibrous glass-reinforced plastic shall be formed by any combination of methods including molding, filament winding, and hand layup to produce a laminate conforming to requirements specified herein.

Resin used for housing construction shall have a burn rating not in excess of 0.15 inch per minute. Resin used for wheel construction shall have chemical resistance and physical-strength properties that parallel specified values. Low-burning rate of wheel resin may be relaxed in exchange for superior physical strength and chemical resistance. Original manufacturer's resin formulation may be modified to suit the manufacturing process except that: not more than 5 percent of antimony trioxide shall be used; not more than 10 percent of styrene resin, by weight, may be added; and no dyes or pigments shall be added that reduce or tend to reduce the translucency of laminate, thus hindering in-depth inspection. Resin to fibrous glass ratio, by weight, shall be such that the following minimum laminate physical characteristics are provided for service at 175 degrees F:

TEST METHOD	PROPERTY	VALUE (PSI)
ASTM D 638	Tensile strength	15,500
ASTM D 790	Flexural strength	29,000
	Compressive strength	2,400
ASTM D 790	Modulus of elasticity flexural	18 by 10
ASTM D 2583	Barcol hardness-45	

In general, laminate shall be smooth, dense, and uniform in texture, color, and cross section, and without apparent or latent defects including foreign inclusions, cracks, crazing, pin holes, striations, unsaturated and resin-poor areas, and excessive resin-rich areas. Wheel-laminate acceptable visual defects shall conform to ASTM D 2563, Level 1.

WHEEL DIAMETER (INCHES)	RPM (MAXIMUM)
12	4,400
15	3,600
17	2,970
21	2,470
24	2,135
28	1,800
31	1,630
35	1,445
38	1,350
42	1,200
49	1,000
56	900

2.8 TYPE C-F CABINET FANS

Unit cabinet shall be suitable for pressure class indicated and shall have

leaktight joints, closures, penetrations, and access provisions. Cabinet shall not expand or contract perceptibly during starting and stopping of fans, and cabinet shall not pulsate during operation. For AMCA Class A or B fans, surface deflections in excess of 1/240th of unsupported span shall be additionally reinforced prior to acceptance by the Contracting Officer. For AMCA Class C fans, surface deflections in excess of 1/360th of unsupported span shall be additionally reinforced prior to acceptance by the Contracting Officer. Pulsating panels which produce low-frequency noise due to diaphragming of unstable panel walls shall be stiffened to raise natural frequency to an easily attenuated level. Enclosure shall be fabricated from mill-galvanized or primed and painted carbon-steel sheet of required thickness. Mill-galvanized sheet metal shall conform to ASTM A 653/A 653M and ASTM A 924/A 924M and shall be coated with not less than 1.25 ounces of zinc per square foot of two-sided surface. Mill-rolled structural steel shall be hot-dip galvanized or primed and painted. Cut edges, burns, and scratches in galvanized surfaces shall be corrosion-protected. Primed and painted black carbon-steel cabinet construction shall comply with requirements specified herein.

Cabinet fans shall be forward-curved or nonoverloading centrifugal-scroll type, unless otherwise specified. Cataloged fan capacity shall have been determined with fan installed within cabinet. Nonoverloading type shall be backward curved or single- or double-skin airfoil-blade type. Fans shall be selected to avoid instability in service, and shall be constructed so that the relationship of wheel diameter to outlet area conforms to AMCA 99. Forward-curved-blade fans shall, in addition, conform to the following requirements:

Duty point shall be to the right of the second-peak static-pressure point from shutoff and at approximately 60 percent overall efficiency.

Forward-curved fans shall operate in a stable manner when filters are dirty and when system dampers respond to automatic environment controls.

Forward-curved-blade fans shall be used only where fan-wheel diameter is less than 12-1/4 inches.

Two forward-curved fans shall not be substituted where a single fan is specified or indicated.

For fan wheel sizes 27 inches and larger, blades shall be airfoil type.

Fan wheels, on shafts supported by flanged bearings mounted on the cabinet, shall be balanced after mounting in cabinet.

Fan scroll shall be fabricated from mill-galvanized steel. Wheel shall be fabricated from aluminum or mill-galvanized steel and coated with the manufacturer's standard corrosion-protection coating.

2.9 MOTORIZED DAMPERS

Fans shall be provided with motorized dampers where indicated. Damper frames shall be sealed construction with gaskets and elastomer calk as necessary to prevent bypass.

Minimum distance between fan wheel and damper shall be 8 inches, unless otherwise recommended by the manufacturer.

Damper effective-opening size shall be coordinated with fan wheel size to

ensure maximum operating efficiency.

Motorized damper shall be opened and closed by electric motor, and shall consist of frame, blades and linkage. Shafts shall be 3/16-inch diameter, full-blade length. Shaft bearings shall be oil-impregnated bronze or graphite-impregnated nylon. Maximum blade width shall be 4 inches and maximum blade length shall be 36 inches. Blade edges shall have mechanically retained edge seals. Frames shall be 14-gaugemill-galvanized steel.

For velocities to 1,800 fpm, blades shall be 24-gauge, 2-mil dry-film clear acrylic coated, Aluminum Association Alloy 5052 or 6063 aluminum.

For velocities to 2,500 fpm, blades shall be 22-gauge, 2-mil dry-film clear acrylic coated, Aluminum Association Alloy 5052 or 6063 aluminum.

Linkage shall preclude distortion of blades under operation.

Damper operating circuit shall have a time-delay relay complete with motor-controller interlocks to ensure full-open shutter position before fan starts.

2.10 GRAVITY BACKDRAFT AND RELIEF DAMPERS

Frame shall be constructed of not less than 1-1/2- by 4-inch, adequately reinforced, 16-gauge galvanized carbon steel. Frames and mullions shall be solidly secured in place and sealed with elastomer calking against air bypass.

Blade maximum width shall be 9 inches, and maximum length shall be 36 inches. Blade material shall be 16-gauge galvanized steel, 14-gauge Aluminum Association Alloy 6063 or 5052 aluminum, or 18-gauge AISI 18-8 corrosion-resistant steel. Blades shall be provided with mechanically retained seals and 90-degree limit stops.

Dampers used for relief service shall have blades linked together to open not less than 30 degrees on 0.05-inch water gauge differential pressure.

Shaft bearings shall be graphite-impregnated nylon or oil-impregnated bronze.

Counterbalanced dampers shall be equipped with fixed and adjustable counterbalancing weights. Backdraft dampers shall be gravity operated with adjustable counterweight of the same material as fan housing.

Gravity backdraft dampers in sizes 18 by 18 inches or smaller, when furnished integral with air moving equipment, shall be equipment manufacturer's standard construction.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed as indicated, as specified herein, and in accordance with manufacturer's recommendations.

3.2 FAN TESTING

Fan alignment and balancing shall be performed in accordance with Section

01750, "Equipment Alignment and Balancing for RCM", prior to air balancing or any operation of the unit.

Air Balancing shall be performed in accordance with Section 15950, "Testing and Balancing" prior to conducting the Operational Readiness Review. Operational Testing of the fan and any associated automatic temperature controls shall be performed in accordance with Section 15902, "Non-UCS Control Systems", or coordinated with UCS Contractor in accordance with Section 15900, "UCS Controls", prior to conducting the Operational Readiness Review.

3.3 OPERATIONAL READINESS REVIEW (ORR)

Provide an operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for the system as a whole. The system ORR shall include the fan, along with any other associated equipment, ductwork arrangement, location and operation of key balancing dampers, fire dampers, and other components. Include locations of control devices, and a complete demonstration of all control sequences, for controls provided under Section 15902, "Non-UCS Control Systems"; or coordinate ORR with such demonstration by the UCS Contractor in accordance with Section 15900, "UCS Controls". For task orders which involve replacement or modification of only a portion of the system, the ORR shall cover only the replaced or modified components. Fans which are part of an air handling unit, return air fans, or other fans functioning as part of an HVAC system, shall be included as part of the ORR for the air handling unit and the HVAC system as a whole.

-- End of Section --

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SECTION 15732

PACKAGED AIR-CONDITIONING AND HEAT PUMP UNITS

09/96

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SECTION 15732

PACKAGED AIR-CONDITIONING AND HEAT PUMP UNITS
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 210/240	(1994) Unitary Air-Conditioning and Air-Source Heat Pump Equipment
ARI 340/360	(1993) Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
ARI 450	(1993) Water-Cooled Refrigerant Condensers, Remote Type
ARI 620	(1996) Self Contained Humidifiers

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1	(1989) Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels, Division 1, Basic Coverage

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 269	(1998) Seamless and Welded Austenitic Stainless Steel Tubing for General Services

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABEMA)

ABEMA 11	(1990) Load Ratings and Fatigue Life for Roller Bearings
ABEMA 9	(1990) Load Ratings and Fatigue Life for Ball Bearings

ASSOCIATION OF HOME APPLIANCE MANUFACTURERS (AHAM)

AHAM RAC-1	(1992) Room Air Conditioners

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 1940-1	(1986) Mechanical vibration - Balance quality requirements of rigid rotors - Part 1: Determination of permissible residual unbalance

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1999) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 484	(1993; rev thru Jun 1997) Room Air Conditioners
UL 900	(1994; Rev thru Apr 1997) Test Performance of Air Filter Units

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Control Diagrams shall be submitted for the items listed below, 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.

All units and components

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

All units and components

SD-05 Design Data

Equipment and Performance Data shall be submitted for Packaged Air-Conditioning Units consisting of use life, power ratings, capacity ranges, face area classifications, and rotational velocities.

SD-06 Test Reports

Field Test Reports shall be submitted for the items listed below.

Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the contractor, by an authorized official of the testing laboratory or agency (if applicable), and by the Government inspector who witnessed the test.

Operational Tests - all units

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the items listed below, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

All units and components

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the following items, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

All units and components

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

Section 15072, "Vibration Isolation for Air Conditioning Equipment," applies to work specified in this section.

PART 2 PRODUCTS

2.1 ROOM AIR CONDITIONER, SELF-CONTAINED

Unit shall be a room-type, packaged, self-contained assemblage that includes hermetic compressor, fan(s), motor drives, coils and controls for fully automatic operation, intercomponent piping and wiring, totally enclosed weatherproof casing, and frame mounting ready for power connection.

Unit shall be certified as complying with AHAM RAC-1.

Refrigerant shall be R-22. Units shall be shipped with a refrigerant holding-charge.

Units indicated for window installation shall have side-louvered cabinet.

Units indicated for through-wall installation shall have sleeved cabinet without side louvers.

Unit shall be Underwriters Laboratories (UL) listed, to comply with UL 484.

Capacity of unit at standard rating conditions of AHAM RAC-1 shall be as indicated.

Rating shall be at unit maximum speed.

Controls shall be located on front face of unit unless otherwise indicated. Conditioned air circulating fan control shall be two- or three-speed or solid-state.

Unit shall have provisions for admitting controlled amounts of outside air as makeup and for exhausting internal air.

Unit shall be labeled to comply with the EPA/DOE Energy Star program, including the minimum EER requirement for the unit type and capacity..

Evaporator fan shall be centrifugal type or propeller type.

Condenser fan shall be centrifugal or propeller type.

Evaporator and condenser fans shall be driven by a common motor with double shaft or individual motors.

Evaporator coil shall be nonferrous construction aluminum or copper plate fins per inch, mechanically bonded to staggered copper tubing.

Condenser coil shall be nonferrous construction with aluminum or copper plate fins per inch, mechanically bonded to staggered copper tubing.

Unit shall have an internally mounted reusable or throwaway filter. Filter material shall be non-fiberglass, and shall comply with UL 900.

Outlet grilles shall be constructed to permit adjustable horizontal and vertical flow.

2.2 UNITARY EQUIPMENT

Provide unitary, factory-assembled package, split-type or single-package, air-conditioning or heat pump unit, with air-cooled or water-cooled condenser, as indicated on drawings and as specified below. Unit shall operate on 60 Hz, single or three phase, 120, 208, 230, or 460 volt power as indicated.

Unit shall be provided complete with frame and enclosure, internal piping and wiring, necessary controls and safety devices, other components as indicated, and operating charge of oil. Units shall be shipped with a refrigerant holding-charge. In addition, split-type unit shall consist of matched assemblies and be provided with interconnecting piping and wiring. Unit shall be ready for full-capacity operation after removal of shipping protection, connection to remote compressor/condenser or condenser for split-type, charging, and connection to utilities. System shall be completely charged in the field. Refrigerant shall be R-22.

Unit shall be configured for roof mounting, floor mounting or suspended mounting, as indicated, and equipped with plenum or duct connection arrangement as shown. Roof mounted units shall be complete with roof curbs for mounting and for duct penetrations. If indicated, provide unit with integral, 100 percent outdoor air, cooling economizer cycle including all

required dampers and controls.

2.2.1 Unit Capacity and Efficiency Ratings

Unit shall be of the capacity indicated on drawings, at the indicated operating conditions. If operating conditions are not indicated, the indicated capacity shall be provided at standard ARI rating conditions.

Efficiency ratings of the unit, at standard ARI rating conditions, shall be as indicated below. Ratings acronyms used are the following, defined in accordance with the indicated ARI standards: Coefficient of Performance (COP), Energy Efficiency Ratio (EER), Heating Seasonal Performance Factor (HSPF), Integrated Part Load Value (IPLV), and Seasonal Energy Efficiency Ratio (SEER).

Units with a cooling capacity less than 19 kilowatts at ARI standard rating conditions, shall comply with and have performance certified in accordance with ARI 210/240. With air-cooled condenser they shall have the DOE/EPA Energy Star rating, the cooling SEER shall be 12.0 Btu per hour per watt or higher. With water-cooled condenser, the cooling EER shall be 12.1 Btu per hour per watt or higher. For heat pumps, the HSPF shall be 7.6 Btu per hour per watt or higher.

Units with a cooling capacity of 65,000 Btu per hour or greater, but less than 135,000 Btu per hour at ARI standard rating conditions, shall comply with and have performance certified in accordance with ARI 210/240. With air-cooled condenser, the cooling EER shall be 10.3 Btu per hour per watt or higher, the cooling IPLV shall be 8.3 Btu per hour per watt or higher. With water-cooled condenser, the cooling EER shall be 11.5 Btu per hour per watt or higher. For heat pumps, the heating COP shall be 3.2 or higher at the ARI high temperature rating, and 2.0 or higher at the ARI low temperature rating.

Units with a cooling capacity of 135,000 Btu per hour or greater, up to 240,000 Btu per hour at ARI standard rating conditions, shall comply with and have performance certified in accordance with ARI 340/360. With air-cooled condenser, the cooling EER shall be 9.7 Btu per hour per watt or higher, the cooling IPLV shall be 7.5 Btu per hour per watt or higher. With water-cooled condenser, the cooling EER shall be 11.0 Btu per hour per watt or higher. For heat pumps, the heating COP shall be 3.1 or higher at the ARI high temperature rating, and 2.0 or higher at the ARI low temperature rating

2.2.2 Compressor

Compressor shall be 1,750-revolution per minute (rpm) semihermetic or hermetic type with internal crankcase sight glass and protected motor. A 3,500-rpm compressor is acceptable in units of 20 tons and less. Unit shall be capable of continuous operation under ARI, "Maximum Operating Conditions" and "Load Temperature Operations".

Compressors shall be provided with capacity reduction devices to produce automatic-capacity reduction of at least 66 percent in two equal steps. Compressors shall start with capacity reduction devices in the unloaded position. If standard with the manufacturer, two equal-sized compressors shall be provided in lieu of a single compressor, and shall operate in completely independent refrigerant circuits, shall be actuated by capacity control relays interlocked with a time sequence switch, and shall start unloaded or with gas pressures across the compressor equalized.

Compressors shall be provided with high/low pressure safety cutoff. Compressor shall be equipped with reversible oil pump for lubrication, an oil-pressure-failure switch and gauge, crankcase heaters, suction and discharge flanged valves, head pressure, and suction pressure gauges with shutoff valves. Gauges shall have dual scales with both English (psig) and Metric (kPa) units. System selection shall limit the compressor power input to 1.2 kilowatts per ton of refrigeration at standard ARI conditions. Compressor shall be mounted on spring-type vibration isolators.

2.2.3 Cooling Coil

Separate cooling-coil circuits shall be provided for each compressor in the unit or Pilot expansion valves shall be furnished. For compressors with capacity reduction, the associated coil shall be provided with a separate circuit, liquid solenoid valve, and an expansion device for each two stages of capacity reduction. For each compressor of a dual-compressor unit, the associated coil shall be provided with a protected, insulated drain pan. Tubes shall be seamless copper, and fins shall be copper or aluminum, mechanically bonded to the tube at 12 fins per inch, maximum. Coils shall be vertical or set at an angle and shall be equipped with liquid-feed distributors to ensure equal feed to each refrigerant circuit. Coils shall be tested at 400 pounds per square inch (psi) at the factory and completely dehydrated. Air flow shall be limited to 500 feet per minute (fpm). Design shall preclude carryover of water.

2.2.4 Fans

Centrifugal-type fans with forward-curved type blades, or as indicated, shall be provided in each fan section. Fans shall be mounted on a common shaft or on two shafts if each shaft is driven by double belts and a single double-end motor. Bearings shall be antifriction type, manufactured from vacuum processed alloys. Bearing shall have ABEMA 9 or ABEMA 11, L-10 life expectancy rating of 40,000 hours under service load conditions. Fans shall be statically and dynamically balanced. Fans shall be V-belt driven by constant-speed motor of sufficient size that the brake power rating shall not exceed the nominal motor rating. Adjustable sheave shall provide not less than 20 percent fan-speed adjustment. Sheave size shall be selected so that fan speed at the approximate midpoint of the sheave adjustment will produce the specified air quantity. After the unit is balanced with adjustable motor sheave(s), the adjustable sheave(s) shall be replaced with fixed pitch sheave(s) on both the motor and the fan.

Fan wheels shall be statically and dynamically balanced at the factory and after installation. Dynamic balancing shall be in two planes. For fans with motors rated 5.6 kW or greater, Balance Grade shall be G2.5 or better in accordance with ISO 1940-1, unless a different Balance Grade is indicated on the drawings.

Fans driven by motors rated 5.6 kW or over shall be furnished with access doors and other provisions necessary to permit field balancing of the rotating elements, addition of corrective weights, and measurements of residual unbalance in accordance with ISO 1940-1.

2.2.5 Casing

Outer casing shall be constructed of insulated 18-gage metal panels

adequately reinforced with angles or formed metal frame, and provided with easily removable access panels located for access to all parts of the equipment. Corners shall be rounded to provide a neat appearance. All metal surfaces shall be Bonderite treated, phosphatized, and have a baked enamel finish. Return air inlet grilles located on the front face of the unit shall be an integral part of the unit casing. Casing and insulation shall be designed to limit noise and vibration within acceptable levels.

Insulation and adhesive shall comply with NFPA 90A requirements for flame spread and smoke generation.

Outlet grilles shall be constructed to permit adjustable directional flow in both horizontal and vertical planes.

2.2.6 Controls

A switch with fan/off/cool positions, or fan/off/heat/cool positions for heat pump units, shall be mounted in the unit or with the remote thermostat, as indicated. Thermostat, and humidistat if applicable shall be remotely mounted where shown on the drawing. Other controls, including motor starter or contactors and safety controls, shall be mounted inside the enclosure and wired at the factory. Motor starters shall be magnetic across-the-line type. Enclosures for motor starter shall be general purpose. Where two or more compressors are used, time-delay relays shall be provided for sequence starting. Thermostat shall have emergency heat position, and shall conform to the requirements of ASHRAE 90.1.

2.2.7 Filters

Filters shall be located in the filter return air fixture in the rear of the casing or on the inside of the front casing. Filters shall limit air velocities to 500 fpm. Provide filters of the type, efficiency, and maximum pressure drop indicated on the drawings. Filters shall be in accordance with Section 15865, "Filters".

2.2.8 Air-Cooled Condenser

Air-cooled condenser with vertical discharge, in a weather-protected casing, shall be suitable for installation remote from air-conditioning unit. Air inlet and discharge grilles shall be provided with galvanized wire-mesh birdscreens.

Condenser coil shall be an extended surface fin-and-tube type, constructed with copper tubes with copper or aluminum fins mechanically bonded to coil. Entire refrigerant circuit shall be dehydrated and sealed at the factory. Coil shall be designed for the refrigerant used in the air conditioner. R-22 condensers shall be designed for working pressure of not less than 300 psi and shall be factory tested at not less than 400 psi or as indicated.

Fans shall be centrifugal or propeller type. Fans shall be belt-driven or directly connected to low-speed (1,200 rpm maximum) electric motors. Belt drive shall be provided with guard and adjustable sheaves to provide not less than 20 percent fan speed adjustment. Sheaves shall be selected to provide the capacity indicated at the approximate midpoint of the adjustment.

Electric motor shall be totally enclosed. Motor starter shall be magnetic across-the-line type within a weather-resistant housing.

Condenser enclosure shall be constructed of not less than 18-gage sheet steel or aluminum adequately reinforced and braced, with access panels and with rust-inhibitive baked enamel or galvanized finish.

Condensing pressure control shall be accomplished as indicated, by either: an electronic solid-state control system that will modulate speed of condenser fan motor from 0 to 100 percent by fan cycling, an electric thermostat that cycles the condenser fan motor, or a head pressure switch that cycles the condenser fan motor.

Defrost controls and necessary tubing, piping, wiring, and accessories shall be provided for heat pump units.

2.2.9 Water-Cooled Condenser

Water-cooled condensers shall include all necessary openings, water and refrigerant connections, purge valves, relief devices, refrigerant valves, liquid-level indicating device, and support provisions.

Condenser shall conform to ARI 450, ASME BPV VIII Div 1 and so stamped.

When a condenser is being used as a combination receiver, the pump-down capacity shall be 80 percent of the available condenser volume.

Unit shall be selected for water velocities not in excess of 7 feet per second and a fouling factor of 0.0010.

Condensing surface between halogen refrigerant and cooling water shall be copper or brass as indicated.

Condensers with a refrigeration capacity of 10 tons and under shall be shell and coil, shell and U-tube, or shell and tube construction. Coil joints shall be brazed or silver soldered as indicated.

Condensers with a refrigeration capacity of 10 tons or more shall be shell and tube cleanable type construction, and tubes shall be rolled or brazed into tube sheet.

Intermediate tube supports shall be provided so that distance between straight-tube supports does not exceed 3 feet for copper tubes and 4 feet for brass tubes or as indicated. Supports shall be fitted to the tubes in a manner to preclude corrosion, vibration, and abrasion.

2.2.10 Humidifier

Where indicated, self contained, atomizing, electrically operated humidifiers conforming to ARI 620 shall be provided. Capacity shall be as indicated on drawings.

Humidifier dispersion piping shall be stainless steel tubing AISI Type 304, conforming to ASTM A 269, or as indicated. Humidifier drains shall be at least 3/4-inch diameter.

2.2.11 Electric Heating Coil

If indicated, provide unit with electric heating coil, of capacity and voltage as shown on drawings, and in accordance with Section 15768, "Electric Duct Heaters".

2.2.12 Vibration Isolators

Vibration isolation provisions shall conform to requirements specified in Section 15072, "Vibration Isolation for Air Conditioning Equipment."

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed in accordance with manufacturer's recommendations. External refrigerant piping for split-type units shall be installed in accordance with Section 15185, "Refrigeration Piping and Specialties", and tested in accordance with Section 15950, "Testing Adjusting and Balancing".

3.1.1 Installation of Traps and Drains

For unitary equipment, provide drain lines from each section of the unit with a condensate drain pan shall include traps of the configuration indicated below. Coils shall be mounted in the air handler with sufficient height above the floor to permit the installation of traps and drain lines as indicated. If necessary, the unit shall be furnished with supplemental supports or installed on a thicker equipment pad to provide the height required for proper trapping of the condensate lines. Trap depth is defined as the distance from the bottom of the outlet pipe, to the top of the pipe forming the bottom of the U shape of the trap. Static pressure shall be the worst case under normal operation for the system, accounting for pressure drops at full air flow volume, and with fully loaded (dirty) filters.

Traps draining condensate from sections of a unit under positive pressure shall have a trap depth not less than the highest static pressure of the section, in inches or water (gage), plus 1/2 inch. In addition, the trap outlet shall be not less than 1/2 inch below the height of the trap inlet.

Traps draining condensate from sections of a unit under negative pressure shall have a trap depth not less than 1/2 of the highest (most negative) static pressure of the section, in inches of water (gage), plus 1/2 inch. In addition, the trap outlet shall be lower than the height of the trap inlet, by a distance not less than the highest (most negative) static pressure of the section, in inches of water (gage), plus 1 inch.

The inlet from the drain pan to the trap shall be made with a vertical tee, with a threaded plug on the top to serve as a vertical clean-out opening. Lines from the trap outlet to the drain shall be sloped a minimum of 1/4 inch per foot.

3.2 TESTING AND OPERATIONAL READINESS REVIEW (ORR)

3.2.1 Room and Console Units

Test each unit in all modes of operation, and record entering and leaving air temperatures, for both evaporator and condenser, in operation at full speed and capacity.

Provide an operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for the units. Demonstrate operation of all control modes, and location of all control and maintenance items.

3.2.2 Unitary Equipment

Fan alignment and balancing shall be performed in accordance with Section 01750, "Equipment Alignment and Balancing for RCM", prior to air balancing or any operation of the unit.

Air Balancing and Operational Testing of the air-conditioning unit and its associated controls shall be performed in accordance with Section 15950, "Testing and Balancing", and Section 15902, "Non-UCS Control Systems", prior to conducting the Operational Readiness Review.

Provide an operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for the HVAC system as a whole. The HVAC system ORR shall include the unit, along with any associated exhaust or return air fans, ductwork arrangement, location and operation of key balancing dampers, fire dampers, terminal units, and other components. Include locations of control devices, and a complete demonstration of all control sequences. For task orders which involve replacement or modification of only a portion of the HVAC system, the ORR shall cover only the replaced or modified components.

-- End of Section --

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DIVISION 15 - MECHANICAL

SECTION 15736

COMPUTER ROOM AIR CONDITIONING UNITS

03/98

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SECTION 15736

COMPUTER ROOM AIR CONDITIONING UNITS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 430	(1999) Central-Station Air-Handling Units

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210	(1997) Laboratory Methods of Testing Fans for Rating
AMCA 99	(1986; AMCA 99-0401) Standards Handbook

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI SG-911	(1991) Load and Resistance Factor Design Specification for Steel Structural Members

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M	(2001) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 280	(1999) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.1	(1992) Gravimetric and Dust Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 1940-1	(1986) Mechanical vibration - Balance quality requirements of rigid rotors - Part 1: Determination of permissible residual unbalance

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 90A	(1999) Standard for the Installation of Air Conditioning and Ventilating Systems

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Control Diagrams shall be submitted for computer room air conditioning units, including all specified components and accessories, 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.

SD-03 Product Data

Manufacturer's Data shall be submitted for the computer room air conditioning units, including all specified components and accessories. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

SD-05 Design Data

Equipment Schedules shall be submitted for the computer room air conditioning units, including all specified components and accessories. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

SD-06 Test Reports

Field Test Reports shall be submitted for the computer room air conditioning units, including all specified components and accessories. Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the contractor, by an authorized official of the testing laboratory or agency (if applicable), and by the Government inspector who witnessed the test.

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the computer room air conditioning units, including all specified components and accessories, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the computer room air conditioning units, including all specified components and accessories, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

PART 2 PRODUCTS

2.1 GENERAL

AHU shall be one of the following types, as indicated on the drawings:

Data center air conditioning system shall consist of one or more (as indicated) self-contained chilled water type computer room air handling unit(s) capable of precision environmental control. Units shall be factory fabricated, fully assembled and shall include components and auxiliaries specified herein and defined under ARI 430. Units shall be of the type, class and capacities as shown in the schedules on the drawings.

Data center air conditioning system shall consist of computer room air handling units with semi-hermetic compressors and direct expansion cooling coils, and remote mounted air-cooled condensing units specified in Section 15732, "Packaged Air-Conditioning and Heat Pump Units," capable of precision environmental control. Computer room air handling units direct expansion coils and the remote air-cooled condensers shall have matched capacities and shall be shipped fully charged with refrigerant. Air handling units shall be factory fabricated, fully assembled, and shall include all components and auxiliaries as specified herein and shall be of the type, class and capacities as shown in the schedules on the drawings. Fully charged condensers shall be adjusted in the field to accommodate field conditions.

Data center air conditioning system shall consist of self-contained, air conditioning units with semi-hermetic compressors, direct expansion cooling coils, and water cooled condensers, capable of precision environmental control. Entire system shall be factory piped, charged with refrigerant and sealed. Air handling units shall be factory fabricated, fully assembled, and shall include all components and auxiliaries as specified herein and shall be of the type, class and capacities as shown in the schedules on the drawings.

Data center air conditioning system shall be a combination chilled water/direct expansion cooling system consisting of computer room air handling units with both chilled water cooling coils and direct expansion

cooling coils, and remote mounted air-cooled condensing units specified in Section 15732, "Packaged Air-Conditioning and Heat Pump Units," capable of precision environmental control. Computer room air handling units direct expansion coils and the remote air-cooled condensers shall have matched capacities and shall be shipped fully charged with refrigerant. Air handling units shall be factory fabricated, fully assembled, and shall include all components and auxiliaries as specified herein and defined, as applicable, under ARI 430. Air handling units shall be of the type, class and capacities as shown in the schedules on the drawings. Fully charged condensers shall be adjusted in the field to accommodate field conditions.

2.1.1 Air Return and Delivery Orientation

AHU shall be down flow or up flow as indicated, and comply with the following paragraphs:

Computer room air handling unit shall be downflow discharge, top return, draw-thru cooling coil, and shall discharge air into a raised floor plenum with a turning vane provided to direct the unobstructed flow of air away from the back of the unit.

Computer room air handling unit shall be upflow discharge, bottom return, draw-thru cooling coil, and shall be fitted with a collar for top supply duct connection.

2.1.2 Components and Accessories

Unit shall be complete with all components indicated, including as applicable: chilled water cooling coil, direct expansion cooling coil, hot water reheat coil, electric reheat coil, infra-red humidifier, electric cartridge steam humidifier, steam grid humidifier, filters, pre-filters, main power panel, non-locking electrical disconnect switch, centrifugal fans, microprocessor based control system, firestat, smoke detector, and solid-state underfloor water sensor.

2.1.3 Performance

Each computer room air handling unit and its components shall be performance tested for conformance to the manufacturer's ratings and in accordance with AMCA 210. Ratings shall comply with Section 7 of ARI 430. Total static pressure and coil face area classification shall conform to AMCA 99.

Chilled water units shall have coils sized to provide both: total capacity with 45 degree F entering water and sensible capacity with 50 degree F entering water.

2.2 CABINET

Unit frame shall be minimum 10-gauge welded steel tubes or steel angles and shall be mill-galvanized or coated with a corrosion-inhibiting epoxy finish. Exterior panels shall be furniture grade steel sheet, mill-galvanized or coated with a corrosion-inhibiting epoxy finish, and insulated with neoprene coated, one inch minimum thickness, 1-1/2 pound per cubic foot density fiberglass insulation. Insulation shall be applied to the cabinet panels with 100 percent adhesive coverage and both the insulation and the adhesive shall conform to NFPA 90A. Mill galvanized sheet metal shall conform to ASTM A 653/A 653M and ASTM A 924/A 924M and shall be coated with not less than 1.25 ounces of zinc per square foot of

two-sided surface. Mill rolled structural steel shall be hot-dip galvanized or primed and painted. Cut edges, burns and scratches in galvanized surfaces shall be corrosion protected. Panels shall be gasketed to prevent air leakage under system operating pressure and shall be removable for service access without the use of special tools. Condensate pans shall be minimum 22-gauge AISI SG-911 Type 304 stainless steel for corrosion protection and shall be piped to drain. Unit color shall be as selected by the Contracting Officer.

Exterior surfaces of cabinets constructed of mill-galvanized steel shall be prepared by a phosphatizing treatment, and painted with two coats of manufacturer's standard enamel finish in color selected by the Contracting Officer.

Unit shall be supplied with elevating floorstand or jacks for freestanding installation on the main building floor. Floorstand or jacks shall elevate the unit to the height of the raised computer floor and shall allow for leveling and locking at the desired height. Floorstand or jacks shall be retractable, or removable, for installing the unit directly on the raised floor. Unit shall be fully gasketed (rubber or neoprene) to prevent air leakage at the raised floor penetration.

2.3 BLOWER

Fans shall be the double width, double inlet, centrifugal type with forward curved blades. Fan wheels shall be galvanized steel and the entire fan assembly shall be statically and dynamically balanced. Blower shafts shall be heavy duty steel with self-aligning, permanently lubricated ball bearings having a minimum rating of 100,000 hours. Fans shall be belt driven and shall have adjustable motor sheaves, fixed fan sheaves and a minimum of two belts. Drive assembly shall be sized for a minimum of 140 percent of the fan motor nameplate power. Blower and motor assembly shall be mounted on a vibration-isolating sub-base. After the unit is balanced with adjustable pitch sheave(s), the adjustable sheave(s) shall be replaced with fixed pitch sheave(s) on both the motor and the fan.

Blower motors shall be UL listed, have copper windings, be equipped with heavy duty ball bearings, and be mounted on an adjustable base. Motor shall have internal overload protection and be UL listed for having protection against primary single phasing. Blower motors shall meet the requirements of Section 16003, "General Electrical Provisions," and Section 16225, "Motors."

Fan wheels shall be statically and dynamically balanced at the factory and after installation. Dynamic balancing shall be in two planes. For fans with motors rated 5.6 kW or greater, Balance Grade shall be G2.5 or better in accordance with ISO 1940-1, unless a different Balance Grade is indicated on the drawings.

Fans driven by motors rated 5.6 kW or over shall be furnished with access doors and other provisions necessary to permit field balancing of the rotating elements, addition of corrective weights, and measurements of residual unbalance in accordance with ISO 1940-1.

2.4 COOLING COIL

Chilled water coil shall be constructed of minimum copper tubing with corrugated aluminum fins. Maximum face velocity shall be 500 feet per minute. Minimum coil face area shall be one (1) square foot per ton

(12,000 Btuh) of unit capacity. Chilled water circuit shall be designed to evenly distribute water throughout the entire coil face area and shall be controlled by a 2-way modulating valve. Microprocessor control shall position the valve in response to room conditions. Entire coil assembly shall be mounted in a 22-gauge AISI SG-911 Type 304 stainless steel condensate pan. Chilled water coil shall meet the requirements of section 15762, "Air Coils."

Direct expansion coil shall be A-frame design and constructed of copper tubing with corrugated aluminum fins. Maximum face velocity shall be 500 feet per minute. Refrigerant shall be evenly distributed throughout the entire coil face area from any of the unit's compressors. Direct expansion coils shall meet the requirements of section 15762, "Air Coils."

Water flow control valves shall be two-way modulating type, cast brass, spring return, normally-closed. Assembled valves shall be rated for an operating pressure of 150 psig. Control valve assembly shall be capable of tight shut-off, when controls are operating at system pressure, with the system pump operating at shut-off head and shall be mounted in the circuit with dielectric unions for protection and ease of service.

2.5 REHEAT COIL

Reheat coil shall be hot water or electric as indicated, and shall comply with the following paragraphs:

Hot water reheat coil shall be constructed of minimum copper tubing with corrugated aluminum fins. Maximum face velocity shall be 500 feet per minute. Water circuit shall be designed to evenly distribute water through out the entire coil face area and shall be controlled by a two-way modulating type valve. Valve shall be made of cast brass. Microprocessor control shall position the valve in response to room conditions. Reheat coil shall be capable of maintaining room dry bulb temperature conditions when the system is calling for dehumidification. Assembled valves shall be rated for an operating pressure of 150 psig. Control valve assembly shall be capable of tight shut-off when operating at system pressure with the system pump operating at shut-off head and shall be mounted in the circuit with dielectric union for ease of service. Hot water reheat coil shall meet the requirements of Section 15762, "Air Coils."

Electric reheat coil shall be finned, enclosed, and constructed with a stainless steel core sheath with plated fins to withstand moist conditions. Reheat coil shall be installed down stream of the cooling coil. Coil shall have a minimum of 3 stages of capacity control and shall be protected by UL approved thermal safety switches to protect the system from overheating. Reheat coil shall be capable of maintaining room dry bulb temperature conditions when the system is calling for dehumidification. Electric reheat coil shall meet the requirements of Section 15768, "Electric Duct Heaters."

2.6 HUMIDIFICATION

Humidification shall be of the type indicated and shall comply with the following paragraphs.

An infra-red humidification system shall be furnished within the unit. Evaporator pan shall be stainless steel and shall be serviceable without disconnecting high voltage connections. Humidifier shall be pre-piped for final connections and shall include an automatic water supply system.

Infra-red humidifier shall be provided with a flush control system which shall be field adjustable to change the flush cycle time in accordance with local water conditions. Flush system shall ensure that the humidifier pan remains clean to reduce maintenance and eliminate unwanted particles.

A self-contained electric cartridge humidifier shall be furnished and shall discharge steam directly into the air stream. Humidification system shall consist of a replaceable electric steam generation cartridge, a flush control system suitable for field adjustment to change the flush cycle time an automatic fill system, and steam discharge tubing designed to evenly distribute the steam into the passing airflow.

A steam grid humidifier shall be furnished and shall be the steam separator type with a steam jacketed stainless steel distribution manifold and internal drying chamber. System shall be complete with all control valves, traps and strainers. Control components shall be located in a separate compartment away from the air stream. Humidifier capacity and steam supply pressure shall be as scheduled.

2.7 FILTRATION

Filters shall be accessible from the side of the unit and shall consist of a main filter in standard sizes for ease of replacement. Main filter shall be non-woven synthetic or natural fiber media having a minimum average atmospheric dust spot efficiency of 35 percent and a minimum average synthetic dust arrestance of 90 percent based upon ASHRAE 52.1 test methods. Unit shall be shipped with all filters installed. Filtration system shall meet the requirements of Section 15865, "Filters."

2.8 MAIN POWER PANEL

Main power panel shall include individually fused branch circuits, which will isolate any electrical component from the main power supply and completely protect each electrical component from primary single phasing and overcurrent. Fuses shall be provided by the manufacturer and factory installed. Components shall be coded to correspond to a wiring diagram for servicing of the power panel. Panel shall have terminal blocks for the main power supply and for auxiliary connections, all clearly marked for identification. Components shall be UL listed. Main power panel shall meet the requirements of Division 16, "Electrical".

Access to main power panel shall be from the front of the unit without interrupting the operation of the unit and shall have one main door for check of voltage and current of each component and two (2) doors for access to main power terminal block and auxiliary terminals. Control panel box shall conform to the requirements for a NEMA Type 1 enclosure.

All internal wiring shall be not less than 14-gauge, 105 degrees C, appliance type wire for high voltage, and not less than 18-gauge, 105 degrees C, for low voltage control wiring. All wiring shall be in accordance with UL and NFPA 70.

Unit shall be supplied with a non-locking main circuit breaker to provide an external switch for disconnecting electrical power without directly accessing the high voltage electrical section.

2.9 CONTROLS

Control system shall be microprocessor based and shall control all cooling,

humidification and reheating locally, based on return air conditions. Control system shall be low voltage and provide dry contact closures for all listed alarm points. Manufacturer shall provide a labeled terminal strip for remote monitoring of the alarm points as well as remote start/stop.

2.9.1 System Controls

Control system shall be located on the front of the unit and shall contain the following controls:

- Unit main on/off switch
- System reset
- Setpoint adjustment for temperature and humidity
- Alarm silence switch which silences audible malfunction alarm, alarm lights stay illuminated until corrective measures have been taken
- Press-to-test switch illuminates all malfunction lights and sounds malfunction alarm (test purposes only)

2.9.2 System Display

Control panel shall contain indicator lights or illuminated function display for the following:

- Systems on
- Power on
- De-humidification, heating, cooling (number of stages as required)

2.9.3 System Alarms

Control system shall monitor unit operation and shall activate an audible and visual alarm in the event of any of the following alarm conditions:

- High room temperature
- Low room temperature
- High room humidity
- Low room humidity
- Dirty filters
- Loss of airflow
- Humidifier problem
- Underfloor water alarm
- Return air smoke detector
- Loss of water flow

All indicator functions shall be illuminated when in alarm mode.

2.9.4 Thermostat

Thermostat shall be an electronic solid state device with its element located in the filtered return air stream. Thermostat shall have a minimum range of 60 to 80 degrees F and shall be accurate to within 1.0 degrees at the set point.

2.9.5 Humidistat

Humidistat shall be an electronic solid state device with its element located in the filtered return air stream entering the unit's coils. Humidistat shall have an accuracy of plus or minus 5 percent in reading relative humidity and shall have a minimum adjustable dead band of plus or

minus 5 percent. Humidistat shall have a minimum operating range of 35 to 65 percent relative humidity and shall be adjustable over the full range.

Humidistat shall start the cooling system upon an increase in humidity while the thermostat regulates room temperature using reheat.

2.9.6 Heating Coil Interlock

An interlock shall be provided to de-energize the electric heating coil in the event of air flow failure.

2.9.7 Air Sensor

Air sensing devices shall be installed to indicate clogged filters and loss of air flow.

2.9.8 Water Sensor

A water sensor shall be mounted on the main floor directly below the unit and shall activate the alarm system if it detects the presence of moisture.

2.9.9 Smoke Detector

Smoke detector shall be located in the return air stream and shall shut down the air handling unit and activate the alarm when smoke is detected. Alarm shall be connected to building alarm system, in accordance with Section 13851, "Fire Alarm Systems (Low Voltage Non-Addressable)" or Section 13852, "Fire Alarm Systems (Addressable Systems)".

2.10 COMPRESSORS

Air conditioning unit shall contain a single or multiple hermetic or semi-hermetic compressors complete with high pressure and low pressure switches, service valves, charging ports, crankcase heaters, three-phase short circuit protection and thermal overload protection. Compressors shall operate at 1750 RPM and shall be set on vibration isolators. Refrigerant circuits within the air handling unit shall be made up of copper tubing manufactured to ASTM B 280 and shall include liquid line filter dryers, liquid and moisture indicators, expansion valves, and liquid line solenoid valves.

2.11 WATER COOLED CONDENSER

Water cooled condensers shall be internal or remote coaxial or shell-and-tube counter flow type designed to balance the heat rejection requirements of the system with entering and leaving water temperature, water flow, and pressure drop as indicated.

Condensers shall be ASME stamped for maximum refrigerant pressure of 400 psi at 300 degrees F.

Water cooled condensers shall be factory piped with manual or head-pressure actuated water regulating valve and hand operated isolation valves.

Condensers shall be designed to permit pump-down and isolation of the entire refrigerant charge within 80 percent of available condenser volume. If the condenser does not have sufficient pump-down capacity, a receiver shall be provided.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed, adjusted and tested in accordance with manufacturer's recommendations. Contractor shall install all equipment in such a way that it permits access for practical and safe maintenance.

Brass or Aluminum identification tags providing manufacturer's name, address, equipment type or style, catalog number or model, and serial number, shall be securely attached to major equipment components.

Air conditioning unit shall be installed on an elevated floorstand , independent of adjacent raised flooring, or beneath the flooring, providing additional support.

3.2 ELECTRICAL SERVICE

Electrical service shall conform to NFPA 70 and the requirements of Division 16, "Electrical".

3.2.1 Air Conditioning Unit

Air conditioning unit shall operate on 208, 230, or 460 volt, single or three phase electrical service, as indicated.

3.2.2 Condenser Unit

Remote air cooled condenser shall operate on 120, 208, 230, or 460 volt, single or three phase electrical service, as indicated.

3.3 PIPE INSTALLATION

Refrigerant piping for units with remote condensing unit shall be installed in accordance with Section 15185, "Refrigeration Piping and Specialties", and tested in accordance with Section 15950, "Testing, Adjusting and Balancing".

All supply piping shall be supplied with main isolation valves and strainers including any humidifier piping. Cooling and reheat returns shall also have isolation. All supply and return lines shall also have pressure and temperature gauges located on the unit side of the isolation valves. Isolation valves shall be located within 1200 millimeters from the unit control valves.

All piping below the elevated floor shall be located so that it offers the least resistance to air flow discharging from the system.

Provide drainage connections for water cooled units, condensate, and humidifier flushing system.

Provide shut-off valves in condenser water inlet and outlet piping on water cooled units.

3.3.1 Installation of Traps and Drains

Drain lines from each section of the unit with a condensate drain pan shall include traps of the configuration indicated below. Coils shall be mounted in the air handler with sufficient height above the floor to permit the

installation of traps and drain lines as indicated. If necessary, the unit shall be furnished with supplemental supports or installed on a thicker equipment pad to provide the height required for proper trapping of the condensate lines. Trap depth is defined as the distance from the bottom of the outlet pipe, to the top of the pipe forming the bottom of the U shape of the trap. Static pressure shall be the worst case under normal operation for the system, accounting for pressure drops at full air flow volume, and with fully loaded (dirty) filters.

Traps draining condensate from sections of a unit under positive pressure shall have a trap depth not less than the highest static pressure of the section, in inches or water (gauge), plus 1/2 inch. In addition, the trap outlet shall be not less than 1/2 inch below the height of the trap inlet.

Traps draining condensate from sections of a unit under negative pressure shall have a trap depth not less than 1/2 of the highest (most negative) static pressure of the section, in inches of water (gauge), plus 1/2 inch. In addition, the trap outlet shall be lower than the height of the trap inlet, by a distance not less than the highest (most negative) static pressure of the section, in inches of water (gauge), plus 1 inch.

The inlet from the drain pan to the trap shall be made with a vertical tee, with a threaded plug on the top to serve as a vertical clean-out opening. Lines from the trap outlet to the drain shall be sloped a minimum of 1/4 inch per foot, or 2 percent.

3.3.2 Provisions for Steam Traps

For air handling units equipped with steam coils or steam humidifiers, those devices shall be mounted in the air handler with sufficient height above the floor to permit the installation of steam traps, drip legs, and condensate drain lines as indicated in Section 15125, "Steam Traps". If necessary, the unit shall be furnished with supplemental supports or installed on a thicker equipment pad to provide the height required for proper trapping of the steam condensate.

3.4 VIBRATION ISOLATION

Air handling unit shall be vibration isolated from building structure and from connecting ductwork. Refer to Section 15072, "Vibration Isolation for Air Conditioning Equipment," for vibration isolation considerations.

3.5 TESTING AND OPERATIONAL READINESS REVIEW (ORR)

Fan alignment and balancing shall be performed in accordance with Section 01750, "Equipment Alignment and Balancing for RCM", prior to air balancing or any operation of the unit.

Air Balancing and Operational Testing of the air-conditioning unit and its associated controls shall be performed in accordance with Section 15950, "Testing and Balancing", and Section 15902, "Non-UCS Control Systems", prior to conducting the Operational Readiness Review.

Provide an operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for the units. Include locations of control devices, and a complete demonstration of all control sequences.

-- End of Section --

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SECTION 15762

AIR COILS

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SECTION 15762

AIR COILS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 410	(1991) Forced-Circulation Air-Cooling and Air-Heating Coils

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M	(2001) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification. For coils which are part of a unit, the following information shall be included in the unit submittals under the applicable unit specification section:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following coil types indicating, tested and certified equipment response and performance characteristics, when applicable, coil pressure and temperature ratings, coil casings, headers, tubing, circuiting, and drainable coils, and outline drawings with coil dimensions and connection sizes.

Steam Heating
Hot-Water Heating
Chilled-Water Cooling
Volatile Refrigerant Cooling

SD-10 Operation and Maintenance Data

Contractor shall submit 4 copies of the Operation and Maintenance Manuals 30 days prior to testing the Coil Systems. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

1.4 LABEL

Coils shall bear the ARI certification seal indicating compliance with ARI 410.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 Coil Pressure and Temperature Ratings

Coils shall be designed for the following fluid operating pressures and temperatures.

Service	Pressure (psi)	Temperature (Degrees F)
Steam - low pressure	25	267
Steam - high pressure	150	366
Hot water	200	250
Chilled water	200	45
Volatile refrigerant	200	300

Coils shall be air-pressure tested under water at the following minimum pressures:

Service	Pressure (psi)
Steam	250
Hot water	250
Chilled water	250
Volatile refrigerant	400

2.1.2 Coil Casings

Coil casing shall be mill-galvanized 16-gauge, minimum, sheet metal with not less than 1.25 ounces of zinc per square foot of two-sided metal surface conforming to ASTM A 653/A 653M and ASTM A 924/A 924M. Casing shall be flanged on four sides for bolted assembly, except as otherwise specified.

Where coils are stacked, casing shall be of double-bend construction.

Duct-mounted reheat coil casings not over 36 inches in length shall be fabricated from a minimum 20-gauge galvanized steel conforming to above specified requirements; casings shall be flanged or suitable for drive-slip assembly.

Coil mounting within housing shall be slide-out type, except as otherwise specified. Coils shall be slide-out type for ceiling-suspended package units, and for other package units whose capacity exceeds 15,000 cubic feet per minute.

2.1.3 Coil Headers

Coil headers shall be cast iron, brass, copper, or aluminum casting.

Direct expansion, volatile refrigerant coils shall have copper or brass headers with necessary control connections.

Steam and water coil headers shall be fitted with 1/4-inch iron pipe size spring-loaded plug drains and vent petcocks. Automatic vents shall be provided where indicated.

2.1.4 Coil Tubing

Coils shall be constructed of copper tubing with aluminum or copper fins. Helical coil fins shall be wound tight to the tubes and solder-coated. Plate fins shall have spacer collars in metallic contact with the adjacent fin, and fins shall be mechanically bonded to the tube. No bare tube surface shall be visible within the finned portion of the coil.

Cooling coils of helical wound copper design shall be solder-coated.

Coil tubes in water and volatile refrigerant service shall be parallel and shall have sufficient intermediate full coil depth supports to prevent sagging of unsupported span due to working fluid pressures and temperatures and summer and winter coil-ambient conditions. Sagging shall be unacceptable if tube centerline is displaced by more than 3/16 inch from centerline of tube connection at outlet header when coils are more than two rows deep and when installed in accordance with the manufacturer's instructions. Provisions for expansion and contraction shall be adequate to preclude sagging and distortion under thermal loads applied in indicated or specified service. Tubes shall be sloped to be free draining.

Heating-coil face tube spacing shall be a maximum of 3 inches on center for 1-inch outside-diameter (o.d.) tubes, 2 inches for 3/4-inch o.d. tubes, and 1-1/2 inches for 5/8-inch o.d. tubes.

Coil face tube spacing for cooling coils and for helically wound heating coils immediately followed by water-cooling coils shall not exceed 1-1/2 inches on center.

Tubes shall be straight, turns shall be made through headers or return U-bends, and connections and joints shall be brazed, except as otherwise specified.

Coil tube material shall be seamless deoxidized copper.

Raw coil tube stock wall minimum thickness shall be 0.025 inch.

Raw coil tube stock wall minimum thickness shall be 0.035 inch.

Where mechanical insert devices are used to increase liquid turbulence within tubes, the wall thickness of these tubes shall be increased by 0.010 inch over the minimum raw coil tube stock specified for the service.

Tube minimum o.d. shall be 1/2 inch.

2.1.5 Coil Circuiting

Standard or full-circuited water coils shall have as many full-length tubes in each circuit as the number of tubes in the depth of the coil face; double-circuit water coils shall have twice as many as standard coils; and half-circuit water coils shall have half as many as standard coils and to the next larger whole number where odd numbers are involved.

Coils more than two rows deep shall be counterflow type, except that in the case of double- or half-circuit coils, reasonable deviation from counterflow arrangement will be permitted, provided the pressure drop and capacity requirements are met.

2.1.6 Drainable Coils

Drainable coils shall be capable of being purged free of water with compressed air.

Self-draining coils shall have a drain point at the end of every tube and shall be pitched to that point. Drain provisions shall include: drained headers; U-bends with integral plugs; or nonferrous plugs in cast-iron headers. Each tube shall drain substantially dry by gravity alone when drains and vents are open.

Where necessary, the coil shall be filled with water to the end of the manufacturer's header connections and drainage volume shall be checked against the manufacturer's data.

2.2 COIL TYPES

2.2.1 Steam Heating

Type SA shall be steam distributing, tube-in-tube with multiple-orifice distributors. Minimum o.d. shall be 1 inch wherever coil is exposed to airstream at freezing temperatures. For all other applications, minimum tube o.d. shall be 5/8 inch. Tubes shall be pitched 1/8 inch per foot, and coil casing shall be level. Inlet and outlet connections shall be on the same side of the coil.

Type SB shall be tube-in-tube type, for reheat service, with modulating control. When located in ductwork over 6 feet in total width, either two separate coils or one coil with supply to both ends and a single return shall be provided. Inlet and outlet connections shall be on the same end of a coil and on opposite sides of the two-coil assembly.

Type SC shall be single row, single circuit, for reheat service with two-position control.

Type SD shall be integral damper face and bypass type. Coil shall include headered, finned elements, with return bends pitched within the casing, and bypasses with interlocked dampers controlled by a damper motor and airstream thermostats.

Maximum fin spacing shall be 10 per linear inch. Tubes shall be connected to supply and return headers by mechanical joints and shall be secured against vibration by a channel that permits expansion and contraction. Damper blades shall be 16-gauge cold-rolled steel. Damper rod bearings

shall be graphite-impregnated nylon. Linkage bearings shall be oil-impregnated bronze. Proportioning of air shall be such that the average temperature at any point in a plane parallel to the coil face, 3 feet downstream of the leaving side, shall vary not more than 5 degrees F from the thermostat setting. Pressure-drop of air passing through the coil shall vary not more than plus or minus 5 percent, regardless of the position of the internal dampers.

2.2.2 Hot-Water Heating

Type HA shall be continuous circuit type, limited to two rows depth.

Type HB shall be drainable counterflow type, with more than two rows.

2.2.3 Chilled-Water Cooling

Type CA shall be continuous circuit, drainable type, limited to two rows depth.

Type CB shall be self-draining, counterflow type.

Type CC shall be self-draining, cleanable, counterflow type. Tubes shall be straight-through type, rolled or brazed into steel tube sheets. Headers shall be enclosed with gasketed and bolted removable cover plates to provide access to tube internals from either one end or both ends of coil.

Unless otherwise indicated, chilled water coils for service in Air Conditioning Systems (ACS) units shall have a minimum of eight rows depth.

2.2.4 Volatile Refrigerant Cooling

Type DX shall be counterflow type, designed for use with refrigerant specified, with equal length circuiting arrangement. Number of distributors provided shall suit indicated refrigerant and shall eliminate trapping of refrigerant and oil. Coil capacity shall be obtained with expansion valve set for not less than 8 degrees F of superheat. Refrigerant distributor shall be furnished and installed by the coil manufacturer. Tube o.d. shall be either 5/8 inch or 3/4 inch.

Refrigerant distributor shall be suitable for use with a balanced, double-ported thermostatic expansion valve or with a pilot-operated valve where indicated. Arrangement shall be capable of stable operation down to 15 percent of design capacity.

PART 3 EXECUTION

3.1 INSTALLATION

Coils shall be installed in accordance with the manufacturer's recommendations.

3.2 TESTS

For drainable types:

Coil pitch and leveling shall be field checked for drainability in the presence of the Contracting Officer.

For refrigerant coils:

Coils shall be pressure tested, dehydrated, vacuum tested, purged with inert gas, and sealed, in accordance with Section 15950, "Testing, Adjusting and Balancing".

3.3 TESTING AND OPERATIONAL READINESS REVIEW (ORR)

Air and water balancing and operational testing of the coils and associated controls shall be performed in accordance with Section 15950, "Testing, Adjusting and Balancing", and Section 15902, "Non-UCS Control Systems", prior to conducting the Operational Readiness Review.

Provide an operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for the coils. Include locations of control devices, and a complete demonstration of all control sequences.

For coils furnished as part of the HVAC unit, the ORR shall be part of the ORR for the unit.

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SECTION 15764

FAN-COIL UNITS

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SECTION 15764

FAN-COIL UNITS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 440	(1998) Room Fan-Coil Air-Conditioners

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S12.23	(1989) Method for the Designation of Sound Power Emitted by Machinery and Equipment

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1999) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 883	(1986; 6th Ed; Rev thru Feb 15, 1989; Errata Apr 24, 1989) UL Standard for Safety Fan-Coil Units and Room Fan-Heater Units
UL-02	(2000) Building Materials Directory

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Data shall be submitted for the fan-coil units. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

SD-04 Samples

Manufacturer's Standard Color Chart shall indicate the manufacturer's standard color selections and finishes for Fan Coil Units.

SD-05 Design Data

Equipment Schedules shall be submitted for the fan-coil units. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

SD-06 Test Reports

Manufacturer's Test Reports shall be submitted for the sound rating of fan-coil units if manufacturer's data does not include certified data. Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the manufacturer, by an authorized official of the testing laboratory or agency (if applicable), and by the Government's witness (if applicable).

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the fan-coil units, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted for the fan-coil units in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

Section 15072, "Vibration Isolation for Air Conditioning Equipment," applies to work specified in this section.

PART 2 PRODUCTS

2.1 GENERAL

Units shall include an enclosure for cabinet models and casing for concealed models.

Base unit shall be complete with galvanized casing, water-coil assembly with auxiliary water or steam heating-coil, valve and piping package, drain pans, air filter, fan motor, and motor control.

Sound-power-level, decibels reference, 10 to the minus 12 power watt, at

the fan operating speed selected to meet the specified capacity, shall not exceed the following values at the midfrequency of each octave band:

	OCTAVE BANDS				
	3RD	4TH	5TH	6TH	7TH
Frequency (hertz)	250	500	1,000	2,000	4,000
Power Level (decibels)	60	55	53	50	48

Sound-power-level data or values for these units shall be obtained in accordance with the test procedures specified in ANSI S12.23. Sound-power values apply to units provided with factory-fabricated cabinet enclosures and standard grilles. Values obtained for the standard cabinet models will be acceptable for concealed models without separate tests provided there is no variation between models as to the coil configuration, blowers, motor speeds, or relative arrangement of parts. Each unit shall be fastened securely to the building structure.

Capacity of the units shall be as indicated. Room fan-coil units shall be certified as complying with ARI 440 and shall meet the requirements of UL 883. Indicated capacity shall be with the fan on high speed, except that a unit with larger coil or fan sized to provide the capacity at medium speed shall be provided where necessary to comply with sound-power-level requirements.

2.2 ENCLOSURE

Enclosure shall be constructed of not lighter than 18-gage steel, properly reinforced and braced. Front panel of enclosure shall be removable and provided with 1/2-inch thick insulation conforming to NFPA 90A, to prevent condensation. Discharge louvers shall be four-way adjustable and shall be designed to properly distribute air throughout the conditioned space. All ferrous-metal surfaces shall be galvanized or treated with a rust-inhibiting finish. All exposed-to-view enclosure corners and edges shall be rounded. Discharge louvers shall be mounted in a top panel that is removable for coil cleaning. Access doors shall be hinged and shall be provided for all piping and control compartments. Enclosure finish shall be manufacturer's standard in color selected by the Contracting Officer.

2.3 CASING

Casing shall be acoustically and thermally insulated internally with not less than 1/2-inch thick insulation conforming to NFPA 90A, fastened with waterproof and fire-resistant adhesive.

2.4 FAN

Fan shall be galvanized steel or aluminum, centrifugal type with forward type blades or as indicated. All surfaces shall be smooth. Assemblies shall be accessible for maintenance. Disassembly and reassembly shall be by mechanical fastening devices, not adhesives. Fan shall be balanced dynamically and statically at the factory and after installation.

2.5 COILS

Water coils shall be constructed of not less than 1/2-inch outside diameter (o.d.) seamless copper tubing with copper or aluminum plate fins mechanically bonded or soldered to the tubes and shall be provided with not less than 5/8-inch o.d. female solder connectors, accessory piping package with terminal connections for control valves, and manual air vent on returns. Provisions shall be made for coil removal.

Coils shall be hydrostatically tested at the factory, at 250 pounds per square inch (psi) or under water at 250 psi air pressure and shall be suitable for 200-psi working pressure.

2.6 DRAIN PANS

Drain pans shall be sized and located to collect condensed water dripping from any item within the unit enclosure. Drain pans shall be constructed of not lighter than 20-gage galvanized steel, thermally insulated to prevent condensation. Thermal insulation shall be coated with a waterproofing compound. Not less than 3/4-inch National Pipe Thread (NPT) or 5/8-inch o.d. copper drain connection shall be provided in the drain pan. Pans shall slope not less than 1/8-inch per foot to drain.

2.7 FILTERS

Filters shall be provided for each unit and shall be permanent washable type, 1-inch nominal thickness, Class 1 or 2, in conformance with UL-02. Filters shall be removable without tools.

2.8 MOTORS

Motors shall be direct connected, two-bearing, permanent split-capacitor type with built-in overload protection, and shall be mounted on a resilient base. Motors shall be designed for 1,060 revolutions per minute maximum on 115-volt, single-phase, 60-hertz power. Motors shall be furnished with three built-in speeds, with four insulated leads (common, high, medium, and low) to terminate in a control-junction box.

A solid-state variable speed controller capable of not less than 50 percent speed reduction shall be provided in lieu of step speed control, when so specified.

2.9 CONTROLS

Applicable requirements of Section 15902, "Non-UCS Control Systems," shall apply.

Unit manufacturer shall factory-install control valves furnished by the automatic temperature-control manufacturer.

Controls shall be in a unit-mounted control panel. Remote-mounted controllers shall be provided where indicated.

Motor speed-control switch shall provide speed selection and off position and shall be mounted to be conveniently accessible from an access door.

Where indicated on drawings, motor control and power wiring shall be coordinated with UCS controls (provided under separate contract by UCS contractor as indicated in Section 15900, "UCS Controls") to provide remote

ON/OFF control of groups of fan-coil units by the UCS system.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed as indicated and specified and in accordance with manufacturer's recommendations.

3.2 TESTING AND OPERATIONAL READINESS REVIEW (ORR)

Air and water balancing and operational testing of the fan coil unit and its associated controls shall be performed in accordance with Section 15950, "Testing, Adjusting and Balancing", and Section 15902, "Non-UCS Control Systems", prior to conducting the Operational Readiness Review.

Provide an operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for the units. Include locations of control devices, and a complete demonstration of all control sequences.

-- End of Section --

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SECTION 15765

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03/98

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SECTION 15765

FINNED TUBE RADIATION
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 516/A 516M	(1996; Rev e1) Pressure Vessel Plates, Carbon Steel, for Moderate-and Lower-Temperature Service
ASTM A 568/A 568M	(2000; Rev B) Standard Specifications for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE-03	(1997) Handbook, Fundamentals (IP Edition)
ASHRAE-04	(1997) Handbook, Fundamentals (SI Edition)

FEDERAL SPECIFICATIONS (FS)

FS TT-E-496	(Rev B; Am 3) Enamel; Heat-Resisting (400 Degrees F, Black)

HYDRONICS INSTITUTE (HYI)

HYI-O1	(1994) I=B=R Ratings for Boilers, Baseboard Radiation and Finned Tube (Commercial) Radiation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1999) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 499	(1997; 12th Ed) UL Standard for Safety Heating and Cooling Equipment

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

Baseboard Radiation
Finned Tube Radiation
Convectors

SD-04 Samples

Manufacturer's Standard Color Chart shall indicate the manufacturer's standard color selections and finishes for the following items:

Baseboard Radiation
Finned Tube Radiation
Convectors

SD-05 Design Data

Equipment Schedules shall be submitted for the items listed below. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

Baseboard Radiation
Finned Tube Radiation
Convectors

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the items listed below, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

Heating Elements
Enclosures and Supports
Dampers
Acoustic Sealing Materials and Methods (in accordance with paragraph entitled "Acoustic Sealing"

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the following items, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

Baseboard Radiation

Finned Tube Radiation
Convectors

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

PART 2 PRODUCTS

2.1 BASEBOARD RADIATION (BR)

2.1.1 General

Hot water baseboard radiation shall be complete with heating element, supports, access doors, dampers, expansion provisions, heating-medium control, vent provisions, and enclosures.

Steam baseboard radiation shall be complete with heating element, supports, access doors, dampers, expansion provisions, heating-medium control, vent provisions, and enclosures.

Enclosures shall longitudinally fill the space provided, wall-to-wall.

Baseboard assembly shall have not less than indicated capacity, shall be rated in accordance with HYI-O1 and shall conform to requirements specified herein.

Hot water system pressure components shall be rated for continuous service at not less than 240 degrees F and at not less than 1-1/2 times the maximum system service pressure.

Steam system pressure components shall be rated for service at not less than 290 degrees F and at not less than 1-1/2 times the maximum system service pressure, but in no case less than 15 pounds per square inch, gage (psig).

2.1.2 Heating Element

Nonferrous heating element shall be the manufacturer's standard copper tube and aluminum fin assembly.

Method of attachment of extended surface to the tube shall be the manufacturer's standard which produces an element with permanently bonded fins and permanent cataloged capacity. Loose fins at operating temperatures shall be regarded as causing a reduction in capacity, and the Contractor shall provide additional heating surface or replace all such material at no additional cost to the Government. Elements with bent or damaged fins are not acceptable.

An element slope toward return of 1/4 inch per 10 feet shall be provided.

2.1.3 Element Expansion Provisions

Expansion joints shall be provided for all elements longer than 25 feet. Joints shall be nonferrous packless type with phosphor-bronze bellows. Guides and anchors shall be provided in accordance with manufacturer's published instructions.

Flexible riser connections shall be corrugated, nonferrous metal hose.

2.1.4 Enclosures and Supports

Enclosure shall be constructed of not less than 20-gage carbon steel and shall include a roll-formed back with integral top molding deflector and a roll-formed snap-on front panel to form a large slot for directed air discharge. Steel shall be cold rolled or stretcher-leveled quality conforming to ASTM A 568/A 568M.

Enclosure shall cover all riser pipes, controls, and expansion joints. Hinged access doors shall be provided at all vent, control, and adjustment devices.

Heating element shall be supported on rolling support elements or on molded polypropylene cradles to provide noise-free movement.

Surface finish shall include manufacturer's standard phosphate pretreatment and prime coat, ready for field finish.

Baked enamel finish shall be provided as selected by the Contracting Officer from manufacturer's standard colors.

2.1.5 Dampers

Full-length dampers shall be provided. Dampers shall remain stable in any set position and shall have a knob for position control or other means of adjustment of holding force.

2.2 FINNED TUBE RADIATION (FTR)

2.2.1 General

Hot water finned tube radiation shall be complete with heating elements, supports, access doors, expansion provisions, heating medium control, vent provisions, and enclosures.

Steam finned tube radiation shall be complete with heating elements, supports, access doors, expansion provisions, heating-medium control, vent provisions, and enclosures.

Enclosures shall longitudinally fill the space provided, wall-to-wall.

Finned tube assemblies shall have not less than indicated capacity, shall be rated in accordance with HYI-O1, and shall conform to requirements specified herein.

System pressure components, including heating elements, expansion provisions, and accessories, shall be rated for service at not less than 300 degrees F and at not less than 1-1/2 times the maximum system pressure, but in no case less than 50 psig.

2.2.2 Heating Element

Ferrous heating element shall consist of black carbon steel fins as the extended surface, bonded to standard black carbon steel pipe. Fins shall have a thickness of not less than 0.032 inch and shall be spaced not closer than 32 fins per foot.

Nonferrous heating element shall consist of aluminum fins as the extended

surface, bonded to 0.032 inch wall thickness, seamless deoxidized-copper tubing. Aluminum fins shall have a thickness of not less than 0.020 inch and shall be spaced not closer than 40 fins per foot.

Ferrous heating elements, with fins not less than 0.040 inch thick, shall be provided wherever elements with expanded metal covers are located within 4 feet of the floor.

Method of attachment of extended surface to the pipe shall be the manufacturer's standard which produces an element with permanently bonded fins and permanent cataloged capacity. Loose fins at operating temperatures shall be regarded as causing a reduction in capacity, and the Contractor shall provide additional heating surface or replace all such material at no additional cost to the Government. Elements with bent or damaged fins are not acceptable.

Ferrous elements shall be properly cleaned and prepared, and finished with a black paint conforming to FS TT-E-496.

An element slope toward return of 1/4 inch per 10 feet shall be provided.

2.2.3 Element-Expansion Provisions

Short-run expansion shall be accommodated within element supports and piping.

Expansion loops shall be provided where space permits within covers and around columns. Loop proportions shall be provided as indicated.

Expansion joints shall be provided at any point where more than 1/2 inch of expansion movement occurs.

Expansion joints shall be packless, shroud-protected, bellows type, with internal bellows guiding and antitorque provisions. Service pressure shall be external to the bellows.

Ferrous system expansion joints shall have corrosion-resistant steel bellows and carbon steel end connectors.

Nonferrous system joints shall have phosphor-bronze bellows and bronze or brass shrouds and end connectors.

Proper alignment, guiding, and anchoring shall be provided at each expansion provision.

Flexible riser connections shall be single-braid covered corrugated metal hose. Corrugated metal and pipe end connections shall be corrosion-resistant steel or Monel for ferrous element systems, and phosphor-bronze, corrosion-resistant steel, or Monel for nonferrous element systems. Braid shall be nonferrous. Material shall be installed in strict accordance with manufacturer's instructions.

2.2.4 Enclosures and Supports

Enclosure configuration shall be as indicated.

Single-slope-top wall-mounted enclosures with louvers in angle face shall be provided.

Double-slope-top, freestanding enclosures shall be provided, together with 1 inch angle corrosion-resistant steel apex cap, attached with corrosion-resistant steel screws. Louvers shall be located in both angle faces.

Expanded and flattened metal enclosures of not less than 18-gage thickness, with 1/2- to 3/4-inch diamond-mesh and solid-metal edging spotwelded to mesh, shall be provided in indicated areas.

Enclosure and trim surfaces exposed to view shall be constructed of not less than 18-gage cold-rolled carbon-steel stretcher-leveled quality, conforming to ASTM A 516/A 516M.

Enclosure shall be of substantial construction with smooth and blemish-free surfaces free of sharp edges and with flush interlocking joints without visible fasteners. Front panel bottom shall have turned-over edge. Reinforcement shall be 2 feet on center. Louvers shall be pencilproof venetian type.

Enclosure back panel shall be not less than 20-gage, extending to the floor.

Enclosure shall cover all riser pipes, control valves, and expansion joints, and shall be of the same cross section throughout, except that louvers may be omitted for appearance purposes. Hinged hand-access doors shall be provided at all vent, control, and adjustment devices, with tamperproof latches.

Free-standing enclosure shall be pedestal mounted 2 feet on center. Pedestal material shall be Schedule 40 carbon-steel pipe, with equal or heavier thickness welded plate flange with four anchor bolt provisions. Pedestals shall accommodate riser pipes.

Elastomer wall gasketing shall be provided for wall-mounted units to seal space between wall and top of enclosure and to eliminate streaking.

Element supports shall be located not more than 4 feet on center. Mounting provisions shall provide for quiet element movement by adequate spacing between moving and stationary components and through the use of rolling elements or equivalent low-friction cradle bearing surfaces utilizing nylon, polypropylene, or tetrafluoroethylene. Rod, wire, and similar support provisions are not acceptable.

Bottom of front face of enclosure shall be 6 inches off the floor.

Enclosure surface finish shall include manufacturer's standard phosphate pretreatment and prime coat ready for field finish.

Baked enamel finish shall be provided as selected by the Contracting Officer from manufacturer's standard colors.

2.2.5 Dampers

Dampers shall be knob-operated mechanical type extending the full length of the enclosure. Friction type is not acceptable.

Dampers shall be manufacturer's standard construction type.

Dampers shall be provided for finned-tube radiation where indicated.

2.3 CONVECTORS

2.3.1 General

Convectors shall be complete with heating elements, access doors, dampers, baffles and division wall, expansion provisions, control and vent provisions, and enclosures.

Cabinet shall be sized as indicated.

Convectors shall have not less than indicated capacity and shall conform to requirements specified herein.

Hot water convector pressure components shall be rated for service at not less than 240 degrees F and at not less than 1-1/2 times the maximum system service pressure.

Steam convector pressure components shall be rated for service at not less than 300 degrees F and 50 psig.

2.3.2 Heating Element

Heating element shall be the manufacturer's standard aluminum fin or copper type.

Hot water heating element tube material shall be seamless deoxidized copper.

Steam heating element tube material shall conform to the requirements of ASHRAE-03, Chapter 36 and UL 499.

Method of attachment of extended surface to the tube shall be the manufacturer's standard which produces an element with permanently bonded fins and permanent cataloged capacity. Loose fins at operating temperatures shall be regarded as causing a reduction in capacity, and the Contractor shall replace all such material at no additional cost to the Government. Elements with bent or damaged fins are not acceptable.

An element slope of 1/4 inch per 10 feet shall be provided toward return.

Expansion provisions and supports shall be such that element movement is strain-free and noiseless.

2.3.3 Enclosure

Enclosure configuration shall be as indicated.

Slope-top surface-mounted enclosures shall be provided with discharge louvers in angle face and inlet louvers in the bottom front face of freestanding units.

Enclosure front shall be constructed of not less than 16-gage cold-rolled carbon steel, sides of not less than 18-gage cold-rolled carbon steel, and back of not less than 20-gage cold-rolled carbon steel, all of stretcher-leveled quality conforming to ASTM A 568/A 568M.

Semi- or fully-recessed enclosures with inlet and discharge grilles shall have 14-gage fronts of stretcher-leveled quality cold-rolled carbon steel conforming to ASTM A 568/A 568M and 20-gage construction elsewhere.

Enclosure shall be of substantial construction with smooth and blemish-free surfaces, free of sharp edges, with flush joints. Fronts shall be formed and braced to ensure plane surfaces without oilcan effect. Wrinkled-metal and notched-corner construction is not acceptable. Louvers shall be pencilproof, venetian type. Enclosure shall cover all riser pipes and controls. Hinged access doors shall be provided where necessary for access to components. Fronts shall have rounded bottom flange for units installed above floor level.

Elastomer wall gasketing shall be provided for recessed units to seal space between wall and enclosure.

Enclosure surface finish shall include manufacturer's standard phosphate pretreatment and prime coat ready for field finish.

Baked enamel finish shall be provided as selected by the Contracting Officer from manufacturer's standard colors.

2.3.4 Dampers

Dampers shall be knob- or key-operated type.

2.3.5 Insulation

Backs of semi-recessed or fully-recessed units shall be insulated with not less than 1/2 inch of 3-pound per cubic foot density fibrous-glass insulation conforming to NFPA 90A.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed as indicated, specified, and in accordance with manufacturer's recommendations. Piping, valves, and instrumentation shall be provided in accordance with Section 15183, "Steam and Condensate Systems", or Section 15625, "Hydronic Water Systems". Steam traps shall be provided in accordance with Section 15125, "Steam Traps".

3.2 ACOUSTIC SEALING

Effective acoustic sealing of noise paths which occur when radiation components penetrate ceiling-high walls or partitions shall be provided. Effective acoustic sealing shall be defined as equal to wall or partition sound transmission loss.

A proposed method of sealing that uses materials that will not flow or sag at system maximum design temperature or make noise under contraction and expansion movement shall be submitted for approval.

3.3 TESTING AND OPERATIONAL READINESS REVIEW (ORR)

Performance of finned-tube elements shall be tested and reported as part of "Air and Hydronic Systems Balancing and Adjustment", as specified in Section 15950, "Testing, Adjusting and Balancing". Provide and Operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", as part of the ORR for the HVAC system as a whole. ORR shall include location of all valves and controls.

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SECTION 15766

UNIT HEATERS AND VENTILATORS

09/98

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SECTION 15766

UNIT HEATERS AND VENTILATORS
09/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ALUMINUM ASSOCIATION (AA)

AA 45	(1980) Designation System for Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S12.11	(1987) Method for the Measurement of Noise Emitted by Small Air-Moving Devices
ANSI S12.30	(1990) Guidelines for the Use of Sound Power Standards and the Preparation of Noise Test Codes
ANSI S12.33	(1990) Engineering Methods for the Determination of Sound Power Levels of Noise Sources in a Special Reverberation Test Room

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M	(2001) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 568/A 568M	(2000; Rev B) Standard Specifications for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM F 1040	(1987; R 1993) Standard Specification for Filter Units, Air Conditioning, Viscous - Improvement and Dry Types, Replaceable

MILITARY SPECIFICATIONS (MS)

MS DOD-G-24508	(1987a; Am 3) Grease, High Performance, Multipurpose (Metric)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(1999) National Fuel Gas Code
NFPA 70	(1999) National Electrical Code

NFPA 90A (1999) Standard for the Installation of Air Conditioning and Ventilating Systems

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Control Diagrams shall show physical and functional relationships of equipment. Electrical diagrams shall show size, type, and capacity of the systems. Pneumatic diagrams shall be submitted for air and gas systems.

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

Gas Unit Heaters
Propeller Unit Heaters
Cabinet Unit Heaters
Unit Ventilators

SD-04 Samples

Manufacturer's Standard Color Chart shall be submitted for the following items showing manufacturer's standard color selections and finishes.

Gas Unit Heaters
Propeller Unit Heaters
Cabinet Unit Heaters
Unit Ventilators

SD-05 Design Data

Equipment Schedules shall be submitted for the items listed below. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

Gas Unit Heaters
Cabinet Unit Heaters
Propeller Unit Heaters
Unit Ventilators

SD-06 Test Reports

Field Test Reports shall be submitted for the items listed below.

Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the contractor, by an authorized official of the testing laboratory or agency (if applicable), and by the Government inspector who witnessed the test.

Operational Tests

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the items listed below, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

Gas Unit Heaters
Propeller Unit Heaters
Cabinet Unit Heaters
Unit Ventilators

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the following items, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

Gas Unit Heater
Propeller Unit Heaters
Cabinet Unit Heaters
Unit Ventilators

Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

SD-11 Closeout Submittals

As-Built Drawings shall be submitted for the following items providing current factual information including deviations from, and amendments, to the drawings and concealed and visible changes in the work.

Gas Unit Heaters
Propeller Unit Heaters
Cabinet Unit Heaters
Unit Ventilators

1.3 MECHANICAL PROVISIONS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

Section 15072, "Vibration Isolation for Air Conditioning Equipment," applies to work specified in this section.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

2.1.1 Gas Unit Heaters (GUH)

Drawings or schedule shall include capacity, gas data, mounting height, and type.

2.1.1.1 Type

Unit heaters shall be suspended type and arranged for discharge of air as indicated. Unit shall comply with applicable American Gas Association standards.

2.1.1.2 Casing

Casing shall be manufactured of not less than 20-gage steel. Casing inside and outside shall be given a phosphate pretreatment, primer, and baked enamel finish. Horizontal adjustable louvers shall be provided and shall be completely recessed inside the casing frame.

One way deflection vanes shall be provided unless otherwise noted.

2.1.1.3 Heat Exchangers

Heat exchangers shall be welded construction, heavy aluminized steel. Each exchanger shall be formed in a clam-shell design to completely surround the burner. Individual combustion chambers shall be provided for each burner.

2.1.1.4 Burners

Burners shall be die-formed, aluminum-painted, heavy mild steel with long slot ports for even supply of gas. Burner assembly shall be of unitized construction with integral crossover for positive burner ignition. A draft diverter shall be an integral part of each heat exchanger section to allow backdrafts to bypass burner assembly without affecting normal operation.

2.1.1.5 Fans

Fans shall be propeller type, designed and manufactured for unit heater application. Fans shall have a minimum of three aluminum blades.

2.1.1.6 Motors

Motors shall be totally enclosed, with sleeve bearings and built-in overload protection. Motors shall be mounted to back panel by a fan guard motor mount constructed of spring steel wire.

2.1.1.7 Controls

Controls shall include high limit switch, fan controls, a 24-volt automatic gas valve with 100 percent safety pilot shutoff, a pressure regulator with leak limiting device, and manual main and pilot valves. An integral junction box for all power and control connections shall be provided.

A low voltage transformer shall be provided or a spark ignition controller shall be provided as indicated.

2.1.2 Propeller Unit Heaters (PUH)

Propeller unit heaters shall be hot water or steam, as indicated.

Drawings or schedule shall include capacity, heating media data, mounting height, and type.

2.1.2.1 Type

Unit heaters shall be suspended type and arranged for discharge of air as indicated.

2.1.2.2 Vertical Discharge Units

Vertical discharge units shall operate at speeds not in excess of 1,200 revolutions per minute (rpm), except that units with 50,000 British thermal units per hour output and less shall operate at speeds up to 1,800 rpm. Discharge opening shall be covered with a fan guard.

Louver cone diffusers shall be provided or adjustable vane diffuser shall be provided as indicated.

2.1.2.3 Horizontal Discharge Units

Maximum volume in and face velocity in feet per minute (fpm) for horizontal discharge units shall be:

Volume (cfm)	Velocity (fpm)
Up to 1,000	800
1,001 to 3,000	900
3,001 and over	1,000

Adjustable double deflection louvers shall be provided.

2.1.2.4 Heating Elements

Heating elements shall be manufacturer's standard construction, rated for standard service of not less than 300 degrees F at 75 pounds per square inch (psi).

2.1.2.5 Casings

Casings with smoothly contoured propeller orifice rings shall be constructed of 20-gage or thicker cold-rolled carbon steel. Casing surface finish shall include phosphate pretreatment, prime coating, and baked enamel finish.

2.1.2.6 Propellers and Motors

Propellers shall have not less than four aluminum blades and shall be dynamically balanced.

Horizontal-discharge units shall be provided with fan inlet safety guard.

Motors shall be mounted on elastomer vibration isolators.

2.1.2.7 Control

Unit heaters shall be controlled by line-voltage thermostats, unless otherwise indicated.

2.1.3 Cabinet Unit Heaters (CUH)

Cabinet unit heaters shall be hot water or steam, as indicated.

Drawings or schedule shall include capacity, power rating, heating media, filter, pressure drop, size, and other pertinent data.

2.1.3.1 Type

Cabinet unit heaters shall be quiet-operating type, complete with heating elements, fans and drives, filters, baffles and division walls, control provisions, and enclosures with access panels.

Cabinet shall not exceed drawing dimensions.

Unit pressure components shall be rated for service at not less than 150 psi at system working temperature.

2.1.3.2 Heating Element

Heating element shall be manufacturer's standard aluminum fin,serpentine copper-type tube and shall be drainable and ventable.

Cataloged capacity of the heating element shall be constant and permanent.

Tube material shall be seamless deoxidized copper.

Fins shall be mechanically connected to the tubes. Loose fins at operating temperatures will be regarded as causing a reduction in capacity, and the Contractor shall replace all such material at no additional cost to the Government. Elements with bent or damaged fins are not acceptable.

Expansion provisions and supports shall be such that element movement is strainfree and noiseless.

Face area of the coil shall be not less than that specified on the drawings.

2.1.3.3 Fan and Drive Assembly

Fan shall be centrifugal, forward-curved, double-width, double-inlet type, and shall be statically and dynamically balanced at the factory.

Fan drives shall be direct.

Fan drives shall be direct. Independent fan shafts shall be elastomer mounted in self-aligning antifriction sleeve-type bearings, with essentially lifetime lubrication.

Switch positions shall include an off position.

Rotating elements shall be statically and dynamically balanced. Fan and drive assembly shall be vibration isolated. Refer to Section 15072, "Vibration Isolation for Air Conditioning Equipment," for vibration isolation considerations.

Direct-drive motor rotational speed shall not exceed 1,200 rpm.

2.1.3.4 Filters

Filters shall be 1-inch minimum thickness, replaceable, throwaway type conforming to ASTM F 1040.

Filters shall be installed in a bypass-proof frame to ensure filtering of all moving air before entry into heating element and shall be removable without tools.

2.1.3.5 Enclosures

Enclosure configuration shall not deviate from drawing specifications.

Enclosure construction shall be minimum 16-gage, cold-rolled carbon steel of stretcher-leveled quality conforming to ASTM A 568/A 568M. Construction shall have smooth, blemish-free surfaces, without sharp edges, and with flush joints. Wrinkled-metal and notched-corner construction is not acceptable. Enclosure shall provide space for all riser pipes and controls. Access doors shall have tamperproof latches. Doors and panels shall be hinged to protect surface finishes and personnel.

Enclosure surface finish shall include manufacturer's standard phosphate pretreatment, prime coat, and baked enamel finish in color as selected by the Contracting Officer.

2.1.3.6 Insulation

Backs of recessed units shall be insulated with not less than 1/2 inch of 3-pound per cubic foot density fibrous-glass insulation conforming to NFPA 90A.

2.1.3.7 Control Cycle

Sequence of operation shall be as per manufacturer's recommendations, or as indicated on drawings.

Control components shall conform to requirements specified under Section 15902 "Control Systems."

2.1.4 Unit Ventilators (UV)

Drawings or schedule shall include capacity, power rating, heating duty and method, and other pertinent data. Unit ventilators shall be hot water or steam, as indicated.

2.1.4.1 Type

Unit ventilators shall be quiet-operating modular type, complete with heating elements, fans and drives, filters, baffles and division walls, dampers, control provisions, and enclosures with access panels.

Unit pressure components shall be rated for service at not less than 150 psi

at system working temperature.

Intercomponent wiring shall conform to NFPA 70. Components of unit assembly shall be UL listed and approved.

Heating, fan, and control modules shall have polarized, color-coded, plug-in connections.

2.1.4.2 Heating Element

Heating element shall be the manufacturer's standard aluminum fin serpentine copper-tube type and shall be drainable and ventable.

Cataloged capacity of the heating element shall be constant and permanent.

Tube material shall be seamless deoxidized copper.

Fins shall be mechanically connected to the tubes. Loose fins at operating temperatures will be regarded as causing a reduction in capacity, and the Contractor shall replace all such material at no additional cost to the Government. Elements with bent or damaged fins are not acceptable.

Expansion provisions and supports shall be such that element movement is strainfree and noiseless.

Face area of the coil shall be not less than specified drawing dimensions.

2.1.4.3 Fan and Drive Assembly

Fan shall be centrifugal, forward-curved, double-width, double-inlet type, and shall be statically and dynamically balanced.

Fans shall be belt driven, mounted on a common shaft. Shaft shall be supported by independent, elastomer-mounted, self-aligning, antifriction or sleeve-type bearings with lifetime lubrication. Motor sheave shall be adjustable to provide not less than 20 percent speed variation either way from capacity point. Belt tension shall be adjustable.

Motor shall be manually controlled by two-position on/off switch.

Motors shall be elastomer vibration-isolation mounted, permanent split-capacitor type with adjustable rail mounting.

2.1.4.4 Filters

Filters shall be 1-inch minimum thickness, replaceable, throwaway type conforming to ASTM F 1040.

Filters shall be installed in a bypass-proof frame to ensure filtering of all moving air before entry into the heating element and shall be removable without tools.

2.1.4.5 Dampers

Dampers shall be opposed-blade type constructed to resist salt air. Blades shall be galvanized steel with mechanically attached not dependent upon adhesives. Bearings shall be high-grade commercial quality flanged-type with extended race and corrosion-resistant steel balls and heat-treated carbon steel construction with factory-applied grease conforming to

MS DOD-G-24508, suitable for salt air exposure. Bearings shall be sleeve-type oil-impregnated bronze.

Face and bypass damper shall be provided with external bypass duct if required by unit.

Mixing dampers shall be provided as an assembly within a mixing box. Dampers shall be capable of varying the mixed air in any proportion from 100 percent room air to 100 percent outside air.

2.1.4.6 Enclosure

Enclosure configuration shall be as per manufacturer's recommendations.

Enclosure shall be of not less than 16-gage cold-rolled carbon steel of stretcher-leveled quality conforming to ASTM A 568/A 568M. Construction shall be smooth with blemish-free surfaces, without sharp edges, and with flush joints. Enclosure shall be formed and braced to ensure plane surfaces with no oilcan effect. Wrinkled metal and notched corner construction is not acceptable. Louvers shall be pencilproof venetian type. Louvers shall be constructed of metal and, in their normal position, shall sustain a distributed load of 200 pounds, maximum. Enclosure shall provide space for all riser pipes and controls. Access doors shall have tamperproof latches.

Enclosure internal surfaces, exposed to condensation and to salt airstream, shall be specially protected with heavy coatings or noncorroding materials. Flash chrome- and cadmium-plating is not acceptable.

Enclosure surface finish shall include manufacturer's standard phosphate pretreatment, prime coat, and baked enamel finish. Color shall be as selected by the Contracting Officer.

2.1.4.7 Wall Sleeve

Wall sleeve shall be constructed of not less than 18-gage galvanized carbon steel, with commercial zinc weight conforming to ASTM A 653/A 653M. Finish shall consist of manufacturer's standard galvanized surface preparation and not less than two finish coats of baked enamel or one finish coat of high-build epoxy. Color shall be as selected by the Contracting Officer. All penetrations shall be sealed in accordance with Section 07840, "Firestopping".

2.1.4.8 Thermal and Acoustic Insulation

Insulation shall prevent heat loss, heat gain, condensation, and shall provide acoustic treatment of surfaces.

2.1.4.9 Control Cycle

Sequence of operation shall be as per manufacturer's recommendation's, or as indicated on drawings.

Control components shall conform to requirements specified under Section 15902, "Control Systems."

2.1.4.10 Fresh Air Intakes

Extruded-aluminum intake louvers with 16-gage, 1/2-by 1/2-inch mesh

aluminum wire birdscreens shall be provided for all fresh air intakes. Extruded aluminum shall be subjected to caustic etch and 0.5 micrometer anodize treatment in accordance with AA 45. Aluminum shall be protected from dissimilar metals and causticity of concrete or mortar by elastomeric seals. Intake shall be particularly suited to indicated building-construction penetration.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed in accordance with manufacturer's recommendations. Piping, valves and instrumentation shall be installed in accordance with Section 15183, "Steam and Condensate Systems" or Section 15625, "Hydronic Water Systems". Steam traps shall be provided in accordance with Section 15125, "Steam Traps". Installation of gas-fired units shall comply with NFPA 54.

3.2 FIELD QUALITY CONTROL

Operational tests shall be conducted per manufacturer's instructions.

3.3 TESTING AND OPERATIONAL READINESS REVIEW (ORR)

Air and Water Balancing and Operational Testing of the units and associated controls shall be performed in accordance with Section 15950, "Testing, Adjusting and Balancing", and Section 15902, "Non-UCS Control Systems", prior to conducting the Operational Readiness Review.

Provide an operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for the units. Include locations of control devices, and a complete demonstration of all control sequences.

-- End of Section --

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SECTION 15767

ELECTRIC UNIT HEATERS

03/97

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-- End of Section Table of Contents --

SECTION 15767

ELECTRIC UNIT HEATERS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

UNDERWRITERS LABORATORIES (UL)

UL 1096 (1986; 4th Ed; Rev thru Jan 30, 1988)
Electric Central Air Heating Equipment

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Control Diagrams shall be submitted for Electric Heaters showing arrangement, interconnection, function and rating of controls.

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

Electric Unit Heaters

SD-05 Design Data

Equipment Schedules shall be submitted for the items listed below. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

Electric Unit Heaters

SD-06 Test Reports

Field Test Reports shall be submitted for the items listed below. Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the contractor, by an authorized official of the testing laboratory or agency (if applicable), and by the Government inspector who witnessed the test.

Electric Unit Heaters

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the items listed below, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

Electric Unit Heaters

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the following items, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

Electric Unit Heaters

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

Unit heaters shall conform to the requirements of UL 1096.

2.2 DESCRIPTION

Unit heaters shall be suspended type and shall be arranged for discharge of air as indicated.

Unit heaters shall have not less than indicated capacity and shall conform to requirements specified herein.

Unit heaters shall be factory prewired, ready for field terminal connections.

Voltage shall be as indicated on drawings.

2.3 CASINGS

Casings with smoothly contoured propeller orifice rings shall be constructed of not less than 20-gage cold-rolled carbon steel. Casing surface finish shall include phosphate pretreatment, prime coating, and baked-enamel finish.

2.4 AIR DISTRIBUTION

Vertical discharge units shall be fitted with louver-cone diffusers.

Horizontal units shall be provided with adjustable single- or double-deflection louvers as indicated.

2.5 HEATING ELEMENT

Element construction shall consist of a resistance wire insulated by highly compacted refractory insulation protected by a sealed metallic-finned sheath. Component materials shall be as follows:

Resistance wire shall be not less than 20-helix wound alloy approximately 80-percent nickel and 20-percent chromium.

Refractory insulation shall be magnesium oxide with a resistance of not less than 50,000-ohms after exposure to an ambient temperature and humidity of 90 degrees F and 85 plus or minus 5-percent relative humidity, respectively, for not less than 24 hours.

Sheathing shall consist of aluminum fins cast around an internal steel sheath containing refractory insulation and resistance wire or carbon-steel fins permanently attached to a tubular carbon-steel or corrosion-resistant steel sheath containing refractory insulation and resistance wire and with all external surfaces porcelainized.

Maximum surface temperature of porcelain-protected steel sheathing shall be 700 degrees F or as indicated.

Maximum surface temperature of cast-aluminum sheathing shall be 500 degrees F or as indicated.

2.6 CONTROLS

Units up to and including 5 kilowatts shall be fitted with integral controls including thermal overload cutout switches, necessary transformers, liquid-vapor system, and low-mass bimetal thermostat as required. Cutout switch shall be automatically resettable.

Unit shall be provided with a remote unfused knife blade type disconnect switch that opens ungrounded conductors in the OFF position and a thermostat with integral controls including thermal overload cutout switches, magnetic contactors, necessary transformers, and thermostat protection as required. Cutout switches shall be automatically resettable.

Wall-mounted thermostats shall be complete with thermometer, mechanical high-limit stop, calibrated operator, and an adjustable heater to effect anticipation and to prevent override of space temperature. Range shall be between 55 and 105 degrees F. Differential shall not exceed 1.5 degrees F. Thermostat shall be rated for operation at 24 volts, 60 hertz. Transformers, wiring, and devices necessary to meet this requirement shall be provided. Cases shall be finished in brushed or satin chrome.

2.7 PROPELLERS AND MOTORS

Propellers shall have mill-aluminized or galvanized-steel or all-aluminum blades, as indicated, and shall be statically and dynamically balanced to within 0.5 percent. Units shall be provided with fan-inlet safety guards.

Propellers and motors shall be certified by the AMCA for air performance and noise level.

Motors shall be protected against damage by the heating element and shall be resiliently mounted.

Motors shall conform to Section 16225, "Motors," except that load-matched and custom-designed motors may be used and shall be so identified on the shop drawings. Motors not so identified shall conform to the requirements specified.

Subfractional and fractional custom-designed or applied motors may deviate from the preceding motor requirements as follows:

Shaded-pole motors rated less than 1/6-horsepower may be used for direct-drive service.

Permanent split-capacitor, split-phase, and capacitor-start motors rated 1/4-horsepower and less may be used for direct-drive service.

Split-phase and capacitor-start motors, rated 1/4-horsepower and less, may be used for belt-drive service.

Motor bearings may be manufacturer's standard prelubricated sleeve type except that motors shall have antifriction thrust bearings, when specified. Lubricant provisions shall be extended service requiring replenishment not more than twice per year of continuous operation.

Motor identification plate shall be manufacturer's standard.

Motor speed and control shall be unit-heater manufacturer's standard.

PART 3 EXECUTION

3.1 INSTALLATION

Unit heaters shall be installed in accordance with the manufacturer's instructions at the mounting heights indicated.

3.2 FIELD TESTING AND OPERATIONAL READINESS REVIEW (ORR)

Unit heaters shall be demonstrated to operate satisfactorily in the presence of the Contracting Officer.

Unit heaters shall be cycled five times, from start to operating thermal conditions to off, to verify adequacy of construction, system controls, and component performance.

An operational test shall be conducted for a minimum of 6 hours.

Provide an Operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", including location of units and controls, and demonstration of operation.

-- End of Section --

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DIVISION 15 - MECHANICAL

SECTION 15768

ELECTRIC DUCT HEATERS

09/96

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SECTION 15768

ELECTRIC DUCT HEATERS
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

UNDERWRITERS LABORATORIES (UL)

UL 1096 (1986; 4th Ed; Rev thru Jan 30, 1988)
Electric Central Air Heating Equipment

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification. For coils furnished as part of an HVAC unit, the following information shall be included in the unit submittals, under the applicable unit specification section:

SD-02 Shop Drawings

Control Diagrams shall be submitted showing arrangement, interconnection, function and rating of controls.

Electric Duct Heaters

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

Electric Duct Heaters

SD-05 Design Data

Equipment Schedules shall be submitted for the items listed below. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

Electric Duct Heaters

SD-06 Test Reports

Field Test Reports shall be submitted for the items listed below. Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the contractor, by an authorized official of the testing laboratory or agency (if applicable), and by the Government inspector who witnessed the test.

Electric Duct Heaters

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the items listed below, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

Electric Duct Heaters

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the following items, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

Electric Duct Heaters

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

Duct heaters shall conform to the requirements of UL 1096.

2.2 DESCRIPTION

Duct heaters shall have the capacity indicated, plus or minus 5 percent.

Duct heaters shall be factory prewired, ready for field terminal connections.

Capacity shall be based on 60 degrees F entering air and 85-degree F discharge air at 300 cubic feet per minute, or as indicated.

2.3 HEATING ELEMENTS AND ENCLOSURE

Heating elements shall be installed with a framework complete with terminal, and junction boxes shall be constructed of mill-aluminized or galvanized carbon steel. A magnetic contactor shall be provided in a separate enclosure insulated from the duct at duct heater location or at a

separate, remote location.

Gasketing shall be 1/16-inch thick non-asbestos woven-cloth tape.

Flange depth shall be suitable for duct insulation provided. Terminal junction box shall be insulated to prevent elevated temperatures.

Heating-element construction shall consist of a resistance wire insulated by highly compacted refractory insulation protected by a sealed metallic-finned sheath. Component materials shall be as follows:

Resistance wire shall be a helix-wound alloy approximately 80 percent nickel and 20 percent chromium.

Refractory insulation shall be magnesium oxide. Element shall be subjected to a dielectric test of twice the element rated voltage plus 1,000 volts applied between terminal and sheath for a period of 1 minute.

Sheathing shall consist of aluminum fins cast around an internal steel sheath containing refractory insulation and resistance wire or carbon-steel fins permanently attached to a tubular carbon-steel or corrosion-resistant steel sheath containing refractory insulation and resistance wire and with all external surfaces porcelainized.

Wattage density shall not exceed 90 watts per linear inch of heated element length or not greater than 22 watts per square inch.

Open heating-element construction shall consist of a helix-wound resistance wire alloy approximately 80 percent nickel and 20 percent chromium. Wattage density shall not exceed 50 watts per linear inch of heated element. Element support shall minimize abrasion and sagging. Safety screens shall be provided on both upstream and downstream sides of heater elements.

Dummy open heating elements shall be provided or other provisions similar to open area perforated screens shall be included if required to uniformly distribute airflow across heater face.

2.4 CONTROLS

Units shall be furnished with integral overheat cutouts for primary and secondary protection. Automatic-reset primary cutout shall be the disk type and shall be suitable for 277-volt, 60-hertz service.

Disk type manual-reset secondary cutouts shall be provided and shall be wired in series with each circuit.

Indicating light(s) shall be provided to indicate:

Heater on

Each circuit on

Pilot switch shall be locally provided to cut off heater through integral magnetic contactors.

Heater assemblies rated at 45 amperes and larger shall have the heater assembly subdivided and fused. Each subdivided 45-ampere heater load

section shall be fused. In circuits of less than 45 amperes, appropriate sections shall be fused.

Control box(es) containing any contactors, etc. shall be U.L. approved and location shall be coordinated with the Construction Coordinator for easy access and service. Each unit shall be equipped with Knife blade type disconnect switch.

Step controllers for sequencing heater loads shall be constructed of UL-approved components and shall include the following:

Delay to prevent line surge when energizing loads

Individual fusing of each step

Intercomponent wiring to terminals for field connection

Cabinet

Wall-mounted thermostats shall be single- or two- or three- stage type as required.

Thermostats shall be complete with thermometer, mechanical high-limit stop, calibrated operator, and an adjustable heater to effect anticipation and to prevent override of space temperature. Range shall be between 55 and 105 degrees F. Differential shall not exceed 1.5 degrees F. Thermostat shall be rated for operation at 24 volts, 60 hertz. Any necessary transformers, wiring, and devices to meet this requirement shall be provided. Cases shall be finished in brushed or satin chrome.

Power to unit shall be controlled by a UL-listed solid-state silicon-controlled rectifier (SCR) system such that voltage is continuously impressed and varied in minute increments over a range of zero to rated voltage or to 105 percent of rated voltage maximum.

PART 3 EXECUTION

3.1 INSTALLATION

Duct heaters shall be installed in accordance with the manufacturer's instructions and shall be located to permit access to the heater after installation.

3.2 FIELD TESTING

Duct heaters shall be demonstrated to operate satisfactorily in the presence of the Contracting Officer.

An operational test shall be conducted for a minimum of 6 hours.

Duct heaters shall be cycled five times, from start to operating thermal conditions to off, to verify adequacy of construction, system controls, and component performance.

3.3 TESTING AND OPERATIONAL READINESS REVIEW (ORR)

Air balancing and operational testing of the coils and associated controls shall be performed in accordance with Section 15950, "Testing, Adjusting and Balancing", and Section 15902, "Non-UCS Control Systems", prior to

conducting the Operational Readiness Review.

Provide an operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for the coils. Include locations of coils, control devices, and a complete demonstration of all control sequences.

For coils furnished as part of an HVAC unit, ORR shall be part of the overall ORR for the system.

-- End of Section --

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SECTION 15815

HVAC SYSTEMS DUCTWORK

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SECTION 15815

HVAC SYSTEMS DUCTWORK
08/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 36/A 36M	(2000; Rev A) Standard Specification for Carbon Structural Steel
ASTM A 653/A 653M	(2001) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM C 1071	(1998) Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
ASTM E 477	(1999) Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers
ASTM E 84	(2001) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F 1137	(1988) Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S328	(1986) Specification for Structural Steel Buildings Load and Resistance Factor Design

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Specification for Filler Metals for Brazing

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1999) Standard for the Installation of Air Conditioning and Ventilating Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA-06	(1995; 2nd Ed) HVAC Duct Construction Standards - Metal and Flexible
SMACNA-F	(1992; 4th Ed) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems

UNDERWRITERS LABORATORIES (UL)

UL 181	(1996; 9th Ed) UL Standards for Safety Factory-Made Air Ducts and Air Connectors
UL 555	(1999; 6th Ed) Safety Fire Dampers
UL 555S	(1999; 4th Ed) Safety Leakage Rated Dampers for Use in Smoke Control Systems
UL 723	(1996; Rev thru Dec 1998) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Records of Existing Conditions consisting of 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.

SD-02 Shop Drawings

Installation Drawings for HVAC Ductwork Systems. Drawings shall show details of equipment room layout and design. Installation drawings shall be submitted for plenums, for ductwork of pressure classes over 2 inch water gage and for other work as indicated on the drawings.

SD-03 Product Data

Manufacturer's Catalog Data for the following items:

Flexible Ductwork Materials
Dampers (all types, including mounting accessories)
Flexible Connecters

SD-05 Design Data

Submit Shop Standards for duct construction and reinforcement, indicating contractor's standard fabrication method for various duct sizes and pressure classes, selected from those in SMACNA-06. Alternatively, contractor may submit a copy of the SMACNA-06 narrowscope construction table and certify that duct fabrication will be in compliance with those requirements.

SD-06 Test Reports

Test Reports for HVAC systems ductwork on the following tests in accordance with the paragraph entitled, "Ductwork Leakage Tests" and "Fire and Smoke Damper Tests," of this section.

Operational Tests
Leakage Tests

SD-07 Certificates

Provide Certificates of Compliance for:

Galvanized Steel
Reinforcing Materials
Ductwork Supports
Brazing Materials
Fasteners
Sealants and Adhesives

SD-10 Operation and Maintenance Data

Operation and maintenance manuals shall be consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions.

Operation and maintenance manuals for:

Power Operated Dampers
Fire Dampers, Smoke Dampers, Combination Fire and Smoke Dampers

SD-11 Closeout Submittals

As-Built Drawings shall provide current factual information including deviations from, and amendments to the drawings and concealed or visible changes in the work, for Low Pressure Ductwork Systems.

1.3 PERFORMANCE REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

Section 15072, "Vibration Isolation for Air Conditioning Equipment," applies to work in this section.

1.4 DESIGN REQUIREMENTS

Unless otherwise indicated, ductwork shown on drawings shall be fabricated and installed in accordance with this section, which includes rectangular

and round galvanized steel ductwork, and flexible ducts, for standard HVAC and general exhaust applications. Other types of ductwork, for use only as indicated on drawings, shall be provided in accordance with Section 15818, "Special Application Ductwork".

PART 2 PRODUCTS

2.1 GALVANIZED STEEL DUCTWORK MATERIALS

Galvanized steel ductwork sheet metal shall be carbon steel, of lock-forming quality, hot-dip galvanized, with regular spangle-type zinc coating, conforming to ASTM A 924/A 924M and ASTM A 653/A 653M, G90. Duct surfaces to be painted shall be treated by phosphatizing.

All fasteners shall be galvanized.

Sheet metal gages and reinforcement type and spacing shall conform to SMACNA-06, except as otherwise specified. No ductwork shall be less than 26 gage.

2.1.1 Duct Hangers

Duct hangers in contact with galvanized duct surfaces shall be galvanized or shall be black carbon steel painted with inorganic zinc.

2.1.2 Mill-Rolled Reinforcing and Supporting Materials

Mill-rolled structural steel shall conform to ASTM A 36/A 36M and, whenever in contact with sheet metal ducting, shall be galvanized in accordance with ASTM A 123.

Equivalent strength, proprietary-design, rolled-steel structural support systems may be submitted for approval in lieu of mill-rolled structural steel.

2.1.3 Brazing Materials

Brazing materials shall be silicon bronze, in accordance with AWS A5.8.

2.2 FLEXIBLE DUCT MATERIALS

Flexible duct connectors shall be in accordance with UL 181, Class 1 material and shall comply with NFPA 90A.

2.2.1 Metal Flexible Duct

Metal duct shall be bendable through 180 degrees without damage, with an inside bend radius not greater than one-half the diameter of duct. Metal shall be carbon steel galvanized in accordance with ASTM A 123.

2.2.2 Uninsulated Flexible Duct

Wire-reinforced cloth duct shall consist of a chloroprene fibrous-glass cloth bonded to and supported by a corrosion-protected spring steel helix. Fabric may be a laminate of metallic film and fibrous glass. Working pressure rating of ducting shall be not less than three times maximum system pressure, and temperature range shall be minus 20 to plus 175 degrees F.

2.2.3 Insulated Flexible Duct

Wire-reinforced fibrous-glass duct shall consist of a minimum 1 pound/cubic foot density fibrous glass bonded to and supported by corrosion-protected spring helix. Vapor barrier shall be a 4 mil minimum, pigmented polyvinylchloride film. Duct shall be bendable without damage through 180 degrees with an inside bend radius not greater than two duct diameters. Minimum insulation thickness shall be 1 inch. Thermal conductivity shall be not greater than 0.23 Btu per hour per square foot per degrees F at 75 degrees F mean. Permeance shall be not greater than 0.10 perm. Working pressure range shall be from minus 1/2-inch w.g. to plus 1-1/2 inches w.g.. Working temperature shall range from minus 20 to plus 250 degrees F. Minimum sustained velocity without delamination shall be 2,400 fpm. Materials shall conform to NFPA 90A.

2.3 MANUAL VOLUME DAMPERS

Volume damper construction shall conform to SMACNA-06, Figures 2.12 and 2.13, and associated notes.

Dampers shall be equipped with an indicating quadrant regulator with a locking feature externally located and easily accessible for adjustment. Where damper rod lengths exceed 30 inches, a regulator shall be provided at each end of damper shaft. Where located in ducts with external insulation, shaft and regulator shall extend beyond the insulation thickness, so that operation of the damper will not damage the surface of the insulation.

A square shaft shall be used for damper lengths up to and a square shaft shall be used for damper lengths over . All damper shafts shall be supported through the ductwork at both ends, and shaft penetrations shall be sealed consistent with the pressure class and seal class of the duct. Shafts shall be continuous on rectangular dampers over 450 millimeter width on round dampers over 300 millimeter diameter, and on all dampers for pressure class 500 pascal and above.

Dampers in ducts having a width perpendicular to the axis of the damper that is greater than 12 inches shall be multiblade type having a substantial frame with blades fabricated of 16-gage metal. Blades shall not exceed 10 inches in width and 48 inches in length and shall be welded to 1/2-inch diameter shafts. Dampers greater than 48 inches in width shall be made in two or more sections with intermediate mullions, each section being mechanically interlocked with the adjoining section or sections. In ducts of 750 pascal pressure class and above, damper blades shall have graphite-impregnated nylon or oil-impregnated sintered bronze bearings at each end.

All multi-blade dampers shall be the opposed-blade type (connected so that adjoining blades rotate in opposite directions), except where the drawing specifically calls for a parallel-blade type damper.

2.4 GRAVITY BACKDRAFT AND RELIEF DAMPERS

Frame shall be constructed of not less than 1-1/2- by 4-inch reinforced 16-gage galvanized carbon steel. Frames and mullions shall be solidly secured in place and sealed with elastomer calking against air bypass.

Maximum blade width shall be 9 inches, and maximum blade length shall be 36 inches. Blade material shall be 16-gage galvanized steel. Blades shall be provided with mechanically retained seals and 90-degree limit stops.

Dampers used for relief service shall have blades linked together to open not less than 30 degrees on 0.05-inch differential pressure.

Shaft bearings shall be graphite-impregnated nylon or oil-impregnated bronze.

Dampers shall be equipped with fixed or adjustable counterbalancing weights.

Gravity backdraft dampers in sizes 18 by 18inches or smaller, when furnished integral with air moving equipment, may be equipment manufacturer's standard construction.

2.5 POWER-OPERATED DAMPERS

Dampers shall conform to applicable requirements specified under Section 15902, "Non-UCS Control Systems." Where indicated, Contractor shall install control dampers furnished by the UCS contractor in accordance with Section 15900, "UCS Controls".

2.6 FLEXIBLE CONNECTORS FOR SHEET METAL

For pressure class up to 500 pascals, connectors shall be UL-listed, 20-ounce, fire-retardant, airtight, woven fibrous-glass cloth impregnated with chloroprene. Clear width, not including clamping section, shall be 3 to 5 inches.

For pressure class 750 pascals and over, connectors shall be UL listed, 30-ounce per square foot, waterproof, fire-retardant, airtight, woven fibrous-glass cloth, double coated with chloroprene. Clear width, not including clamping section, shall be 6 to 8 inches.

2.7 FIRE DAMPERS

Fire dampers shall have free-area equal to full duct size.

Fire dampers shall be constructed and labeled in accordance with UL 555 to provide damper and mounting fire-resistance as required for the fire-resistance of the construction in which installed. In construction with fire-resistance rating of 3 hours or more, damper shall have a 3 hour rating. In construction with fire resistance rating under 3 hours, damper shall have 1-1/2 hour rating. For link loads in excess of 20 pounds, UL-approved quartzoid links shall be provided.

Sleeves shall be constructed in accordance with UL 555 and NFPA 90A.

2.8 SMOKE DAMPERS

Smoke dampers shall be constructed and labeled in accordance with UL 555S. Leakage class, maximum pressure, maximum velocity, installation mode (horizontal or vertical), and degradation test temperature shall be as indicated on the drawings.

Combination fire and smoke dampers shall be as above, and also in compliance with the paragraph entitled "Fire Dampers".

2.9 SEALANTS AND ADHESIVES

Duct sealants and adhesives shall have a flame spread rating of 25 or less,

and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723.

2.10 SOUND TRAPS

Sound traps shall be provided where indicated, and shall be factory-fabricated units, with performance certified in accordance with ASTM E 477. Minimum insertion loss, maximum airflow generated noise, and maximum pressure drop shall be as indicated on the drawings, when tested at the indicated airflow velocity and direction.

Trap shall be airtight when operating under an internal pressure of 0.37 pound per square inch. Air-side surface shall be capable of withstanding air velocities of 10,000 feet per minute without any particulate matter leaving the trap and being carried downstream.

Sound traps shall be double-metal walled, round or rectangular, as indicated. Sheet metal shall be mill-galvanized steel with commercial weight of zinc, conforming to ASTM A 653/A 653M. Exterior metal shall act as a vapor barrier. Metal thickness and reinforcements shall be not less than that required for the pressure class, in accordance with SMACNA-06, but not less than 22-gage. Absorbing material, on the sound-impinging side, shall be covered with formed perforated mill-galvanized steel of not less than 24-gage. Exterior sheet joints shall be continuously welded or made with lockseams filled, prior to forming, with a chloroprene mastic.

Interior surfaces shall be spot welded not more than 3 inches on center. Connections to duct transitions shall be flanged with through-bolted 1/8-inch by 1-inch continuous rubber gasketing. Supports shall be trapeze type, vibration isolated.

Absorption material shall be fibrous glass. Surface exposed to airstream shall be chloroprene coated or protected with woven fibrous-glass cloth conforming to ASTM C 1071. Total compressed thickness shall provide required attenuation and thermal insulation to preclude condensation on exterior surface under operating conditions normal to installed location. Compressed material density shall be approximately 4.5 pounds per cubic foot. Material shall conform to fire hazard requirements of NFPA 90A.

PART 3 EXECUTION

3.1 INSTALLATION

Sheet metal construction shall be provided in accordance with SMACNA-06, for pressure class indicated on the drawings, and NFPA 90A. If not indicated, pressure class shall be 500 pascal for ducts between supply fans and VAV boxes, and 250 pascal for other ducts.

Fabrication shall be airtight and shall include necessary reinforcements, bracing, supports, framing, gasketing, sealing, and fastening to provide rigid construction and freedom from vibration, airflow-induced motion, noise, and excessive deflection at specified maximum system air pressure and airflow.

Offsets and transitions shall be provided as required to avoid interference with the building construction, piping, or equipment. Offset and transition angles shall not exceed those in SMACNA-06, Figure 2-7, and duct aspect ratio shall not exceed 4 to 1, without approval.

Duct strength shall be adequate to prevent failure under pressure or vacuum created by fast closure of ductwork devices. Leaktight automatic relief devices shall be provided where indicated on drawings, with pressure rating as indicated.

3.2 DUCT SEAL CLASS

Ductwork shall be sealed as indicated below, except when the drawings indicate a higher class is required:

All ducts of pressure class 4 inches water gage or greater shall meet Seal Class A (all transverse joints, longitudinal seams, and duct wall penetrations shall be sealed);

All ducts of pressure class3 inches water gage shall beet Seal Class B (all transverse joints and longitudinal seams shall be sealed);

All ducts of Pressure class 2 inches water gage shall meet Seal Class C (all transverse joints shall be sealed);

All HVAC supply ducts of pressure classes 1/2 inch and 1 inch water gage which are upstream of VAV boxes, or which are located in return air plenums or unconditioned spaces, shall meet Seal Class C (all transverse joints shall be sealed);

Ducts other than those described above are not required to be sealed unless otherwise indicated.

Materials and methods for sealing of ducts, where required, shall be selected from those described in SMACNA-06; except that pressure sensitive tape shall not be used as the primary sealant on any ducts.

3.3 DUCT CONSTRUCTION

Angle iron frames shall be welded at corners and ends, whenever possible. Angle iron reinforcements shall be riveted or welded to ducts not more than 6 inches on center, with not less than two points of attachment. Spot welding, where used, shall be 3 inches on center.

Crossbreaking shall be limited to 4 feet and shall be provided on all ducts 8 inches wide and wider. Bead reinforcement shall be provided in lieu of crossbreaking where panel popping may occur. Where rigid insulation will be applied, crossbreaking is not required.

3.3.1 Longitudinal Duct Seams

For duct sizes through 12 inches, corner seams shall be button-punch snap lock. For duct sizes larger than 12 inches, corner locks shall be used.

3.3.2 Joints and Gaskets

Companion angle flanges shall be bolted together with 1/4-inch diameter bolts and nuts spaced 6 inches on center. Flanged joints shall be gasketed with chloroprene full-face gaskets 1/8 inch thick, with Shore A 40 durometer hardness. Gaskets shall be one piece and vulcanized at joints.

3.3.3 Flexible Duct Joints

Joints between flexible duct without sheet metal collars and round metal

ductwork connections shall be made by trimming the ends, coating the inside of the flexible duct for a distance equal to depth of insertion with elastomer calk, and by securing with sheet metal screws or binding with a strap clamp.

3.3.4 Square Elbows

Single-vane duct turns shall be provided in accordance with SMACNA-06, and may be used on ducts 12 inches wide and narrower.

Double-vane duct turns shall be provided in accordance with SMACNA-06 on ducts larger than 300 millimeter wide.

3.3.5 Radius Elbows

Radius elbows shall conform to SMACNA-06. Radius elbows shall have a centerline inside radius equal to 1.5 times the width of the duct. Where installation conditions preclude use of standard elbows, the inside radius may be reduced to a minimum of 0.25 times duct width and turning vanes shall be installed in accordance with the following schedule.

WIDTH OF ELBOWS INCHES	RADIUS OF TURNING VANES IN PERCENT OF DUCT WIDTH VANE NO. 1	VANE NO. 2	VANE NO. 3
Up to 16	56	--	--
17 to 48	43	73	--
49 and over	37	55	83

Where two elbows are placed together in the same plane in ducts 30 inches wide and larger, the guide vanes shall be continuous through both elbows rather than spaced in accordance with above schedule.

3.3.6 Outlets, Inlets, and Duct Branches

Branches, inlets, and outlets shall be installed so that air turbulence will be reduced to a minimum and air volume properly apportioned. Wherever an air-diffusion device is shown as being installed on the side, top, or bottom of a duct, a commercially manufactured air extractor shall be provided to allow adjustment of the air quantity and to provide an even flow of air across the device or duct it services.

Where a duct branch is to handle more than 25 percent of the air handled by the duct main, a divided flow branch shall be used, constructed in accordance with SMACNA-06, Figure 2-5. Size of the leading end of the increasing elbow within the main duct shall have the same ratio to the main duct size as the ratio of the related air quantities handled.

Other branch connections shall be made with 45 degree entry (rectangular) or 45 degree lead-in (round) in accordance with SMACNA-06, Figure 2-6.

3.3.7 Duct Transitions

Where the shape of a duct changes, the angle of the side of the transition piece shall not exceed 15 degrees from the straight run of duct connected thereto.

Where equipment is installed in ductwork, the angle of the side of the transition piece from the straight run of duct connected thereto shall not exceed 15 degrees on the upstream side of the equipment and 22-1/2 degrees on the downstream side of the equipment.

3.3.8 Branch Connections

Radius tap-ins shall be constructed in accordance with SMACNA-06.

3.3.9 Round Sheet Metal Duct Fittings

Fittings shall be shop fabricated or manufactured as separate fittings, not as tap collars welded or brazed into duct sections.

Offset configurations shall be submitted for approval.

Miter elbows shall be two-piece type for angles less than 31 degrees, three-piece type for angles 31 through 60 degrees, and five-piece type for angles 61 through 90 degrees. Centerline radius of elbows shall be 1-1/2 times fitting cross section diameter.

Crosses, increasers, reducers, reducing tees, and 90-degree tees shall be conical type.

Cutouts in fitting body shall be equal to branch tap dimension or, where smaller, excess material shall be flared and rolled into smooth radius nozzle configuration.

3.4 ACCESS OPENINGS

Access doors and panels shall be installed in ductwork upstream from all duct-mounted filters and coild, and adjacent to fire dampers, smoke dampers, control dampers, and smoke detectors.

Minimum size of access opening shall be 12 by 18inches, unless precluded by duct dimensions or otherwise indicated. Location and size of opening shall permit maintenance, inspection and resetting of the device.

Access door construction shall be in accordance with SMACNA-06, except that sliding doors may be used only for special conditions upon prior approval. Insulated doors shall be double-panel type, and shall be provided in all insulated ductwork.

Access doors that leak shall be made airtight by adding or replacing hinges and latches or by construction of new doors adequately reinforced, hinged, and latched.

Access doors shall be marked with GOMAR tags as specified in Section 01600, "Material and Equipment" to identify the equipment inside.

3.5 DUCT SUPPORTS

Selection of hanging system shall be at the Contractor's option. The following support sizes, configurations, and spacings are given to show the minimal type of supporting component required. Where installed loads are excessive for the specified hanger spacings, hangers, and accessories, heavier-duty components shall be provided the hanger spacing shall be reduced. After system startup, any duct support device which, due to

length, configuration, or size, vibrates or causes possible failure of a member or damage to ducting shall be replaced or the condition shall be alleviated.

Supplementary steel shall be designed and fabricated in accordance with AISC S328.

Hanger rods, angles, and straps shall be attached to beam clamps. Concrete inserts and masonry anchors and fasteners shall be approved for the application.

Hardened high-carbon spring-steel fasteners fitted onto beams and miscellaneous structural steel are acceptable upon prior approval of each proposed application and upon field demonstration of conformance to specification requirements. Fasteners shall be made from steel conforming to AISI Type C1055 or C1070, and shall be treated and finished in accordance with ASTM F 1137, zinc phosphate base. A 72-hour load-carrying capacity shall be verified by a certified independent laboratory. Hanger spacing shall be limited to provide 20-to-1 safety factor for supported load. Maximum weight supported by any two fasteners shall be 100 pounds.. Friction rod assemblies are not acceptable.

Where support from metal deck systems is required, support requirements shall be coordinated with installation of metal deck.

Ductwork and equipment shall not be hung from roof deck, piping, or other ducts or equipment. Maximum span between any two points shall be 10 feet with lesser spans for duct assemblies, interferences, and loads imposed or permitted.

There shall be not less than one set of hangers for each point of support. Hangers shall be installed on both sides of all duct turns, branch fittings, and transitions.

Hangers shall be sufficiently cross-braced to eliminate vertical and lateral sway.

Rectangular ducts up to 36 inches shall be supported by strap hangers attached at not less than three places to not less than two duct surfaces in different planes.

Perforated strap hangers shall not be acceptable.

Rectangular ducting over 36 inches shall be supported by trapeze hangers. Ducts situated in unconditioned areas and required to have insulation with a vapor-sealed facing shall be supported on trapeze hangers. Hangers shall be spaced far enough out from the side of the duct to permit the duct insulation to be placed on the duct inside of the trapeze. Under no circumstances shall duct hangers penetrate the vapor-sealed facing.

Where trapeze hangers are used, the bottom of the duct shall be supported on angles sized as follows:

WIDTH OF DUCT, INCHES	MINIMUM BOTTOM ANGLE SIZE, INCHES
30 and smaller	1-1/4 by 1-1/4 by 1/8
31 to 48	1-1/2 by 1-1/2 by 1/8

WIDTH OF DUCT, INCHES	MINIMUM BOTTOM ANGLE SIZE, INCHES
49 to 72	1-1/2 by 1-1/2 by 3/16
73 to 96	2 by 2 by 1/4
97 and larger	3 by 3 by 1/4

Where ductwork system contains heavy equipment, excluding air-diffusion devices and dampers, such equipment shall be hung independently of the ductwork by means of rods or angles of sizes adequate to support the load.

Ducting supported from roof purlins shall be supported at points not greater than one-sixth of the purlin span from the roof truss. Load per hanger shall not exceed 400 pounds when support is from a single purlin or 800 pounds when hanger load is applied halfway between purlins by means of auxiliary support steel provided under this section. When support is not halfway between purlins, the allowable hanger load shall be the product of 400 times the inverse ratio of the longest distance to purlin-to-purlin spacing.

When the hanger load exceeds the above limits, reinforcing of purlin(s) or additional support beam(s) shall be provided. When an additional beam is used, the beam shall bear on the top chord of the roof trusses and bearing shall be over gusset plates of top chord. Beam shall be stabilized by connection to roof purlin along bottom flange.

Purlins used for supporting fire-protection sprinkler mains, electrical lighting fixtures, and electrical power duct or cable tray shall be considered fully loaded, and supplemental reinforcing or auxiliary support steel to support ductwork shall be provided for these purlins.

Duct supports shall be vibration isolated from the structure, where indicated, in accordance with Section 15072, "Vibration Isolation for Air Conditioning Equipment".

3.6 PLENUM CONSTRUCTION

Intake and discharge plenum shall have companion angle joints with the following minimum thickness of materials:

LONGEST ANGLES SIDE INCHES	SHEET METAL USS GAGE ALL SIDES	COMPANION ANGLES INCHES	REINFORCEMENT INCHES, 24 INCHES ON CENTER MAXIMUM
To 48	20	1-1/2 by 1-1/2 by 1/8	1-1/2 by 1-1/2 by 1/8
49 to 84	18	2 by 2 by 1/8	2 by 2 by 3/16
85 to 120	16	2 by 2 by 1/8	2 by 2 by 1/8
121 and larger	14	2 by 2 by 3/16	2 by 2 by 3/16

At the floor line and other points where plenums join masonry construction, panels shall be bolted 12 inches on center to 2- by 2- by 3/16 inch thick hot-dip galvanized steel angle that has been secured to the masonry with masonry anchors and bolts 24 inches on center and calked tight to the masonry.

Panels shall be anchored to curbing by not less than 2- by 2- by 3/16 inch thick hot-dip galvanized steel angle iron. Concrete curbing shall include angle iron nosing with welded studs for the anchoring of panels. Nosing shall be level at curb height within plus or minus 1/16 inch .

Plenum anchorage provisions, sheet metal joints, and other areas shall be made airtight and watertight by calking mating galvanized steel and concrete surfaces with a two-component elastomer.

Plenum access doors shall be constructed in accordance with SMACNA-06except that access doors smaller than man-access doors shall have door openings framed with angle iron that is one commercial size smaller than specified panel reinforcement.

Man-access door size shall be per SMACNA-06 and paragraph entitled, "Access Openings," of this section. Insulated and uninsulated construction shall be per SMACNA-06. Door openings shall be framed with channel iron. Doors shall be framed with angle iron. Channel iron and angle iron shall be approximately the same size as specified panel reinforcement. Exterior door skin shall be 16 gage . Latches shall be fabricated steel, hinges shall be at least 4 inches long, and bolting shall be at least 3/8-inch diameter.

Angle iron and channel iron shall have welded and ground miter corners.

3.7 FLEXIBLE DUCTWORK INSTALLATION

Flexible ductwork shall be used only as indicated below, unless otherwise indicated on the drawings.

Flexible ductwork used to connect to round-neck ceiling diffusers shall not exceed 1500 millimeter in length. For inlet to VAV boxes, flexible ductwork length shall not exceed 1000 millimeter.

Unless otherwise indicated insulated flexible ductwork shall be used for supply air, and uninsulated flexible duct shall be used for return and exhaust air.

3.8 MANUAL VOLUME DAMPERS

Manual volume dampers shall be provided to balance each respective main and branch duct.

Dampers regulated through non-removable ceilings shall have regulator concealed in box mounted in the ceiling, with a cover finish aesthetically compatible with ceiling surface. Where ceiling is of removable construction, regulators shall be above ceiling, and location shall be marked on ceiling in a manner acceptable to the Contracting Officer.

3.9 FLEXIBLE CONNECTORS FOR SHEET METAL

Air handling equipment, ducts crossing building expansion joints, and fan

inlets and outlets shall be connected to upstream and downstream components by treated woven-cloth connectors.

Connectors shall be installed only after system fans are operative, and vibration isolation mountings have been adjusted. When system fans are operating, connectors shall be free of wrinkle caused by misalignment or fan reaction. Width of surface shall be curvilinear.

3.10 PENETRATIONS

3.10.1 Non-rated Construction

At ductwork penetrations through cosntruction which is not fire-rated or designated as a smoke barrier, openings shall be neatly cut and the average clearance around duct shall not exceed 1 inch. In finished areas, sheet metal angle frames shall be provided to fit tightly around the duct and conceal any opening.

The clearance from metal air ducts used for heating to assemblies constructed of combustible materials, including plaster on wood lath, shall be not less than 1/2 inch, or the combustible material shall be protected with minimum 1/4 inch approved insulating material.

3.10.2 Smoke Barriers

At all ductwork penetrations of smoke barriers, the integrity of the smokestopping shall be maintained in accordance with Section 07840, "Firestopping and Smokestopping".

3.10.3 Fire Rated Construction

Where ducts pass through walls, floors, or partitions required to have a fire resistance rating and where fire dampers are not required, the integrity of the firestopping shall be maintained. The opening in the construction around the air duct shall not exceed a 1 inch average clearance on all sides and shall be filled solid with an approved material, in accordance with Section 07840, "Firestopping and Smokestopping".

3.10.4 Fire Damper Installation

Fire dampers and associated sleeves shall be installed in accordance with the conditions of their listings, the manufacturer's installation instructions, NFPA 90A and SMACNA-F. These requirements apply also to combination fire and smoke dampers.

Ductwork shall not be continuous through the partition, but shall connect on each side of the partition to the damper sleeve or frame. Sleeve or frame shall be secured by perimeter-mounting angles on both sides of the opening, or other installation as required per the listing of the device. Perimeter angle dimensions, size and frequency of fasteners, clearance for expansion, and duct-sleeve connections shall be in accordance with the listing and the manufacturer's installation instructions.

3.10.5 Smoke Damper Installation

Smoke dampers shall be installed in accordance with the conditions of their listings, the manufacturer's installation instructions, NFPA 90A and SMACNA-F. These requirements apply also to combination fire and smoke dampers.

Where smoke dampers are indicated at smoke barriers, they shall be installed in the barrier or adjacent to it, but no more than 2 feet from the barrier or after the first air duct inlet or outlet, whichever is closer to the smoke barrier.

Controls for smoke dampers shall be provided in accordance with Section 13851, "Fire Alarm Systems", or by the UCS Contractor for dampers associated with smoke control system operation if so indicated on the drawings.

3.11 DUCT PROBE ACCESS

Holes shall be provided with neat patches, threaded plugs, or threaded or twist-on caps where indicated, and where necessary, for air-balancing pitot tube access. Extended-neck fittings shall be provided where probe access area is insulated.

3.12 OPENINGS IN ROOFS AND EXTERIOR WALLS

Building openings are fixed and equipment shall be provided to suit. Contractor may propose to alter these openings upon prior approval, and at his expense.

Dampers located behind architectural intake or exhaust louvers shall be enclosed by a rigid sheet metal collar and sealed to building construction with elastomers for complete air tightness.

Outside air-intake ducts and plenums shall be sheet metal and shall have soldered watertight joints.

3.13 DUCTWORK CLEANING AND PREPARATION FOR PAINTING

Open ducting shall be protected from construction dust and debris in a manner approved by the Contracting Officer. Dirty assembled ducting shall be cleaned by subjecting main and branch interior surfaces to air streams moving at velocities two times the specified working velocities, at static pressures within maximum ratings. Ducting shall be cleaned by a method approved by the Contracting Officer. Compressed air used for cleaning ducting shall be water- and oil-free. Prior to acceptance of the work, dust and debris shall be removed from exterior surfaces.

Sheet metal surfaces to be painted or surfaces to which adhesives will be applied shall be clean and free of oil, grease, and deleterious substances.

Where interiors of ducting may be viewed through air diffusion devices, the viewed interior shall be sheet metal and shall be painted flat black.

3.14 FIRE AND SMOKE DAMPER TESTS

Fire closure tests shall be performed on each fire damper and combination fire-smoke damper in the presence of the Contracting Officer by removing the fusible link and verifying full closure with normal system operating airflow.

Smoke closure tests shall be performed on each smoke damper and combination fire-smoke damper in the presence of the Contracting Officer, by activating the applicable smoke detection zone in conjunction with testing of the Smoke Detection System or UCS and Smoke Control System, and verifying full

closure with normal operating system air flow.

3.15 DUCTWORK TESTING AND BALANCING

Contractor shall conduct ductwork tests and air balancing in accordance with Section 15950, "Testing, Adjusting and Balancing." Tests shall be performed prior to installing ductwork insulation. Air balancing shall be performed and balance report submitted prior to conducting the Operational Readiness Review.

3.16 OPERATIONAL READINESS REVIEW (ORR)

Conduct an Operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for ductwork in conjunction with the ORR for related air handlers, fans and controls as applicable. ORR shall include pointing out the location of all duct access doors, motorized dampers, fire dampers, smoke dampers, and major branch duct volume dampers. For task orders involving replacement or modification of only a portion of the HVAC system, the ORR shall cover only the replaced or modified sections of the ductwork.

-- End of Section --

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SECTION 15818

SPECIAL APPLICATION DUCTWORK
08/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S328	(1986) Specification for Structural Steel Buildings Load and Resistance Factor Design

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE-02	(1996) Handbook, HVAC Systems and Equipment (IP Edition)
ASHRAE-03	(1997) Handbook, Fundamentals (IP Edition)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 167	(1999) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 36/A 36M	(2000; Rev A) Standard Specification for Carbon Structural Steel
ASTM A 480/A 480M	(1999; Rev B) Standard Specification for General Requirements for Flat Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A 653/A 653M	(2001) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

ASTM B 209	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C 1071	(1998) Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
ASTM C 581	(2000) Standard Practice for Determining Chemical Resistance of Thermosetting Resins Used in Glass Fiber Reinforced Structures, Intended for Liquid Service
ASTM C 582	(1995) Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment
ASTM D 1784	(1999; Rev A) Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
ASTM D 257	(1999) Standard Test Methods for D-C Resistance or Conductance of Insulating Materials
ASTM E 84	(2001) Standard Test Method for Surface Burning Characteristics of Building Materials

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Specification for Filler Metals for Brazing

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825	(2001) Approval Guide

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1999) Standard for the Installation of Air Conditioning and Ventilating Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA-03	(1992; 6th Ed) Fibrous Glass Duct Construction Standard
SMACNA-06	(1995; 2nd Ed) HVAC Duct Construction Standards - Metal and Flexible
SMACNA-09	(2000; 2nd Ed) HVAC Duct Systems Inspection Guide

SMACNA-A	(1995; 2nd Ed) Thermoplastic Duct (PVC) Construction Manual
SMACNA-B	(1999; 2nd Ed) Round Industrial Duct Construction Standard
SMACNA-C	(1980; 2nd Ed) Rectangular Industrial Duct Construction Standard
SMACNA-D	(1975; 1st Ed) Accepted Industry Practices for Industrial Duct Construction
SMACNA-E	(1997; 1st Ed) Thermoset FRP Duct Construction Manual
SMACNA-F	(1992; 4th Ed) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems

UNDERWRITERS LABORATORIES (UL)

UL 181	(1996; 9th Ed) UL Standards for Safety Factory-Made Air Ducts and Air Connectors

1.2 DESIGN REQUIREMENTS

Section 15003, "General Mechanical Provisions," apply to work specified in this section.

Section 15072, "Vibration Isolation for Air Conditioning Equipment" applies to work in this section.

1.3 SCOPE OF WORK

This section specifies a variety of types of ductwork for special applications. Where one of these types is indicated on the drawings, ductwork shall be fabricated and installed in accordance with the applicable portions of this section. Standard galvanized steel ductwork and flexible ducts, for HVAC and general exhaust applications, are specified in Section 15815, "HVAC System Ductwork".

Rigid fibrous-glass ductwork shall be provided only where specifically indicated on the drawings, and shall not be substituted for other HVAC ductwork specified in Section 15815, "HVAC System Ductwork".

For each section of the ductwork types specified in this Section, the Pressure Class and Seal Class shall be as indicated on the drawings, in accordance with the definitions in SMACNA-06. If not indicated, Contractor shall request this information from the Government prior to generating a proposal for the task order, ordering any materials, or fabricating any ductwork. The default classes from SMACNA-06 shall not be assumed to apply.

Where ducts will handle corrosive materials, the materials and concentrations shall be as indicated on the drawings. Duct material, coatings, adhesives and gasketing shall be certified by the manufacturer to be suitable for contact with the indicated corrosive material and concentration.

Where ducts will handle abrasive material, the abrasiveness class shall be

as indicated on the drawings, in accordance with the definitions in SMACNA-D: Class 1 (non-abrasive), Class 2 (moderately abrasive material in low concentration), Class 3 (highly abrasive material in low concentration), or Class 4 (highly abrasive material in high concentration). Material thickness and details of construction shall be as appropriate for the class, in accordance with SMACNA-B, SMACNA-C and SMACNA-D.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Fabrication Drawings shall be submitted for Special Application Ductwork Systems consisting of fabrication and assembly details to be performed in the factory or shop.

Fabricated Fittings and Accessories

SD-02 Shop Drawings

Installation Drawings shall be submitted (if indicated in Task Order). Drawings shall show details of equipment and duct layout and design. Installation drawings shall include full fabrication details, selected gages and reinforcements, to demonstrate compliance with the referenced standards.

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

Double Wall Sheet Metal Ducts
Rigid Fibrous Glass Materials (including friction loss coefficients, thermal and acoustical performance and closure systems)
Manufactured Fittings
Accessories

SD-07 Certificates

Certificates of Compliance shall be submitted for the items listed below. Certificates shall be signed by responsible officials of the manufacturer or supplier, attesting that the product, system or material complies with the specified standards, shall list the issuing organization(s) and standard number(s) which are applicable, and additional specified requirements such as type, grade, or specific materials.

Duct Galvanized Steel Materials
Coated Galvanized Ductwork Materials
Aluminum Ductwork Materials

Stainless Steel Ductwork Material
Rigid Fibrous-Glass Ductwork Materials
Polyvinylchloride (PVC) Ductwork Materials
Fiberglass-Reinforced Plastic (FRP) Ductwork Materials
Brazing Materials
Sealants and Adhesives
Joining Materials for PVC and FRP

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the items listed below, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

Double Wall Sheet Metal Ducts
Coated Galvanized Ductwork Materials
Rigid Fibrous-Glass Ductwork Materials
Polyvinylchloride (PVC) Ductwork Materials
Fiberglass-Reinforced Plastic (FRP) Ductwork Materials

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the following items, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

Accessories

SD-11 Closeout Submittals

As-Built Drawings shall provide current factual information including deviations from, and amendments to, the drawings and concealed or visible changes in the work, for Special Application Ductwork Systems.

PART 2 PRODUCTS

2.1 GALVANIZED STEEL MATERIALS

2.1.1 Galvanized Steel Ductwork Materials

Galvanized steel ductwork sheet metal shall be carbon steel, of lock-forming quality, hot-dip galvanized, with regular spangle-type zinc coating, conforming to ASTM A 653/A 653M, and ASTM A 924/A 924M, Designation G90. Duct surfaces to be painted shall be treated by phosphatizing.

2.1.2 Brazing Materials

Brazing materials shall be silicon bronze conforming to AWS A5.8.

2.1.3 Mill-Rolled Reinforcing and Supporting Materials

Mill-rolled structural steel shall conform to ASTM A 36/A 36M and, wherever

in contact with sheet metal ducting, shall be galvanized to commercial weight of zinc or coated with materials conforming to ASTM A 123.

Equivalent strength, proprietary design, rolled-steel structural support systems may be submitted for approval in lieu of mill-rolled structural steel.

2.2 DOUBLE-WALL SHEET METAL DUCTS

Ducts and fittings shall be shop fabricated, to comply with SMACNA-06 and additional requirements specified below. Ducts shall be round or flat-oval as indicated and as required for connection to existing ductwork.

Construction shall comprise an airtight, vapor barrier, outer pressure shell, a 1-inch insulation layer, and a perforated-metal inner liner that completely covers the insulation throughout the system.

Insulation shall conform to NFPA 90A and ASTM C 1071. Thermal conductivity shall be in accordance with ASTM D 257.

2.2.1 Duct and Fitting Gages

Outer pressure shell shall be as specified in SMACNA-06; the inner liner shall be as recommended by the manufacturer but not lighter than 26-gage.

Perforations shall be 3/32-inch diameter, and the open area shall be 13 percent.

2.2.2 Reinforcement

Inner liners of both duct and fittings shall be supported by metal spacers welded in position to maintain spacing and concentricity.

2.2.3 Fittings

Divided flow fittings shall be made as separate fittings, not tap collars into duct sections, with the following construction requirements:

Sound, airtight, continuous welds at intersection of fitting body and tap

Tap liner securely welded to inner liner, with weld spacing not to exceed 3 inches

Insulation shall be packed around the branch tap area for complete cavity filling.

Branch connection shall be carefully fit to cutout openings in inner liner without spaces for air erosion of insulation and without sharp projections that cause noise and airflow disturbance.

Seams in the pressure shell of fittings shall be continuously brazed. Galvanized areas that have been damaged by welding shall be protected with manufacturer's standard corrosion-resistant coating.

Offset configurations shall be submitted for approval.

Elbows shall be two-piece type for angles through 35 degrees, three-piece type for angles 36 through 71 degrees, and five-piece type for angles 72

through 90 degrees.

2.3 COATED GALVANIZED DUCTWORK MATERIALS

Materials for use in coated galvanized ductwork shall be as specified for galvanized ductwork, but shall also be coated with corrosion resistant coating in accordance with requirements indicated on drawings. Manufacturer shall certify that coating is suitable for use with the indicated corrosive materials and concentrations.

2.4 ALUMINUM DUCTWORK MATERIALS

Materials for use in aluminum ductwork shall be in accordance with ASTM B 209, and shall be of lock-forming grade. Where aluminum ductwork is specified all reinforcements, dampers and accessories shall also be of aluminum

2.5 STAINLESS STEEL DUCTWORK MATERIALS

Materials for use in stainless steel ductwork shall be in accordance with ASTM A 167 and ASTM A 480/A 480M, types 309 and 310, and shall be of lock-forming grade. Where stainless steel ductwork is specified all reinforcements, dampers and accessories shall also be of stainless steel.

2.6 RIGID FIBROUS-GLASS DUCTWORK MATERIALS

Rigid fibrous-glass duct system, including tapes, adhesives, vapor barriers, and joint sealers, shall conform to requirements of NFPA 90Aand shall be in accordance with FM P7825 and UL 181, Class 1 airduct listing, and be so labeled. Duct system shall have a thermal-conductivity K-value of 0.26 Btu per hour per square foot per degree F for flat and 0.23 Btu per hour per square foot per degrees F for round duct at 75 degrees F mean temperature. Duct system shall have a noise-reduction coefficient of 0.070 and a vapor-transmission rate of less than 0.02 perm for flat board and 0.10 perm for round duct. Minimum density shall be 5 pounds per cubic foot for flat board and 3.25 pounds per cubic foot for round duct. Vapor barrier shall be factory applied. Material acoustic properties shall be submitted for approval. Materials shall be odorless and nonallergenic when in service.

2.7 POLYVINYLCHLORIDE (PVC) DUCTWORK MATERIALS

Materials for use in polyvinylchloride (PVC) ductwork shall be of ASTM D 1784, Type I PVC (for service temperatures not exceeding 140 degrees F) or CPVC (for service temperatures over 140 degrees F up to 210 degrees F). Where PVC or CPVC ductwork is provided, all reinforcements, dampers and accessories shall be of the same material. PVC welding materials and solvent cement shall be as recommended by the manufacturer.

2.8 FIBERGLASS-REINFORCED PLASTIC (FRP) MATERIALS

Materials for use in fiberglass-reinforced plastic (FRP ductwork (also referred to as reinforced thermoset plastic, RTP) shall be in accordance with ASTM C 582, Type I, with a flame spread rating not to exceed 25 when tested in accordance with ASTM E 84. Class (type of resin, as defined in ASTM C 581) shall be selected based on the service (materials to be exhausted and maximum operating temperature) indicated on the drawings, and shall also be of a type resistant to ultraviolet degradation if installed outdoors. Where FRP ductwork is provided, all reinforcements, dampers and

accessories shall be of the same material.

2.9 ACCESSORIES

2.9.1 Turning Vanes

Turning vanes shall be double-wall type, commercially manufactured of same materials as ductwork.

2.9.2 Dampers

Low pressure drop, high-velocity manual volume dampers, and high-velocity fire dampers shall be constructed in accordance with ASHRAE-02, Chapter 16, ASHRAE-03, Chapter 32 and SMACNA-06. Materials shall be the same as the ductwork, or compatible with the duct materials and the service.

2.2.9 Flexible Connectors for Sheet Metal

Connectors shall be UL listed, 30-ounce per square foot, waterproof, fire-retardant, airtight, woven fibrous-glass cloth, double coated with chloroprene. Clear width, not including clamping section, shall be 6 to 8 inches.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Duct construction shall be provided in accordance with the requirements of NFPA 90A, and the standards referenced herein for the type of ductwork.

Where construction methods for certain items are not described in the referenced standards or herein, the work shall be performed in accordance with recommendations for best practice defined in ASHRAE-02.

Sheet metal surfaces to be painted and surfaces to which adhesives are to be applied shall be clean and free of oil, grease, and deleterious substances.

Duct strength shall be adequate to prevent failure under service pressure or vacuum created by fast closure of duct devices. Leaktight, automatic relief devices shall be provided.

Supplementary steel shall be designed and fabricated in accordance with AISC S328.

Fabrication shall be airtight and shall include reinforcements, bracing, supports, framing, gasketing, sealing, and fastening to provide rigid construction and freedom from vibration, airflow-induced motion and noise, and excessive deflection at specified maximum system air pressure and velocity.

Where ducts pass through firewalls, a flanged duct segment with fire damper and access door shall be provided in that surface during surface construction.

3.2 SHEET METAL DUCTWORK

These requirements apply to galvanized steel, coated galvanized steel, aluminum, and stainless steel ductwork.

3.2.1 Rectangular Sheet Metal Ducts

3.2.1.1 Gages, Joints, and Reinforcement

Minimum sheet metal gages, joints, and reinforcements and additional types of construction shall be in accordance with SMACNA-C and SMACNA-D, for the indicated pressure class, and abrasiveness class if applicable.

Minimum gages, joints and reinforcements for aluminum ductwork shall be based on those for galvanized steel, but adjusted as indicated in the commentary on aluminum ductwork in SMACNA-06.

3.2.1.2 Branches, Inlets, Outlets

Branches, inlets, and outlets shall be installed to minimize air turbulence and to ensure proper airflow.

Dampers shall be installed so that the amount of air entering duct mains can be adjusted.

Where a duct branch is to handle over 25 percent of the air handled by the duct main, a complete 90-degree increasing elbow shall be used, with an inside radius of 0.75 times duct branch width. Size of the trailing end of the increasing elbow within the main duct shall be in the same ratio to the main duct size as the ratio of the relative air quantities handled.

Where a duct branch is to handle 25 percent or less of the air handled by the duct main, the branch connection shall have an inside radius of 0.75 times branch duct width, a minimum arc length of 45 degrees, and an outside radius of 1.75 times duct branch width. Arc shall be tangent to duct main.

3.2.2 Round Sheet Metal Ducts

3.2.2.1 Duct Gages, Joints, and Reinforcement

Sheet metal minimum thickness, joints, and reinforcement and additional types of construction shall be in accordance with SMACNA-B and SMACNA-D, for the indicated pressure class, and abrasiveness class if applicable..

Longitudinal duct joint shall be manufactured by machine, with spiral lock seams to and including 60-inch diameters, and to dimensional tolerances compatible with fittings provided.

Minimum gages, joints and reinforcements for aluminum ductwork shall be based on those for galvanized steel, but adjusted as indicated in the commentary on aluminum ductwork in SMACNA-06.

Draw band girth joints are not acceptable.

Slip joints shall be made up by coating the male fitting with elastomer sealing materials, exercising care to prevent mastic from entering fitting bore, leaving only a thin annular mastic line exposed internally. Sheet metal screws shall be used to make assembly rigid, not less than four screws per joint, maximum spacing 6 inches. Pop rivets shall not be used. All joints shall be taped and heat sealed.

Bolt heads and nuts shall be hex-shaped, 5/16-inch diameter for ducts up to 50-inch diameter, and 3/8-inch diameter for 51-inch diameter ducts

and larger.

Flanges shall be continuously welded or brazed to duct on outside of duct and intermittently welded with 1-inch welds every 4 inches on inside joint face. Excess filler metal shall be removed from inside face. Galvanized areas that have been damaged by welding shall be protected with manufacturer's standard corrosion-resistant coating.

3.2.2.2 Round Sheet Metal Duct Fittings

Fittings shall be shop fabricated or manufactured as separate fittings, not as tap collars welded or brazed into duct sections.

Offset configurations shall be submitted for approval.

Miter elbows shall be two-piece type for angles less than 31 degrees, three-piece type for angles 31 through 60 degrees, and five-piece type for angles 61 through 90 degrees. Centerline radius of elbows shall be 1-1/2 times fitting cross section diameter.

Crosses, increasers, reducers, reducing tees, and 90-degree tees shall be conical type.

Cutouts in fitting body shall be equal to branch tap dimension or, where smaller, excess material shall be flared and rolled into smooth radius nozzle configuration.

3.2.3 Duct Transitions

Where the shape of a duct changes, the angle of the side of the transition piece shall not exceed 15 degrees from the straight run of duct connected thereto.

Where equipment is installed in ductwork, the angle of the side of the transition piece from the straight run of duct connected thereto shall not exceed 15 degrees on the upstream side of the equipment and 22-1/2 degrees on the downstream side of the equipment.

3.3 DOUBLE-WALL SHEET METAL DUCT INSTALLATION

3.3.1 Joints

An inner coupling shall be provided to align the inner lining to maintain good airflow conditions equivalent to standard round high-pressure duct joints. Butt joints are not suitable for the inner liner. This alignment shall be accomplished by extending the liner of the fitting for slip joint into the pipe, or by the use of a double concentric coupling with the two couplings held by spacers for rigidity and wall spacing. For ducts over 34 inches inside diameter, a separate coupling for inner alignment, with the pressure shells joined by angle-ring flanged connections, shall be provided.

3.3.2 Insulation Ends

At the end of an uninsulated section or run where internally insulated duct connects to uninsulated spiral duct, fitting, fire damper or flexible duct, an insulation end-fitting shall be installed to bring the outer pressure shell down to nominal size.

3.4 Transverse Reinforcement Joints

Transverse reinforcements shall be riveted with solid rivets to duct sides 6 inches on center or spot welded 4 inches on center. Transverse reinforcement shall be welded at all corners to form continuous frames.

3.5 Joint Gaskets

Flanged joints shall be gasketed with chloroprene full-face gaskets 1/8-inch thick, Shore A 40 durometer hardness. Gaskets shall be one piece, vulcanized or dovetailed at joints.

3.6 Radius Elbows

Elbow proportions and radius elbows shall be fabricated in accordance with ASHRAE-02, Chapter 16, ASHRAE-03, Chapter 32 and SMACNA-06.

3.7 Plenum Connections

Round duct connections shall be welded joint bellmouth type.

Rectangular duct connections shall be bellmouth type, constructed in accordance with SMACNA-06.

3.8 RIGID FIBROUS-GLASS DUCTWORK

Fibrous-glass ductwork shall be provided in accordance with SMACNA-03, NFPA 90A, and manufacturer's instructions where construction methods are not covered by SMACNA-03. Ductwork and closure systems shall be listed and comply with UL 181, Class 1 materials, and shall be installed in accordance with the conditions of their listing.

3.8.1 System Resistance

Duct size shall be increased to maintain design conditions when fibrous-glass duct system resistance exceeds sheet metal system resistance by more than 5 percent.

3.8.2 Duct Thickness, Joints, and Reinforcement

Minimum thickness of rectangular duct shall be . Round duct thickness shall vary from minimum to, depending upon reinforcement necessary for a given duct size.

Duct reinforcement shall be in accordance with SMACNA-03.

Cut ends and edges of duct to be jointed in the field shall be coated with a suitable mastic or cement to prevent delamination or erosion. Only very sharp tools shall be used to cut and fabricate ducting. Longitudinal joints shall appear as straight lines. Scalloped cuts are not acceptable.

3.8.3 Fabrication

Cuts and surfaces shall be cleaned, prior to duct or fitting assembly with oil- and water-free compressed air at velocities not less than 1-1/2 times nor more than twice the manufacturer's rated working velocity.

Round duct joints shall be male/female shiplap or sheet metal insert type.

Sheet metal fasteners shall have minimum 1-1/2-inch diameter, 22-gage support-washer reinforcement at duct surface.

Control rods and similar shaft penetrations shall be made through sheet metal reinforcement on both sides of duct. Sheet metal for reinforcement, fabrication and accessories shall be as specified in paragraph "Galvanized Sheet Metal Materials".

3.8.4 Duct Supports

Paragraphs entitled, "Rectangular Sheet Metal Ducts" and "Plenum Construction," in this section and SMACNA-03 specify requirements applicable to fibrous glass ducts.

Rectangular ducts shall be supported either from joint reinforcement or by trapeze hangers installed to prevent edge cutting of duct. At each point of duct support there shall be not less than two hangers uniformly attached to the trapeze channel or angle 1 inch from the outer surface of the duct. Ducts over 48 inches wide shall be supported by rods and 2- by 22-by 1/8 inch galvanized angle iron.

Round ducts sized 8 inches and under shall be supported 3 feet on center, and larger ducts shall be supported 6 feet or less on center. At each duct-support point, minimum 6-inch wide semicircular support saddles with sharp sheared edges turned away from direct contact with the duct shall be provided. Support saddle width shall be sufficient to preclude indentation of duct material due to support load. Saddles shall be 26 gage for sizes 8 inches and under and 20 gage for all larger ducts. Straps for ducts sized 8 inches and under shall be 1 inch wide by 20 gage minimum. Larger ducts shall be supported by straps of sizes recommended by the manufacturer, but in no case shall straps be less than 1 inch wide by 16 gage.

Perforated strap hangers are not acceptable. Sheet-strap hangers shall not be spliced. Galvanized wire, 9-gage diameter, may be used in lieu of 18-gage or lighter strap hangers. Straps shall be attached by solid rivets or 1/4-inch 20 round-head screws and nuts. Exposed threads shall be upset after assembly.

3.8.5 Duct Transitions

Configuration shall conform to requirements specified in paragraphs entitled, "Rectangular Sheet Metal Ducts" and "Plenum Construction," in this section.

Rectangular transitions shall be joined to duct runs with sheet metal collars, which shall also provide support points.

Complex transitions shall be made from sheet metal lined with acoustic materials.

3.8.6 Round Duct Fittings

Elbows, laterals, tees, transitions, access-door openings, and similar fittings shall be made with sheet metal inserts. Elbows 12 inches and larger shall have 5-gore sheet metal inserts. Smaller fittings shall have 4-gore universal-type sheet metal inserts.

3.8.7 Access Openings

Fibrous-glass duct shall have internal metal reinforcement around entire duct perimeter at point of access, and openings shall be framed with sheet metal.

3.9 POLYVINYLCHLORIDE (PVC) DUCTWORK

Polyvinylchloride (PVC) ductwork, fittings, dampers and other accessories shall be fabricated and installed in accordance with SMACNA-A, for the pressure class indicated on the drawings.

3.10 FIBERGLASS-REINFORCED PLASTIC (FRP) DUCTWORK

Fiberglass-reinforced plastic (FRP) ductwork, fittings, dampers and other accessories shall be fabricated and installed in accordance with SMACNA-E, for the pressure class indicated on the drawings.

3.11 DUCT SUPPORTS

Duct support shall be installed in accordance with the applicable referenced standards, and as specified herein. Two hangers shall be provided where necessary to eliminate sway. Support attachment to duct surfaces, shall be by solid rivet, bolt, or welding 4 inches on center, or as indicated in the referenced standards.

Round, double-wall duct supports shall be as recommended by the manufacturer except that minimum hanger ring and strap size shall be 1-1/2 inches by 1/8 inch.

If installed loads are excessive for the specified hanger spacing, hangers, and accessories heavier-duty components shall be provided. After system startup, any duct support device which, due to length, configuration, or size, vibrates or causes possible failure of a member, shall be replaced or the condition shall otherwise be alleviated. Special care shall be exercised to preclude cascade-type failures.

Hanger rods, angles, and straps shall be attached to beam clamps. Concrete inserts, masonry anchors, and fasteners shall be approved for the application.

Hanger spacing shall provide a 20-to-1 safety factor for supported load.

Maximum load supported by any two fasteners shall be 100 pounds.

Friction rod assemblies are not acceptable.

Where support from metal deck systems is involved, support requirements shall be coordinated with installation of metal deck.

Ductwork and equipment shall not be hung from roof deck, piping, or other ducts or equipment. Maximum span between any two points shall be 10 feet, with lesser spans as required by duct assemblies, interferences, and permitted loads imposed.

There shall be not less than one set of hangers for each point of support. Hangers shall be installed on both sides of all duct turns, branch fittings, and transitions.

Hangers shall be sufficiently cross braced to eliminate sway vertically and laterally.

Perforated strap hangers are not acceptable.

Ducting, when supported from roof purlins, shall not be supported at points greater than one-sixth of the purlin span from the roof truss. Load per hanger shall not exceed 400 pounds when support is from a single purlin or 800 pounds when hanger load is applied halfway between purlins by means of auxiliary support steel provided under this section. When support is not halfway between purlins, the allowable hanger load shall be the product of 400 times the inverse ratio of the longest distance to purlin-to-purlin spacing.

When the hanger load exceeds the above limits, reinforcing of purlin(s) or additional support beam(s) shall be provided. When an additional beam is used, the beam shall bear on the top chord of the roof trusses, and bearing shall be over gusset plates of top chord. Beam shall be stabilized by connection to roof purlin along bottom flange.

Purlins used for supporting fire-protection sprinkler mains, electrical lighting fixtures, electrical power ducts, or cable trays shall be considered fully loaded, and supplemental reinforcing or auxiliary support steel shall be provided for these purlins.

Duct supports shall be vibration isolated from structure at points indicated. Refer to Section 15072, "Vibration Isolation for Air Conditioning Equipment."

3.12 ACCESSORIES

3.12.1 Access Openings

Access panels shall be installed in ductwork adjacent to fire dampers, control dampers, coils or other equipment, and where indicated..

Minimum size of access opening shall be 12 by 18 inches, unless precluded by duct dimension, or shall be as indicated.

Access openings shall be framed by welded and ground miter joint, 1/8-inch thick angle iron, for steel ductwork, or of similar strength angles of the same material as the duct for other types of ductwork. Cover plate shall be not less than the thickness of the duct in which installed, and reinforced as necessary for rigidity under normal system operating pressures.

In lieu of access doors, readily accessible flanged duct sections may be provided upon approval. Stable hanger supports shall be provided on the duct on each side of the removable section.

3.12.2 Flexible Connectors for Sheet Metal

Air-handling equipment, ducts crossing building expansion joints, and fan inlets and outlets shall be connected to upstream and downstream components by treated woven-cloth connectors.

Connectors shall be installed only after system fans are operative and all vibration isolation mountings have been adjusted. When system fans are operating, connectors shall be free of wrinkles caused by misalignment or

fan reaction. Width of surface shall be curvilinear.

3.12.3 Insulation Protection Angles

Galvanized 20-gage sheet, formed into an angle with a 2-inch exposed long leg with a 3/8-inch stiffening break at outer edge, and with a variable concealed leg, depending upon insulation thickness, shall be provided.

Angles shall be installed over all insulation edges terminating by butting against a wall, floor foundation, frame, and similar construction. Angles shall be fastened in place with blind rivets through the protection angle, insulation, and sheet metal duct or plenum. Angles shall be installed after final insulation covering has been applied.

3.12.4 Duct Probe Access

Holes shall be provided with neat patches, threaded plugs, or threaded or twist-on caps for air-balancing pitot tube access. Extended-neck fittings shall be provided where probe access area is insulated.

3.13 PENETRATIONS

Building openings are fixed and equipment shall be provided to suit.

3.13.1 Non-Rated Construction

At ductwork penetrations through construction which is not fire-rated or designated as a smoke barrier, openings shall be neatly cut and the average clearance around duct shall not exceed 1 inch. In finished areas, sheet metal angle frames shall be provided to fit tightly around the duct and conceal any opening.

The clearance from metal air ducts used for heating to assemblies constructed of combustible materials, including plaster on wood lath, shall be not less than 1/2 inch, or the combustible material shall be protected with minimum 1/4-inch approved insulating material.

3.13.2 Smoke Barriers

At all ductwork penetrations of smoke barriers, the integrity of the smokestopping shall be maintained in accordance with Section 07840, "Firestopping and Smokestopping".

3.13.3 Fire Rated Construction

Where ducts pass through walls, floors, or partitions required to have a fire resistance rating and where fire dampers are not required, the integrity of the firestopping shall be maintained. The opening in the construction around the air duct shall not exceed a 1-inch average clearance on all sides and shall be filled solid with an approved material, in accordance with Section 07840, "Firestopping and Smokestopping".

3.13.4 Fire Dampers

Fire dampers and associated sleeves shall be installed in accordance with the conditions of their listings, the manufacturer's installation instructions, NFPA 90A and SMACNA-F. These requirements apply also to combination fire and smoke dampers.

Ductwork shall not be continuous through the partition, but shall connect on each side of the partition to the damper sleeve or frame. Sleeve or frame shall be secured by perimeter-mounting angles on both sides of the opening, or other installation as required per the listing of the device. Perimeter angle dimensions, size and frequency of fasteners, clearance for expansion, and duct-sleeve connections shall be in accordance with the listing, the manufacturer's installation instructions and SMACNA-F.

3.13.5 Smoke Dampers

Smoke dampers shall be installed in accordance with the conditions of their listings, the manufacturer's installation instructions, NFPA 90A and SMACNA-F. These requirements apply also to combination fire and smoke dampers.

Where smoke dampers are indicated at smoke barriers, they shall be installed in the barrier or adjacent to it, but no more than 2 feet from the barrier or after the first air duct inlet or outlet, whichever is closer to the smoke barrier.

Controls for smoke dampers shall be provided in accordance with Section 13851, "Fire Alarm Systems" , or by the UCS Contractor for dampers associated with smoke control system operation if so indicated on the drawings.

3.14 FIELD QUALITY CONTROL

3.14.1 Fire and Smoke Damper Tests

Fire closure tests shall be performed on each fire damper in the presence of the Contracting Officer by removing the fusible link and verifying full closure with normal system operating airflow.

Smoke closure tests shall be performed on each smoke damper and combination fire-smoke damper in the presence of the Contracting Officer, by activating the applicable smoke detection zone in conjunction with testing of the smoke detection system or UCS and smoke control system, and verifying full closure with normal operating system airflow.

3.14.2 Ductwork Leakage Test

Contractor shall conduct complete leakage test of new ductwork in accordance with Section 15950, "Testing, Adjusting and Balancing."Tests shall be performed prior to installing ductwork insulation.

3.14.3 Inspection

Ductwork shall be inspected in accordance with SMACNA-09.

3.14.4 Testing and Balancing

Contractor shall conduct testing and air balancing in accordance with Section 15950, "Testing, Adjusting and Balancing." Air balancing shall be performed and balance report submitted prior to conducting the Operational Readiness Review.

3.15 DUCTWORK CLEANING PROVISIONS

Open ducting shall be protected from construction dust and debris in a

manner approved by the Contracting Officer. Dirty assembled ducting shall be cleaned by subjecting all main and branch interior surfaces to airstreams moving at velocities two times specified working velocities, at static pressures within maximum ratings. This may be accomplished by: filter-equipped portable blowers which remain the Contractor's property; wheel-mounted, compressed-air operated perimeter lances which direct the compressed air and which are pulled in the direction of normal airflow; and other means approved by the Contracting Officer. Compressed air used for cleaning ducting shall be water- and oil- free. After construction is complete, and prior to acceptance of the work, construction dust and debris shall be removed from exterior surfaces..

3.16 OPERATIONAL READINESS REVIEW (ORR)

Conduct an Operational readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for ductwork in conjunction with the ORR for related air handlers, fans, and controls as applicable. ORR shall include pointing out the location of all duct access doors, motorized dampers, fire dampers, smoke dampers, and major branch duct volume dampers. For task orders involving replacement or modification of only a portion of the system, the ORR shall cover only the replaced or modified sections of the ductwork.

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SECTION 15838

POWER VENTILATORS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 99	(1986; AMCA 99-0401) Standards Handbook

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M	(2001) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 37	(1992) Standard Specification for Aluminum for Use in Iron and Steel Manufacturer

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2000) Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE-06	(1996) Handbook, HVAC Systems and Equipment (IP Edition)
ASHRAE-07	(1996) Handbook, HVAC Systems and Equipment (SI Edition)

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 1940-1	(1986) Mechanical vibration - Balance quality requirements of rigid rotors - Part 1: Determination of permissible residual unbalance

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 705 (1994; 5th Ed) UL Standard for Safety Power Ventilators

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications, including all indicated operating and mounting accessories. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

Power Roof Ventilators.

SD-05 Design Data

Equipment Schedules shall be submitted for the items listed below. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

Power Roof Ventilators

SD-06 Test Reports

Field Test Reports shall be submitted for the items listed below. Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the contractor, by an authorized official of the testing laboratory or agency (if applicable), and by the Government inspector who witnessed the test.

Power Roof Ventilators

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for the items listed below, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

Power Roof Ventilators

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the following items, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

Power Roof Ventilators

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

1.4 QUALITY ASSURANCE

Ventilators shall be rated and labeled in accordance with the applicable standards of the Air Movement Control Association, and shall be licensed to bear the AMCA seal for both air and sound. Fan performance and sound ratings shall be AMCA-certified. Roof ventilators shall comply with the requirements of UL 705.

PART 2 PRODUCTS

2.1 DESIGN AND FABRICATION REQUIREMENTS

Roof ventilators shall be furnished complete with bases, curbs, flashing flanges, noise baffles, dampers, damper controls, louvers, and screens.

Ventilators shall be designed for windloads in accordance with ASCE 7 and ASHRAE-06, Chapters 17 and 18, and in no case shall the installed design be for less than 80 miles per hour windload. Structural bracing shall be properly spaced to accommodate this loading and in accordance with the design requirements of the covering material. Ventilators shall be adequately reinforced and well braced with joints properly formed. Edges shall be wired or beaded where necessary to ensure rigidity. Galvanic action between different metals in direct contact shall be prevented by nonconductive separators. All soldering shall be even and smooth.

Bolts, rivets, and other fastenings used in connection with protected metal shall be corrosion-resistant steel.

Fan wheels shall be statically and dynamically balanced at the factory and after installation. Dynamic balancing shall be in two planes. For fans with motors rated 5.6 kW or greater, Balance Grade shall be G2.5 or better in accordance with ISO 1940-1.

Fans driven by motors rated 7.5 hp or over shall be furnished with access doors and other provisions necessary to permit field balancing of the rotating elements, addition of corrective weights, and measurement of residual unbalance in accordance with ISO 1940-1.

2.1.1 Spark Resistant Construction

Where indicated on drawings, provide fans with spark resistant construction of the indicated type in accordance with AMCA 99:

Type A - All parts of fan in contact with the air or gas being handled shall be made of nonferrous material.

Type B - Fan shall have an entirely nonferrous wheel and a nonferrous ring about the opening through which the shaft passes.

Type C - Fan shall be constructed so that a shift of the wheel will not permit ferrous parts of the fan to rub or strike other ferrous parts.

Materials shall be selected from those specified elsewhere in this section for the type of fan, to comply with the indicated spark-resistant construction type.

2.2 HOUSING STYLE(S)

Power roof ventilator shall be round mushroom style, louvered penthouse style, low contour style or vertical discharge style as indicated. Ventilators for hazardous exhaust service (numbered with "HXF" on drawings) shall be vertical discharge style only. Ventilators for general exhaust (numbered with "EXH" on drawings) shall be round mushroom style unless otherwise indicated

2.3 FAN TYPE(S)

Fan shall be of the following type(s) as indicated on the drawings:

2.3.1 Type C-PRV Centrifugal, Direct Drive

Type C-PRV ventilator shall be a centrifugal roof ventilator with direct drive, nonoverloading, backward-inclined wheel. Drive shall be vibration isolated with elastomer. Drive components shall be mounted in a compartment isolated from airstream.

2.3.2 Type CB-PRV Centrifugal, V-Belt Drive

Type CB-PRV ventilator shall be a centrifugal roof ventilator with V-belt drive, nonoverloading, backward-inclined wheel. Drive shall be vibration isolated with elastomer. Drive components shall be mounted in a compartment isolated from airstream.

2.3.3 Type P-PRV Propeller, Direct Drive

Type P-PRV ventilator shall be a propeller roof ventilator with direct drive and shall be vibration isolated with elastomer. Drive components shall be mounted in a compartment isolated from airstream.

2.3.4 Type PB-PRV Propeller, V-Belt Drive

Type PB-PRV ventilator shall be a propeller roof ventilator with V-belt drive and shall be vibration isolated with elastomer. Drive components shall be mounted in a compartment isolated from airstream.

2.3.5 Type VA-PRV Vane Axial, Direct Drive

Type VA-PRV ventilator shall be a vane axial roof ventilator with direct drive and shall be vibration isolated with elastomer.

2.3.6 Type VAB-PRV Vane Axial, V-Belt Drive

Type VAB-PRV ventilator shall be a vane axial roof ventilator with V-belt drive and shall be vibration isolated with elastomer.

2.3.7 Type TA-PRV Tube Axial, Direct Drive

Type TA-PRV ventilator shall be a tube axial roof ventilator with direct drive and shall be vibration isolated with elastomer.

2.3.8 Type TAV-PRV Tube Axial, V-Belt Drive

Type TAV-PRV ventilator shall be a tube axial roof ventilator with V-belt drive and shall be vibration isolated with elastomer.

2.4 MATERIALS

Materials shall be manufacturers standard materials.

2.4.1 Aluminum Alloy

Aluminum alloy shall be in accordance with ASTM B 37.

2.4.2 Zinc-Coated Steel

Zinc-coated steel shall be in accordance with ASTM A 653/A 653M and ASTM A 924/A 924M.

2.4.3 Fibrous Glass

Fibrous glass ventilators shall be molded from a glass-fiber reinforced polyester resin with a pigmented polyester resin gel coat in manufacturer's standard color, and shall be not less than 0.51 or more than 1.53 millimeter thick. Matrix material shall have not less than 30 percent, by weight, of chopped-fiber and random-strand glass fibers, and shall be thoroughly saturated and impregnated with not more than 70 percent high-solids polyester resin with not less than 5-percent antimony trioxide fire-retardant additive. Material shall be smooth, dense, and uniform in texture, color, and cross section and shall be shatter-resistant, rigid, and free from visual defects, foreign inclusions, cracks, crazing, die lines, pinholes, striations, unsaturated and resin-poor areas, and excessive-resin areas.

2.5 FAN MOTOR

Motors shall be in accordance with Section 16225, "Motors", and as indicated below. Where indicated, provide explosion-proof motors rated in accordance with NFPA 70 for hazardous location, Class I, Group A, B, C, or D as indicated.

Belt drive motors smaller than 1/2 horsepower shall be single-phase, 120 volts, 60 hertz with permanently lubricated ball bearings and shall be split-phase type.

Motors 1/2 horsepower and larger shall be three-phase, 460 volts, 60 hertz, unless otherwise indicated. Fans driven by motors rated 7.5 hp or over shall be furnished with access doors and other provisions necessary to permit field balancing of the rotating elements, addition of corrective weights, and measurement of residual unbalance in accordance with ISO 1940-1.

Motors shall have local disconnects to provide means for fan and motor maintenance. All motors shall be provided with thermal overload protection. Motors located in airstreams shall be totally enclosed type.

Direct drive motors 1/2 horsepower and smaller shall be of the energy efficient permanent split capacitor type, single phase, 60 hertz.

2.6 BASES

Bases provided with the ventilators shall be factory formed, of the type indicated, shall be the same material as the hoods, and the thickness necessary to meet the design requirement for connection to the roof. Bases shall be suitable for raised curb mounting where indicated. Curb flanges of the base shall be formed as cap flashing extending at least 2 inches over roofing base. Where indicated or required, shafts of ventilators shall be extended a sufficient distance through the supporting construction to permit attachment of vent ducts.

2.7 ROOF CURBS

Factory-formed metal ventilator curbs shall be of type and design required for the ventilator and suitable for roof configuration and flashing.

Job-built curbs shall conform to the recommendations of the ventilator manufacturer, shall be sized correctly for the ventilator, and shall be suitable for type of supporting roof construction.

2.8 DAMPERS

Damper type shall be as indicated on the drawings:

Back-draft dampers shall be gravity operated with adjustable counterweight of the same material as fan housing.

Automatic (motorized) dampers shall be motor operated and of the same material as fan housing. Damper actuating motor shall be interlocked with fan motor, unless otherwise indicated.

2.9 SCREENS

Bird screens and insect screens shall be provided with frames of the same material as that used in the ventilators and shall be securely attached in a manner that will permit easy removal for access and cleaning.

2.10 SOUND BAFFLES

Sound baffles shall be permanent construction and impervious to moisture. Baffles shall be removable.

PART 3 EXECUTION

3.1 INSTALLATION

Power roof ventilators shall be installed in accordance with manufacturer's installation instructions. Installation of ventilators shall be properly coordinated with other work. Anchors, attachments, and other items to be built shall be coordinated for installation as the work progresses. Ventilators shall be rigidly installed in a weathertight and watertight manner and shall be free from vibration. Refer to Section 15072, "Vibration Isolation for Air Conditioning Equipment," for vibration isolation requirements.

3.2 TESTS

After installation, each power roof ventilator shall be tested to demonstrate proper operation at indicated and specified performance requirements including running, balance, noise, and proper direction of fan rotation.

3.3 LUBRICATION

Movable parts of dampers and related operating hardware shall be lubricated in accordance with manufacturer's printed instructions and shall operate smoothly and quietly without binding.

3.4 FAN TESTING

Fan alignment and balancing shall be performed in accordance with Section 01750, "Equipment Alignment and Balancing for RCM", prior to air balancing or any operation of the unit.

Air Balancing shall be performed in accordance with Section 15950, "Testing, Adjusting and Balancing" prior to conducting the Operational Readiness Review. Operational Testing of the fan and any associated automatic temperature controls shall be performed in accordance with Section 15902, "Non-UCS Control Systems", or coordinated with UCS Contractor in accordance with Section 15900, "UCS Controls", prior to conducting the Operational Readiness Review.

3.5 OPERATIONAL READINESS REVIEW (ORR)

Provide an operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for the system as a whole. The system ORR shall include the fan, along with any other associated equipment, ductwork arrangement, location and operation of key balancing dampers, fire dampers, and other components. Include locations of control devices, and a complete demonstration of all control sequences, for controls provided under Section 15902, "Non-UCS Control Systems"; or coordinate ORR with such demonstration by the UCS Contractor in accordance with Section 15900, "UCS Controls". For task orders which involve replacement or modification of only a portion of the system, the ORR shall cover only the replaced or modified components. Fans which are part of an air handling unit, return air fans, or other fans functioning as part of an HVAC system, shall be included as part of the ORR for the air handling unit and the HVAC system as a whole.

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SECTION 15840

VARIABLE AIR VOLUME (VAV) BOXES

09/96

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SECTION 15840

VARIABLE AIR VOLUME (VAV) BOXES
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 880	(1998) Air Terminals
ARI 885	(1998) Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1999) Standard for the Installation of Air Conditioning and Ventilating Systems

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Where a range of sizes or capacities is specified for an item, include performance data for the manufacturer's models or sizes which cover that range. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and certified performance data tables or curves, for the following items:

Variable Air Volume Boxes
Pneumatic Controls
Reheat Coils
Pneumatic Hot Water Valves and Actuators

SD-05 Design Data

Equipment Schedules shall be submitted to provide specific information for each VAV box provided under the task order. Schedules shall be in tabular form and include for each VAV box: GOMARS equipment number as indicated on the drawings, manufacturer, model number, size, minimum/maximum flow settings, type of controls, reheat coil flow/capacity, optional features, and other pertinent information regarding the specific VAV boxes.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, including approved equipment schedule, manufacturer's operation, maintenance and repair instructions, spare parts lists, shall be submitted for the following items, as applicable for the task order:

Variable Air Volume Boxes
Pneumatic Controls
Reheat Coils
Pneumatic Hot Water Valves and Actuators

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

Units shall be provided with the configuration, capacity, and static-pressure characteristics indicated.

Where dimensional data are given, these shall constitute nominal sizing, which shall be adjusted by the manufacturer when necessary to accommodate acoustic material thickness.

Units identical to the proposed units shall have at least 2 years of proven satisfactory field service.

Units shall be certified as having been tested and rated in accordance with ARI 880 and ARI 885.

1.4 COORDINATION WITH UCS CONTRACTOR

Where the drawings indicate Direct Digital Controls (DDC) for VAV boxes, some portions of the work will be performed by the Utility Control System (UCS) Contractor. Such work is indicated in this Section to be "by the UCS Contractor". Provide coordination between the terminal unit manufacturer, the work under this contract, and the UCS contractor in accordance with Section 15900, "UCS Controls".

PART 2 PRODUCTS

2.1 VARIABLE AIR-VOLUME (VAV) BOXES

Casing shall be fabricated from galvanized steel and shall have internal thermal and acoustic insulation. Insulation shall be coated to prevent erosion and shall conform to NFPA 90A.

Casing internal leakage shall be limited to 2 percent of ARI 880 standard rating box capacity when the internal pressure is.

Casing shall be fitted with rigid, airtight access panels, easily removable, and of ample size to give free access to all interior parts, including controls, actuators, and linkages.

Inlet valve shall be self-seating, and leakage in full closed position shall not exceed 2 percent of ARI 880 standard rating capacity against inlet pressure of.

2.2 VAV BOX SIZING AND SOUND LEVELS

The air flow indicated in the table below for each box inlet size is the flow which ARI uses as the standard rating condition for that size based on an inlet velocity of approximately 2000 feet per minute. New boxes shall be sized so that the maximum cooling flow indicated on the drawings is no more than this value; if necessary the next larger size box shall be provided. Where existing boxes are rebalanced, they may be adjusted to a higher flow, up to 120% of the standard flow, if indicated on the drawings.

VAV box discharge and radiated sound power levels shall be tested and certified in accordance with ARI 880. Unless indicated otherwise sound power levels, at the standard ARI rating conditions of the indicated flow at an inlet pressure of 1.5 inches w.g. shall not exceed those shown below for each octave band, in decibels referenced to (1 times 10 to the minus 12 power) watts:

Box Inlet Diam. (in.)	Air Flow Rate (cfm)	Maximum Discharge Sound Power Level (decibels)					
		Band 2 250 Hz	Band 3 500 Hz	Band 4 1000 Hz	Band 5 2000 Hz	Band 6 4000 Hz	Band 7 8000 Hz
4	150	74	67	67	64	64	55
5	250	"	"	"	"	"	"
6	400	77	70	70	67	67	58
7	550	"	"	"	"	"	"
8	700	"	"	"	"	"	"
9	900	79	72	72	69	69	60
10	1100	"	"	"	"	"	"
12	1600	"	"	"	"	"	"
14	2100	"	"	"	"	"	"
16	2800	"	"	"	"	"	"

Box Inlet Diam. (in.)	Air Flow Rate (cfm)	Maximum Radiated Sound Power Level (decibels)					
		Band 2 250 Hz	Band 3 500 Hz	Band 4 1000 Hz	Band 5 2000 Hz	Band 6 4000 Hz	Band 7 8000 Hz
(all inlet sizes)	(as in above table)	67	61	57	59	62	66

The ratings shown above are estimated to result in actual room sound levels of NC 35 or better, in typical applications with room construction, room size, unlined ductwork, and diffuser type and quantity considered typical for the box size.

In special areas where extra quiet operation is critical, the drawings may indicate more stringent ratings are required. In areas with high ambient noise levels, the drawings may indicate less stringent ratings are acceptable. If indicated, provide boxes to meet those requirements in those specific locations, instead of the ratings above.

2.3 CONTROLS FOR VAV BOXES

Controls for VAV boxes shall be pneumatic or direct digital controls (DDC) as indicated on drawings.

For use with either pneumatic or DDC controls, provide boxes with a multi-point air flow sensing element in the inlet duct, in either a ring or a cross configuration, to provide an average velocity pressure signal to the controller.

When constant volume operation of VAV boxes is indicated, provide controls as described below, except without thermostat, and with both minimum and maximum air flow set to the volume indicated on the drawings.

2.3.1 Pneumatic Controls

Where pneumatic controls are indicated, provide a factory mounted pneumatic damper actuator and pneumatic, pressure-independent controller, operating from a supply of 15 psig dry compressed air. Controller shall provide for separately adjustable settings for maximum cooling airflow, minimum airflow, and maximum heating airflow, and shall operate air damper and hot water heating valve in sequence in response to a 3-15 psig input signal from a pneumatic thermostat, either direct or reverse acting. The minimum airflow, maximum cooling airflow, and minimum heating airflow, as applicable, shall be factory set in accordance with the schedule on the drawings.

Pneumatic thermostats, control tubing, two-way modulating control valves, and pneumatic valve actuators, shall be provided under this contract in accordance with Section 15902, "Non-UCS Control Systems".

2.3.2 Direct Digital Controls (DDC)

DDC pressure-independent type controllers and electronic damper actuators will be furnished by the UCS contractor. Controllers will be Johnson Controls Metasys type VMA integrated controller/actuator, or type VAV with separate actuator, as required to fit approved VAV boxes.

Controllers and damper actuators will be furnished by the UCS Contractor to the VAV box manufacturer for factory mounting, unless otherwise indicated. Where indicated on drawings (for projects requiring only a few boxes per task order), controllers and damper actuators will be furnished and field installed on boxes by the UCS contractor.

Hot water control valves and electronic actuators for use with DDC controls will be furnished by the UCS contractor, and shall be installed under this contract, in accordance with Section 15900, "UCS Controls".

The UCS Contractor will provide 120V/24V step-down transformers with fuses and switches to power the VAV controllers. The UCS Contractor will provide the 24V power wiring from the transformers to the VAV's, as well as the control wiring. Transformers will be located as indicated on the drawings, either in a centrally located panel in the mechanical equipment room for most new VAV's, or mounted in the field for projects adding a few boxes to an existing system.

Power to the transformer panel, or field-mounted transformers, shall be provided under this contract in accordance with Division 16, "Electrical", run from the source indicated on the drawings, and connected to the UCS

Contractor's transformers or transformer panel.

2.4 REHEAT COILS

Where indicated on drawings, provide VAV boxes with factory-mounted hot water reheat coils. Water coils shall be constructed of not less than 3/8-inch outside diameter seamless copper tubing with copper- or aluminum-plate fins mechanically bonded or soldered to the tubes, and with not less than 5/8-inch outside diameter female solder connectors and manual air vent on return. Provisions shall be made for coil removal in field. Coils shall be hydrostatically tested at 250 psig.

Distance between coil and upstream inlet valve shall ensure uniform air velocities over face of coil.

Capacity shall be as indicated on drawings. Unless otherwise indicated, capacity shall be rated with entering water at 180 degrees F and leaving at 140 degrees F.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed as shown on the drawings and in accordance with the manufacturer's recommendations. Boxes shall be located so access to controls and access doors are not obstructed by walls, columns or other ductwork, piping, etc. Locate VAV box so inlet duct has a minimum of 2 feet of straight duct, of the same size as the inlet, upstream.

3.2 VAV BOX TESTING

Air and Water Balancing shall be coordinated with UCS Contractor (if applicable), and performed in accordance with Section 15950, "Testing, Adjusting and Balancing" prior to conducting the Operational Readiness Review.

Operational Testing of the VAV Boxes and associated automatic temperature controls shall be performed in accordance with Section 15902, "Non-UCS Control Systems", or coordinated with UCS Contractor in accordance with Section 15900, "UCS Controls", prior to conducting the Operational Readiness Review.

3.3 OPERATIONAL READINESS REVIEW (ORR)

Provide an operational Readiness Review (ORR) in accordance with Section 01770, "Task Order Closeout", for the VAV Boxes as a part of the ORR for the HVAC system as a whole. ORR shall include locations of boxes and a complete demonstration of control sequences for each, for pneumatic controls in accordance with Section 15902, "Non-UCS Control Systems", or for DDC controls shall be coordinated with such demonstration by the UCS Contractor in accordance with Section 15900, "UCS Controls". For task orders which involve replacement or modification of VAV boxes on an existing HVAC system, the ORR shall cover only the replaced or modified VAV boxes.

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SECTION 15852

DIFFUSERS

03/98

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SECTION 15852

DIFFUSERS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 70	(1991) Method of Testing for Rating the Performance of Air Outlets and Inlets
ASHRAE 113	(1990) Method of Testing for Room Air Diffusion

1.2 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

1.3 PERFORMANCE REQUIREMENTS

Air diffusion devices shall be certified as having been tested and rated in accordance with ASHRAE 70 or ASHRAE 113.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Data shall be submitted for the Air Diffusion Devices. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

Data shall also include sound data in terms of sound-power level in octave bands second through eighth and Noise Criteria (NC) index for the capacity range of the device. Where room attenuation is not specified or indicated, 10 decibels shall be assumed. Where space or sound data are not specified or indicated, NC35 shall be assumed.

SD-04 Samples

Manufacturer's Standard Color Chart shall indicate the

manufacturer's standard color selections and finishes for Air Diffusion Devices. Required only if drawings indicate finish to be other than white (baked enamel) or clear (anodized).

SD-05 Design Data

Equipment Schedules shall be submitted for the Air Diffusion Devices. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for the Air Diffusion Devices, in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

PART 2 PRODUCTS

2.1 AIR-DIFFUSION DEVICE CONSTRUCTION

Air-diffusion device construction and mounting shall preclude flutter, rattle, or vibration. Refer to Section 15072, "Vibration Isolation for Air Conditioning Equipment," for vibration isolation considerations. Devices shall have the modifications and accessories necessary for mounting in indicated surface construction.

Color selection shall be from manufacturer's standard color chips.

Color shall be white (for baked enamel) or clear (for anodized) unless otherwise indicated.

Supply diffusers shall be provided with combination damper and equalizing grid. Dampers shall be extracting-splitter type, except as otherwise indicated.

Air-diffusion device volume and pattern adjustments shall be made from the face of the device. Volume adjustments shall be made by tamper-deterring device.

Gaskets shall be provided for supply-terminal air devices mounted in finished surfaces.

2.2 TYPES OF AIR-DIFFUSION DEVICES

2.2.1 Type DRA

Type DRA supply diffuser shall be round with five or more expanding cones with beaded edges to provide hemispherically diffused discharge air. Cones shall be arranged to provide a minimum of four air paths which simultaneously diffuse air at 20 to 50 feet per minute (fpm) and aspirate room air at 25 to 35 percent of discharge volume.

Diffuser shall be constructed of aluminum or steel. Finish shall be baked enamel.

Antismudge rings and extended cones shall be provided.

2.2.2 Type DRB

Type DRB supply diffuser shall be round with four more expanding cones to provide hemispherically diffused discharge air. Cones shall be arranged to provide a minimum of three air paths which simultaneously diffuse air at 20 to 50 fpm. Pattern adjustment shall range from horizontal to downward projection, and any intermediate point, when mounted on exposed ductwork.

Diffuser shall be constructed of aluminum or steel. Finish shall be baked enamel.

Antismudge ring and extended ceiling cone shall be provided.

2.2.3 Type DP Series

Type DP series supply diffuser shall have a square or rectangular, perforated, hinged, face plate with opposed blade volume control. Diffuser shall be constructed of aluminum or steel. Finish shall be baked enamel exterior finish, and black matte finish on exposed-to-view interior surface. Type DPE (four-way deflection) shall be provided unless otherwise indicated.

Type DPA shall provide one-way deflection.

Type DPB shall provide two-way opposed deflection.

Type DPC shall provide two-way diagonal deflection.

Type DPD shall provide three-way deflection.

Type DPE shall provide four-way deflection.

2.2.4 Type DLB

Type DLB supply diffuser shall be linear bar type, frame mounted, with extruded-aluminum bar and frame.

Bars shall be 1/4 inch thick by 3/4 inch high, 1/2 inch on center. Bar spacing shall be pencilproof. Bar deflection angle shall be zero degrees.

Floor- and sill-mounted diffusers shall be heavy-duty reinforced construction to carry loads of not less than 100 pounds per square foot.

Diffusers shall be continuous length with hairline butt joints.

Mitered end caps shall be provided where diffuser run terminates.

Dampers shall be opposed-blade type.

An integral, pivoted, bar-type access door shall be provided where indicated.

Straightening grids shall be provided where indicated.

Exposed-to-view parts shall be anodized aluminum, and all interior exposed-to-view components shall have a black matte finish.

2.2.5 Type DLS

Type DLS supply diffuser shall be linear slot type, extruded aluminum construction, with fully adjustable integral air pattern and volume control vanes that deflect air pattern from horizontal along ceiling to straight down, or any intermediate setting. Pattern control element shall permit complete blanking-off of slot.

Slot width shall be 3/4 inch.

Number of slots per unit run shall be as indicated.

Butts in continuous runs shall be aligned for hairline joints.

Ends of diffuser shall butt against walls without mitered end caps. End caps shall be provided where slot terminates.

Exposed-to-view parts shall be anodized aluminum, and all interior exposed-to-view components shall have a black matte finish.

2.2.6 Type DSA

Type DSA supply diffuser shall be square with four expanding flared members to provide radially diffused discharge air. Flared members shall be arranged to provide a minimum of four air paths which simultaneously diffuse air at 20 to 50 fpm. Pattern adjustments shall include horizontal, vertical projection, and an intermediate position or range.

Diffuser shall be constructed of aluminum or steel. Finish shall be baked enamel.

Antismudge ring shall be provided.

Integral extended surface to fit into module of lay-in ceiling shall be provided.

2.2.7 Type GS

Type GS supply grille shall be double deflection type with adjustable face bars parallel to short dimension and adjustable rear bars parallel to long dimension.

Grille shall be constructed of aluminum or steel. Finish shall be baked enamel.

Integral extended surface to fit into module of lay-in ceiling shall be provided.

2.2.8 Type GR

Type GR return grilles shall be single deflection type with fixed face bars.

Grilles installed in vertical surfaces shall have horizontal face bars set downward at 35 degrees from vertical.

Grilles installed in horizontal surfaces shall have face bars straight and parallel to short dimension.

Grille shall be constructed of aluminum or steel. Finish shall be baked

enamel.

Integral extended surface to fit into module of lay-in ceiling shall be provided.

2.2.9 Type GCA

Type GCA shall have an individually adjustable, horizontal, curved-blade grille and a one-way pattern.

Grille shall be constructed of aluminum or steel. Finish shall be baked enamel.

2.2.10 Type GCB

Type GCB shall have an individually adjustable, vertical, curved-blade grille and a one-way pattern.

Grille shall be constructed of aluminum or steel. Finish shall be baked enamel.

2.2.11 Type GCD

Type GCD shall have an individually adjustable, vertical, curved-blade grille and a two-way pattern.

Grille shall be constructed of aluminum or steel. Finish shall be baked enamel.

2.2.12 Type GE

Type GE "eggcrate" grille shall be white plastic, approximately 0.25 inch thick, with a grid of approximately 0.25 inch, square openings over entire area. Grille shall be sized for lay-in installation in suspended ceiling support grid, for transfer of air from room into return air ceiling plenum.

2.2.13 Type RS

Type RS shall be supply register, double-deflection type, with adjustable face bars parallel to short dimension and adjustable rear bars parallel to long dimension. Dampers shall be opposed-blade type.

Register shall be constructed of aluminum or steel. Finish shall be baked enamel.

Integral extended surface to fit into module of lay-in ceiling shall be provided.

2.2.14 Type RR

Type RR shall be return register, single-deflection type, and shall have fixed face bars with opposed-blade dampers.

Registers installed in vertical surfaces shall have horizontal face bars set downward at approximately 35 degrees from vertical.

Registers installed in horizontal surfaces shall have face bars set straight and parallel to short dimension.

Register shall be constructed of aluminum or steel. Finish shall be baked enamel.

2.2.15 Type TS

Type TS supply troffer complete assembly shall be provided as specified in Section 16511, "Fluorescent Luminaires," and as indicated. Air handling section of unit shall be installed under this section.

2.2.16 Type TR

Type TR return troffer shall conform to requirements for Type TS supply troffer.

2.2.17 Type TSR

Type TSR combination supply and return troffer assembly shall be provided as specified in Section 16511, "Fluorescent Luminaires," and as indicated. Air handling section of unit shall be installed under this section.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed as indicated and specified and in accordance with manufacturer's recommendations.

Wall-mounted registers shall be mounted 6 inches below ceiling, unless otherwise indicated.

Air balancing shall be performed in accordance with Section 15950, "Testing, Adjusting and Balancing".

Air balancing shall be completed, and balance reports submitted and approved, prior to conducting an Operational Readiness Review (ORR) for the HVAC system and related equipment as specified in the applicable sections.

-- End of Section --

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SECTION 15855

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09/98

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SECTION 15855

GRAVITY VENTILATORS
09/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123	(1999; Rev E1) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM B 209	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(2000) Minimum Design Loads for Buildings and Other Structures

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE-03	(1997) Handbook, Fundamentals (IP Edition)
ASHRAE-04	(1997) Handbook, Fundamentals (SI Edition)

FEDERAL SPECIFICATIONS (FS)

FS FF-B-171	(Rev A; Am 1) Bearings, Ball, Annular (General Purpose)
FS FF-B-185	(Am 4) Bearings, Roller, Cylindrical; and Bearings, Roller, Self and Aligning

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and

dimension drawings, and performance data tables or curves as applicable.

Gravity Roof Ventilators

SD-06 Test Reports

Test Reports shall be submitted for Leakage Tests in accordance with the paragraph entitled, "Tests," of this section.

SD-08 Manufacturer's Instructions

Installation Instructions shall be submitted for Gravity Roof Ventilator Systems.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted for Gravity Roof Ventilators in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

Section 15072, "Vibration Isolation for Air Conditioning Equipment," applies to work specified in this section.

PART 2 PRODUCTS

2.1 DESIGN AND FABRICATION REQUIREMENTS

Roof ventilators shall be of the sizes indicated and shall be furnished complete with bases, curbs, flashing flanges, dampers and damper controls, louvers, and screens.

2.1.1 Design

Ventilators shall be weatherproof and shall be free from backdraft except for interior negative pressure. Ventilators shall be self-cleaning by the action of the elements, with provision for carrying water and normal wind-transported matter to the outside.

Turbine and oscillating-head ventilators shall rotate automatically with any change in wind direction without binding and shall be accurately balanced with permanently lubricated bearings designed to ensure quiet operation. Bearings shall be bronze or corrosion-resistant steel conforming to FS FF-B-171 for ball bearings and to FS FF-B-185 for roller bearings of type, class and grade required.

Ventilators shall be designed for windloads in accordance with ASCE 7, and in no case shall the installed design be for less than 80 miles per hour windload. Structural bracing shall be properly spaced to accommodate this loading and in accordance with the design requirements of the covering material.

Ridge type ventilators shall be equipped with wind jump diaphragms spaced at each structural frame to afford efficient ventilation regardless of wind direction.

2.1.2 Fabrication

Ventilators shall be reinforced and braced with properly formed joints. Edges shall be wired or beaded, where necessary, to ensure rigidity. Galvanic action between dissimilar metals shall be prevented by nonconductive separators. Soldering shall be even and smooth.

Bolts, rivets, and other fastenings used in connection with protected metal shall be corrosion-resistant steel.

Ridge ventilators shall be constructed in sections suitable for shipment and installation. Joints between sections shall be waterproof and shall allow for expansion and contraction. Suitable end fittings shall be provided for each continuous run of ventilator.

2.2 VENTILATOR TYPE

Ventilator framing shall be the same material as the hood or a compatible material.

2.2.1 Round, Industrial, Stationary

Type RIS-GRV ventilator shall be round, industrial appearance, low-profile, metal, stationary, gravity ventilator, mounted on square-to-round base designed to match roof slope and roof panel configuration. Ventilators shall be fabricated of sheet metal with rib-reinforced metal throat, baffle ring and circular wind band, a reinforced cone-shaped rain cap, and solid sheet metal vertical bracing. Edges shall be beaded and reinforced.

2.2.2 Square, Stationary

Type SS-GRV ventilator shall be a square or rectangular, metal, high-capacity, low-profile, stationary, gravity ventilator, of modular size and shall be not more than 22 inches higher than the roof curb. Ventilators shall be a formed plate, overlap baffle design with a minimum of 40-percent net opening through the throat.

2.2.3 Heat Valve Stationary

Type HVS-GRV ventilator shall be a continuous heat-valve type industrial monitor ridge ventilator. Each ventilator shall be furnished in standard 10-foot sections with throat size indicated, complete with side baffles, ventilator assembly, hardware, end caps, splice plates, flashing, reinforcing diaphragms, closures, and fasteners. Ventilators shall be reinforced and braced. Diaphragms shall be not more than 3 feet on center, flanged at contact points, and riveted or welded in place. Side baffles shall have integral rain-drip slots, not more than 16 inches on center.

2.2.4 Round, Commercial, Stationary

Type RCS-GRV ventilator shall be round, commercial or institutional appearance, low-profile, stationary, gravity ventilator. Hood shall be free of exposed seams, joints, and fasteners, except for hinge fasteners.

2.2.5 Square, Commercial, Stationary

Type SCS-GRV ventilator shall be square or rectangular, commercial or institutional appearance, low-profile, stationary, gravity ventilator. Hood shall be free of exposed seams, joints, and fasteners, except that metal hoods may have hairline joints at ends and edge reinforcing angles may have exposed fasteners.

2.2.6 Rotating Head

Type RH-GRV ventilator shall be rotating-head gravity ventilator mounted on a square-to-round metal base designed to match roof slope and roof panel configuration.

Ventilator shall have an outlet opening of approximately the same size as the throat opening.

Ventilator hood shall rotate on sealed, permanently lubricated antifriction thrust bearings. Hood assembly shall be formed of sheet metal properly reinforced and braced for the design windload. Hood shall incorporate an effective metal wind vane.

2.2.7 Turbine-Head

Type TH-GRV ventilator shall be turbine-head gravity ventilator mounted on a square-to-round metal base designed to match roof slope and roof panel configuration.

Rotor head shall be spherical in configuration with reinforced-edge airfoil-shaped rotor blades. Rotor shaft shall be carried by a factory sealed antifriction thrust bearings at one end and by a bronze, self-lubricated sleeve bearing at the other end. Rotor shaft and bearing assembly shall be housed in a sealed and lubricant-packed aluminum casting.

2.3 CAPACITY RATING

Capacity ratings indicated shall be in accordance with ASHRAE-03 for the combined effects of 5 mph minimum winds, exterior-interior temperature differential of 10 degrees F, and stack height indicated.

2.4 MATERIALS

Materials shall be manufacturer's standard materials and shall conform to the requirements specified herein. Metals shall be of temper best suited for forming and intended use.

2.4.1 Aluminum Alloy

Aluminum alloy shall conform to ASTM B 209.

2.4.2 Zinc-Coated Steel

Zinc-coated steel shall conform to ASTM A 123, Class C.

2.4.3 Fibrous Glass

Fibrous glass ventilators shall be molded from a glass-fiber reinforced polyester resin with a pigmented polyester resin gel coat in manufacturer's standard color, and shall be not less than 20 or more than 60 mils thick.

Matrix material shall have not less than 30 percent, by weight, of chopped-fiber and random-strand glass fibers and shall be thoroughly saturated and impregnated with not more than 70 percent high-solids and polyester resin with not less than 5 percent antimony trioxide fire-retardant additive. Material shall be smooth, dense, and uniform in texture, color, and cross section and shall be shatter-resistant, rigid, and free from visual defects, foreign inclusions, cracks, crazing, die lines, pinholes, striations, unsaturated and resin-poor areas, and excessive-resin areas.

2.5 BASES

Bases provided with the ventilators shall be factory formed, of the type indicated, shall be the same material as the hoods, and the thickness necessary to meet the design requirements specified herein. Bases shall be provided with flashing. Flanges shall extend a sufficient distance over the adjoining roof surfaces to provide for proper connection with the roof. Bases shall be suitable for raised curb mounting where indicated. Curb flanges of the base shall be formed as cap flashing extending at least 4 inches over roofing base. Where indicated or required, shafts of ventilators shall be extended a sufficient distance through the supporting construction to permit attachment of vent ducts.

2.6 ROOF CURBS

Factory-formed metal ventilator curbs shall be of type and design required for the ventilator and suitable for roof configuration and flashing.

Job-built curbs shall conform to the recommendations of the ventilator manufacturer, be sized correctly for the ventilator, and shall be suitable for type of supporting roof construction.

2.7 DAMPERS

Dampers shall be constructed of the same materials as the ventilators or translucent fiberglass-reinforced plastic to provide for daylight as indicated.

Dampers shall be provided with chains or cables, locking devices, and required hardware for satisfactory operation. Dampers shall be a type that will completely close the opening or that may be set securely at any desired position. Dampers for ridge ventilators shall be manually or motor operated, either individually or in groups, as indicated. Dampers shall be designed to open automatically in case of fire by means of mechanical linkage and 212-degree F fusible links.

2.8 SCREENS

Bird and insect screens shall be provided with frames of the same material as that used in the ventilators and shall be securely attached in a manner that will permit easy removal for access and cleaning.

Screens for ridge ventilators shall be in sections to match ventilator sections with cross members of frames flanged for bolted connection.

PART 3 EXECUTION

3.1 INSTALLATION

Ventilators, ventilator bases, and prefabricated curbs shall be installed in accordance with manufacturer's instructions, the approved shop drawings, and as indicated.

Installation of ventilators shall be coordinated with other work. Anchors, attachments, and other items to be built shall be coordinated for installation as the work progresses. Ventilators shall be rigidly installed in a weathertight and watertight manner and shall be free from vibration. Following installation, operating devices shall be adjusted for proper operation.

3.2 TESTS

Ventilators shall be tested for leakage in the presence of the Contracting Officer. Ventilators shall not leak when tested as follows:

Each unit shall be subjected to spot leak tests with a water hose held at a distance of not more than 10 feet and adjusted for a spray impact of approximately 50 pounds per square inch at not less than 5 gallons per minute.

3.3 LUBRICATION

Movable parts of dampers and related operating hardware shall be lubricated in accordance with manufacturer's printed instructions and shall operate smoothly and quietly without binding.

3.4 OPERATIONAL READINESS REVIEW (ORR)

Provide operational readiness review (ORR) in accordance with Section 01770, "Task Order Closeout", including location of all units and maintenance/adjustment points.

-- End of Section --

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DIVISION 15 - MECHANICAL

SECTION 15865

FILTERS

03/98

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SECTION 15865

FILTERS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 176	(1999) Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 653/A 653M	(2001) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 924/A 924M	(1999) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 209	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2000) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM D 92	(1998; Rev A) Standard Test Method for Flash and Fire Points by Cleveland Open Cup

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASTM A 176	(1999) Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.1	(1992) Gravimetric and Dust Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter
ASHRAE 52.2	(1999) Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-50554	(1997) Filter, Air-Extended Area, Initial

Installation

INSTITUTE OF ENVIRONMENTAL SCIENCES AND TECHNOLOGY (IEST)

IEST RP-CC001.3	(1997) HEPA and ULPA Filters

MILITARY SPECIFICATIONS (MS)

MS MIL-F-51079	(Rev D; Int Am 1) Filter Medium, Fire-Resistant, High-Efficiency

MILITARY STANDARDS (MIL-STD)

MIL-STD 282	(1995; Notice 4) Filter Units, Protective Clothing, Gas-Mask Components, and Related Products: Performance-Test Methods

UNDERWRITERS LABORATORIES (UL)

UL 586	(1996; 8th Ed) UL Standard for Safety High-Efficiency Particulate, Air Filter Units
UL 900	(1994; Rev thru Apr 1997) Test Performance of Air Filter Units

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification. For filters which are furnished as part of an HVAC unit, include the following information as part of the unit submittal under the specification section for the unit:

SD-03 Product Data

Manufacturer's Data shall be submitted for the items listed below. Data shall include preprinted catalog data, plus any supplemental data required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, equipment outline and dimension drawings, and performance data tables or curves as applicable.

All Filters
Filter Gauges

SD-05 Design Data

Equipment Schedules shall be submitted for all filters. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order.

SD-06 Test Reports

Manufacturer's Test Reports shall be submitted for the items listed below. Each report shall be properly identified, including

description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the manufacturer, by an authorized official of the testing laboratory or agency (if applicable), and by the Government's witness (if applicable).

HEPA filters efficiency test (and scan test if required)

SD-06 Test Reports

Field Test Reports shall be submitted for HEPA filters field testing (if required). Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the contractor, by an authorized official of the testing laboratory or agency (if applicable), and by the Government inspector who witnessed the test.

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings shall be submitted for all filters, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions.

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, shall be submitted for all filters in accordance with Section 01770, "Task Order Closeout". Manuals shall include approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists.

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

PART 2 PRODUCTS

2.1 FILTERS

Filters shall have a net effective filtering area and a face area to provide the required airflow at the indicated initial pressure-drop.

Filter assembly shall be suitable for space provided with sufficient clearance for maintenance and operation.

Filter-holding frames shall be constructed of extruded aluminum or type 300 corrosion-resistant steel. All frame assemblies and fasteners shall be corrosion-resistant metal or carbon steel with a corrosion-resistant finish to preclude surface degradation.

Dry filter gaskets shall be closed-cell foamed neoprene or urethane

elastomer of sufficient hardness to compress to not more than 40 percent of original thickness when filter is in position.

2.1.1 Filters, Disposable Type

Minimum acceptable performance for the air filter shall be as listed below, based on arrestance and dust holding capacity tests in accordance with ASHRAE 52.1.

DIMENSIONS (INCHES)	INITIAL RESISTANCE (INCH WG)	ARRESTANCE (PERCENT)	DUST-HOLDING CAPACITY (GM/SQ FT)
14 by 20 by 1	0.04	65	145
16 by 20 by 1	0.04	65	145
16 by 25 by 1	0.04	65	145
20 by 20 by 1	0.04	65	145
20 by 25 by 1	0.04	65	145
16 by 20 by 2	0.08	75	190
16 by 25 by 2	0.08	75	190
20 by 20 by 2	0.08	75	190
20 by 25 by 2	0.08	75	190

For all sizes of filters, final resistance value shall be 0.50 inch, and airflow velocity shall not exceed 300 feet per minute.

2.1.2 Filters, Replaceable Type

Filters shall conform to CID A-A-50554, type and grade as indicated. Filter efficiency for the Filter Types specified below is based on ASHRAE 52.1. Efficiency, by definition, is average dust-spot efficiency using atmospheric dust. However, if the drawings indicate filters shall have particle size efficiencies (PSE) and minimum efficiency reporting value (MERV), either for specific particle sizes in micrometers or for particle size ranges E1, E2, and E3, those requirements shall be in accordance with ASHRAE 52.2 and shall supercede the ASHRAE 52.1 dust spot efficiency requirements indicated below. The efficiency percentages based on these two standards are not interchangeable. Filters with efficiency specified based on ASHRAE 52.2 shall comply with the non-efficiency requirements below for the filter type, including arrestance or dust-holding capacity based on ASHRAE 52.1, unless otherwise indicated.

Each air filter shall consist of a permanent corrosion-resistant holding frame and a replaceable factory-assembled filter element. Permanent holding frame shall be supplied with suitable gaskets and shall be designed to maintain a positive pressure seal between the frame and the filter element(s). Frames shall be arranged to accommodate standard 610 millimeter x 610 millimeter elements unless otherwise indicated.

Air filters shall be designed and constructed to facilitate field maintenance. Adjustments and replaceable accessories shall be readily accessible. Conditions which may be hazardous to personnel or deleterious to equipment shall not be permitted. Side-access filter housing and frame shall be provided where indicated, and where required by equipment configuration.

Filter element shall be nonallergenic and nontoxic, with no detectable odor. Filter element shall have no adverse effect on the health of personnel handling or served by the filter element.

Adhesive coatings used on filters shall have a flashpoint of not less than 325 degrees F and shall conform to ASTM D 92.

Filters shall be Type I, Grade A, 25-30 percent rated average efficiency, and minimum initial efficiency of 20 percent per ASHRAE 52.1 using atmospheric dust, and shall conform to UL 900, Class 2, and requirements specified herein. Dust-holding capacity (grams per square foot), at a rated air flow (cubic feet per minute) shall be not less than 600 at 1,500, respectively.

Filter shall be Type I, Grade B, 40 percent rated average efficiency, and minimum initial efficiency of 20 percent per ASHRAE 52.1 using atmospheric dust, and shall conform to UL 900, Class 2, and requirements specified herein. Dust-holding capacity (grams per square foot), at a rated air flow (cubic feet per minute) shall be not less than 500 at 1,500 or 600 at 2,000 or 700 at 2,500, respectively.

Filter shall be Type II, Grade C, 80-85 percent rated average efficiency and minimum initial efficiency of 58 percent per ASHRAE 52.1 using atmospheric dust, and shall conform to UL 900, Class 1 and requirements specified herein. Dust-holding capacity (grams per square foot), at a rated air flow (cubic feet per minute) shall be not less than 300 at 1,500 or 400 at 2,000 or 470 at 2,500, respectively.

Filter shall be Type II, Grade D, 90-95 percent rated average efficiency and minimum initial efficiency of 78 percent per ASHRAE 52.1 using atmospheric dust, and shall conform to UL 900, Class 1 and requirements specified herein. Dust-holding capacity (grams per square foot), at a rated air flow (cubic feet per minute) shall be not less than 220 at 1,500 or 300 at 2,000 or 380 at 2,500, respectively.

Filters shall be Type III, Grade E, 95 percent rated efficiency (DOP test), and shall conform to UL 900, Class 1. Filter initial pressure drop shall not exceed 1.0 inch wg with face velocity of 325 fpm on 6-inch deep filter or 1.0 inch wg with face velocity of 500 fpm on 12-inch-deep filter, and final pressure drop shall not exceed 2.0 inches wg with face velocity of 325 fpm on 6-inch-deep filter or 2.0 inches wg with face velocity of 500 fpm on 12-inch-deep filter. Filter efficiency shall be not less than 95 percent and shall be determined in accordance with MIL-STD 282, using 0.3-micrometer particle of thermally generated DOP smoke.

2.1.3 Filters, High-Efficiency Particulate Air (HEPA)

HEPA filters shall be fire-resistant type and shall be capable of withstanding a minimum of 90-percent relative humidity determined dynamically at temperatures between 70 and 100 degrees F.

Filtering element shall conform to MS MIL-F-51079. Filter shall be individually certified to have an efficiency of not less than that indicated on the drawings. Test method and acceptable challenge aerosol shall be as indicated on the drawings. Where indicated, individual filter elements shall be scan tested in addition to efficiency testing. Clean filter static pressure drop shall not exceed 1.0 inch wg when the filter is tested at rated capacity.

Filtering element shall contain no holes, cracks, slits, or other visual imperfections. Every splice required in the assembly of a filter pack shall be joined with not less than 1-1/2 inches of fire-retardant adhesive for a continuous coating along the entire width of the element. Filter element shall be glass paper with a minimum tensile strength of 3 pounds per inch of width and shall retain 50 percent of its tensile strength when folded flat upon itself. Elongation before rupture shall be a minimum of 1 percent. Element shall be water-proofed and shall retain 50 percent of its original tensile strength after being immersed in water.

Results of test penetration, test resistance, test flow rate, together with direction of test airflow, manufacturer's name, model number, and serial number of the filter unit, shall be registered legibly and indelibly on the frame of the filter unit.

Frames shall be fabricated from minimum 1.6 millimeter aluminum complying with ASTM B 209, or 1.6 millimeter stainless steel complying with ASTM A 176, or 1.6 millimeter galvanized steel complying with ASTM A 653/A 653M and ASTM A 924/A 924M, as indicated. Plywood or particle board frames are not acceptable. Corner joints shall be positively sealed by coating with a suitable adhesive with the characteristics specified below. Frames shall be arranged to accommodate standard 610 millimeter x 610 millimeter elements unless otherwise indicated.

Inside face of frame members of materials shall be coated entirely with an adhesive before assembly with filter pack. Following assembly, a continuous bead of the same adhesive shall be formed to seal between cut edges of filter pack and edges of abutting frame member on both faces of the filter unit. Filter unit shall be square to a diagonal tolerance of 1/8 inch.

Adhesive, when cured, shall be resilient and water-resistant and shall withstand a temperature of 250 degrees F for 8 hours. If capable of ignition, the adhesive shall be self-extinguishing and shall meet general operating conditions without change in physical properties and without loss of seal. Cured adhesive shall contain no cracks, checks, alligatoring, or separation.

HEPA filters shall be in accordance with UL 586, and IEST RP-CC001.3.

Separators shall be constructed of aluminum or corrosion resistant steel that will not contribute to fire, will remain structurally intact under fire exposure, and will not be damaged by exposure to the humidity and temperature.

Gasket shall be 1/4-inch thick closed cellular construction neoprene or approved elastomer of 20 to 40 Shore A durometer hardness. Gasketing shall be attached firmly and continuously to the frame with rubber-based adhesive.

Filter unit shall be assembled to provide uniformity of materials and construction, surface smoothness and finish, cleanliness, and freedom from protrusions and obvious flaws.

Depending on the specific application of the filters, requirements different from, or additional to, those above may be specified on the drawings.

2.2 FILTER GAUGES

Air-filter gauges shall be photohelic and shall be provided for each type filter assembly.

Photohelic gauges shall be Dwyer Series 3000 or equal, suitable for 24 volt AC application. Appropriate model and range shall be used to suit the required application, but range shall not be less than 0 to 500 Pascals. Photohelic gauges shall be connected to static-pressure port(s) of approved design and located so that resistance to airflow will be correctly indicated. Gauges shall have dual scales with both English (inches w.g.) and Metric (Pascals) units.

PART 3 EXECUTION

3.1 FILTER INSTALLATION

Filter supports and retention elements shall be coordinated to provide a substantial, structurally sound, leakproof installation.

3.2 HOLDING FRAME INSTALLATION

Holding frames shall be gasketed on perimeter, or calked to each other, to supplementary steel, or to closures with elastomeric compounds recommended by the filter manufacturer. Substrate shall be prepared in accordance with the elastomer manufacturer's instructions, including the priming of surfaces in areas where the elastomer is not confined.

3.3 HEPA FILTER INSTALLATION

Further requirements for installation of HEPA filters, and for field testing, if required, shall be as indicated on the drawings.

3.4 PROTECTION DURING CONSTRUCTION

Provide construction filters for any equipment to be operated during construction in accordance with Section 15003, "General Mechanical Provisions".

3.5 TESTING AND OPERATIONAL READINESS REVIEW (ORR)

Air balancing and operational testing of the filters and associated controls shall be performed in accordance with Section 15950, "Testing, Adjusting and Balancing" prior to conducting the Operational Readiness Review.

Provide an operational Readiness Review (ORR) in accordance with Section

01770, "Task Order Closeout", for the filters. Include locations of filters, and means of replacement.

For filters furnished as part of an HVAC unit, ORR shall be part of the overall ORR for the system.

-- End of Section --

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SECTION 15900

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SECTION 15900

DDC CONTROL SYSTEMS
03/01

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 666	(2000) Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM B 280	(1999) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 62	(1993) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM D 1693	(2000) Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1	(1989) Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPVC	(2004) Boiler and Pressure Vessel Codes

AMERICAN WELDING SOCIETY (AWS)

AWS-02	(1990) Welding Handbook; Eighth Ed; Vol Two - Welding Process

FEDERAL SPECIFICATIONS (FS)

FS TT-E-489	(Rev J) Enamel, Alkyd, Gloss, Low VOC

Content

FEDERAL STANDARDS (FED-STD)

FED-STD 595	(Rev B) Colors Used in Government Procurement

INSTRUMENT SOCIETY OF AMERICA (ISA)

ISA RP7.1	(1956) Pneumatic Control Circuit Pressure Test

MILITARY SPECIFICATIONS (MS)

MS DOD-G-24508	(1987a; Am 3) Grease, High Performance, Multipurpose (Metric)
MS MIL-F-18280	(Rev E; Supple 1A) Fittings, Flareless Tube, Fluid Connection

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA DC 3	(1989) Residential Controls - Electrical Wall-Mounted Room Thermostats
NEMA MG 1	(2003) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2005) National Electrical Code
NFPA 90A	(2002) Installation of Air Conditioning and Ventilating Systems

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC SP 6	(1991) Surface Preparation Specification No. 6 - Commercial Blast Cleaning

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL(AMCA)

AMCA 500-D	(1998) Laboratory Methods of Testing Dampers for Rating

1.2 SCOPE

This section covers automatic control systems work to be performed completely under this contract. This includes pneumatic, electric or electronic controls which are to be tied into the Goddard Utility Control System (UCS).

Complete networked system of direct digital and pneumatic automatic controls.

Control devices, components, all control wiring, conduit and material.

Include a presubmittal meeting, when required, to review conformance to the contract "Standard Reference Document" (SRD) requirements including point names, descriptions, screen layout information, etc. Meeting to be held at

the site as directed by the Government representative.

The system described herein shall be a JCI (Johnson Controls Incorporated) Metasys System connected to the communications cable in the respective building Network Room and remotely report to B24.

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section, as does Section 16145, "Standard Wiring Systems".

1.4 SYSTEM DESCRIPTION

Automatic temperature control systems shall be complete in all details and shall include all necessary accessories to maintain conditions indicated or specified.

Automatic temperature control systems shall be DDC. As far as practical, control equipment shall be the product of a single automatic control systems manufacturer and tied into the site JCI system. Automatic control systems components not the product of the control system manufacturer shall be approved for use with the control system as indicated.

Automatically controlled valves to control environment shall be furnished by the automatic control systems manufacturer.

Automatically controlled dampers, independent of dampers integral with manufactured air-handling units, shall be furnished by the automatic control systems manufacturer. Damper manufacturer shall be licensed to display the AMCA seal.

Controllers and actuators for variable air volume (VAV) boxes and air-mixing valve operators shall be furnished by the automatic control systems manufacturer.

All gauges provided and described within this specification shall have both the English system and the SI (Metric) system scales.

1.5 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Control Drawings shall fully describe the control system and include at a minimum the following elements:

System Schematic (Flow Diagram) showing location of all sensing elements and all control valves and dampers, in relation to the mechanical system being controlled.

Control Diagram showing the interconnection of all control components, control wiring and tubing, actuator spring range and action, controller range and action, and tag numbering of control components, valves, dampers, wiring and tubing.

Sequence of Operation clearly describing all modes of control of

the system, including set-points.

SD-03 Product Data

Manufacturer's Data shall include preprinted catalog data, plus supplemental data as required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, and performance data, tables or curves as applicable, for the following items:

Control Components
Thermometers
Pressure Gauges
Control System Valves
Power Operated Dampers
Control System Valve and Damper Operators

SD-05 Design Data

Equipment Schedules shall be submitted for the following items. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the project:

Control System Valves
Power Operated Dampers
Control System Valve and Damper Operators

SD-06 Test Reports

Field Test Reports for all inspections and tests specified in Part 3, "Execution" of this Section. Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the contractor, by an authorized official of the testing laboratory or agency (if applicable), and by the Government representative who witnessed the test.

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions, for the following items:

Control Components
Control System Valves
Power Operated Dampers
Control System Valve and Damper Operators

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, including approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists, shall be submitted for the

following items:

Control Components
Control System Valves
Power Operated Dampers
Control System Valve and Damper Operators

In addition the manuals shall include as-built control drawings, with all final adjustments indicated.

SD-11 As-Builts

Shall include the following items:

Updated (as installed) drawings in hard copy.
Electronic format shall also be submitted in AutoCAD for diagrams.

1.6 STORAGE AND HANDLING

Openings shall be sealed after manufacturing and inspection, until ready for installation.

Instruments and equipment shall be carefully handled, shall not be subjected to shock, and shall be protected from weather, dust, construction materials, and damage.

1.7 QUALIFIED PERSONNEL

The services of a qualified manufacturer's Service Engineer or representative shall be provided, for all equipment. The duties shall include the following:

Instruct the personnel installing equipment in proper assembly and installation.

Inspect, adjust, and test equipment after installation for proper electrical and mechanical operation.

Represent the manufacturer and assist in placing equipment into initial service.

Personnel shall be provided who are qualified in servicing and placing in operation the specific manufacturer's type and class of equipment furnished. Personnel assigned shall be satisfactory to the Contracting Officer, or the personnel shall be replaced with persons who are satisfactory, without additional charge or change of schedule.

If indicated, instruct the Government's personnel in the proper operation and maintenance of all equipment furnished, in accordance with paragraph entitled "Operator Training".

1.8 WARRANTY AND CONTRACT CLOSEOUT

Warranty: Refer to BIDDING AND CONTRACT REQUIREMENTS and to DIVISION 1 - GENERAL REQUIREMENTS.

Contract Closeout:

1. Comply with requirements of Section 01770, Contract Closeout.

2. Include information for all products specified in this section, in operations and maintenance manuals.
3. Provide following as specified in this section:
   a. As-built record installation drawings to owner.
   b. Approval of authority having jurisdiction of plastic tubing installed in air plenums.
   c. Approval of authority having jurisdiction of wiring installed in air plenums.
   d. Demonstrate operation of systems to owner.
   e. Training and instruction of owner's personnel.
   f. Statement certifying proper installation and functioning of control systems.
   g. Paid in full services contract with cost for second year.
   h. ASME certification for compressed air receiver(s).
   i. Portable operator's terminal, only when expressly required.

1.9 QUALITY ASSURANCE

Control Contractor shall have an established local branch office staffed with factory trained engineers, technicians and service mechanics within 50 miles of project site.

Installation shall be performed by mechanics regularly employed by the Control Contractor, and referred to as "Control Manufacturer".

1.10 JOB CONDITIONS

Automatic temperature control valves and thermowells furnished by Control Contractor shall be installed by the respective Division 15 Mechanical Contractor under the supervision of Control Contractor.

Certain air handling unit automatic dampers (face and bypass, smoke, return air and outside air), as indicated on drawing schedules, will be provided by unit manufacturer. All other automatic dampers shall be furnished by Control Contractor, and shall be installed by the respective Division 15 Mechanical Contractor under supervision of Control Contractor.

Power wiring to air dryers will be provided under Division 16, Electrical.

Combination fire/smoke and smoke dampers with electric motors, for installation in ducts, will be provided by the Section 15815 Contractor. Control Contractor shall wire electric motors.

Smoke detectors in ducts and at air handling units shall be wired into the Fire Alarm System by Division 16. Required power for those smoke detectors shall also be by Division 16. Provide wiring from zone control modules to respective air handling unit(s) and fan(s) for shutdown in the event of smoke conditions. Contractor for Division 15 will install detectors in ductwork where shown or where required.

Furnish for Section 15950 Contractor: approved temperature control technical data and shop drawings, information relating to changes or revisions in work, and all other information required for proper balancing and adjusting of systems.

Furnish air flow measuring stations and static pressure probes to Section 15815 Contractor for installation.

Through-penetration fire-stop systems at penetrations through floors or

fire or smoke rated walls and partitions will be provided by the contractor for Section 07840.

DDC/ATC panels are located on contract drawings. In the event additional panels are necessary or if the intended locations are required to change due to any condition, the new locations must be approved by the owner and coordinated with all trades prior to installation. If approval and/or coordination is not done, then the panels shall be relocated without cost to the owner.

Provide all power required for electric/electronic control motors.

Provide air volume (constant or variable) box controls. Ship operators, controllers, etc. to air volume box manufacturer for factory installation. Furnish control valve for field installation and provide all additional control wiring and tubing as required for a complete installation.

All deviations from specifications shall be documented separately. Obtain approval for deviations prior to fabrication or installation. Include all costs, including delays to other trades, to remedy deviations in fabrication, installation or other issues. All issues shall be reviewed.

Interlocks of fans or pumps shall be through hard wiring. Software interlocks shall not be acceptable.

Valves and dampers for air handling units shall have pneumatic operators, while valves and operators at air volume boxes shall be electric/electronic.

PART 2 PRODUCTS

2.1 SYSTEM REQUIREMENTS

Provide a direct digital control (DDC) system consisting of sensors, controllers, thermostats, control valves, dampers, operators, panels, indicating devices, interface equipment, and other apparatus required to operate mechanical equipment and to perform functions specified.

Provide materials and field work necessary to connect control components factory supplied as part of equipment controlled, unless specified otherwise. Generally, self-contained valves, filter gauges, liquid level controllers and similar instruments, are not to be installed under this section.

Provide a motor for each damper to be controlled, unless one is specified elsewhere.

Unless specified otherwise, provide fully modulating components.

Unless specified otherwise, provide proportional/integral/inverse derivative components for variable air volume controls, proportional/integral components for air handling unit discharge control, and fully proportional/integral components elsewhere.

Motors which respond to incremental "pulse" signals or do not fail to be specified position, shall not be acceptable.

System shall be completely installed, piped and wired unless otherwise specifically indicated. Provide all wiring in suitable metal conduit (EMT with compression fittings indoors, rigid conduit and fittings outdoors).

Provide all pneumatic control tubing, electrical wiring relays or other additional devices for interlocking of equipment as described in Sequence of Operation and/or as shown on drawings.

Provide a JCI Direct Digital Control (DDC) System complete with:

1. Work Stations (WS), only when expressly required
2. Printers, only when expressly required
3. LCD system flat panel monitor display, only when expressly required
4. Remote terminals
5. Auto-dial modem
6. DDC Panels (DDCP)
7. Input/Output (I/O) functions
8. Field hardware panels
9. Portable operators' terminal, only when expressly required
10. Miscellaneous field hardware such as sensors, valves, dampers, operators, dryers, etc., as required for a complete and operable system.

DDC system sensor ranges and accuracies (from measured point to display, end-to-end) shall be as follows:

1. Temperatures
   a. Space 30 degrees F to 130 degrees F plus or minus 1.0 degrees F.
   b. Duct 40 degrees F to 140 degrees F plus or minus 1.0 degrees F.
   c. Outside Air minus 40 degrees F to 130 degrees F plus or minus 1.0 degrees F.
   d. Water 30 degrees F to 250 degrees F plus or minus 1.0 degrees F.
2. Relative Humidity 5% to 95% plus or minus 3.0%.
3. Pressure Range plus or minus 1.0% of span.
4. Flow Range plus or minus 2.0% of span.
5. Ranges for pressure and flow sensors shall be selected so that expected readout is in upper 50% of the span.

DDC system end-to-end accuracies shall be maintained for at least one year from date of system acceptance.

DDC system shall display analog values or status conditions. In any event, the information displayed shall be no older than 10 seconds.

DDC system, from CPU to DDCPs and FHPs, shall be capable of operating in environmental conditions of 30 degrees F. to 120 degrees F. dry bulb and 10% RH to 95% RH noncondensing. Other equipment, such as sensors and final control elements shall operate in environment in which they are installed. It shall be the Contractor's responsibility to locate all system components in an environment which they are designed to function. Contractor shall bear all costs associated with relocation of any equipment not in the proper environment.

2.2 PRODUCTS AND SERVICES

2.2.1 Air Piping

Piping, hard or soft drawn copper, or polyethylene tubes in electrical EMT conduit. Bundled flame-retardant polyethylene plastic tubing in PVC jacket or single polyethylene tubes in aluminum tray may be used. Do not use plastic tubing or jacket in air plenums without specific written approval of authority having jurisdiction. Submit copy of such approval to Government representative. Plastic tubing shall be self-extinguishing when tested in accordance with ASTM D 635, shall have UL 94 V-2 flammability

classification, and withstand stress cracking when tested in accordance with ASTM Specification D 1693.

Use copper lines in mechanical rooms, where subjected to damage or temperatures in excess of 200 degrees F. where adjacent to heating pipes passing through common sleeve and where not readily accessible, such as masonry or plastered walls. In mechanical room, if allowed by applicable codes, bundled plastic tubing with suitable junction boxes or single plastic tubing with tray may be used.

Use exposed copper tubing in unfinished storage rooms.

Following control air piping shall be copper:

a. Piping run vertically for more than one floor.
b. Piping 3/8 inch or larger in diameter.
c. Piping used for air service 25 psi or greater.
d. Piping run outside/outdoors.

Exposed copper tubing shall be hard drawn Type L, whereas concealed tubing may be soft annealed Type K.

Any air line subjected to outside air temperatures shall be electrically heat traced and insulated as well as protected against physical damage. Provide an outside air controller which shall energize electric heat tracing on a fall in temperature below its setpoint or provide regenerative type air dryer to bring dewpoint down to 80 degrees F. at 20 psi for air lines which pass through unheated spaces.

2.2.2 Air Receiver and Accessories

Provide a receiver constructed in accordance with ASME Code for Unfired Pressure Vessels for a working pressure of not less than 200 pounds per square inch. Furnish ASME certification with each tank.

Accessories shall include; dryer, filters; automatic drain traps, flexible connectors and all required piping. Dryer shall be a refrigerated, air cooled type and be located after storage tank and before pressure reducing valves. Size dryer for 100% of the capacity of consumption and be complete with bucket trap, sediment trap. Dryer shall be furnished with a form A contact which shall include an alarm condition. Dryer shall bring dewpoint down to 14 degrees F. at 20 psig pressure with 80 psig inlet pressure and 80 degrees F. ambient temperature. Particle filters shall filter down to .3 microns.

2.2.3 Thermostats and Temperature Sensors

2.2.3.1 Thermostats

Shall have a Fahrenheit scale. Provide covers with concealed thermometers in all areas. Provide concealed setpoint adjustment in all areas.

Color and finish of cover selected by architect.

2.2.3.2 Duct Temperature Sensors

Rigid element type shall be used in ducts which are less than 4 feet wide and 4 feet high.

Averaging elements shall be a minimum of 8 feet in length. Averaging

elements shall be installed in ducts that are equal to or are over 4 feet wide or 4 feet high. Averaging elements shall be installed in mixing plenums or in fan discharges which have less than two duct diameters (longest side).

2.2.3.3 Liquid Temperature Sensors

Shall be rigid element type with separable socket wells and thermal transmission material.

2.2.4 Humidistats and Humidity Sensors

2.2.4.1 General

Sensing device shall be humidicap type material.

Shall be similar in appearance to room mounted thermostats.

2.2.4.2 Space Humidity Sensors

Shall be programmable from the work station.

Cover color and finish as selected by architect.

2.2.4.3 Duct Mounted Humidity Sensors

Provide duct mounted humidity sensors with specifically designed mounting box which will protect device from physical damage as well as being designed as a sampling chamber.

2.2.5 Low Temperature Limit Thermostats

Shall be electric and manually reset devices.

Shall have a 20 foot minimum sensing element and respond to coldest incremental segment. Devices shall be installed to provide full coil coverage.

Shall have two sets of contacts.

2.2.6 Valves

2.2.6.1 General

Provide standard packing selected for continuous operation for 250 degrees F. or at least 50 degrees F. above design temperature of controlled fluid.

Valve trim shall be brass (for low temperature water, below 210 degrees F., only) or bronze (for low temperature water (below 210 degrees F.) and low pressure steam service (below 30 psig)).

Valves which are 2 inches and smaller shall have threaded or flanged end connections. Valves which are 2-1/2 inches and larger shall be provided with flanged ends. Flanges shall suit characteristics of pipe in which installed.

Valves that are not field repairable for packing, etc. are not acceptable.

Two-position valves shall be line size.

Valve assemblies shall be rated for at least 125 psi working pressure or at least 150% of the system operating pressure, whichever is greater, and not less than 250 psig for high pressure systems and in no case shall valve rating be less than system design rating.

Valves which operate in sequence with other valves or devices shall be provided with pilot positioning devices that have adjustable start settings and adjustable operating ranges to provide maximum positioning power at all times.

Where valves are sequenced with other devices, provide operators which will shut off prior to operation of other sequenced device.

Valves which are sized 6 inches or larger shall be butterfly valves.

Butterfly valves shall be 150 pound threaded lug type with bubble tight shut off, suitable for dead end service with carbon steel bodies, noncorrosive disc, stainless steel shaft with bearings at top and bottom of shaft, EPDM seat suitable for minus 40 degrees F. to 250 degrees F. for water application or RTFE seat suitable for minus 40 degrees F to 450 degrees F for low pressure steam service (below 30 psig). Provide extension necks for extending shaft through insulation.

Provide modulating plugs, butterfly valves or V-ports, and pneumatic spring return operators as required. Size operators to operate and close off against pump shutoff head. Valves and operators shall be normally open or closed as required by sequences of operation. Generally, heating valves shall fail safe open and cooling valves fail safe closed unless otherwise specified or shown on drawings. Additionally, reheat valves shall fail as scheduled.

2.2.6.2 Water Valves

Size water control valves for 3 psi or equal to equipment controlled pressure drop, except for 2-way system differential valves which shall be sized for pressure drop equal to 50% of pump head.

Water valves shall be equal percentage.

2.2.6.3 Steam Valves

Valves handling 30 psig steam and above or used for superheat steam control shall have stainless steel trim, seats, disc and stainless seat ring, and be provided with stem extensions and heat dissipation fins. Reduced pressure steam served from systems where steam is generated at 30 psig or greater shall be considered as superheated.

For equipment requiring a steam flow rate of 1000#/hour or more or control valves installed in steam lines larger than 2 inches, provide two valves in parallel with 1/3 to 2/3 capacities sequenced so that smaller valve opens first.

Size steam valves for maximum pressure drop of 50% of the system pressure, pressure drop which will allow required inlet pressure to the device for which the service is required. In any valve sizing, pressure drop shall not exceed critical pressure drop.

2.2.7 Dampers

Control Dampers: Dampers shall be opposed blade, modulating or two position as required by the sequences of operation, except that dampers for mixing applications shall be parallel blade, with blades installed toward each other such that maximum mixing occurs. Test dampers in accordance with AMCA Standard 500. Pressure drop across damper shall not exceed 0.04 inch of water gauge differential pressure at 1,000 feet/minute velocity and 0.1 inch water gauge or less differential pressure at 1,500 feet/minute velocity. Provide operators such that dampers are able to close off against maximum operating pressure. Dampers shall be extruded aluminum equivalent to 16 gauge steel or 16 gauge galvanized steel. Maximum blade width shall be 6 inches with a maximum length of 48 inches. Bearings shall be oil impregnated sintered bronze bushings. Dampers shall withstand temperatures from minus 20 degrees F. to 200 degrees F. Damper blades shall be guaranteed not to leak more than 10 cfm per square foot with 2 inch differential static pressure. Locations shall be coordinated such that the manufacturer's maximum velocity rating shall not be exceeded.

Where two or more damper operators are operating in sequence or together, provide operators with pilot positioning devices that have adjustable start settings and adjustable operating ranges to provide maximum positioning power at all times.

Unless otherwise specified for smoke control, when a duct smoke detector senses an alarm, supply, return and associated exhaust fans shall stop, and outside air, relief, dampers shall close.

For large or multiple section dampers, provide jack shafts as required for operation.

Smoke dampers furnished by this contractor shall conform to requirements in Section 15815.

2.2.8 Control Panels

Provide local panels of utilized cabinet type for each system under automatic control. Fabricate panels from 12 gauge furniture steel or of aluminum with baked enamel finish, with hinged key lock door and UL listing as a NEMA 1 enclosure. All locks shall be keyed alike. Mount relays, clocks, switches and controllers with or without control point adjustment in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face.

One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic name plates for instruments and controls inside cabinet and on cabinet face. Nameplates shall be white faced with black center core.

Provide control air pressure indicating gauges at least 2 inches in diameter on the face of the control panel for each controlled device to enable a complete visual inspection of the control system.

Provide air gauges for nonpanel mounted devices which are controlling equipment with the mechanical room.

2.2.9 Air Flow Measuring Station and Static Pressure Probe for Variable Air Volume System

Furnish unit containing parallel air straightener, total and static pressure sensing manifolds, internal piping and external pressure transmission ports with flexible tubing and quick-connect fittings. Fabricate of galvanized steel with flanges, size for duct in which mounted. Maximum pressure loss through stations of .08 inches water gauge at 1500 fpm. Sound level within the duct shall not be amplified nor shall additional sound be generated by air measuring station. Station shall have accuracy of 2% and contain minimum of one total pressure sensor per 36 square inches of station area. Identify by model number, size, area and specified air flow capacity.

Furnish fan inlet airflow traverse probes (bell mouth)

a. For fan inlets 20 inches or less, provide copper tubing and larger fan inlets shall be 316 stainless steel.
b. Assembly shall provide accuracy of 3% of actual flow without significantly impacting fan performance or contributing to fan generated noise.
c. There shall be no protruding sensors to be bent, broken or otherwise damaged during installation or with continuous fan operation.
d. The traverse probes shall not require the application of any calibration factors.

Furnish duct static pressure probe and place for static pressure sensing 2/3 of way downstream in system ductwork. Construct with multiple static pressure sensors located along exterior surface of cylindrical probe, of extruded aluminum and (except for 3/4 inch dia. probes with lengths of 24 inches or less) complete with threaded end support rod, sealing washer and nut, and mounting plate with gasket and static pressure signal fitting. Produce steady, nonpulsating signal of standard static pressure, without need for correction factors, with instrument accuracy of 0.5%.

2.2.10 Differential Pressure Transmitters

Low Range Differential Pressure Transmitter shall be an AutoTran (or approved equal) zero maintenance pressure transducer with the following performance characteristics:

a. Pressure Range: 0.1 inch W.G. to 0.5 inch W.G.
b. Accuracy: Plus or minus 1% at less than 1 inch W.G.
c. Stability: Auto zero plus or minus 0.5% FSO over life of device
d. Operating Temp: 32 to 149 degrees F.
e. Operating Humidity: 90% RH
f. Outputs: 4-20 mA

2.2.11 Central Processing Unit (CPU)

Shall be a standard digital computer personal computer (PC) and shall be the main interface with system. Word size shall be 32 bits with a memory cycle time of 1 microsecond.

Shall have a crystal oscillator driven time clock (TC). Clock shall continuously update visual display , and be battery backed up and be accurate within 1 second per day. Backup shall be such that the TC is uninterruptible during switchover for a period of not less than 72 hours.

Shall shut down memory and peripheral hardware upon loss of power. When power is restored, TC shall automatically correct the time of day.

Shall have four ports for plugging in printers, LCD flat panel display or other peripherals using EIA RS-232-C interfaces. Shall also have LAN interface connector.

Shall alarm any Intelligent Direct Digital Control Panel (DDCP) which does not report or which has failed.

CPU Resident Programs/Functions

Alarm Messages

1. Priorities: Alarms shall be assignable to a minimum of 6 priority levels.

2. Reporting

a) Alarm messages shall be English language alphanumeric text. Alarm messages shall include specific location, instruction, etc. It shall be possible for the operator to construct or completely edit alarm messages.

b) Software shall allow operator to assign alarms to any selected local or remote system printer, monitor or pager.

c) Alarm assignments may be grouped by priority class, type or other classification for transmission to system monitors or printers.

3. Message Management: Alarm message software shall include the following capabilities for message management:

a) Allowable alarm message length shall be minimum 200 characters.

b) Automatically send alarms to designated peripherals including dial-out modems during or after operating hours.

c) Display alarms on graphic screens with changing background colors.

d) Assign time delay parameters to certain alarms to avoid nuisance alarming during startup/shutdown or nonoperating periods.

e) Attach a point memo to the alarm record for reference by other operators.

f) Define alarm parameters through on-screen or field panel editor function.

g) Automatic archiving of alarm activity to hard disk.

Color Graphics

1. Provide system color graphics as indicated in Input/Output Summary Sheets or where specified or shown. Each graphic shall contain current stats or analog value of each system component. Values shall be dynamically updated at a maximum interval of 20 seconds.

2. Graphics shall follow the current "Standard Reference Document" (SRD) requirements, including point names, descriptions, screen layout information, etc.

3. Graphics shall contain title and any other necessary identification information.

4. Provide graphic penetration through links on each graphic. Graphics shall be arranged in hierarchical order within each building, floor, area and/or system.

5. Provide graphics which include each mechanical systems and building floor plans.

6. Complete graphics software package shall be provided. Package shall permit operator to create, delete, add text and edit all graphics, and to create custom graphic symbols. Provide capability to store and retrieve graphic symbols from a directory. Color palette shall include 256 predefined colors and shall allow mixing of undefined colors.

Reports: As a minimum, the following reports shall be provided:

1. Alarm Summary: Which shall include all current alarms with time of alarm and time of acknowledgement.

2. Alarm Disable Summary: Which shall contain the points which have been disabled from alarming.

3. Analog and Limit Summary: Listing of all current analog values with their high and low limit alarm values and shall include unit of measurement.

4. Maintenance and Run Time Reports: These reports shall be for filters, pumps, fans or other programmed equipment which need either periodic maintenance or replacement.

5. Trend: Operator shall be capable of trending at least 8 measured variables, in columnar fashion, at an adjustable frequency from 1 minute to 120 minutes.

6. Holiday Programming: Operator shall be able to program at least 50 exception schedules.

7. Historical Data and Reports: Shall be stored on disk. Information such as alarms, trouble, no-response, return to normal and shall be displayed or printed as selected by the operator. Operator shall select by point address, point type, or activity type.

2.2.12 Printer

Printer shall be desk type with a minimum of 96 character standard American Standard Code for Information Interchange (ASCII) character type. Unit shall have adjustable sprockets to accept paper up to 80 columns per line with a minimum print speed of 120 characters per second. Printer shall be 9-1/2 inch single or multiple copy fan fold paper. Printer shall be used to provide hard copy records of alarms, reports, message texts, in addition to being the operator interface with system hardware.

2.2.13 Monitor/Flat Panel Type (LCD)

Display shall be normal 17 inch flat screen, 16.0 inch viewable image size, minimum 256 color palette, Super fine 25 pitch, 30-70 kHz Horizontal Scan range, 50-120 Hz Vertical scan range, 1280 x 1024 maximum resolution at 60 Hz. Preset resolutions 640 x 480 at 60 Hz video graphics array (VGA Graphics), 1280 x 1024 at 60 Hz Video Electronics Standards Association (VESA).

Monitor shall operate in an ambient temperature from 50 degrees F. to 100 degrees F. and ambient relative humidity of from 10% to 95% RH.

2.2.14 Dial-Up Modem

Shall transmit/receive English language messages over standard voice grade telephone lines, and be activated by manual command, or automatically by an event or time schedule.

Shall have an alternate number to a second location if first number dialed is busy.

Shall be freestanding device and need no mounting hardware.

2.2.15 Direct Digital Control Panels (DDCP)

Shall be real-time multitasking by 16 bit microcomputer, and shall operate from a 120 V AC source. In event panel requires a different voltage, provide required transformers for proper operation. DDCP shall contain all of memory, RAM, ROM, EPROM, E2PROM required to support resident operating system, control algorithms, energy management programs, also inputs and outputs. Memory shall support stand-alone operation during communication loss with CPU.

Shall have battery backup for all volatile storage. Battery backup shall be automatically charged to exceed minimum operating point. Whenever operating point (or lower) is reached, CPU shall be alarmed. Select batteries to provide standby memory protection for at least 8 hours.

Shall contain all input and output (I/O) cards which are required to provide I/O functions. Provide at least two spare points of each I/O type at each DDCP location.

Upon loss of power, DDCP shall go through an orderly shutdown and operate connected equipment to indicated failure mode. Input alarms shall be retained in memory for uploading after power restoration. Upon restoration of power, DDCP shall sequentially restart appropriate equipment. All alarms which occurred during power failure shall be transmitted to CPU, and the system shall return to its normal operating mode without operator intervention. Additionally, after power restoration, any changes or updates shall be downloaded automatically.

Shall have time delays for each addressable point such that status or value changes will not cause false alarms.

Shall be stand-alone such that loss of communication with CPU, for any reason, shall not cause DDCP failure. Also, shall continue scanning connected points, continue to maintain and hold in memory change of state information, and execute control functions for system operation.

"Abnormal on" and "abnormal off" shall be software comparisons between commanded signals and input signals.

High and low limit alarms shall slide with setpoint changes or be required to be re-entered as selected by operator.

Each DDCP shall have a keypad which uses operator access for changing setpoints, interrogating information, or reconfiguring programming. In event a keypad is not available, provide 1 portable operators terminal for providing same functions. Whenever changes at DDCP are made, changes shall be uploaded to CPU.

Loss of power at any DDCP shall not affect the operation of any other DDCP.

Each input and output circuit shall be completely isolated from voltage, noise, or any other type of interference from entering internal logic circuits. Logic circuits shall also be protected or shielded against radio frequency interference (RFI) or other such disruptive signals.

Shall have at least 1 output port for connection of modems, LCD flat panel displays, PC's or printers.

Maximum response time for reporting alarms shall be 5 seconds.

Shall have common key locks which shall prevent unauthorized access.

Shall have a minimum of 16 input/output points.

Input/Output Functions

a. DDCP shall directly accept analog inputs for:

1. Voltages (0-12 VDC)

2. Currents (4-20 ma)

3. Impedance (RTD type)

b. DDCP shall directly generate analog outputs such as:

1. Voltage (0-12 VDC)

2. Current (4-20 ma)

c. DDCP shall directly accept digital inputs such as contact closures or openings for monitoring or event initiating programs or pulsing contacts for electric metering or demand control.

d. DDCP shall directly generate digital outputs such as 0 volts DC or 12 volts DC which shall operate interposing relays in field hardware panels to provide operation of systems or devices, as required, by I/O summary sheets or as required by the sequences of operation. Relays shall not be added where contacts are rated for the application.

e. Analog output signals shall be protected from short circuiting whereas digital inputs and outputs shall be protected against line surges of 180 V AC peak.

Status inputs shall be from split core current sensors.

DDCP Resident Programs

Security: DDCP shall have an access code in order to be able to enter into the system. There shall be discrete levels for interrogation, modification of setpoints, modification of algorithms.

Upline: DDCP shall transmit data files whenever requested by CPU. It also shall update CPU whenever modifications in programs or changes are made at DDCP.

Time or Event Initiated Programming: Each DDCP shall have individual time or event initiated programming for each system or piece of equipment connected to it. Applicable programs shall include, but not be limited to scheduled time of day, optimized start/stop, warmup/cooldown, normal operation, night setback.

Holiday Programming: DDCP shall have ability to accept at least 50 exception schedules.

Historical Data: Each DDCP shall retain run time and other programmed data for upline transmission when asked for by the CPU.

2.2.16 Field Hardware Panels (FHP)

Provide whenever interfaces between field equipment and DDCP are necessary. Devices such as transducers (current to pressure, pressure to current), relays, contactors, and other devices shall be labeled for quick identification.

Shall be powered from same source as DDCP's.

Provide a gauge to indicate input or output pressure for each sensor or operator.

One cabinet may accommodate more than one system in same equipment room; provide engraved plastic nameplates for instruments and controls inside cabinets and on face.

2.2.17 Portable Operator's Terminal or Keypad

Shall connect to a DDCP without disconnecting data transmission medium; have at least 4 levels of coded or password access; have ability to do menu penetration display or change analog values or setpoints be able to display points or alarm logs; and be able to perform diagnostics.

The portable PC shall have the minimum functional standards: Windows 2000 based laptop PC

a. 32 MB RAM

b. 2.5 GB hard drive

c. 233 mHz Pentium processor

d. VGA color display

e. 33.6 KB internal modem

f. Read/write CD ROM

g. LAN interface connector

h. All cables, connectors, ports needed to communicate to all devices with communications.

2.2.18 CPU and DDCP Communications

Shall downline load, to each DDCP, information which is to be in DDCP RAM storage. This communication shall occur on initial system startup and each time a DDCP has restoration of power. Communication shall include operating parameters, DDCP resident software, any changes to software, as a minimum.

Shall upline load information as requested by CPU in addition to any changes made at DDCP location.

2.2.19 Current Switches

The current sensor shall be induce powered from the monitored load.

The current sensor shall provide on/off status indication of electrical loads from 1.5 to 200 amperes (adjustable).

The current sensor shall have a fixed operating range from 1.5 to 200 amperes.

The current sensor shall be capable of providing accurate status at temperatures from minus 59 degrees to 140 degrees F.

The current sensor shall be isolated to 600 VAC rms.

The current sensor output shall be N.O. solid-state 1.0 ampere at 30 VAC/DC.

The current sensor shall be a self-gripping split-core type.

PART 3 EXECUTION

3.1 CHECKOUT AND ADJUSTMENTS

After completion of installation: calibrate all sensors; adjust and regulate all thermostats, control valves, motors and other equipment, and place in complete operating condition subject to approval of Government representative. Set control motors to operate valves, dampers and other devices to limits required or established by HVAC and Balancing Contractor.

Balancing:

1. Control Contractor shall set up and calibrate the mass flow control devices to the design contract values.

2. Control Contractor shall index the system configuration as requested by the Balancing Contractor.

3. Control Contractor shall adjust air damper box controls (and reheat coil controls where applicable) so that final setup does not deviate more than plus or minus 5% from the design value.

4. Control Contractor shall modify the corrections factor to cause the controlled value to be consistent with the field measured values.

Demonstrate operation of system to satisfaction of Contractor for Section 15950 and in accordance with agenda specified in Part 1 of this section under submittals. Deliver letter so stating from Contractor of Section 15950 to Owner.

Upon completion of all work and tests, including demonstration to Contractor for Section 15950, and at a time agreed on by Owner, in conjunction with other contractors, operate systems for sufficient length of time to demonstrate to Owner, mode of operation and definitely determine whether the systems as a whole are in first-class working condition. This demonstration period shall run for not less than 2 days of 8 hours each. Correct immediately any defects that may develop during this period and place the systems in first-class working condition. Before systems are finally turned over to Owner, schedule a final demonstration test of 24 continuous hours, during which systems shall operate without adjustment.

3.2 OPERATING INSTRUCTIONS AND MANUALS

Instruct Owner's personnel in the operation, adjustment and routine maintenance of all systems and equipment in accordance with requirements of Section 01770, Contract Closeout, of Specifications. Provide training and instruction as indicated in the construction task contract documents.

Before this installation is accepted, deliver to Government representative a statement certifying that control system and equipment have been inspected and found to be properly installed and functioning satisfactorily.

Provide operation and maintenance manual in accordance with requirements of Section 01770 of specifications.

3.3 INSTALLATION

3.3.1 Air Piping

Locate clear of all surfaces which are in excess of 125 degrees F.

Do not install in ducts or outside air intakes.

Install such that sagging shall not occur.

Install concealed in finished areas in a neat manner and properly supported to prevent physical damage.

Where copper tubing is used, make final connections to control equipment with polyethylene tubing originating within 1 foot of control device.

Provide electrolysis control as specified in 15050.

Install pressure gauges on branch lines, at each device controlled.

Shall not be installed concealed under insulation unless done for freeze protection purposes.

Air piping shall be supported as specified in Section 15050 and shall not be supported from ductwork or piping.

Risers shall not go through ductwork or the annular space within ductwork or piping sleeves.

Unless noted otherwise, tubing installation for active air transmission shall be as follows:

a. Use 1/4 inch tubing (OD) up to 25 feet.

b. Use 3/8 inch tubing (OD) from 25 feet to 75 feet.

c. Use 1/2 inch tubing (OD) over 75 feet.

Provide main air to domestic water heaters.

3.3.2 Air Compressors and Accessories

Provide an automatic drain trap for each tank. Pipe to nearest floor drain.

Pipe the dryer drain, bucket trap and sediment trap to nearest floor drain.

Provide a flexible connector from compressor to prevent transmission of vibration to air piping.

Install 3-valve bypass at air dryer for service or maintenance.

3.3.3 Thermostats and Temperature Sensors

Install thermostats and space temperature sensors 48 inches above finished floor, or as directed by Architect or Government representative.

Provide insulation blocks for thermostats and space temperature sensors which are mounted on exterior walls.

Serpentine averaging type duct temperature sensors across the area of duct in order to sense true average temperature.

Secure duct sensors to ductwork in a vibration free area.

Provide rigid supports or secure averaging elements in such a manner as to prevent vibration from causing sensing element fatigue.

In general, provide outside air temperature and humidity data imputs from the two GSFC weather stations. For unusual cases where dedicated outside air temperature and humidity sensors are required, provide sun shields and weather protection.

Furnish wells for sensors to be installed in pipe. Also furnish extension necks where installed in insulated pipes. Material for wells shall be compatible with material of piping where installed.

DDC sensors shall have settable setpoints, raise/lower, increase/decrease, terminology will not be acceptable.

3.3.4 Humidistat and Humidity Sensors

Install space humidistats and space humidity sensors 48 inches above finishes floor, or as directed by Architect or Government representative.

DDC sensors shall have settable setpoints, raise/lower, increase/decrease, terminology will not be acceptable.

3.3.5 Low Temperature Limit Thermostats

Install sensing element serpentined across coil to provide full coil sensing.

Initial setting 35 degrees F. adjustable.

Wire to stop fan and alarm DDC system.

Provide a low temperature limit thermostat for every 20 square feet of coil area.

Install on entering side of the cooling coil, except in event cooling coil has continuous flow when outside air temperature is 35 degrees F. and below, install on the leaving side of cooling coil.

3.3.6 Valves

Instruct Contractor for Section 15003, General Mechanical, for proper installation of valves furnished by the controls contractor.

Tag each valve with a brass or aluminum tag with corresponding number on control drawings. Tag shall identify valve number and be attached to valve with a nonferrous metal chain.

3.3.7 Dampers

Instruct Contractor for Section 15815, Air Distribution, for proper installation of dampers furnished by the controls contractor.

Verify damper size and locations with Contractor for Section 15815, Air Distribution, prior to any fabrication. Locations of dampers shall be reviewed to insure that maximum velocity rating is not exceeded.

Furnish baffles to Contractor for Section 15815 as required.

3.3.8 Control Panels

Mount panels adjacent to associated equipment on vibration free walls or freestanding steel supports.

3.3.9 Air Flow Measuring Station Static Probe for Variable Air Volume System

Instruct Contractor for Section 15800, Air Distribution for Proper Installation of Air Flow Measuring Stations and Static Probes.

3.3.10 Differential Pressure Transmitters

Shall use 1/4 inch tubing.

3.3.11 Central Processing Unit

Install per manufacturer recommendations.

Install resident programs/functions at or prior to startup.

3.3.12 Printers

Install per manufacturer recommendations.

3.3.13 Monitor

Install so as to eliminate screen glare.

3.3.14 Dial-Up Modem

Check phone lines prior to installation.

3.3.15 Direct Digital Control Panels

Mount panels adjacent to associated equipment on vibration free walls or freestanding supports.

Input/output functions shall reside in DDCP.

Install alarm message texts after review with Owner.

Install programs at or prior to startup.

Panels mounted at least 1 inch from wall.

3.3.16 Field Hardware Panels

Mount panels adjacent to associated equipment on vibration free walls or freestanding supports.

Panels mounted at least 1 inch from wall.

3.3.17 Portable Operator's Terminal or Keypad

Furnish to Owner, only when a Portable Operator's Terminal or Keypad is required in the task contract documents.

3.3.18 CPU and DDCP Communications

Shall be installed per manufacturers' recommendations.

3.3.19 Current Switches

Shall be installed such that the core is securely in place.

Shall be adjusted such that the calibrated trip point will detect drive belts slipping, breaking or pump coupling shear.

3.4 TESTING, CALIBRATION, AND ACCEPTANCE

After the inspection has been completed, systems shall be checked for continuity. Pneumatic systems shall be tested in accordance with ISA RP7.1. System pressure shall not exceed 30 psig.

After completion of control and instrument piping, control equipment shall be tested and adjusted in terms of design, function, systems balance, and performance, and shall otherwise be made ready for air handling systems acceptance tests. Equipment to check the calibration of instruments shall be provided by the Contractor. Instruments not in calibration shall be

recalibrated or replaced.

Operational testing of the controls shall be performed to verify proper operation, adjustment and calibration of all controls. Testing shall be conducted and documented by means of a checklist derived from the control diagrams and sequence of operation, verifying proper installation and calibration for each control device, and proper operation of each step or mode of the sequence of operation. For each system the completed checklist, indicating all final set points and adjustments, and signed by the government witness for the testing, shall be submitted as the Operational Test report prior to the operational readiness review.

After air handling system acceptance and after the systems have operated in normal service for 2 weeks, the adjustment on instruments and devices shall be checked. Items found to be out of order shall be corrected. When air handling systems are in specified operating condition and when all other pertinent specifications requirements have been met, automatic temperature-control systems will be accepted.

3.5 OPERATIONAL READINESS REVIEW (ORR)

Provide an operational Readiness Review (ORR) for the controls in accordance with Section 01770, "Contract Closeout", in conjunction with the ORR for the controlled equipment as specified in the applicable equipment specification sections. The ORR shall include an overview of the Operation and Maintenance Manual including as-built control diagrams and sequences of operation, the location and operation all control devices, and a complete demonstration of all control sequences.

3.6 SERVICE/MAINTENANCE

Provide for complete service of control system, including all labor and material for general maintenance and emergency service for one year after acceptance of system. Immediately following system acceptance, furnish to Owner a "paid in full" warranty year service agreement which shall also include pricing associated with second year service which may be accepted by Owner at any time previous to end of warranty year agreement.

Specific requirements of the maintenance agreement shall be as follows:

All control components shall be inspected and serviced as required a minimum of once during each year of the program. This shall include all associated software and hardware diagnostics.

This contractor shall create a computer generated preventive maintenance program detailing specific service requirements of each component within the system, the timing associated with each task, and any other information relative to proper maintenance of the system. A copy of this program shall be given to Owner within sixty (60) days of commencement of warranty year service program.

Give a copy of executed inspection report for each service visit, signed by Owner's representative, to Owner at end of service visit.

Provide emergency service, on a 24 hour basis, to assure proper system operation. Maximum response time shall be (4) hours via telephone connection to system modem. If a site visit is required, then such a visit will be provided within 24 hours. Provide emergency service for weekdays only (Friday's response shall extend to Monday).

All software and firmware upgrades released by system manufacturer during agreement term shall be installed in system at no additional charge including any associated training necessary as a result of upgrade.

3.7 ELECTRICAL WIRING

3.7.1 General

Provide electrical wiring in accordance with Section 15240, National Electrical Code (NEC) and as required below.

Provide all conduit, cable trays and raceways specified and required for all electrical work in this contract.

Wiring shall include final connections to all control devices provided under this section to respective equipment being controlled.

All work shall be supported from building structure. Work supported from fixtures, ductwork, piping or supports/hangers of other trades will not be acceptable, and corrective work shall be performed without cost to the Owner.

All safety devices shall deenergize equipment regardless of manual "hand-off-auto" selector switches.

3.7.2 Scope of Work

Provide signal and power wiring to all panels and devices furnished under this contract, and signal and safety device wiring to all equipment controlled under this contract, except power wiring to air compressor will be provided by Division 16.

Provide all wiring to supply and return duct smoke damper motors.

Provide all power wiring for smoke damper motors and interlock wiring between fire alarm system relay modules and smoke damper motors at smoke barrier partitions.

Provide all interlock wiring between equipment being sequenced as required to accomplish the sequence of operations, which shall include supply and return air fans, exhaust fans, coil circulating pumps, chilled and condenser water pumps, cooling tower fans and chiller control panels, flow switches, etc.

Wiring for 30 volts or less shall be rated for 300 volts and approved for the application.

Wiring above 30 volts shall have insulation rated for 600 volts.

Conduits shall be sized for 40% fill with a minimum size as required by Division 16.

Wiring above 30 volts up to 100 volts may be armor clad (AC) cable.

Wiring above 100 volts shall be installed in electric metallic tubing (EMT).

Low voltage wiring shall not be installed in conduits, raceways or cable

trays with line voltage wiring.

Low voltage wiring installed in occupied spaces, finished spaces or spaces intended to be occupied, shall be concealed. In the event concealment is not possible, then wiring shall be installed in wiremold. All exposed wiring in occupied spaces, or shell spaces, must be reviewed and approved by the Owner or his representative. All wiring installed in power plant mechanical rooms subject to forklift traffic or similar shall be installed in rigid steel conduit up to a minimum of 10 feet high for physical protection. All wiring installed in mechanical rooms not subject to forklift traffic or similar may be installed in EMT conduit.

Wiring in areas exposed to weather shall be in rigid steel conduit.

Installation of conduit or other electrical equipment shall not interfere with access door openings, coil pulls, or other such devices or areas requiring maintenance or service.

Provide all required power wiring and conduit for all panels furnished by this contractor for the project. All panels shall be circuited to the nearest panel and shall utilize 20 amp single pole spare circuit breaker in panelboard. Refer to electrical documents to ascertain exact location of nearest panelboard. Multiple panels may use same circuit within the electrical limitations. Indicate panelboard name and circuit number for each panel on shop drawings.

3.8 MISCELLANEOUS

Where control devices, panels, etc. are surface mounted on piping or ductwork, install standoffs to allow clearance for installation of insulation and to permit maintenance without disturbing insulation. Install fasteners so as not to pierce ductwork.

Check and verify locations of thermostats and other control devices with plans and room details before installation.

3.8.1 System Acceptance

At project completion, deliver the following documentation to the Owner.

Current log of all system hardwired I/O points. Point data log shall include date and time of printing, point type, point description, limits, present analog value, and digital state including normal/abnormal (alarm) digital command status.

Software documentation including project design software, listing of all software package entities and all field revisions/updates incorporated at time of commissioning. System schematics, electronic AutoCAD drawings, and laminated hard copy of drawings shall be posted at each controller and control panel.

Instrumentation and loop calibration log as specified elsewhere.

Operation and maintenance manuals as specified.

A letter to the Government representative stating that the control system has been completely installed, inspected, calibrated to specifications and is operating satisfactorily. Letter shall bear the signatures of contractor's principal field engineer/technician and

project supervisor.

Acceptance Demonstration shall be witnessed by the Owner or Owner's representative, and shall include the following:

Review of all connected points: Display of real-time values, command of setpoint and status changes, updating of values and status, and display of simulated alarms.

Demonstrate complete sequence of operation for each system.

Display and print reports, logs, trends and alarm summaries.

Display graphics for each system. Demonstrate dynamic point value and status changes.

System will not be considered acceptable for Owner's beneficial use until 100% of total system points exhibit acceptable operating values or status and all software routines have been accepted by Owner or Owner's representative. Warranty commencement date shall be established as the date upon which beneficial use of partial system has been established, partial system acceptances and full system acceptances.

System shall be considered fully commissioned and accepted when all documentation and demonstration agenda have been satisfied.

3.9 OPERATOR TRAINING

Provide operator training only where expressly required in construction task contract documents. When required, Contractor shall provide classroom and field instructions in operation and maintenance of systems equipment. These services shall be directed by the Contractor, using the manufacturer's factory trained personnel or qualified representative. Contracting Officer shall be given seven days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor shall be provided for each trainee. Duration of training, number of trainees, and specific equipment to be covered shall be as indicated.

3.10 THROUGH-PENETRATION FIRE-STOP SYSTEMS

Coordinate with Contractor for Section 07270 for requirements for sleeves and clearance between finished surface of penetrating item, including insulation where applicable, and penetrated construction to achieve proper installation of through-penetration fire-stop systems.

3.11 SPECIAL TOOLS

Special tools shall be provided as required for the operation and adjustment of controllers, instruments, or other control system devices.

-- End of Section --

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SECTION 15902

NON-UCS CONTROL SYSTEMS
03/98

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 666	(2000) Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
ASTM B 280	(1999) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 62	(1993) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM D 1693	(2000) Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90A	(1980; 90A-a 1987) Energy Conservation in New Building Design
ASHRAE 90.1	(1989) Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.22	(1995) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN WELDING SOCIETY (AWS)

AWS-02	(1990) Welding Handbook; Eighth Ed; Vol Two - Welding Process

FEDERAL SPECIFICATIONS (FS)

FS TT-E-489	(Rev J) Enamel, Alkyd, Gloss, Low Voc Content

FEDERAL STANDARDS (FED-STD)

FED-STD 595	(Rev B) Colors Used in Government Procurement

INSTRUMENT SOCIETY OF AMERICA (ISA)

ISA RP60.9	(1981) Piping Guide for Control Centers
ISA RP7.1	(1956) Pneumatic Control Circuit Pressure Test

MILITARY SPECIFICATIONS (MS)

MS DOD-G-24508	(1987a; Am 3) Grease, High Performance, Multipurpose (Metric)
MS MIL-F-18280	(Rev E; Supple 1A) Fittings, Flareless Tube, Fluid Connection

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA DC 3	(1989) Residential Controls - Electrical Wall-Mounted Room Thermostats

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(1999) Standard for the Installation of Air Conditioning and Ventilating Systems

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6	(1991) Surface Preparation Specification No. 6 - Commercial Blast Cleaning

1.2 SCOPE

This section covers automatic control systems work to be performed completely under this contract. This includes pneumatic, electric or electronic controls which are not part of the Goddard Utility Control System (UCS), and which are not labeled on the drawings to be "by UCS Contractor".

This section does not cover work to be performed under this contract in coordination with related work to be performed by the UCS contractor. Such work shall be performed in accordance with Section 15900, "UCS Controls".

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

1.4 SYSTEM DESCRIPTION

Automatic temperature control systems shall be complete in all details and shall include all necessary accessories to maintain conditions indicated or specified.

Automatic temperature control systems shall be pneumatic, electronic, electric/electronic, low-voltage electric, or DDC, as indicated on the drawings. As far as practical, control equipment shall be the product of a single automatic control systems manufacturer. Automatic control systems components not the product of the control system manufacturer shall be approved for use with the control system as indicated.

Automatically controlled valves to control environment shall be furnished by the automatic control systems manufacturer.

Automatically controlled dampers, independent of dampers integral with manufactured air-handling units, shall be furnished by the automatic control systems manufacturer. Damper manufacturer shall be licensed to display the AMCA seal.

Controllers and actuators for variable air volume (VAV) boxes and air-mixing valve operators shall be furnished by the automatic control systems manufacturer.

All gages provided and described within this specification shall have both the English system and the SI (Metric) system scales.

1.5 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Control Drawings shall fully describe the control system and include at a minimum the following elements:

System Schematic (Flow Diagram) showing location of all sensing elements and all control valves and dampers, in relation to the mechanical system being controlled.

Control Diagram showing the interconnection of all control components, control wiring and tubing, actuator spring range and action, controller range and action, and tag numbering of control components, valves, dampers, wiring and tubing.

Sequence of Operation clearly describing all modes of control of the system, including set-points.

SD-03 Product Data

Manufacturer's Data shall include preprinted catalog data, plus supplemental data as required to provide sufficient detail to show full compliance with the specifications. Data shall include statements of compliance with indicated standards, and performance data, tables or curves as applicable, for the following items:

Control Components
Thermometers
Pressure Gauges
Control System Valves
Power Operated Dampers
Control System Valve and Damper Operators

SD-05 Design Data

Equipment Schedules shall be submitted for the following items. Schedules shall be in tabular form and shall identify the manufacturer, model number, size, special or optional features, or other pertinent information regarding the specific items applicable to the task order:

Control System Valves
Power Operated Dampers
Control System Valve and Damper Operators

SD-06 Test Reports

Field Test Reports for all inspections and tests specified in Part 3, "Execution" of this Section. Each report shall be properly identified, including description of methods and instrumentation used, compliance with specified or recognized test standards, all test data and results, analysis and interpretation of test results, and indicate whether the material, product, or system has passed or failed the test. Reports shall be signed by an authorized official of the contractor, by an authorized official of the testing laboratory or agency (if applicable), and by the Government inspector who witnessed the test.

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions and Drawings, describing recommended methods for installation, including special notices, quality control checks, and material safety data sheets, hazards, and safety precautions, for the following items:

Control Components
Control System Valves
Power Operated Dampers
Control System Valve and Damper Operators

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals, including approved submittal data, manufacturer's operation, maintenance and repair instructions, spare parts lists, shall be submitted for the following items:

Control Components
Control System Valves
Power Operated Dampers
Control System Valve and Damper Operators

In addition the manuals shall include as-built control drawings, with all final adjustments indicated.

1.6 STORAGE AND HANDLING

Openings shall be sealed after manufacturing and inspection, until ready for installation.

Instruments and equipment shall be carefully handled, shall not be

subjected to shock, and shall be protected from weather, dust, construction materials, and damage.

1.7 QUALIFIED PERSONNEL

The services of a qualified manufacturer's Service Engineer or representative shall be provided, for all equipment. The duties shall include the following:

Instruct the personnel installing equipment in proper assembly and installation.

Inspect, adjust, and test equipment after installation for proper electrical and mechanical operation.

Represent the manufacturer and assist in placing equipment into initial service.

Personnel shall be provided who are qualified in servicing and placing in operation the specific manufacturer's type and class of equipment furnished. Personnel assigned shall be satisfactory to the Contracting Officer, or the personnel shall be replaced with persons who are satisfactory, without additional charge or change of schedule.

If indicated, instruct the Government's personnel in the proper operation and maintenance of all equipment furnished, in accordance with paragraph entitled "Operator Training".

PART 2 PRODUCTS

2.1 CONTROL COMPONENTS

2.1.1 Temperature Sensors

Temperature sensors, sensor transmitters, and controller output signals shall be directly proportional to the variations in the measured variable. Linearity shall be within plus or minus 1/2 percent for a 200-degree-F span, and plus or minus 1 percent for a 50-degree-F span, throughout the scale range.

Where extremely accurate temperature sensing is required or the transmitter is a considerable distance from the receiver controller, a two-pipe relay-type transmitter shall be used. Instrument shall have feedback incorporated into the design and shall have 50, 100, or 200-degree-F temperature range. Capillary shall be compensated and shall be available in short style 8 and 16-foot averaging lengths. Unit shall operate on 20 pounds per square inch (psi) input pressure, and shall have a 3 to 15-psi output over the specified range.

2.1.2 Humidity Sensors

Humidity sensors, sensor transmitters, and controller output signals shall be directly proportional to the variations in the measured variable. Linearity shall be within plus or minus 1 percent for a 70-percent relative humidity span. When humidity sensor is duct-mounted downstream from a cooling coil, element shall be capable of withstanding 98 percent relative humidity without loss of calibration.

2.1.3 Receiver Controllers

Receiver controllers shall have a calibrated set point adjustment, minimum calibrated scale with no greater than 2 degrees F divisions for duct and immersion application and 1 degree F divisions for room control application. Set point indication and an adjustable proportional band covering the complete range necessary for the specific application shall be provided. Controller range shall match that of the temperature sensor. Each device shall incorporate authority and remote set point calibrated adjustments, as required.

2.1.4 Receiver Indicators

Receiver indicators shall provide visual readout for temperature and humidity, using the transmitted signal from the sensor device to the receiver-controller device. Readout and accuracy of the receiver indicator shall provide the indicated value within plus or minus 1/2 percent of the span of the measured variable, as transmitted by the sensor. Factory calibration shall be marked on back of instrument. Range shall match that of the temperature or humidity sensor.

Combined accuracy of the sensor and the receiver indicator shall be within 2 degrees F and 5 percent relative humidity of the span.

Ambient conditions to 150 degrees F shall not cause a shift in control point in pneumatic sensor, receiver controller, or indicator systems.

2.1.5 Space Thermostats

Thermostats shall conform to ASHRAE 90.1, and shall have temperature restrictions as indicated.

2.1.5.1 Electrical Control

Space thermostat shall be low-voltage type with setback/setup temperature control for cooling only, heating only, or cooling and heating. Thermostat shall conform to NEMA DC 3, and shall be as indicated.

2.1.5.2 Pneumatic Control

Space thermostat shall be of the adjustable proportioning type containing a single bimetallic element for heating only or cooling only, or shall be dual bimetallic elements, one for heating and one for cooling.

Thermostats shall have locking covers and built-in concealed thermostats.

Thermostats with field-adjustable or removable set point limits are not permitted.

2.1.5.3 Space Thermostat Accessories

Thermostat covers shall be brushed aluminum.

Insulating bases shall be provided for thermostats located on exterior walls.

Thermostat guards in unfinished spaces shall be cast-metal type.

Guards and thermostats shall be mounted on separate bases.

2.1.6 Outdoor Reset Thermostat

Outdoor reset thermostat shall be a remote-bulb type or functionally equivalent bimetallic rod and tube type for proportioning action with an adjustable throttling range. Scale range shall be minus 10 to plus 70 or 35 to 95 degrees F with adjustable set point over the full range. Unit shall be mounted indoors, with sensing bulb mounted outdoors with solar compensation when indicated. Unit shall proportionally reset the control point of a remote sensing submaster temperature controller.

2.1.7 Immersion Thermostats

Immersion thermostats shall be remote-bulb type or functionally equivalent bimetallic rod and tube type, for proportional action with adjustable set point over the full operating range, and adjustable throttling range. A nonferrous separable socket shall be provided for each thermal element.

When used as a secondary controller, a remotely set adjustable set point shall be provided.

2.1.8 Airstream Thermostats

Airstream two-position thermostats shall be remote-bulb type or functionally equivalent bimetallic rod and tube type, with adjustable set point. Set point shall be in middle third of range of device.

Airstream thermostats for control of modulating devices shall be remote-bulb type for proportional action with adjustable set point over the full operating range, and adjustable throttling range.

Airstream thermostats for averaging service shall have a remote-bulb element not less than one-half as long as the longest side of the airstream cross section, of a type suitable for averaging service with liquid-filled bulb or equivalent. Gas- or vapor-filled bulbs are not acceptable for averaging service. Bulb shall be located to sense average temperature.

Airstream temperature primary controllers for remote reset or compensating operation, shall be remote-bulb type for proportional operation with adjustable set point over the full operating range, adjustable throttling range, and an adjustable authority of the secondary controller. Low- or high-limit thermostats, or other instruments having one-sided control, are not acceptable where reset or compensating controllers are indicated.

2.1.9 Line-Voltage Thermostats

Line-voltage thermostats shall have integral "MANUAL ON/OFF/AUTO" selector switch, a maximum differential of 2 degrees F, concealed temperature adjustment, and a locking cover. Line-voltage thermostats shall be rated for the load, single or two-pole as required. Thermostats shall be suitable for use as an electrical disconnect device, with an OFF position.

Insulating bases for thermostats located on exterior walls shall be provided.

Key lock thermostat guards in unfinished spaces shall be cast-metal type.

Guards and thermostats shall be mounted on separate bases, unless otherwise approved.

Line-voltage thermostats shall be furnished and mounted under this section, and wired in accordance with applicable sections of Division 16, "Electrical," unless otherwise specified.

2.1.10 Electrical Low-Limit Thermostat (Freezestat)

Air-handling unit freeze protection shall be provided. Lowest temperature across any 12 inches of bulb length, single or multiple tube, shall be sufficient to trip a snap-acting, single-pole, single-throw switch when the temperature sensed is equal to, or below, set point. Minimum length of bulb shall be 20 feet. One limit thermostat shall be provided for every 20 square feet of coil surface. Thermostats shall have manual reset.

During the smoke removal mode (where applicable), the low temperature protection shall be over-ridden. The fans shall continue to operate under any conditions when a smoke removal override is initiated.

2.1.11 Fire Thermostats

Fire thermostats shall be UL-approved and listed, shall be factory set in accordance with NFPA 90A, and shall have normally closed contacts. Reset shall be performed manually.

2.1.12 Heating/Cooling Valve-Top Thermostat

Induction air-conditioning units shall be furnished with valve-top thermostats. Units shall be proportional acting for proportional flow, remote-bulb liquid-filled element, direct and reverse acting at variable pressures to match those in the existing system. Operator diaphragm shall be molded rubber, housing shall be die-cast, and unit shall be furnished with position indicator and adjusting knob.

2.1.13 Room Humidistats

Room humidistats shall be wall-mounted, reverse acting, proportioning type, with adjustable minimum throttling range no greater than 2-percent relative humidity. Humidistats shall be capable of maintaining the relative humidity within the limits of the throttling range for relative humidity of 30 to 80 percent and temperatures to 110 degrees F.

2.1.14 Duct Humidistats

Duct humidistats shall be insertion type, mounted on outside of duct, with sensing element within duct. Duct humidistats shall be reverse acting, proportioning type, with adjustable minimum-throttling range no greater than 2 percent relative humidity. Humidistats shall be capable of maintaining relative humidity within the limits of the throttling range for relative humidity of 20 to 80 percent and temperatures to 150 degrees F. Sensing element provided shall be suitable for the indicated installation location.

2.1.15 High-Limit Duct Humidistats

High-limit duct humidistats shall be insertion type, mounted on outside of duct, with sensing element within duct. Humidistats shall be reverse acting, two-position type, with minimum differential no greater than 2 percent relative humidity. Sensing element provided shall be suitable for the indicated installation location.

2.1.16 Water Temperature Controllers

Water temperature controller shall be inserted in a nonferrous separable socket installed in the waterline. Controller shall operate remotely or integrally on an adjustable differential over an adjustable temperature range, and shall be suitable for operating in conjunction with the control valve provided.

2.1.17 Building Static-Pressure Transmitter

Building static-pressure transmitter shall be a double-bell, differential type with temperature compensation. Scale range shall be minus 0.5 to plus 0.5 inch water gage (wg), and sensitivity shall be within plus or minus 0.0005 inch wg. Transmitter shall transmit an electronic or pneumatic signal to an indicating receiver with a matched scale range.

Total system accuracy shall be not less than 0.05 inch wg.

2.1.18 Building and Duct Static-Pressure Controller

Duct static-pressure controller shall be a slack diaphragm type, with an adjustable set point, and adjustable throttling range. Controller range shall be 0.01 inch to 6.0 inches wg. Throttling range shall be adjustable from 0.02 to 0.05 inch wg. Output shall be electronic or pneumatic.

Building static-pressure controller shall be a double bell, differential type with temperature compensation. Scale range shall be minus 0.5 to plus 0.5 inch wg, and sensitivity shall be within plus or minus 0.05 inch wg. Controller shall be provided with an adjustable set point over the full-scale range and adjustable throttling range, proportional band. Output shall be electronic or pneumatic.

2.1.19 Pressure Transmitter

Pressure transmitters shall be the indicating type for gas, liquid, or steam service. Transmitter range shall be suitable for system operating characteristics. Output shall be proportional to system pressure and shall be electronic or pneumatic. Indicating receiver shall have a matched scale range.

Total system accuracy shall be not less than 1/2 percent of system range.

2.1.20 Remote Pressure Transmitter

Pressure sensors for gas, liquid, or steam service remote indication shall be pneumatic or pressure-to-current type. Direct current output and power supply shall be compatible with the remote readout indicator.

2.1.21 Remote Element Instruments

All remote element instruments shall have sufficient length of capillary to mount the instrument on the control panel in an accessible location. Excess capillary shall be coiled and concealed. Armored capillary shall be provided where indicated.

2.1.22 Airflow Switches

Airflow switches shall be UL-approved, pressure range shall be 0.12 to 10

inches wg, and electrical rating shall be 110 volts ac, 10 ampere and 3/4 horsepower ac pilot duty.

2.1.23 Pneumatic Relays

Relays shall be positive-acting, gradual-acting, direct, or reverse.

2.1.24 Switches

Switches shall be provided as indicated.

Adjustable switches shall have indicating plates and accessible adjustment. Minimum-positioning switches that control dampers shall be calibrated and marked in percent of maximum airflow determined by airflow test.

2.2 THERMOMETERS

Thermometers shall be provided with nonferrous separable sockets when in immersion service. Thermometer scale range shall be selected according to service. Thermometers shall be readable from operating level.

Dial type temperature indicators shall have a 2-1/2, 3, 3-1/2, 4-1/2, or 5-inch diameter antiparallax dial face with white background and black markings.

Pointer shall be friction or micrometer maximum-registering type with external calibrator adjustment. Accuracy shall be within 1 percent of dial range.

Case shall be corrosion-resistant steel, cast aluminum, or brass; bottom-connection, back-connection, or adjustable-head type; with corrosion-resistant steel or chrome-plated close-type ring.

Activating medium shall be vapor, solid liquid, or bimetal.

Stem length shall be 1/2-inch taper pipe thread, fixed thread; or shall be 3/4-inch taper pipe thread, separable socket.

Thermometers with a minimum 9-inch vertical scale may be provided, in lieu of dial type, unless otherwise indicated.

2.3 PRESSURE GAUGES

Pressure gages shall conform to ASME B40.1 and as indicated. Pressure gages shall be Type I, gage for air, steam, oil, and water, Class 1, pressure gage, with range as indicated. Pressure-gage size shall be 3-1/2-inch nominal diameter. Case shall be AISI 300 series corrosion-resistant steel with No. 4 standard commercial polish, or better, conforming to ASTM A 666. Gauges shall be equipped with adjustable marking pointer and damper screw adjustment in inlet connection. Gauges shall have safety case, safety glass, and blowout plug.

Gauge cocks shall be T-head or lever-handle ground-key type, with washer and screw, constructed of polished ASTM B 62 bronze and rated for 125-psi saturated-steam service. End connections shall suit the service.

2.4 CONTROL SYSTEM VALVES

All control valves 1 inch and larger and all steam humidifier valves shall

be pneumatically controlled. All other valves smaller than 1 inch shall be electrically controlled.

Valve bodies, 2-inch iron pipe size (ips) and smaller, shall be bronze with screwed or flanged end connections. Valve bodies, 2-1/2-inch ips and larger, shall be cast iron and shall have flanged end connections.

Valves shall be single seated for dead-end service except where otherwise indicated.

Modulating service valves shall have plugs matched to the characteristics of the coil for effective control. Valve-stem packing shall be tetrafluoroethylene, spring-loaded, and self-adjusting.

Valve stem shall be top and bottom guided and shall be AISI 303 corrosion-resistant steel or Monel. Cage construction is acceptable.

Valves shall be provided with position indicators and, where indicated or required for proper operation, shall be provided with positioners.

Valve linkage shall have an adjustment for valve lift.

2.4.1 Hydronic

Hydronic systems shall include chilled water, secondary water, and hot water systems.

Hydronic system valve bodies and trim shall be rated for service pressures through 125 psi at 250 degrees F.

Hydronic system valves shall have replaceable plugs and seats of SAE 72 brass or AISI 303 corrosion-resistant steel, selected for maximum life depending on application conditions.

Maximum pressure drop across any hydronic system valve at maximum flow shall be 5 feet of water.

2.4.2 Steam (Low Pressure)

Steam valve bodies and trim shall be rated for service pressures through 125 psi saturated steam.

Steam valve replaceable plugs and seats shall be AISI 440C corrosion-resistant steel hardened to not less than 500 Brinell.

Maximum pressure drop across any steam valve at maximum flow shall not be greater than 3 psi except if otherwise specifically indicated on drawings.

2.5 CONTROL TUBING AND ACCESSORIES

Pipe connections shall be provided in air lines at each pneumatic room controller to connect gages for testing.

2.5.1 Tubing

Copper tubing with 1/4 inch outside diameter shall be hard drawn or annealed seamless copper, conforming to ASTM B 280.

Fittings shall be solder joint, wrought copper, conforming to ASME B16.22.

Ball-sleeve shall be compression type, rod or forged brass conforming to SAE 72 or 88 UL-approved, conforming to MS MIL-F-18280, with minimum pressure rating of 200 psi at 100 degrees F.

Solder shall be 95-5 tin-antimony, alloy Sb5, conforming to AWS-02.

Polyethylene tubing shall be black virgin polyethylene, meeting stress crack test performed in accordance with ASTM D 1693. Multi-tube harness material shall consist of the same tubing, with polyester film barrier and vinyl jacket not less than 0.062 inch thick.

Fittings shall be ball-sleeve compression type, brass or aluminum, with internal sleeves.

2.5.2 Control Pressure Gauges

Pressure gauges used to indicate supply and outlet air pressures of automatic control instruments shall be the manufacturer's standard, minimum 3-1/2 inch diameter.

2.5.3 Air Supply Source

Unless otherwise indicated, instrument air shall be supplied from an existing 125 kilopascal central, dry, compressed-air header. Connect tubing to existing header serving adjacent equipment, or at other location indicated on drawings.

Where a new air compressor, pressure reducing station, or other accessories are indicated, they shall be provided in accordance with Section 15211, "Low Pressure Compressed Air Systems".

2.6 POWER-OPERATED DAMPERS

The manufacturer shall be licensed to display the AMCA seal.

Automatic smoke dampers shall be furnished and installed by the Contractor, refer to Section 15815, "HVAC Systems Ductwork".

Dampers furnished as part of an air handling unit shall be furnished by the equipment manufacturer in accordance with these specifications. Refer to Section 15720, "Air Handling Units".

2.6.1 Frame and Blade Assembly

Frames and blades shall be constructed of extruded aluminum, galvanized steel, rolled carbon steel, or corrosion-resistant steel.

Resilient seals shall be mechanically attached, field replaceable seals. Attachment by adhesive shall not be acceptable. Jamb seals shall be neoprene, flexible metal compression-type constructed of aluminum or corrosion-resistant steel.

Frames shall have corner reinforcement and stay rods, where necessary. Frames shall be fabricated by welding or riveting. Damaged galvanized surfaces shall be repaired by coating with an equal weight of zinc.

For static pressures in excess of 3 inches wg, master-blade-driven dampers with blades longer than 24 inches shall have a maximum blade width of 8

inches. Maximum blade width for other services shall be 10 inches. Maximum blade length shall be 48 inches. Dampers more than 48 inches wide shall be made in two or more sections with intermediate mullions; each section shall be mechanically interlocked with adjoining section or sections.

Minimum shaft size shall be 1/2-inch, round or square.

Where linkage is such that operator torque is applied to a master blade and transmitted therefrom, that blade shall be reinforced and the shaft shall be full length. This type construction shall be limited to 2-inch wg, static pressure.

Blades shall be attached to round shafts by hardened cup-point setscrews, or by being pinned. A minimum three-thread engagement shall be provided. Where setscrews are used, two setscrews, 90 degrees apart, shall be provided to secure master blade. Shaft end retainers may be secured by pins or spring washers in grooved shaft or by similar construction.

Frames shall be calked with elastomer compounds to prevent bypass leakage.

Blades without resilient seals shall have interlocking edges.

Maximum leakage of dampers shall be 2 percent at 2-inch wg.

2.6.2 Bearings

Shaft bearings shall be oil-impregnated sintered bronze, or graphite-impregnated nylon sleeve type, except as otherwise indicated. Thrust washers shall be provided at bearings, when necessary to maintain blade alignment.

Shaft bearings shall be single row, unground, flanged, radial, antifriction type with extended inner race suitable for press mounting in damper frame. Bearing materials shall be AISI type 316 corrosion-resistant steel. Bearings shall be lubricant free. Operation and maintenance manual shall be marked, and instructions shall be attached to the damper frame noting: "DO NOT LUBRICATE CORROSION-RESISTANT STEEL BEARINGS." Factory sealed, shielded carbon-steel ball bearings will be acceptable provided lubricant conforms to MS DOD-G-24508.

Linkage pivot bearings shall be oil-impregnated sintered bronze or graphite-impregnated nylon.

2.6.3 Installation

Dampers shall be installed in accordance with the manufacturer's instructions.

2.7 CONTROL SYSTEM VALVE AND DAMPER OPERATORS

2.7.1 Operators

Motor operators shall provide smooth proportional control under operating conditions normal to the system.

Spring-return operators shall be provided for two-position control, unless otherwise indicated.

Spring returns shall be provided on reversible operators where required for fail-safe operation.

Operators operating in sequence with other operators shall have adjustable operating ranges and set points.

Operators shall have sufficient power on closeoff to provide tight sealing against maximum system pressures.

Operators shall close valves and dampers to fail-safe position indicated.

2.7.2 Dampers

Dampers shall be 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.

2.7.3 Pneumatic Operators

Positioners shall be provided where two or more operators are controlled from the same controller, and where indicated. Positioners shall be mounted directly on the driven device. Feedback from the stem or rod shall be through a pilot spring. Starting point shall be adjustable from 2 to 12 psi. Operating span shall be adjustable from 5 to 13 psi.

2.7.4 Electric Operators

Electric motor operators for modulating control shall be reversible type.

Electric motor operators shall be split-phase type with oil-immersed gear train. Motor shall have ample capacity to handle applied loads under operating conditions normal to the system. Locations where temperatures fall below minimum operating temperature of operator shall be heated.

2.8 CENTRAL CONTROL CABINET

Control cabinet shall be a free-standing modular type with hinged, locking access door, one per module.

Control cabinet shall consist of enclosed wall-mounted modular cabinet sections. Front of each cabinet shall be hinged to provide access to the interior of each cabinet and shall be lockable.

A 60-mil thick, high-pressure laminate-covered writing surface and recessed storage drawers with locks shall be provided.

2.8.1 Cabinet Construction

Cabinets shall be made of steel or aluminum, suitably reinforced and braced to provide a flat-faced, rigid-front panel.

Surfaces shall be free of scale, welding slag, and dirt, and shall be flat without waves. Handling during installation shall not distort or buckle the cabinet.

Cutouts shall be square with panels to ensure that instruments will be installed level and square.

Finished cutouts and holes shall be free of burrs and sharp edges. Cutouts

shall be made up of modular sections or fabricated sections in sizes suitable for handling. Cabinet section joints shall be neat and straight. Cabinets shall be securely fastened together and aligned, and each cabinet shall be securely wall or floor anchored, as required.

Exterior hardware shall be high-grade steel with polished-nickel or chrome-plated finish.

Interior hardware shall be cadmium-plated steel.

Access doors shall be provided with hinges, latches, and locks. Cabinet frames shall be sufficiently sturdy to prevent doors from sagging when open. Latches shall be provided to hold doors open at 90 degrees and roller latches shall be provided to hold doors closed. Keys shall be furnished and shall be common to all access door locks.

2.8.2 Finish

Surfaces shall be cleaned in accordance with SSPC SP 6. Blast pattern shall have a maximum surface profile of 2.0 mils. Not more than 8 hours after cleaning, the manufacturer's standard procedure shall be followed for priming and finish painting. Final coat shall conform to FS TT-E-489. Color shall conform to FED-STD 595, semi-gloss green enamel for all external surfaces. Soft gloss white paint shall be used for interior surfaces. When painting is not started within 8 hours after cleaning, surfaces shall be recleaned before painting.

2.8.3 Graphic System Portrayal

Cabinet shall be provided with individual modules portraying systems configurations. Portrayals shall be by approved color-coded graphic tapes in laminated plastic securely fastened to the front panel. Edges shall be beveled and finished smooth and shall be free of waves, scratches, or gouges. Instruments and auxiliary equipment shall be identified by engraved plastic or formica labels. Tape shall not be acceptable.

2.8.4 Instruments and Components

Instruments shall be approved prior to installation. Instruments shall be clean and free of foreign matter.

Pipe connections shall be provided in air lines at each pneumatic room controller to connect gauges for testing.

2.8.4.1 Receiver-Type Indicator

Receiver-type dial size indicators shall be as indicated.

Indicator cases shall be made of drawn steel, flush mounted with three equally spaced screws or panel clamps and panel cutout to match indicator as furnished.

Bourdon tube shall be of material and construction suitable for 3 to 15 psig input.

Indicator movement shall be accomplished by precision brass or approved manufacturer's standard practice.

Dial shall be black numerals and graduating marks on a flat white

background.

Pointer shall be by fixed needle.

Indicator calibration shall be by means of calibration screw on face of indicator, with dial accuracy to within 1 degree F in the applicable range.

Scale ranges shall operate full scale between 3 and 15 psig, with scale ranges as indicated.

2.8.4.2 Electronic Temperature Indicator

Electronic temperature indicator shall indicate the sensor input throughout the operating range of the system. Accuracy shall be within plus or minus 1/2 percent of the system range. Input shall be proportional to the measured variable. Scale range shall be minus 20 to plus 200 degrees F.

2.8.4.3 Electronic Pressure Indicator

Electronic pressure indicator, calibrated in inches wg, shall indicate the pressure drop through range of transmitter. Accuracy shall be not less than plus or minus 0.05 inch wg.

2.8.4.4 Remote Control Point Adjuster

Remote adjustment for resetting the set point of the control device shall be in 2-degree increments for the full range of the control span.

2.8.4.5 Manual Minimum Position Switch

Manual minimum position switch shall have an adjustable minimum output between 3 and 13 psi, shall be furnished with a calibrated 0 to 100 percent set point scale with scale divisions of 5 or less, and shall have a set point-locking adjustment knob. Switch shall be suitable for a maximum pressure of not less than 25 psig.

2.8.4.6 Remote Temperature Transmitter

Remote temperature transmission of discharge air and space temperature shall transmit a signal in proportion to the measured temperature to an electronic thermometer in the central control panel. Total system accuracy shall be plus or minus 0.5 degree F.

2.8.4.7 Remote Filter Pressure Transmitter

Filter pressure-drop transmitter shall transmit an electronic signal to a common pressure indicator, calibrated in inches wg, at the control center. Accuracy shall be of not less than plus or minus 0.05 inch wg. Range of the pressure transmitter shall be from 0 to 6 inches wg.

2.8.5 Panel Instrument Tubing

Instrument tubing within panels shall be copper or black polyethylene tubing. Tubing connections at panels shall be made with through-bulkhead-type fittings.

Tubing shall be neatly installed and properly supported. Instruments and accessories mounted on hinged access panels shall have sufficient flexible tubing to allow the door to open at least 135 degrees. Flexible tubing

shall be tied into a single cable.

Fittings and joints shall be pressuretight, and as indicated.

2.9 INDIVIDUAL SYSTEM CONTROL PANELS

Each air handling system shall be provided with an individual control panel mounted adjacent to and vibration isolated from the air handling unit.

Control panel shall be of manufacturer's standard steel construction of adequate gauge and sufficient reinforcement to be completely rigid. Finish shall be manufacturer's color approved by the Contracting Officer. Identification plates shall be mechanically attached, engraved, 1/8-inch thick, laminated, black and white plastic. Panel location shall be as indicated.

Panel shall contain a thermometer for each duct or immersion thermostat, as indicated, and for electropneumatic and pneumoelectric switches not connected to starters, pilot lights for fan air filters, pump motors, filter runout pilot lights, air switches, or other accessories, as indicated. Panel shall also contain all controllers, recorders, and other instruments, including a 1-1/2-inch gauge showing pressure of primary air to pneumatic controllers; and 1-1/2-inch gauges showing pressures of controlled air from each controller, other than room controllers.

2.10 SMOKE DETECTOR AIR HANDLING UNIT SHUTDOWN

Duct smoke detectors shall be furnished under Division 16 Electrical and installed under Division 15 Mechanical. The Contractor shall wire the detectors to the respective motor controller and the Fire Alarm System.

The general contractor shall wire the duct smoke detectors to their respective air handling unit fan motor starter, for fan shut-down upon sensing products of combustion.

2.11 SMOKE REMOVAL-OVERRIDE CONTROL PANEL

Where the project includes installation or modification of smoke removal systems, provide a graphic annunciator for the smoke removal system override, and install panel adjacent to the fire alarm control panel. Refer to electrical drawings for location.

The graphic layout of the annunciator shall be designed by the annunciator manufacturer and submitted for approval. The graphic annunciator shall display the general building layout indicating the various mechanical equipment serving the air distribution, exhaust and smoke removal systems. The panel shall be U.L. listed.

Graphic information shall be white photo-emulsion factory applied to a 1/4 inch minimum thick smoke plexiglas face. The face shall be protected by clear plexiglas enclosed by an architectural-gray extruded aluminum frame. The annunciator shall be point back-lighted and use socket mounted LED's to facilitate any future changes.

The annunciator shall indicate normal operation (green), and smoke removal mode (red). The annunciator shall include switches to manually activate the smoke removal mode, and to select the floor on which smoke removal is to occur. Each switch shall have a Normal-OFF-Smoke position, and it shall clearly indicate the system and floor being controlled. Refer to the

control drawings for equipment and floors being provided with the smoke removal mode.

2.11.1 Manual Operator Override

Provide for manual, operator override of the low temperature and smoke detector control of the fan motors associated with all smoke removal systems.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment and materials shall be installed in accordance with all applicable listings. Sealing of penetrations of the fire rated walls, partitions, ceilings and floors shall be in accordance with Section 07840 ,"Firestopping and Smokestopping".

Installation of control components shall be done by qualified control and instrumentation specialists working under the direction of the manufacturer's representative.

Installation of control components shall be done by Contractor-certified control and instrumentation specialists.

Installation shall be in accordance with the manufacturer's instructions and as indicated.

All control valves shall be installed with upstream strainers, with manual shutoff valves upstream and downstream, and with unions upstream and downstream to facilitate valve repair and replacement.

3.2 CONTROL- AND INSTRUMENT-AIR TUBING INSTALLATION

Tubing shall be concealed, except in mechanical rooms or areas where other piping is exposed.

Tubing shall be mechanically attached to supporting surfaces. Supporting adhesives are not acceptable. See additional requirements under Section 15072, "Vibration Isolation for Air Conditioning Systems."

Tubing penetrations in concrete surfaces shall be made through minimum, 1-inch ips, Schedule 40, rigid, unplasticized, polyvinylchloride (PVC) sleeves. Sleeves shall extend 6 inches above floors and 1 inch below bottom surface of slabs. Where water- or vapor-barrier sealing is required, 1/2-inch deep elastomer calk shall be applied to surfaces cleaned free of oil and other deleterious substances.

Tubing shall be purged 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

Tubing with mechanical joints shall be cut square and burrs shall be removed. Care shall be exercised not to work-harden copper surfaces. Tube ends shall be cut off or annealed by heating and air cooling in accordance with the manufacturer's instructions.

Copper tubing for solder joints shall be cut square and burrs shall be removed. Inside surfaces of fittings and outside surfaces of tubes in joint area shall be cleaned before assembly of joint. Joint flux, filler material, and heat source shall be applied in accordance with the manufacturer's instructions. Valves in copper piping shall have screwed ends with end adaptors to suit mechanical connections, unless solder jointing is otherwise indicated. Copper joints that fail pressure tests shall be remade with new materials, including pipe or tubing fittings and filler metal.

Hard-drawn copper tubing shall be used in all exposed areas. Hard drawn or annealed tubing shall be used where tubing is concealed.

Fittings for supply system copper tubing shall be wrought-copper solder-joint type except at connection to apparatus where specified brass mechanical and ips thread-adapter fittings shall be used. Tool-made bends in copper tubing will be acceptable in lieu of fittings.

Copper-tubing runs embedded in concrete shall be annealed and shall be protected by metallic or plastic electric conduit.

Copper tubing horizontal supports for less than three tubes shall be rigid 1- by 3/8-inch metal channel and shall be proprietary metal tube race for three or more tubes.

Copper tubing runs in soil shall be jointless and shall be protected by 12-mil thick bituminous coating or equivalent PVC tape wrapping.

3.2.2 Plastic Tubing

Plastic tubing, sheathed or unsheathed, except as otherwise indicated, may be used in lieu of, or in conjunction with, copper tubing upon prior approval, provided that tubing is enclosed within conduit or control panel cabinets, or is concealed behind control panels.

Plastic tubing, installed inside or behind control panels, shall be color coded or number coded. Tubing shall be neatly tied and supported. Flexible connections bridging the cabinet and cabinet door shall be neatly fastened along the hinge side and protected against abrasion.

Plastic tubing, in mechanical rooms or in spaces where copper tubing is exposed, shall be run in metallic electric conduit.

Fittings for plastic tubing shall be used in accordance with the manufacturer's instructions.

3.3 MECHANICAL REFRIGERATION AIR DRYER INSTALLATION

Wall mounting shall be through rubber-in-shear mounts. Dryer shall be connected to air compressor outlet with pressure regulator installed downstream of dryer.

3.4 VIBRATION ISOLATION

To prevent vibration, controllers shall be isolated by location or by mounting devices supplied by the equipment manufacturer.

Tubing and conduit shall be installed to prevent the transmission of equipment vibration. Connections from any tubing runs subject to equipment

vibration, to controllers or control panel, shall be made with a minimum 150 millimeters length of plastic tubing.

3.5 TESTING, CALIBRATION, AND ACCEPTANCE

After the inspection has been completed, systems shall be checked for continuity. Pneumatic systems shall be tested in accordance with ISA RP7.1. System pressure shall not exceed 30 psig.

After completion of control and instrument piping, control equipment shall be tested and adjusted in terms of design, function, systems balance, and performance, and shall otherwise be made ready for air handling systems acceptance tests. Equipment to check the calibration of instruments shall be provided by the Contractor. Instruments not in calibration shall be recalibrated or replaced.

Operational testing of the controls shall be performed to verify proper operation, adjustment and calibration of all controls. Testing shall be conducted and documented by means of a checklist derived from the control diagrams and sequence of operation, verifying proper installation and calibration for each control device, and proper operation of each step or mode of the sequence of operation. For each system the completed checklist, indicating all final setpoints and adjustments, and signed by the government witness for the testing, shall be submitted as the Operational Test report prior to the operational readiness review.

After air handling system acceptance and after the systems have operated in normal service for 2 weeks, the adjustment on instruments and devices shall be checked. Items found to be out of order shall be corrected. When air handling systems are in specified operating condition and when all other pertinent specifications requirements have been met, automatic temperature-control systems will be accepted.

3.6 OPERATIONAL READINESS REVIEW (ORR)

Provide an operational Readiness Review (ORR) for the controls in accordance with Section 01770, "Task Order Closeout", in conjunction with the ORR for the controlled equipment as specified in the applicable equipment specification sections. The ORR shall include an overview of the Operation and Maintenance Manual including as-built control diagrams and sequences of operation, the location and operation all control devices, and a complete demonstration of all control sequences.

For task orders which involve replacement or modification of only a portion of the HVAC system, the ORR shall cover only the replaced or modified components.

3.7 OPERATOR TRAINING

When indicated on the drawings, Contractor shall provide classroom and field instructions in operation and maintenance of systems equipment. These services shall be directed by the Contractor, using the manufacturer's factory trained personnel or qualified representative. Contracting Officer shall be given seven days written notice of scheduled instructional services. Instructional materials belonging to the manufacturer or vendor shall be provided for each trainee. Duration of training, number of trainees, and specific equipment to be covered shall be as indicated.

3.8 SPECIAL TOOLS

Special tools shall be provided as required for the operation and adjustment of controllers, instruments, or other control system devices.

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SECTION 15950

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SECTION 15950

TESTING, ADJUSTING AND BALANCING
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE-01	(19982) Handbook, Refrigeration (IP Edition)
ASHRAE-08	(1998) Handbook, Refrigeration (SI Edition)
ASHRAE-15	(1994) Safety Code for Mechanical Refrigeration

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B31.5	(2000) Refrigeration Piping

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	(1989; 5th Ed) National Standards for Testing and Balancing, Heating, Ventilating, and Air Conditioning Systems

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR Part 82	(2000) Protection of Stratospheric Ozone

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB-01	(1998; 6th Ed) Procedural Standards for Testing-Adjusting-Balancing of Environmental Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA-07	(1993; 2nd Ed) HVAC Systems - Testing, Adjusting and Balancing
SMACNA-G	(1985; 1st Ed) HVAC Air Duct Leakage Test Manual

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-01 Preconstruction Submittals

Records of Existing Conditions shall be submitted consisting of 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.

SD-03 Product Data

Equipment and Performance Data shall be submitted for instruments and equipment to be used during testing.

SD-06 Test Reports

Test Reports shall be submitted to the Contracting Officer for approval. Six bound copies of the testing, adjusting, and balancing report shall be provided.

SD-07 Certificates

Proof of certification of the independent testing and balancing agency, it's field representative, and it's instrumentation, by either AABC or NEBB for the type(s) of systems.

SD-07 Certificates

Certificates of Compliance shall be submitted by the Contractor showing independent laboratory certification of test-apparatus calibration data, dated after the award of the contract.

1.3 GENERAL REQUIREMENTS

Section 15003, "General Mechanical Provisions," applies to work specified in this section.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 DUCT LEAKAGE TESTING

Structural integrity and leakage testing of DUCTWORK systems shall be performed by system or by duct mains and branches.

Tests shall be performed prior to insulation of surfaces, painting, or concealment of work. Unless waived by the Contract Officer, systems containing repaired defects shall be retested to original criteria for acceptance.

3.1.1 Low Pressure Classes

These requirements apply to ductwork of pressure class 2 inches water gage and less, positive or negative.

Portions of systems shall be inspected and tested to positive or negative pressures, or both, whichever is normal to the portion of system under test, in accordance with the following:

There are no visible mechanical defects.

There is no audible leakage at any point when area ambient noise is at normal-occupancy level.

No leakage is perceptible to the hand, when placed within 6 inches of a joint.

3.1.2 Medium Pressure Classes

These requirements apply to ductwork of pressure classes over 2 inches water gage but below 6 inches water gage, positive or negative.

Duct systems shall be structurally tested at static pressures 25 percent in excess of total fan pressure. Leakage testing shall be at a pressure equal to the pressure class, and, in dual duct systems at maximum pressure at mixing box, when inlet valve is shut off. System will be acceptable provided:

a. There are no visible mechanical defects.

b. Measured total system leakage does not exceed Leakage Class 6 as defined in SMACNA-G for the test pressure, measured leakage, and surface area of ductwork tested, when tested in accordance with "Leak Test."

c. There is no audible leakage at any point when area ambient noise is at normal-occupancy level.

3.1.3 High Pressure Classes

These requirements apply to ductwork of pressure classes 6 inches water gage and above, positive or negative.

Duct systems shall be structurally tested at static pressures 50 percent in excess of air-handling apparatus discharge pressure. Leakage testing shall be at a pressure equal to the pressure class, and, in dual-duct systems at maximum pressure at mixing box, when inlet valve is shut off. System will be acceptable provided:

a. There are no visible mechanical defects.

b. Measured total system leakage does not exceed Leakage Class 6, as defined in SMACNA-G for the test pressure, measured leakage, and surface area of ductwork tested, when tested in accordance with "Leak Test."

c. There is no audible leakage at any point when area ambient noise is at normal-occupancy level.

3.1.4 Leak Tests

Test apparatus and procedures shall be similar in all respects to those defined in SMACNA-G. Filtered blower inlet and automatic safety relief device shall be provided to protect system. Accuracy of measurement of leakage flow rate shall be certified to be within that allowed by SMACNA-G.

Leak tests shall be performed on representative sections rather than the

entire system, provided these sections represent at least 25% of the total installed duct area for the tested pressure class, unless the drawings indicate leak testing for the entire installed area for the tested pressure class.

3.1.4.1 Test Apparatus

Test apparatus shall consist of:

a. A source of high pressure air - a portable rotary blower or tank type vacuum cleaner.

b. A flow measuring device usually an orifice assembly consisting of straightening vanes and an orifice plate mounted in a straight tube with properly located pressure taps. Each orifice assembly shall be accurately calibrated to its own calibration curve. Pressure and flow readings are usually taken with U-tube manometers.

3.1.4.2 Test Procedures

Test for audible leaks as follows:

a. Close off and seal openings in the duct section to be tested. Connect the test apparatus to the duct by means of a flexible duct section.

b. Start the blower with its control damper closed (some small blowers popularly used for testing ducts may damage the duct because they can develop pressures up to 25 inches wg).

c. Gradually open the inlet damper until the duct pressure reaches 2 inches wg in excess of designed duct operating pressure. Test pressure is read on manometer No. 1. Note that the pressure is indicated by the difference in level between the two legs of the manometer and not by the distance from zero to the reading on one leg only.

d. Survey joints for audible leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealants have set.

After all audible leaks have been sealed, the remaining leakage should be measured with the test apparatus orifice section as follows:

a. Start blower and open damper until duct pressure reaches test pressure.

b. Read the pressure differential across the orifice on manometer No. 2. Leakage rate in cfm is read directly from the calibration curve. If leakage does not occur, the pressure differential will be zero.

c. Calculate the observed leakage class from the formula in SMACNA-G. (Test readings taken in metric units shall be converted to English units, and indicated in the report, prior to calculation of Leakage Class, since SMACNA has not yet provided formulas and Class curves in metric units.) When partial sections of the duct system are tested, the surface area in the formula shall be that

of the section tested, not the entire system.

d. If all audible leaks have been corrected, it is unlikely that the measured leakage will exceed the required leakage class. If it does, the leaks shall be located by careful listening or feeling along the joint.

e. It should be noted that even though a system may pass the measured leakage test, a concentration of leakage at one point may result in a noisy leak that shall be corrected.

3.1.5 Smoke-Test Apparatus and Procedures

This test shall be performed, for any pressure class, but only if indicated on the drawings.

System shall be tested with smoke bombs while under structural-integrity testing, with 5-minute, ignitable-wick, titanium-tetrachloride smoke bombs. A sufficient number of bombs shall be provided to produce the same smoke density for all portions tested. Testing shall be conducted under substantially draft-free conditions, and the area shall be free of smoke of any nature. Smoke bombs shall be placed inside air-handling unit or duct and ignited. Care shall be exercised in placing smoke bombs to ensure that no surface is damaged by the burning candle. Bombs shall be placed inside sand-filled buckets. After the bombs have burned for approximately 3 minutes, the system shall be pressurized until the exterior surfaces and all joints have been inspected for signs of smoke. Pressurization shall be done with a test fan started at less than 10 percent maximum-volume flow. Prior to starting testing, system shall be purged at various extremities until detectable smoke appears. Test pressure-relief device shall be tested for proper operation. All joints from extremities to source of smoke shall be checked.

3.1.6 Test Report Criteria

A test report shall be provided for each system tested, identified by system or section thereof. For measured leakage tests, report shall contain leak-test curves for apparatus used and data pertinent to acceptance requirements, including identification of section tested, section surface area, test pressure, measured leakage, and calculated leakage class.

3.2 REFRIGERATION SYSTEMS TESTING

All testing shall be performed in compliance with applicable provisions of 40 CFR Part 82.

Refrigeration systems testing shall be performed only by certified technicians, and using certified equipment, as specified in Section 15003, "General Mechanical Provisions". Proof of certifications shall be submitted in accordance with Section 15003 prior to scheduling testing.

Pressure, vacuum, structural-integrity, and leakage tests shall be applied to all systems and shall be conducted in accordance with the provisions of Paragraph 537 of ASME B31.5 except Subparagraphs 537.5, ASHRAE-01, and as modified and supplemented herein.

Systems shall be tested in the presence of the Contracting Officer.

Tests shall be performed prior to insulation of surfaces, painting, and concealment of work. Systems containing repaired defects shall be retested to original criteria for acceptance, except when waived by the Contracting Officer.

Factory-sealed refrigeration equipment assemblies shall be kept isolated from field-installed piping until final acceptance of high-vacuum test.

Brazed and mechanical joints that fail structural or leakage tests shall be disassembled, cleaned, and remade with new materials, including tubing, fittings, and filler metal. Flanged joints shall be regasketed with new gasket materials.

After repairs have been made, tests shall be repeated until satisfactory results are obtained.

Manufacturer's instructions shall be followed for the protection of system equipment and devices to preclude damage by systems test pressures.

Safety precautions shall be observed to protect human life and equipment. Personnel not directly involved in pneumatic pressure testing shall be evacuated from the area.

3.2.1 Pressure Testing

Pressure tests shall be conducted with a composite gas consisting of dry nitrogen and the refrigerant that will be used in the system being tested.

Test gages shall have a 6-inch or larger dial with accuracy of plus or minus one-half of 1 percent of full-scale range. Dial graduations and pointer width shall be readable within one-quarter of 1 percent of full-scale range. Maximum permissible scale range for a given test shall be such that the pointer 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 days prior to use, test-gage number, and project number. Pressure shall be applied to field-erected piping system in accordance with ASHRAE-15 and ASME B31.5.

Structural integrity and leaktight ness under positive pressure shall be tested in accordance with the following basic procedures, modified as necessary to suit specific equipment:

Shutoff valves in the system under test shall be opened, except for connections to atmosphere.

Condenser purge valve and receiver drain valve shall be closed and cover caps shall be installed and tightened securely.

Refrigerant cylinder shall be connected to charging valve in a manner to preclude entry of dirt into system.

Charging valve shall be opened; refrigerant cylinder valve shall be cracked open. System pressure shall be raised to steady-state 20 psig. Charging valve and cylinder valve shall be closed and cylinder disconnected.

Optional preliminary low-pressure leak-detection methods may include

audible sound, visual bubbling, (swabbing of joints with standard high-film-strength soap solution), halogen gas-detector torch, ultrasonic detectors, and electronic refrigerant-detectors.

Leaks shall be repaired and low-pressure test shall be repeated.

When system is tight at 20 psig for not less than 4 hours, line shutoff valves shall be closed back to charging connection.

A cylinder of dry nitrogen shall be connected to the charging connection through a nitrogen gas pressure regulator. Pressure in this section shall be raised to the next shutoff valve in accordance with refrigerant test pressure specified in ASME B31.5 and ASHRAE-01.

Joints shall be tested with a flame or electronic halogen gas detector. Joints shall be repaired if necessary and test repeated.

Next shutoff valve shall be opened and test pressure raised in this section. All steps shall be repeated until entire system is tested.

Final test pressure shall be held for not less than 12 hours. There shall be no perceptible drop in pressure at the end of the test period. Correction of 0.3 psi will be allowed for each degree of change between initial and final temperature, plus for an increase in temperature and minus for a decrease.

Charging valve shall be closed and the nitrogen cylinder disconnected.

Nitrogen test gas shall be purged to the atmosphere, keeping factory-sealed assemblies isolated during purging. System components disconnected for test period and factory-sealed assemblies shall be connected. Shutoff valves shall not be opened before acceptance of field-piping high-vacuum tests.

System shall be dehydrated in a preliminary manner by passing dry hot air or nitrogen at 225 degrees F through the system. Direct heating of refrigeration system surfaces is not an acceptable practice.

3.2.2 Vacuum Testing

After a successful pressure test and preliminary dehydration, each system shall be connected to a high-vacuum pump capable of reducing absolute pressure in the system to a point where any water present will vaporize at a temperature appreciably below ambient temperature and will be withdrawn from the system. System shall be evacuated twice to a vacuum of 2.5 millimeters of mercury (mm Hg), absolute. First vacuum shall be held for not less than 1 hour and then broken with dry nitrogen. Second vacuum shall be held for not less than 6 hours at an ambient temperature of 40 degrees F or more. With the system isolated at 2.5 mm Hg vacuum, the pressure shall not increase noticeably. Vacuum shall be checked with the use of a Zimmerli gage. Neither pressure tests nor vacuum condition check shall be obtained with the system compressor.

During this test, pressures shall be recorded using Zimmerli, electronic, or calibrated micron gages.

Calibration certification shall be provided as specified under pressure testing herein.

3.2.2.1 Hermetic Compressor Systems

System shall be evacuated with a two-stage pump connected in parallel for 2 hours; the attained pressure shall be held for an additional 2 hours.

After satisfactory initial evacuation, pump shall be connected in series and system evacuated to an absolute pressure not higher than 0.10 mm Hg; i.e., 100 micrometer, at not less than 35 degrees F ambient. After this condition has been attained, the system shall be isolated from the pump. Pressure shall be maintained for 24 hours.

3.2.2.2 Open-Compressor System

System shall be evacuated with a high-vacuum pump to an absolute pressure not higher than 0.20 mm Hg; i.e., 200 micrometer, at not less than 35 degrees F ambient. After this condition has been attained, the system shall be isolated from the pump. Pressure shall be maintained for 12 hours.

Valves to sealed equipment shall be opened and the system shall be charged to normal operating condition.

3.2.3 Operating Test

After repairs have been made and tests completed, sealed equipment valves shall be opened, and system shall be charged with refrigerant and lubricant, if necessary. Compressor may then be operated. For systems containing 50 pounds or more of refrigerant, technician shall provide the Government an invoice that indicates the amount of refrigerant added, in accordance with 40 CFR Part 82

For the first 8 hours of operation under load, each system shall be operated with the refrigerant dryers in the circuit. If the sight glass or moisture indicator reveals moisture in the system, dryer cartridges shall be replaced and the operation shall be repeated. This procedure shall be followed until there is no indication of moisture in the system. Dryer cartridges shall be replaced and the dryers shall be bypassed. Oil levels shall be checked frequently and oil added only from sealed cans furnished by the compressor manufacturer.

System shall be operated for not less than 8 hours under full load. Refrigerant cycle pressures and temperatures shall be checked for correspondence to thermodynamic characteristics of refrigerant. Final check of equipment and piping shall be made with a halogen gas-leak detector.

If there is excessive hot-gas pulsation during operation, mufflers with not more than 1 psi drop at design conditions shall be provided. After installation of mufflers, steps necessary to bring system to specified operating condition shall be repeated.

Refrigeration system is now ready for operation for air-handling systems acceptance testing.

3.3 AIR AND HYDRONIC SYSTEMS BALANCING AND ADJUSTMENT

Operational balancing and adjustment of air-handling and hydronic systems shall be performed under the direction of an independent balancing agency certified by either AABC or NEBB, and whose field representative is certified by the same organization for the type of system(s) involved. All

work shall be done in accordance with SMACNA-07 and AABC MN-1 or NEBB-01, the requirements of the contract documents, and in the presence of the Contracting Officer.

Government reserves the right to require recalibration of any or all test apparatus in accordance with the frequency recommended by the component manufacturer, or when reasonable doubt of accuracy exists.

Equipment shall not be operated until properly lubricated and brought into specified service condition. In addition, all applicable requirements of Section 01750, "Equipment Alignment and Balancing for RCM", shall be completed prior to air and water balancing.

The following tests of system installation shall be completed successfully before beginning balancing and adjustment specified in this section:

Steam and condensate systems pressure and leakage testing shall be performed in accordance with Section 15183, "Steam and Condensate Systems".

Hydronic systems pressure and leakage testing shall be performed in accordance with requirements specified in Section 15625, "Hydronic Water Systems".

Refrigerant systems pressure, vacuum and operating tests shall be performed in accordance with requirements specified herein under "Refrigerant Systems Testing".

Air-handling systems structural and leakage testing shall be performed in accordance with requirements specified herein under "Air-Handling System Testing."

Components of the various air systems shall be adjusted to operate within the design and operating characteristics published by the equipment manufacturer. Government will require the services of an authorized representative of the manufacturer if the Contractor is unable to adjust any equipment.

Air- and hydronic-system final adjustments shall be permanently marked to be readily restorable if disturbed.

Systems acceptance is predicated upon successful completion of specified work, receipt by the Contracting Officer of certified data summarizing the performance of all systems within design intent, and approval thereof. Data shall be arranged by system and identified by apparatus and item, using standard forms, where possible, and supplementing with reasonable facsimiles, where necessary.

3.3.1 Air-Handling Systems

For new systems, air balancing shall be performed on the entire air distribution system.

For projects involving modifications to a portion of an existing area or building, the air balancing shall be performed on all the new or modified portions of the system. In addition, re-balancing of existing unmodified portions of the system shall be performed to the extent indicated on the drawings, to maintain the design airflow in other parts of the existing system. The method for this may be either of, or a combination of, the following as indicated:

After system modifications are complete, balance existing inlet/outlet devices in the existing system, or in the indicated portion of the system, to the airflow indicated and report the balancing data for those existing devices in the manner as specified below, in addition to the data for new devices.

Prior to system modifications, measure and record the existing airflow and static pressure in the existing branches that are not to be modified. After system modifications are complete, adjust the system to provide the same branch airflow and static pressure for the unmodified branches as was measured previously. Report these branch pressures and airflows, both before and after modifications, in addition to the report data for new devices as specified below.

For balancing of new systems, and any indicated rebalancing of existing portions of the system, review drawings and survey the system to verify that existing dampers, plus any new ones shown to be installed, are adequate for balancing. Bring any discrepancy or balancing provisions considered insufficient to the attention of the contracting officer for resolution prior to beginning any air balancing activities.

Balancing of belt driven fans with variable frequency drives (VFD) shall still be done by adjusting the belt drive so that the fan delivers the design airflow at the full speed setting of the VFD. Merely adjusting the VFD speed to get design airflow at some other speed is not acceptable.

3.3.1.1 Balancing, Adjustment, and Acceptance Criteria

Final volume conditions for all systems shall be within the following limits, unless otherwise indicated on drawings:

Air-handler, fan, duct main, hazardous exhaust inlets or hoods delivery: Plus 10 percent, minus 0 percent of designcfm at design temperature

Primary air delivery duct branch, individual inlets or outlets for HVAC system: Plus or minus 10 percent of design cfm at design temperature

3.3.1.2 Balancing and Adjustment, Apparatus and Procedures

Balancing and adjustment apparatus and procedures shall be in accordance with SMACNA-07, AABC MN-1, or NEBB-01.

Instrumentation shall be provided to record air movement data, motor kilowatt (kW) input, and power factor. If motor identification plate current value is exceeded, the next size larger motor, starter, and wiring (if necessary) shall be provided.

3.3.1.3 Test Reports

Test reports shall be provided on all systems tested together with test-apparatus data and air-diffusion device flow coefficients, and the following information, as applicable, as a minimum. Where Systems are equipped with airflow measuring stations, independent traverse readings shall be taken, and those readings as well as the airflow station indication shall be reported.

Air-handling apparatus data

Exhaust-fan data

Air-diffusion devices data

VAV Boxes minimum/maximum flow settings and data

Duct-traverse data for the following:

Main supply duct
Main exhaust duct
Outside air-intake duct
Other ducts as indicated

Duct zone-traverse data for the following:

All zones
Air-handling apparatus
Air-diffusion devices data
Each main duct, exhaust duct, and outside intake data

Filter apparatus data, including visual condition, inlet pressure, and differential pressure for each filter installation

Coil data, including visual condition, inlet pressure, and differential pressure for each coil installation

Pressure at inlet to face zone duct on multizone units

3.3.2 Hydronic Systems

3.3.2.1 System Balancing, Adjustment, and Acceptance Criteria

Systems final flow conditions shall be within the following limits:

Pump delivery: Plus 10 percent, minus 0 percent of design gallons per minute (gpm) at design temperature

Flow-station delivery: Plus or minus 10 percent of design gpm at design temperature

Pump delivery: Plus 5 percent, minus 0 percent of design gpm at design temperature

Flow station delivery: Plus or minus 5 percent of design gpm at design temperature

3.3.2.2 Test Apparatus and Procedures

Test apparatus shall consist of devices required for hydronic systems flow measuring and balancing including:

Pressure gages and fittings

Dry bulb thermometers

Wet bulb thermometers

Pyrometers

Balancing-cock adjustment wrenches

Differential-pressure gages or manometers

Thermometer wells, where necessary for balancing, but where permanent installation of thermometers is not indicated or required

Complete air balance shall have been accomplished before water balance begins.

3.3.2.3 Hydronic Systems Preparation

Hydronic systems shall be prepared in the following manner:

Proper installation of valves and balancing devices shall be verified.

Valves shall be opened to full-open position, including coil-stop valves, bypass valves, and return-line balancing cocks.

Strainer screens shall be removed and cleaned.

Water in each system shall be examined to determine that it has been treated.

Rotation of pumps shall be checked only after obtaining approval.

Expansion tanks shall be checked to determine that they are not air-bound and that system is full of water.

Air vents shall be checked at high points to verify proper installation and operation.

Temperature controls shall be set so that cooling coils are on full cooling, and heating coils are set on full heating.

Water-circulating pumps shall be set to proper gpm delivery.

Water flow through convertors shall be adjusted.

Leaving-water and return-water temperatures through convertors and chilled water temperature and pressure, entering and leaving the building, shall be checked.

Water temperature shall be checked at inlet side of cooling and heating coils. Note rise or drop of temperature from source, and air entering and leaving temperatures, and airflow readings for VAV systems.

Next, each coil shall be balanced.

Steam pressure shall be recorded, entering the building, leaving the pressure-reducing station, and entering each heating coil, and the air entering and leaving temperature at each coil shall be recorded.

Upon completion of flow reading and adjustment of coils, all settings shall be marked and all data recorded.

After adjustments to coils have been made, settings at pumps, chiller, and convertors shall be rechecked and readjusted if required.

Pressure drop through coils shall be measured at set flow rate on call for full cooling and on full heating.

Pressure drop across bypass valve shall be set to match coil full-pressure drop to prevent unbalanced flow conditions when coils are on full bypass.

Instrumentation shall be provided to record apparatus motor kW input and power factor. If motor identification plate current capacity and larger starter is exceeded, next-size larger motor and wiring shall be provided, as necessary.

3.3.2.4 Operational Test Report

Operational test report shall provide data on systems tested, test apparatus data, and orifice or Venturi data, and shall include the following information, as applicable, as a minimum:

For each heating and cooling element:

Inlet steam pressure

Inlet water temperature

Leaving water temperature

Refrigerant coil pressure

Inlet air temperature

Leaving air temperature

Air pressure drop across each element

Water pressure drop across each coil

Calculated and measured flow rates through coils and radiation elements

For each pump:

Balanced-condition suction and discharge pressures

Flow rate

Mechanical and electrical specifications of unit

Rated and actual amps per phase, kW input and power factor

For each apparatus such as chiller, cooling tower, and converter:

Inlet water temperature

Leaving water temperature

Pressure drop across units

Calculated and measured waterflow

Mechanical specifications of units

3.3.3 System and Temperature-Control Adjustment

3.3.3.1 Adjustment and Acceptance Criteria

After balance and adjustment operations have been completed, the system shall be tested as a whole to see that components perform as an integral part of the system and that temperature and conditions are evenly controlled. Corrections and adjustment shall be made as necessary to meet the specified design requirements.

3.3.3.2 System Test Report

Test report shall be provided on the system and shall include:

Outdoor temperature

Room-by-room temperature and humidity conditions (center of cooled area at table top)

Calculation for total British thermal units per hour (Btu/hr) cooling required, including time of day and dry bulb outside temperature

Calculation for total Btu/hr heating required, including time of day and dry bulb outside temperature

3.4 STEAM AND CONDENSATE SYSTEMS OPERATIONAL TESTING

Prior to acceptance of the work, completed systems shall be tested in the presence of the Contracting Officer. Hydrostatic and leakage tests shall be performed in accordance with Section 15183, "Steam and Condensate Systems", prior to operational testing.

System shall be subjected to operational and cyclic tests, as necessary, to determine that system functions and operates as required.

System components shall be adjusted for proper operation within the design and operating characteristics published by the component manufacturer. In addition to the services of an authorized representative of the manufacturer, the Government reserves the right to require the services of an authorized representative of a component manufacturer if the Contractor is unable to adjust a component. Contractor shall arrange for such services and defray the cost.

3.4.1 Operational Testing

System shall be cycled five times, from start to operating thermal conditions, to verify adequacy of construction, system controls, and component performance, unless otherwise approved.

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SECTION 16003

GENERAL ELECTRICAL PROVISIONS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2001) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

FEDERAL SPECIFICATIONS (FS)

FS W-J-800	(Rev F) Junction Box: Extension, Junction Box; Cover, Junction Box (Steel, Cadmium, or Zinc-Coated)

FEDERAL STANDARDS (FED-STD)

FED-STD 595	(Rev B) Colors Used in Government Procurement

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(1997) National Electrical Safety Code

MILITARY SPECIFICATIONS (MS)

MS MIL-T-704	(Rev K) Treatment and Painting of Material

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA Z 535.1	(1998) Safety Color Code

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL-00	(2001) Electrical Construction Equipment Directory

1.2 SUBMITTALS (Not Applicable)

1.3 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

It is the intent of these specifications and the contract drawings to provide a complete and workable facility.

Design drawings are diagrammatic and do not show all offsets, bends, elbows, or other specific elements that may be required for proper installation of the work. Such work shall be verified at the site. Additional bends and offsets, and conduit as required by vertical and horizontal equipment locations or other job conditions, shall be provided to complete the work at no additional cost to the Government.

Except where shown in dimensional detail, the locations of switches, receptacles, lights, motors, outlets, and other equipment shown on plans are approximate. Such items shall be placed to eliminate interference with ducts, piping, and equipment. Exact locations shall be determined in the field. Door swings shall be verified to ensure that light switches are properly located.

Equipment sizes indicated are minimum. Before installing any wire or conduit, the Contractor shall obtain the exact equipment requirements and shall install wire, conduit, disconnect switches, motor starters, heaters, circuit breakers, and other items of the correct size for the equipment actually installed. Wire and conduit sizes shown on the drawings shall be taken as a minimum and shall not be reduced without written approval.

1.4 CODES AND STANDARDS

Equipment design, fabrication, testing, performance, and installation shall, unless shown or specified otherwise, comply with the applicable requirements of NFPA 70 and IEEE C2 to the extent indicated by the references.

1.5 COORDINATION

Installation of the electrical work shall be coordinated with the work of other trades.

1.6 APPROVAL REQUIREMENTS

Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories (UL), Inc., the label of, or listing with re-examination, in UL-00 will be acceptable as sufficient evidence that the items conform to the requirements.

Where materials or equipment are specified to be constructed or tested in accordance with the standards of NEMA, ANSI, ASTM, or other recognized standards, a manufacturer's certificate of compliance indicating complete compliance of each item with the applicable NEMA, ANSI, ASTM, or other commercial standards specified will be acceptable as proof of compliance.

1.7 PREVENTION OF CORROSION

Metallic materials shall be protected against corrosion. Equipment enclosures shall be given a rust-inhibiting treatment and the standard finish by the manufacturer. Aluminum shall not be used in contact with earth. Dissimilar metals in intimate contact shall be protected by approved fittings, barrier material, and treatment. Ferrous metals such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials shall be hot-dip galvanized in accordance with ASTM A 123/A 123M for exterior locations and cadmium-plated in conformance with FS W-J-800 for interior locations.

1.8 HAZARDOUS AREA

Electrical work within any hazardous location shall meet the applicable requirements of NFPA 70, Chapter 5, Articles 500 through 517. The following definitions apply:

Explosion proof: A receptacle, fixture, device, or equipment enclosure that is designed to withstand explosion of a specified liquid, gas, vapor, or dust within the enclosure and to prevent the ignition of a specified gas, vapor, or dust surrounding the enclosure by sparks, flashes, or explosions of the specified liquid, gas, vapor, or dust that may occur within the enclosure. Enclosure shall be capable of operating at an external temperature that will not ignite a surrounding flammable atmosphere.

Hazardous location: An area where ignitable vapors or dust may cause a fire or explosion created by energy emitted from lighting or other electrical equipment or by electrostatic generation.

NFPA 70, Article 500-2 lists chemical atmospheres by groups A, B, C, and D. In addition, although not defined as a hazardous material by the NEC, oxygen concentrations (liquid and gaseous) are considered to provide a hazard because of the increased flammability of materials exposed to oxygen. Therefore, oxygen concentrations shall be classified under Group D.

PART 2 PRODUCTS

2.1 IDENTIFICATION PLATES

Identification plates shall be 3-layer black-white-black, engraved to show white letters on a black background. Letters shall be uppercase. 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 not less than 3/16-inch high. Identification plates having edges of 1-1/2 inches high and larger shall be beveled.

In addition to standard manufacturer's identification plates, GOMAR Tags, as specified in Section 01600, "Material and Equipment", shall be provided for each piece of electrical equipment. GOMAR Tags shall show the equipment number as shown on the drawings.

2.2 WARNING SIGNS

Each item of electrical equipment operating at 480 volts and above shall be provided with conspicuously located warning signs conforming to the requirements of Occupational Safety and Health Agency (OSHA) standards.

Any equipment with externally powered wiring shall be marked with a laminated plastic nameplate having 3/16-inch high white letters on a red background as follows:

DANGER - EXTERNAL VOLTAGE SOURCE

Safety color coding for identification of warning signs shall conform to NEMA Z 535.1.

2.3 ANCHOR BOLTS

Anchor bolts shall be provided for equipment placed on concrete equipment pads or slabs.

2.4 PAINTING

Enclosures of the following listed items shall be cleaned, primed, and factory-painted inside and outside in accordance with MS MIL-T-704.

ITEM	FINISH COLOR
Circuit Breakers	No. 61 gray (FED-STD 595)
Substations	No. 61 gray (FED-STD 595)
Switchgear	No. 61 gray (FED-STD 595)
Transformers	No. 61 gray (FED-STD 595)
Safety Switches	Manufacturer's standard
Panelboards	Manufacturer's standard
Electric Heaters	Manufacturer's standard
Motors	Manufacturer's standard
Limit Switches	Manufacturer's standard
Control Components	Manufacturer's standard

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be accomplished by workers skilled in this type of work. Installation shall be made so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors. Except as otherwise indicated, emergency switches and alarms shall be installed in conspicuous locations.

3.2 PAINTING APPLICATION

Exposed conduit, supports, fittings, cabinets, pull boxes, and racks, if not factory painted, shall be thoroughly cleaned and painted as specified in Section 09915, "Painting," unless otherwise noted. Work shall be left in a neat and clean condition at final completion of the contract.

Emergency equipment, such as fire-alarm junction boxes and covers, shall be cleaned, primed, and painted red. Color shall conform to FED-STD 595, Color 11105.

3.3 IDENTIFICATION PLATE INSTALLATION

Identification plates shall be fastened by means of corrosion-resistant steel or nonferrous metal screws. Hand lettering, marking, or embossed self-adhesive tapes are not acceptable.

3.4 EQUIPMENT PADS

Equipment pads shall be constructed with a minimum 4-inch margin around the equipment and supports.

3.5 CUTTING AND PATCHING

Contractor shall install his work in such a manner and at such time as will require a minimum of cutting and patching on the building structure.

Holes in or through existing masonry walls and floors in exposed locations shall be drilled and smoothed. Use of a jackhammer will be permitted only where specifically approved.

3.6 DAMAGE TO WORK

Required repairs and replacement of damaged work shall be done as directed by and subject to the approval of the Contracting Officer, and at no additional cost to the Government.

3.7 CLEANING

Exposed surfaces of wireways, conduit systems, and equipment that have become covered with dirt, plaster, or other material during handling and construction shall be thoroughly cleaned before such surfaces are prepared for final finish or painting or are enclosed within the building structure.

Before final acceptance, electrical equipment, including lighting fixtures and glass, shall be clean and free from dirt, grease, and fingermarks.

3.8 FIELD TESTING AND TEST EQUIPMENT

All Field testing specified in Divisions 16 electrical specification shall be made with test equipment specially designed and calibrated for the purpose. Test equipment used shall be calibrated and certified by an approved testing laboratory. Date of last calibration and certification shall not be more than 1 year old at the time of field testing.

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SECTION 16065

SECONDARY GROUNDING
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 3	(1995) Standard Specification for Soft or Annealed Copper Wire

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System

MILITARY STANDARDS (MIL-STD)

MIL-STD 889	(Rev B, Notice 2) Dissimilar Metals

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 467	(1993; 7th Ed) UL Standard for Safety Grounding and Bonding Equipment

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Grounding Rods
Ground Wires
Connectors and Fasteners
Bonding Materials
Accessories

SD-06 Test Reports

Test Reports shall be submitted for the following tests on grounding systems in accordance with the paragraph entitled, "Field Tests," of this section. Report shall include certified record of ground-resistance tests on each driven ground rod, ground rod assembly, and other grounding electrodes. Record shall include the number of rods driven and their depth at each location to meet the required resistance-to-ground measurements specified. A statement shall be included describing the condition of the soil at the time of measurement.

Bond Resistance Tests
Grounding Resistance Tests
Ground Isolation Tests
Continuity Isolation Tests

SD-11 Closeout Submittals

As-Built Drawings shall indicate the location of ground rods, mats, grids, building ground bus, supplementary grounding electrodes, steel building columns, and other metal structures connected to the grounding system.

Location of each ground rod and ground-rod assembly and other grounding electrodes shall be identified by letter in alphabetical order and keyed to the record of ground-resistance tests.

PART 2 PRODUCTS

2.1 GROUND RODS

Ground rods shall conform to the requirements of NFPA 70 and UL 467.

Ground rods shall be copper-clad steel rods not less than 3/4 inch in diameter and not less than 10-feet long per section. Ground rods shall be clean and smooth and have a cone-shaped point on the first section.

2.2 GROUND WIRES

Ground wires shall be in accordance with Section 16145, "Standard Wiring Systems."

Ground and bond wires for substations, main panels and distribution points, and ground rod connections shall be annealed bare copper conforming to ASTM B 3, stranded, with 98 percent conductivity. Wire size shall be in accordance with the grounding requirements of NFPA 70.

Ground wires for equipment receptacles for noncurrent carrying hardware, installed in conduit shall be soft drawn copper, in accordance with ASTM B 3, stranded, with green insulation. Wire size shall be as noted.

2.3 CONNECTORS AND FASTENERS

Grounding and bonding fasteners and connectors shall conform to the requirements of UL 467, and Section 16145, "Standard Wiring Systems."

Grounding and bonding fasteners shall be copper.

Bonding straps and jumpers shall be copper and shall have a cross-sectional area of not less than AWG No. 6. Bonding straps and jumpers for shock-mounted devices with pivot, hinged, or swivel joints shall be made of woven-wire braid wire.

PART 3 EXECUTION

3.1 BONDING AND GROUNDING

Bonding and grounding requirements shall be in accordance with NFPA 70.

3.2 GROUNDING ELECTRODES

Grounding electrodes shall include ground rods installed expressly for grounding systems.

Minimum ground rod section shall be 10 feet. Sections shall be threaded together and exothermically fusion welded.

Ground rods shall be installed so that the top of the rod is not less than 18 inches below finished grade.

3.3 GROUND GRIDS

Ground grids shall consist of a series of ground rods installed with interconnecting grounding conductors between ground rods. Ground rods shall be spaced as noted.

Ground grid shall be buried not less than 18 inches below the finish grade. Grounding conductors shall be not less than AWG No. 4/0 and shall be exothermically fusion welded together at crossover points and to ground rods.

3.4 BUILDING GROUNDS

Steel framework of the building shall be grounded with a driven ground rod at the base of every corner column and intermediate exterior columns at distances not greater than 60-feet apart. Grounding conductor shall be electrically connected to each ground rod and to each steel column and shall extend around the perimeter of the building. Grounding-conductor loop around the perimeter of the building shall be not less than AWG No. 4/0. Tap connections from the ground loop to the building steel shall be not less than AWG No. 4/0.

Building ground shall be buried not less than 18 inches below grade and 2 feet from the building foundation. Interconnecting grounding conductor between ground grid and building grounds shall be not less than AWG No. 4/0.

3.5 EQUIPMENT GROUNDING

Metallic raceway systems shall have electrical continuity with equipment individually and directly connected to the building ground, independent of the raceway system.

Enclosures for panelboards shall be connected to the building ground system. Equipment grounding conductors shall be sized in accordance with NFPA 70 and shall be connected from the building ground system to a copper ground-bus terminal strip located in the panelboard.

Polarized receptacles, lighting fixtures, and equipment enclosures shall be grounded with an identified (green color) insulated conductor, not smaller than AWG No. 12, connected to the branch circuit ground-bus terminal strip. Ground-bus terminal strip in each panelboard enclosure shall be isolated and independent of the system neutral terminal strip.

Indoor substations, transformers, switchboard frames, motors, generators, frames and tracks of cranes, and other miscellaneous equipment shall be individually and directly connected and grounded to the building ground. Current-carrying capacity of the grounding conductor shall be the same as the current-carrying capacity of the power conductors for circuits utilizing power wiring size AWG No. 2 and smaller. For circuits with power wiring larger than AWG No. 2, the grounding conductor shall be in accordance with NFPA 70, except that the grounding conductor shall be not smaller than AWG No. 2.

Noncurrent carrying metallic parts of electrical equipment, including metallic cable sheaths, conduit, raceways, and electrical structural members, shall be bonded together and connected to the ground grid or ground connection rods.

Secure ground systems shall be installed for power and instrumentation. Each system shall be independently connected to the building counterpoise as shown.

Secure ground systems shall consist of unspliced ground wires in individual welded or epoxied conduit runs from the secure area to the building counterpoise. Welding and epoxying shall conform to Section 16145, "Standard Wiring Systems."

3.6 GROUNDING CONNECTIONS

Ground connections shall be bonded connections in accordance with paragraph entitled, "Bonding."

Ground connections that are buried or in inaccessible locations shall be welded.

Connections in accessible locations shall be bolted. Connections to steel building columns in accessible locations shall be cast-copper-alloy clamp lugs bolted or exothermically fusion-welded to the structure.

Ground connection surfaces shall be cleaned and greased and foreign matter removed. Clad material shall not be penetrated in the cleaning process. Connection shall be made between like metals where possible. Where dissimilar metals are welded, brazed, or clamped, the weld kit manufacturer's instructions shall be followed. Connections between dissimilar metals shall not produce galvanic action in accordance with MIL-STD 889.

3.7 BONDING

3.7.1 Type of Bonds

Bonding of metal surfaces shall be accomplished by welding or structural joining methods.

3.7.1.1 Welding

Welding shall be by the exothermic process. Welding procedure shall include the proper mold and powder charge and shall conform to the manufacturer's recommendations.

Welding processes shall be of the exothermic fusion type that will make a connection without corroding or loosening. Process shall join all strands and shall not cause the parts to be damaged or weakened. Completed connection or joint shall be equal or larger in size than the conductors joined and shall have the same current-carrying capacity as the largest conductor.

3.7.1.2 Structural Joining Methods

Joints made with high-strength structural bolts, and clean unpainted faying surfaces shall be considered sufficiently bonded. A jumper shall be installed across the joint in the form of a AWG No. 4 bare copper wire exothermically welded at each end to the surfaces involved spanning the connection. Wire jumpers shall be used across joints employing miscellaneous machine bolts.

3.7.2 Cleaning of Bonding Surfaces

Surfaces that comprise the bond shall be thoroughly cleaned before joining. An appropriate abrasive shall be applied with a gentle and uniform pressure to ensure a smooth and uniform surface. Excessive metal shall not be removed from the surface. Clad metals shall be cleaned in such a manner that the cladding material is not penetrated by the cleaning process. Bare metal shall then be cleaned with an appropriate solvent to remove any grease, oil, dirt, corrosion preventives, and other contaminants. Cleaned area shall be made within one hour after cleaning. Joint shall be sealed and the exposed surfaces refinished within two hours to prevent oxidation. When additional time is required, a corrosion preventive compound shall be applied until the area can be refinished.

3.7.3 Bonding Straps and Jumpers

Jumpers shall be installed such that the vibration by the shock-mounted device shall not change its electrical characteristics.

Bonds shall be welded for outdoor locations unless a disconnect type of connection is required. When a disconnect is required, clamping with bolts shall be used. A tooth-type lockwasher shall be inserted between the strap and metallic member for each bolt.

Straps shall be bonded directly to the basic structure and shall not penetrate any adjacent parts. Straps shall be installed in an area that is accessible for maintenance.

Single straps shall be used for the bonds and shall be installed such that they will not restrict movement of structural members. Two or more straps shall not be connected in series.

Straps shall be installed such that they will not weaken structural members to which they are attached.

3.7.4 Equipment and Enclosure Bonding

Each metallic enclosure and all electrical equipment shall be bonded to ground. At least one copper connection shall be made from the system ground point to one or more enclosures in the area such that all enclosures and equipment provide a low-impedance path to ground when properly bonded together.

3.7.5 Bonding of Conduit and Raceway Systems

Metal conduit, fittings, junction boxes, outlet boxes, armored and metal sheathed cable, and other raceways shall be bonded as listed below. Care shall be taken to ensure adequate electrical contact at the joints and terminations.

3.7.5.1 Rigid Metal Conduit and Terminations

Threaded connections must be wrench-tight and there shall be no exposed threads. All ends of the conduit shall be reamed to remove burrs and rough edges. Conduits entering boxes and enclosures shall be bonded to the box with locknuts and grounding-type bushings. Locknuts that gouge into the metal box when tightened are not acceptable.

Conduit systems that are interrupted by PVC dielectric links shall be bonded separately on either side of the link. Dielectric link shall not be jumpered.

3.7.5.2 Flexible Metal Conduit

Flexible conduit shall have an integral grounding conductor.

3.7.6 Cable Tray Bonding

Cable tray sections shall be bonded together. Cable tray sections in tandem assembly shall be considered as having electrical continuity when these sections are bonded with the appropriate bolts. Bond straps shall be installed across expansion joints. Cable trays shall be bonded to the building ground system.

3.7.7 Protection of Finished Bonds

Finished bonds shall be protected by painting to match the original finish after the bond is made.

3.8 FIELD TESTS

The following tests shall be performed by the Contractor in the presence of the Contracting Officer.

3.8.1 Bond Resistance

Resistance of any bond connection shall not exceed 0.5 milliohm. Bonds that exceed this resistance shall be reworked by the Contractor at no additional cost to the Government.

3.8.2 Grounding Resistance Tests

Grounding systems shall be tested for ground resistance. Total resistance from any point on the ground network to the building counterpoise shall not

exceed 50 milliohms. Ground resistance tests are not required when grounding to an existing ground system or to building steel.

Ground resistance and counterpoise tests shall be made during dry weather, and no sooner than 48 hours after rainfall. Tests shall be conducted using the ratio method that measures the ratio of the resistance to earth of an auxiliary test electrode to the series resistance of the electrode under test and a second auxiliary electrode. Measurements shall be performed in accordance with IEEE Std 81.

Indicating instrument shall be self-contained and shall include a direct-current generator, synchronized current and potential reversers, crossed-current and potential coils, direct-reading ohmmeter, series resistors, and range-selector switch. Direct-reading ohmmeter shall be calibrated for ranges of 0 to 20 ohms and 0 to 200 ohms.

Auxiliary grounding electrodes shall be placed in accordance with instrument manufacturer's recommendations but not less than 50 feet apart, in accordance with IEEE Std 81.

3.8.3 Ground Isolation Test

Ground systems shall be tested for isolation from other ground systems.

3.8.4 Continuity Isolation Test

Tests for NEMA 5-20R receptacles (including GFCI receptacles) shall be performed with a receptacle circuit tester to ensure correct polarity and proper grounding. GFCI receptacles shall be tested to ensure that the trip mechanism functions properly.

Continuity test shall be performed on all power receptacles to ensure that the ground terminals are properly grounded to the facility ground system.

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SECTION 16135

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03/97

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SECTION 16135

CABLE TRAYS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2001) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 1008	(2001) Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Cable Trays
Supports

SD-02 Shop Drawings

Installation Drawings shall be submitted for Cable Trays in accordance with the paragraph entitled, "Installation," of this section.

SD-05 Design Data

Design Calculations shall be submitted verifying loading capacities for Supports.

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted for Cable Trays including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

PART 2 PRODUCTS

2.1 CABLE TRAY TYPE

Ladder cable trays shall consist of two longitudinal side members connected by individual transverse members.

Trough cable trays shall consist of continuous one-piece ventilated-bottom sections contained within longitudinal side members.

Channel cable trays shall consist of one-piece ventilated channel sections.

2.2 MATERIAL AND FABRICATION

Cable trays shall be high-strength corrosion-resistant aluminum Alloy No. 6063 or 5052-H32 or steel sheet in accordance with ASTM A 1008 with a zinc coating applied after fabrication.

Steel trays shall be hot-dipped galvanized finish in accordance with ASTM A 123/A 123M.

Prior to assembly, contact surfaces of trays shall be coated with an antioxidant compound. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Cable trays shall include splice and end plates, dropouts, and miscellaneous hardware.

2.3 SUPPORTS

Supports and hangers shall permit both vertical and horizontal adjustment, where possible. Horizontal and vertical tray supports shall provide an adequate bearing surface for the tray and shall have provisions for holddown clamps or fasteners. Vertical tray supports shall provide a secure means other than friction for fastening cable trays to supports.

When supported at 6-foot intervals, the cable trays shall be capable of carrying not less than 150 pounds per linear foot. Tray fittings shall have not less than the load-carrying ability of straight tray sections and shall have the manufacturer's minimum standard radius.

PART 3 EXECUTION

3.1 INSTALLATION

Cable trays shall be supported at not more than 6-foot intervals. Supports for horizontal-elbow tray fittings shall be placed within 2 feet of each fitting extremity and as recommended by the cable-tray manufacturer.

3.2 GROUNDING

Cable trays shall be properly grounded by means of a low-resistance conductor of sufficient capacity, but in no case smaller than AWG No. 2 copper for steel trays and AWG No. 1/0 copper for aluminum trays.

Grounding conductor shall be bonded to cable-tray sections and fittings by compatible bolted connections. Effective grounding shall be permanent and continuous with an impedance sufficiently low to limit the potential above ground and to facilitate operation of overcurrent devices in the circuit. Grounding and bonding cable trays shall be in accordance with NFPA 70.

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SECTION 16145

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SECTION 16145

STANDARD WIRING SYSTEMS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C80.1	(1990) Rigid Steel Conduit - Zinc Coated
ANSI C80.3	(1991) Electrical Metallic Tubing - Zinc-Coated
ANSI C80.5	(1990) Rigid Aluminum Conduit

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(2001) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM B 173	(1995) Standard Specification for Rope-Lay-Stranded Copper Conductors Having Concentric-Stranded Members, for Electrical Conductors
ASTM B 3	(1995) Standard Specification for Soft or Annealed Copper Wire
ASTM B 8	(1999) Specification for Concentric -Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 2301	(1999) Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 383	(1974; R 1992) Standard for Type Test Class 1E Electric Cables, Field Splices, and Connections for Nuclear Power Generating Stations

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 309-1	(1999-02) Plugs, Socket-Outlets and Couplers for Industrial Purposes

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electric Equipment (1000 Volts Maximum)
NEMA FB 1	(2001) Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable
NEMA KS 1	(2001) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
NEMA PR 4	(1983; R 1989) Plugs, Receptacles, and Cable Connectors of the Pin and Sleeve Type for Industrial Use
NEMA RN 1	(1998) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 3	(1999) PVC Fittings for Use With Rigid PVC Conduit and Tubing
NEMA WC 5	(1992) Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WD 1	(1999) General Color Requirements for Wiring Devices
NEMA WD 6	(1988) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1	(2000; 10th Ed) UL Standard for Safety - Flexible Metal Conduit
UL 1242	(2000; 3rd Ed) UL Standard for Safety - Intermediate Metal Conduit
UL 1569	(1999; 3rd Ed) Metal-Clad Cables
UL 1581	(1997; 3rd Ed) UL Standard for Safety - Reference Standard for Electrical Wires, Cables, and Flexible Cords
UL 20	(2000; 12th Ed) UL Standard for Safety General-Use Snap Switches
UL 486C	(2000; 4th Ed) UL Standard for Safety Splicing Wire Connectors
UL 50	(1995; 11th Ed) UL Standard for Safety - Enclosures for Electrical Equipment

UL 514A	(1996; 9th Ed) UL Standard for Safety - Metallic Outlet Boxes
UL 514B	(1997; 4th Ed) UL Standard for Safety Fittings for Conduit and Outlet Boxes
UL 6	(2000; 12th Ed) UL Standard for Safety - Rigid Metal Conduit
UL 651	(1995; 6th Ed) UL Standard for Safety Schedule 40 and 80 Rigid PVC Conduit
UL 797	(2000; 7th Ed) UL Standard for Safety - Electrical Metallic Tubing
UL 83	(1998; 12th Ed) UL Standard for Safety Thermoplastic-Insulated Wires and Cables
UL 854	(1999; 10th Ed) UL Standard for Safety Service-Entrance Cables
UL 870	(1995; 7th Ed) UL Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Conduit, Raceways and Fittings
Wire and Cable
Safety Switches
Wiring Devices
Boxes and Fittings
Occupancy Sensors

SD-06 Test Reports

Test Reports shall be submitted for Standard Wiring Systems in accordance with the paragraph entitled, "Field Testing," of this section.

The test report shall document the method of testing and the environmental conditions that existed at the time of the test.

PART 2 PRODUCTS

2.1 CONDUITS, RACEWAYS, AND FITTINGS

Conduit shall be 3/4-inch diameter minimum, except where specifically shown smaller on the contract drawings.

Conduit, connectors, and fittings shall be approved for the installation of electrical conductors.

2.1.1 Intermediate Metal Conduit

Intermediate metal conduit, including couplings, elbows, bends, and nipples, for use as a raceway for wire and cables in an electrical system shall conform to the requirements of UL 1242 as amended for thin or thick-wall types and shall also conform to NFPA 70. Interior and exterior surfaces of the conduit shall be protected with a metallic zinc coating.

2.1.2 Rigid Steel Conduit

Rigid steel conduit, including couplings, elbows, bends, and nipples, shall conform to the requirements of UL 6 and ANSI C80.1. Steel fittings shall be galvanized by the hot-dip process. Where indicated, and in corrosive areas, rigid steel conduit shall be polyvinylchloride (PVC) coated and conform to NEMA RN 1, Type 20.

Fittings for rigid steel conduit shall be threaded and shall conform to NEMA FB 1.

Gaskets shall be solid for fittings sized 1-1/2 inches and less. 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 shall be accessible after the work has been completed.

2.1.3 Rigid Plastic Conduit

PVC conduit shall be not lighter than Schedule 40. Rigid PVC shall be the slip-joint solvent-weld type, and fittings shall be unthreaded solid PVC. Conduit and fittings shall conform to UL 651 and NEMA TC 3.

2.1.4 Electrical Metallic Tubing (EMT)

EMT shall be rigid metallic conduit of the thinwall type in straight lengths, elbows, or bends and shall conform to ANSI C80.3 and the requirements of UL 797.

Couplings and connectors for indoor conduit 2-1/2 inches diameter and smaller shall utilize compression fittings. EMT connectors shall be the insulated-throat type, with a locknut. EMT fittings shall be steel; die cast zinc fittings are not acceptable. Fittings shall meet the requirements of NEMA FB 1.

2.1.5 Flexible Metallic Conduit

Flexible metallic conduit shall meet the requirements of UL 1.

Liquidtight flexible metallic conduit shall be provided with a protective

jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes. The use of liquidtight non-metallic flexible conduit is not acceptable.

Fittings for flexible metallic conduit shall meet the requirements of UL 514B, Type I box connector, electrical, Type III coupling, electrical conduit, flexible steel, or Type IV adapter, electrical conduit.

Fittings for liquidtight flexible metallic conduit shall meet the requirements of UL 514B, Type I box connector, electrical, Class 3 liquidtight flexible metallic conduit connectors.

2.1.6 Wireways and Auxiliary Gutters

Wireways and auxiliary gutters for use in exposed, dry locations shall be a prefabricated channel-shaped sheet metal trough with hinged or removable covers, associated fittings, and supports for housing, and protecting electrical wires and cables in accordance with UL 870.

Straight sections of trough, elbows, tees, crosses, closing plates, connectors, and hanging brackets shall be constructed from sheet steel of commercial quality not less than 16-gage. Sheet metal component parts shall be cleaned, phosphatized, and coated with a corrosion-resistant gray paint.

Straight sections of wireways and auxiliary gutters shall be solid or have knockouts as indicated in both sides and bottom, 3 inches on center.

Straight sections shall be not more than 5-feet long, with covers held closed with screws or with hinged covers held closed with spring catches.

2.1.7 Surface Metal Raceways

Surface metal raceways shall conform to the requirements of NFPA 70. Minimum size shall equal or exceed the capacity of 1/2-inch trade size conduit.

2.1.8 Surface Multiple-Outlet Assemblies

Surface multiple-outlet assemblies shall conform to the requirements of NFPA 70 and shall be provided with receptacles conforming to NEMA WD 1, NEMA PR 4 and NEMA WD 6, Figure 5-20R.

2.2 WIRE AND CABLE

Insulated current-carrying wire and grounding conductors shall be copper and shall conform to NFPA 70 and UL 1581. Wire bundles with cable ties shall be secured to the enclosure with sheet-metal screws. Self-sticking adhesive attachments are not acceptable.

2.2.1 Building Wire

Building wire for use in conduits, raceways, and wireways shall be single-conductor, 600-volt, heat- and moisture-resistant insulated wire suitable for use in wet or dry locations.

Conductors AWG No. 10 and smaller shall be solid round copper wire. Conductors AWG No. 8 and larger shall be standard concentric stranded copper wire. Conductors shall be not less than AWG No. 12, except that AWG

No. 14 shall be used for control wiring.

Building wire shall be Type THHN with insulation of PVC and nylon jacket, with a minimum temperature rating of 90 degrees C, or

Type THWN with insulation of PVC and nylon jacket, with a minimum temperature rating of 75 degrees C.

2.2.2 Lighting-Fixture Wiring

Lighting-fixture wire for outlet-box connection to incandescent-fixture lampholders shall be flexible seven-strand copper wire with insulation conforming to NFPA 70.

Lighting-fixture wire for use in fluorescent fixture wiring channels shall be flexible seven-strand or solid copper wire conforming to NFPA 70.

2.2.3 Switchboard Wire

Switchboard wire used for instrument and control wiring on the back of switchboards and hinged-front instrument panels shall be single-conductor, 600-volt, flame- and heat-resistant insulated wire not smaller than AWG No. 14 with a minimum temperature rating of 90 degrees C.

Conductors rigidly mounted on the back of switchboards and instrument panels shall be solid round, soft or annealed, copper wire conforming to ASTM B 3. Hinge connections shall be rope-lay-stranded copper conductors, Class H, conforming to ASTM B 173. All wires before stranding shall conform to ASTM B 3 for soft or annealed copper wire.

Switchboard wire shall be Type SIS with cross-linked thermosetting polyethylene insulation.

2.2.4 Direct-Burial Cable

Direct-burial cables for underground service entrance and underground feeders shall be single or multiple conductor as indicated, 600-volt, heat-and moisture-resistant Type USE or UF with a minimum temperature rating of 75 degrees C.

Conductors AWG No. 8 and smaller shall be solid, round, soft or annealed, copper wire. Conductors larger than AWG No. 8 shall be standard concentric stranded copper wire. Conductors shall be not smaller than AWG No. 12. Cable insulation shall be cross-linked thermosetting polyethylene.

A vulcanized outer jacket of heavy-duty neoprene compound shall completely cover and closely conform to the surface of the underlying assembly in accordance with UL 854.

2.2.5 Cable Tray Wire

Power and control wire installed in cable trays shall be Type TC cable 600 volts, with current-carrying capacity as determined by NFPA 70. Cable shall also comply with UL 83 and IEEE Std 383.

2.2.6 Standard Flexible Cable

Flexible multiconductor cable shall conform to UL 1581 for control and power below 600 volts, non-instrumentation type. Cable shall contain one

(green) grounding conductor and shall utilize a thermosetting or thermoplastic overall jacket in accordance with NEMA WC 5. A white conductor shall be included for the power neutral or grounded current-carrying conductor. Cable conductor insulation shall conform to NEMA WC 5.

2.2.7 Metal-Clad Cable, Type MC

Metal-clad cables 600 volts and less shall conform to and be listed as UL 1569 and shall comply with NFPA 70, Article 334. General construction shall consist of copper conductors with type THHN insulation, mylar assembly type and galvanized steel armor tape. Conductors shall be solid, soft-annealed copper in compliance with ASTM B 3 and/or ASTM B 8. The polyvinylchloride/nylon (polyamide polymer), Type THHN insulation/jacket shall be heat, flame, moisture resistant dielectric layer manufactured and tested in compliance with UL 83. All conductors, including the grounding conductor, shall be insulated as described above. All type MC cables shall include a ground wire. The circuit and grounding conductors shall be cabled (twisted) with a suitable lag length and covered with a polyethylene terephthalate (polyester) assembly tape. A galvanized steel armor shall be applied over the inner cable assembly with a positive interlock in compliance with UL 1569.

The number of conductors in the cable assembly shall be as indicated, and if not indicated, shall be as required by branch circuit use. The AWG size of the conductors shall be the same size as the branch circuit conductors to which they are connected.

2.2.8 Splices and Connectors

Splices in building wire AWG No. 8 and smaller and multiple conductor cables shall be made with wire nuts or with crimp-type connectors and compression tools to ensure a satisfactory mechanical and electrical connection.

Splices in building wire AWG No. 6 and larger and single-conductor cables shall be made with indentor crimp-type connectors and compression tools or with bolted clamp-type connectors to ensure a satisfactory mechanical and electrical connection.

Splices shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor. Splices in rubber-insulated neoprene-jacketed wire and cables shall be watertight.

Vinyl-plastic electrical insulating tape shall meet the requirements of ASTM D 2301. Where pressure-sensitive tape is used, the surface shall be cleaned free of dust, sand, or other foreign material and a primer recommended by the tape manufacturer shall be applied prior to taping.

Where indicated and for building wire AWG No. 8 and larger, terminations shall utilize screw-set pressure terminal lugs.

Where indicated, building wire AWG No. 10 and smaller shall be terminated in pre-insulated crimp ring lugs on terminal blocks.

Solid wiring shall be terminated with terminal blocks specifically designed for solid wire. Crimp type shall not be used on solid wire for termination.

Stranded wire shall use crimp or spade type lugs for termination on

terminal blocks.

2.3 SAFETY SWITCHES

Switches shall comply with NEMA KS 1.

Safety switches shall be the heavy-duty type with voltage, current rating, number of poles, and fusing as indicated. Switch construction shall be such that, with the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device shall be coinproof and shall be so constructed that an external tool (screwdriver) must be used to open the cover. Provisions shall be made to lock the handle in the "OFF" position, but the switch handle shall not be capable of being locked in the ON position.

Switches shall be the quick-make, quick-break type. Terminal lugs shall be approved for use with copper conductors.

2.4 FLUSH WIRING DEVICES

2.4.1 Wall Switches

Toggle (or snap) switches installed for the control of incandescent, fluorescent, and high intensity discharge lighting fixtures shall be heavy-duty, general-purpose, noninterchangeable flush devices conforming to UL 20 and NEMA WD 1, as indicated.

Switches shall be the toggle type: single-pole, double-pole, three-way, or four-way, two-position devices rated 20 amperes at 277 volts, 60 hertz, ac only, meeting the requirements of UL 20.

Each switch shall be provided with a separate grounding terminal.

Where two or more toggle switches are to be installed at the same location, they shall be mounted in one-piece ganged switch boxes, with a gang cover plate.

Combination toggle switch and single or duplex receptacles shall be mounted in two-gang switch boxes, with a combination two-gang cover plate.

Combination toggle switch and flush pilot light shall be interchangeable devices mounted in a one-gang switch box with a one-gang, two-opening cover plate. Pilot-light cover opening shall be fitted with a rectangular-shaped ruby-red plastic jewel in a metal frame.

2.4.2 Receptacles

Receptacles shall be 20-ampere, 125-volt ac, 2-pole, 3-wire, single or duplex grounded, heavy duty, conforming to NEMA PR 4, NEMA WD 1 and to the 5-20R configuration in NEMA WD 6.

Special purpose receptacles, straight-blade and locking types, shall be heavy duty, grounding type, and shall be in accordance with NEMA PR 4, NEMA WD 1, and NEMA WD 6. Receptacle (and plug) configurations shall be in accordance with NEMA WD 6.

Receptacles shall meet the requirements for retention of plugs, overload, temperature, and assembly security in accordance with NEMA WD 1.

Heavy duty pin and sleeve devices shall be in accordance with IEC 309-1. Cast-metal enclosures (back boxes) shall consist of cast-aluminum bodies, angle adapters, and receptacle housings with spring-loaded hinged lift covers, conforming to NEMA 250. Springs and hinge pins shall be corrosion-resistant steel. Screws and spring covers shall be chromium or cadmium -plated brass. Rubber or neoprene gaskets shall provide a positive seal against the entrance of water, dust, lint, fibers, and oil or coolant seepage. One plug shall be furnished with each receptacle.

2.4.3 Floor Outlets

Convenience outlets installed in floors for connection to 120-volt ac single-phase circuits shall consist of single or duplex receptacles enclosed in floor boxes with cover plates especially approved for this purpose.

2.4.4 Weatherproof Outlets

Convenience outlets installed in outdoor damp or wet locations for connection to 120-volt ac single-phase circuits shall consist of single or duplex Ground Fault Circuit Isolation (GFCI) receptacles enclosed in weatherproof outlet boxes, with gasketed cast-aluminum plates and spring-loaded hinged lift covers. Springs and hinge pins shall be corrosion-resistant steel. Screws and spring covers shall be chromium or cadmium -plated brass. Rubber or neoprene gaskets shall provide a positive seal against the weather.

2.4.5 Device Plates

Wall plates for flush toggle switches and receptacles shall be the appropriate type and size. Dimensions for openings in wall plates shall be in accordance with NEMA WD 1.

Wall plates for flush toggle switches and receptacles shall be corrosion-resistant steel not less than 0.040-inch thick, with beveled edges and a brushed satin finish. Mounting screws shall be corrosion-resistant steel with oval countersunk heads finished to match the plate.

2.5 BOXES AND FITTINGS

Boxes shall have sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of NFPA 70 and UL 514A. Boxes that are exposed to the weather or that are in normally wet locations shall be cast-metal with threaded hubs. Surface-mounted boxes on interior walls shall be cast-metal. Boxes in other areas shall be cadmium-plated or zinc-coated sheet metal.

2.5.1 Sheet Metal Boxes and Outlets

Outlet, switch, and junction boxes flush-mounted in walls or ceilings shall be octagon, square, or rectangular -shaped gang boxes as appropriate, with extension rings and covers.

Ceiling outlet boxes, from which surface- and pendant-mounted lighting fixtures are supported, shall be not less than 4 inches octagonal or square, with plaster rings 1-1/2 inches deep and shall be capable of withstanding a vertical downward force of 200 pounds for 5 minutes. All boxes in spaces above suspended ceilings shall be installed in accessible

locations. Boxes in otherwise inaccessible locations shall be accessible from ceiling space access panels. Ceiling-mounted outlet boxes for lighting fixtures, fittings, and wiring devices shall be symmetrical, except as otherwise indicated, and shall not interfere with the work of other trades.

Wall outlet boxes for single or two -gang flush wiring devices shall be not less than 4 inches square and 1-1/2 inches deep. Wall outlet boxes for multiple-gang flush wiring devices shall be not less than 4-1/2 inches wide and 2-1/2 inches deep. Wall-mounted outlet boxes for lighting fixtures and flush devices shall be capable of withstanding a vertical downward force of 50 pounds for a period of 5 minutes.

Boxes shall be formed from carbon-steel sheets of commercial quality, not less than 14-gage. Boxes shall be one-piece construction, zinc- or cadmium-plated in accordance with UL 514A. Boxes and box extension rings shall be provided with knockouts. Boxes shall be designed for mounting flush wiring devices.

Exposed surface junction boxes shall be installed only in equipment rooms and other utility areas.

Surface-mounted boxes shall be outside flange type with a matching solid flat cover. Flush-mounted boxes in walls and floors shall be the outside flange type with a matching recessed solid walkway cover. Box bodies and covers shall be galvanized by the hot-dip process in accordance with ASTM A 123/A 123M, Class A.

2.5.2 Cast-Metal Boxes

Cast-metal pull and junction boxes having an internal unobstructed air space of more than 100 cubic inches for connection to galvanized rigid steel conduits embedded in concrete or surface mounted shall be watertight rectangular boxes in accordance with UL 50 and NEMA FB 1.

Box bodies and covers shall be cast or malleable iron with a wall thickness not less than 1/8 inch at every point, of greater thickness at reinforcing ribs and cover edges, and not less than 1/4 inch in thickness at tapped holes for rigid steel conduit. Box bodies shall be provided with integral threaded conduit openings, as required. Mounting lugs shall be provided at the back or at the bottom corner of the box body. Boxes shall be provided with neoprene cover gaskets that will prevent the entrance of water into the enclosure. Covers shall be secured to box bodies with AWG No. 6 or larger brass or bronze flathead screws.

2.5.3 Pull and Junction Boxes

Pull and junction boxes shall be fabricated from carbon steel and shall conform to UL 50. Box dimensions and conduit connections shall conform to NFPA 70.

Boxes shall be welded construction with flat removable covers fastened to the box with machine screws. Seams and joints at corners or back edges of the box shall be closed and reinforced with flanges formed of the same material from which the box is constructed or by other means such as continuous welding which provides a construction equivalent to integral flange construction.

Boxes intended for outdoor use shall be cast with threaded hubs and

neoprene-gasketed covers.

Boxes intended for use in dry locations shall be sheet steel hot-dipped galvanized after fabrication conforming to UL 514A.

2.6 LIGHTING CONTROLS

2.6.1 Occupancy Sensors

Occupancy sensors shall be wall (switch) or ceiling mount, and sensor technology shall be passive infrared (PIR), ultrasonic, or dual-technology (combination PIR and ultrasonic) type, as indicated.

Sensors shall be provided with an LED indicator to verify that motion is being detected during testing and normal operation.

Sensors shall be equipped with ambient light level control. The ambient light level control shall be adjustable for setting a level of ambient illumination above which the sensor will not turn lights on when occupancy is sensed.

Switch sensors shall be the PIR type equipped with a pushbutton on/off switch for manual control, 180 degrees field of view, adjustable time delay settings from 30 seconds to 30 minutes, and zero crossing switching to increase sensor and ballast life. Sensors shall utilize DIP switches to adjust sensor settings.

Sensors shall be capable of detecting occupancy by means of heat and movement in the area of coverage. PIR sensors shall turn lighting systems on and off based on occupancy and ambient light levels. Random noises, lights, or motions such as air turbulence, heaters, lightning, telephones, and RFI shall not cause the sensors to activate.

2.6.2 Ceiling Sensors

Ceiling sensors shall be either PIR, ultrasonic, or dual-technology type, as indicated.

Sensors shall be equipped with a bypass manual override in order to override the sensor in the event of a failure. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall toggle switch until the sensor is repaired or replaced.

The sensors timing circuit shall be adjustable from approximately 1 minute to 15 minutes. Sensor coverage shall be as indicated on the drawings.

Ceiling sensors shall utilize power pack control units to provide 24VDC operating voltage to the sensor. Power packs shall have dry contacts capable of switching 20 amp fluorescent ballast loads (at 120 and 277 volts) and 13 amp incandescent loads at 120 volts.

2.6.2.1 PIR

Sensors shall be capable of detecting occupancy by means of heat and movement in the area of coverage. PIR sensors shall turn lighting systems on and off based on occupancy and ambient light levels. Random noises, lights, or motions such as air turbulence, heaters, lightning, telephones, and RFI shall not cause the sensors to activate.

2.6.2.2 Ultrasonic

Sensors shall be capable of detecting occupancy by sensing a change in pattern of reflected ultrasonic energy in the area of coverage. The sensors shall be crystal controlled, operate at a frequency of 22kHZ to 44kHZ, and shall not interfere with adjacent units when two or more sensors are within the same space. The sensors shall activate upon detection of movement of an average size person once within a maximum distance of 12 inches horizontally or vertically, and at an approximate speed of 12 inches per second. These factors represent the average condition required to maintain sensor activation. Random noises, lights or motions such as air turbulence, heaters, lightning, telephones, and RFI shall not cause the sensors to activate.

2.6.2.3 Dual-Technology

Sensors shall be capable of detecting occupancy by using a combination of PIR and ultrasonic detection technology in the area of coverage. The sensors shall activate upon detection of movement of an average size person once within a maximum distance of 12 inches horizontally or vertically, and at an approximate speed of 12 inches per second. These factors represent the average condition required to maintain sensor activation. Random noises, lights or motions such as air turbulence, heaters, lightning, telephones, and RFI shall not cause the sensors to activate.

2.6.3 Incandescent Dimmers

Incandescent dimmers shall be specification grade and shall provide full range dimming for the incandescent lighting as indicated. The dimmer rating shall be as indicated. The dimmer shall be a thin profile slide dimmer with a preset on-off push button. Provide appropriate multi-location/3-way remote interface switches to accommodate 3-way and 4-way switching, as required. Provide matching non-dimming thin profile switches as required when combinations of dimming and non-dimming switches are located adjacent to each other. Provide electronic soft start feature to help preserve lamp life. Provide EMF/RFI filters.

2.6.4 Fluorescent Dimmers

Dimming ballast control shall be a slide dimmer with on/off control. The slide dimmer shall be compatible with the electronic ballast and control the ballast light output over the full dimming range. The dimmer shall be equipped with a preset on-off push button. Provide appropriate multi-location/3-way remote interface switches to accommodate 3-way switching, as required. Provide matching non-dimming thin profile switches as required when combinations of dimming and non-dimming switches are located adjacent to each other.

PART 3 EXECUTION

3.1 INSTALLATION

Power, lighting, control emergency light and power, and special-service systems and all related components shall be installed in accordance with NFPA 70, and shall be enclosed in separate conduit or separate conduit systems.

Any run of EMT, intermediate, or rigid conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall contain

not more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting. Field bends shall be made in accordance with the manufacturer's recommendations, which normally require use of a one-size-larger bender than would be required for uncoated conduit. Installed conduit and fittings shall be free of dirt and trash and shall not be deformed or crushed. Empty conduit shall have a pull rope installed.

Conduit shall be installed with a minimum of 3 inches of free air space separation from mechanical piping.

Conduit in finished areas shall be installed concealed. Conduit passing through masonry or concrete walls shall be installed in sleeves.

Conduit shall be securely clamped and supported at least every 10 feet vertically and 8 feet horizontally. Galvanized pipe straps shall be fastened to structure with bolts, screws, and anchors. Wooden masonry plugs shall not be used.

Conduit and boxes shall not be supported from T-bar ceiling wires.

All recessed outlet boxes in non-combustible walls or ceilings shall be installed flush, such that the outlet box is set back less than 1/16-inch or protrudes less than 1/16 inch from the face of the ceiling or wall.

Conduit connections to boxes and fittings shall be supported not more than 36 inches from the connection point. Conduit bends shall be supported not more than 36 inches from each change in direction. Conduit shall be installed in neat symmetrical lines parallel to the centerlines of the building construction and the building outline. Multiple runs shall be parallel and grouped whenever possible on common supports.

Conduit and raceway runs in or under concrete, in damp, corrosive, or outdoor locations, in hazardous areas, where subject to mechanical damage, or intended for conductors rated over 600 volts, shall be rigid steel conduit. Conduit joints in corrosive areas shall be painted with corrosion or acid-inhibiting compounds.

Ends of conduit extending from the interior to the exterior of the building and portions of interior conduit exposed to widely varying temperatures shall be sealed to prevent the passage of air within the conduit. Conduit shall be sloped to drain and shall be provided with drainage fittings at the lower end of the run. Curved portion of conduit bends shall not be visible above the finished floor. Underground service entrance and feeder conduit entering or leaving the building above the ground floor shall be terminated in a pull box.

Expansion fittings with flexible ground strap shall be provided in conduit runs crossing building expansion joints.

Underground portions of conduit runs shall be painted with bitumastic or shall be provided with a factory-applied coating of PVC not less than 0.20 inch thick. Underground conduit encased in concrete does not require a protective coating of PVC. When the factory-applied coating is chosen by the Contractor, any nicks, cuts, or other abrasions shall be wrapped with a single layer of 0.010-inch thick pressure-sensitive PVC tape, half-lapped to obtain a minimum thickness of 0.20 inch. Couplings shall be wrapped with pressure-sensitive tape, as described above, over the coupling and for 2 inches on each side of the coupling. When precoated couplings designed

for the purpose are used, taping may be omitted provided the manufacturer's adhesive is used between the coating on the coupling and the coating on the conduit. Depth of buried conduit shall be in accordance with NFPA 70 or as indicated on the contract drawings.

All underground conduits or ductbanks shall be provided with a metallic warning tape. Warning tape shall be a yellow PVC ribbon with a non-ferric metallic core, a minimum 2 inches wide, and continuously marked "CAUTION - ELECTRICAL SERVICE BELOW". Warning tape shall be buried in the trench approximately 8 inches below the surface and run continuously parallel with and above the conduit or ductbank.

Exposed ends of underground or outdoor conduit without conductors shall be sealed with watertight caps or plugs.

Bushings shall be provided on the open ends of conduit containing conductors. Insulated bushings shall be provided for conduits containing conductors AWG No. 4 or larger with an insulating ring an integral part of the bushing.

Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit in a manner that will not impair the function of the equipment. Sections of flexible steel conduit shall be not more than 6 feet long and shall be installed only in exposed or accessible locations. Interior surfaces of conduit shall be free from burrs and sharp edges which might cause abrasion of wire and cable coverings. Ends of flexible steel conduit shall be provided with grounding bushings and approved fittings.

Bonding wires shall be used in flexible conduit for all circuits. Flexible conduit shall not be considered a ground conductor.

Liquidtight flexible metallic conduits shall be used in wet and oily locations and to complete the connection to motor-driven equipment.

Wire or cable shall not be installed in conduit until the conduit system is completed; the inner surfaces of conduit shall be clean and dry.

A nylon or polypropylene pull rope with a tensile strength not less than 130 pounds shall be installed in empty conduit.

3.1.1 Installation of Rigid Metal Conduit

Ends of conduit shall be cut square, reamed and threaded, and joints shall be brought butt-to-butt in the couplings. Joints shall be mechanically tight. Conduit shall be protected against damage and the entrance of water or foreign material during construction.

Ninety-degree bends of conduit with a diameter larger than 1 inch shall be made with factory-made elbows. Conduit elbows larger than 2-1/2 inches shall be long radius. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Changes in directions of runs shall be made with symmetrical bends or cast-metal fittings.

At connections to sheet metal enclosures and boxes, a sufficient number of threads shall project through to permit the bushing to be drawn tight against the end of the conduit, after which the locknut shall be pulled up sufficiently tight to draw the bushing into firm electrical contact with the box. Conduit shall be fastened to sheet metal boxes and cabinets with two locknuts where required by NFPA 70 where insulating bushings are used,

where bushings cannot be brought into firm contact with the box, and where indicated.

Conduit joints shall be made with tapered threads set firmly. Each length of conduit cut in the field shall be reamed before installation. Where conduit is threaded in the field, each threaded end shall consist of at least five full threads. Corrosion-inhibitive compound shall be used on conduit threads in exterior areas.

Conduit stubbed-up through concrete floors for connections to free-standing equipment except motor-control centers, cubicles, and other such items of equipment shall be provided with a flush coupling if the floor slab is of sufficient thickness; if not, a floor box shall be provided and 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 Installation of Rigid PVC Conduit

Rigid PVC conduit for underground work shall be encased in a concrete envelope or direct buried as specified for underground ducts. Where suitable protection is provided, PVC can be run exposed particularly in high corrosion areas.

A continuous, bare, soft-drawn copper ground wire shall be run in conduit with conductors and shall be solidly connected to ground at each end. Ground wires shall be sized in accordance with NFPA 70.

Conduits or ductbanks shall be cleaned with a brush and a mandrel pulled through before the conductors are installed.

Rigid PVC conduit shall be stored on a flat surface and shall be protected from the direct rays of the sun.

3.1.3 Installation of EMT

EMT shall be cut square and reamed to remove burrs and rough surfaces.

Field-made bends and offsets shall be avoided where possible but, where necessary, shall be made with an approved hickey or conduit-bending machine. Changes in direction of runs shall be made with symmetrical bends or approved metal fittings.

3.1.4 Installation of Wireways and Auxiliary Gutters

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. Unused conduit openings shall be plugged.

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 not contain switches, overcurrent devices, appliances, or apparatus and shall be not more than 30 feetlong.

3.1.5 Installation of Flexible Metallic Conduit

Flexible metallic conduit shall be installed in accordance with NFPA 70. A

grounding green conductor shall be installed in all runs. Connections to motors and vibrating equipment shall be made with flexible metallic conduit.

3.1.6 Installation of Metal-Clad Cables, Type MC

Metal-clad cables, type MC, shall be installed in accordance with the applicable requirements of NFPA 70, Articles 300 and 334, and as indicated on the construction drawings. MC cable shall not be run horizontally in concealed wall cavities. MC cable shall not be supported from T-bar ceiling wires.

3.2 INSTALLATION OF WIRING

Raceways shall be completely installed, with interiors protected from the weather, before proceeding with the installation of wires and cables. Conductors of special-service systems and emergency light and power systems shall not occupy the same enclosure with light and power conductors or the same enclosure with each other. Conductors shall be continuous with splices and connections made in outlet, junction, or pull boxes only. All control wiring shall be continuous between components and/or terminal boards.

Phase conductors and the neutral conductor of each branch or feeder circuit shall be contained in a single enclosure or paralleled in separate enclosures to avoid overheating the raceway by electromagnetic induction. Conductors and conduit in parallel shall be the same length and size, shall have conductors of the same type of insulation, shall be terminated at both ends in a manner to ensure equal division of the total current among conductors, and shall have a separate neutral conductor in each conduit.

Sharing of a common neutral between single phase circuits, connected to different phases, shall not be permitted.

Conductors installed in heavy-wall rigid steel conduit and EMT shall have allowable current-carrying capacity and ampere ratings in accordance with NFPA 70. Larger-sized conductors shall be used to compensate for derating factors when more than three current-carrying conductors are installed in raceways and when conductors are installed in wet locations.

Conductors 600 volts and below shall be color coded in accordance with the following:

CONDUCTOR	120/208 COLOR	480/277 COLOR
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	White/Gray
Equipment Grounds	Green	Green

Conductors up to and including AWG No. 10 shall be manufactured with colored insulating materials. Conductors larger than AWG No. 10 shall have ends identified with colored plastic tape in outlet, pull, or junction boxes. Control circuit conductors shall be identified at each connection

point.

Connectors and splices shall conform to UL 486C and shall be made in approved enclosures utilizing solderless pressure connectors and adequate insulation with vinyl-plastic electrical insulating tape. Conductors and materials used in a splice, tap, or connection shall be thoroughly cleaned prior to makeup to ensure good electrical and mechanical connections. Conductor identification shall be provided 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 that shown on approved shop drawings. Hand lettering or marking is not acceptable. Control-circuit terminals of equipment shall be properly identified by color-coded insulated conductors, number-coded plastic self-sticking printed markers, or permanently attached metal-foil markers. Cable fittings shall conform to UL 514B; insulating tape shall conform to ASTM D 2301.

Where several feeders pass through a common pullbox, the feeders shall be tagged to clearly indicate the electrical characteristics, circuit number, and panel designation.

Grounding shall be provided in accordance with NFPA 70. Noncurrent-carrying parts of electrical equipment shall be bonded and grounded together.

3.3 DIRECT-BURIAL CABLE

Direct-burial cable shall comply with the following requirements:

Minimum width and depth of trenches shall be as indicated on the drawings.

Minimum depth of cable rated 600 volts and under shall be 24 inches.

Minimum depth of cable rated 600 volts and under in conduit shall be 18 inches.

Direct-burial cable shall be placed in the trench on top of a 3 to 4 inch layer of screened sand or fill dirt.

A layer of screened sand or fill dirt 6 to 8 inches thick shall be laid on top of the cable and tamped tightly.

Direct buried cable shall be provided with a metallic warning tape. Warning tape shall be a yellow PVC ribbon with a non-ferric metallic core, a minimum 2 inches wide, and continuously marked "CAUTION - ELECTRICAL SERVICE BELOW". Warning tape shall be buried in the trench approximately 8 inches below the surface and run continuously parallel with and above the cable.

Where trenches cut roadways or other existing paved areas used for vehicular traffic, the existing pavement shall be sawcut prior to excavation, the pavement removed, and the trench excavated to the required depth. After the cable or conduit has been laid, the trench shall be backfilled and compacted in accordance with Section 02300, "Earthwork." Backfill shall be free of roots, trash, debris, and stones.

3.4 SAFETY SWITCHES

Switches shall be securely fastened to the supporting structure or wall

utilizing a minimum of four fasteners. Sheet metal screws and small machine screws shall not be used for mounting. Switches shall not be mounted 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.

3.5 WIRING DEVICES

3.5.1 Wall Switches and Receptacles

Wall switches and receptacles shall be so installed 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.

3.5.2 Device Plates

Device plates for switches that are not within sight of the load controlled shall be suitably identified with a description of the load and the panelboard and circuit number that serves the load.

Device plates and receptacle cover plates shall be provided with an identification label showing the panelboard and circuit number. Identification label shall be mounted on the outside of the cover plate.

Identification labels shall be 1/2 inch self adhesive label with 3/16 inch letters. Label shall be white background with black lettering for 208/120 volt circuits and white background with red lettering for 480/277 volt circuits.

3.6 BOXES AND FITTINGS

Pullboxes shall be furnished and installed 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.

Boxes and enclosures shall be securely mounted to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

Bonding jumpers shall be used around concentric or eccentric knockouts.

Approximate mounting height of wall-mounted outlet and switch boxes, measured between the bottom of the box and the finished floor, shall be as follows:

LOCATION	MOUNTING HEIGHT
Receptacles in offices	18 inches
Receptacles in corridors	18 inches
Receptacles for clocks	96 inches
Switches for light control	48 inches
Thermostats	60 inches

LOCATION MOUNTING HEIGHT

3.7 IDENTIFICATION PLATES

Red identification plates reading CAUTION: 480/277 VOLTS shall be provided in switch and outlet boxes containing 277- or 480-volt circuits (excluding lighting control toggle switches). An identification plate marked DANGER: 480 VOLTS shall be provided on the outside of 480-volt enclosures. Identification plate shall use white lettering on a red laminated plastic.

Any equipment with externally powered wiring shall be marked with a laminated plaster nameplate having 3/16-inch high white letters on a red background as follows:

DANGER - EXTERNAL POWER SOURCE

Nameplate shall include a description of the external power source. An example is a double-ended loadcenter (secondary unit substations) that utilizes an uninterruptible power supply system for control voltage.

3.8 FIELD TESTING

After completion of the installation and splicing, and prior to energizing the conductors, wire and cable shall be given continuity tests to ensure that no short circuits or accidental grounds exist.

Insulation tests shall be performed on all ungrounded and neutral conductors AWG No. 2 and larger as specified herein.

Necessary test equipment, labor, and personnel shall be provided by the Contractor to perform the tests, as herein specified. Continuity tests shall be conducted using a dc device with bell or buzzer.

Wire and cable in each voltage classification shall be completely isolated 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.

Insulation tests on circuits rated 480-volts and less shall be conducted using a 500- or 1,000-volt insulation-resistance test set. Readings shall be taken every minute until three equal and consecutive readings are obtained. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Insulation tests on circuits rated 240 volts or less, shall be conducted using a 500- or 1,000-volt insulation-resistance test set. Readings shall be taken after 1 minute and until the reading is constant for 15 seconds. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Phase-rotation tests shall be conducted on all three-phase circuits using a phase-rotation indicating instrument. Phase rotation of electrical connections to connected equipment shall be clockwise, facing the source.

Final acceptance will depend upon the successful performance of wire and cable under test. No conductor shall be energized until the installation is approved.

-- End of Section --

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SECTION 16225

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09/96

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SECTION 16225

MOTORS
09/96

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ANTI-FRICTION BEARING MANUFACTURERS ASSOCIATION (AFBMA)

AFBMA 11	(1990) Load Ratings and Fatigue Life for Roller Bearings
AFBMA 9	(1990) Load Ratings and Fatigue Life for Ball Bearings

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 112	(1996) Standard Test Procedure for Polyphase Induction Motors and Generators

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 1940/1	(1986) Mechanical Vibration - Balance Quality Requirements of Rigid Rotors - Part 1: Determination of Permissible Residual Unbalance

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA MG 1	(1998; Rev. 1) Motors and Generators

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Outline Drawings for Motors shall indicate overall physical features, dimensions, ratings, service requirements, and weights of equipment.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following

items:

Motors
Enclosures

SD-05 Design Data

Equipment and Performance Data shall be submitted for Motors consisting of use life, system functional flows, safety features, and mechanical automated details. Curves indicating tested and certified equipment response and performance characteristics shall also be submitted.

For Electric Motors specified to meet a special vibration class in accordance with NEMA MG 1, indicate number of:

Rotor Bars
Stator Slots
Rotational Speed
Cooling Fan Blades
Bearing Manufacturer
Bearing Style
Bearing Type
Balls/Elements
Commutator Bars
Communtator Brushes

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted for Motors including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

SD-07 Certificates

Certificates of Compliance shall be submitted for the following tests showing conformance with the referenced standards contained in this section. Certified copies of previous test reports on identical motors may be submitted in lieu of factory test reports.

Efficiency
Power-Factor
Service Factor
Temperature Rise
Noise
Balance
Full-Load Torque
Locked-Rotor Torque
Pull-up Torque
Breakdown Torque
Insulation Resistance
Winding Resistance
High-Potential tests

PART 2 PRODUCTS

2.1 EQUIPMENT

Design, fabrication, testing, and performance of motors shall be in accordance with NEMA MG 1 and ISO 1940/1.

Testing and performance of polyphase induction motors shall be in accordance with IEEE Std 112, Method B.

Efficiency labeling shall be in accordance with NEMA MG 1.

Allowable balance limits shall be in accordance with ISO 1940/1, Table 1.

2.2 MOTOR TYPES

Motors of Open Drip-Proof (ODP) or Totally Enclosed Fan-Cooled (TEFC) type, and with speeds of 1200, 1800, or 3600 rpm, shall have a minimum acceptable nominal full-load motor efficiency no less than that shown in the table below. All HVAC pumps and fans with motors 0.75 kW and above shall be equipped with motors meeting these requirements. Standard efficiency motors shall be used for equipment designated for emergency use only, such as fire pumps, or fans which function only for smoke evacuation or pressurization. Motor types other than ODP and TEFC are exempted from these minimum efficiency requirements.

MINIMUM NOMINAL MOTOR EFFICIENCIES

		Open Drip-Proof (ODP)			Totally Enclosed Fan-Cooled (TEFC)		
Motor Size (HP)	(kW)	1200 RPM	1800 RPM	3600 RPM	1200 RPM	1800 RPM	3600 RPM
1	0.75	82.5	85.5	80.0	82.5	85.5	78.5
1.5	1.2	86.5	86.5	85.5	87.5	86.5	85.5
2	1.5	87.5	86.5	86.5	88.5	86.5	86.5
3	2.2	89.5	89.5	86.5	89.5	89.5	88.5
5	3.7	89.5	89.5	89.5	89.5	89.5	89.5
7.5	5.6	91.7	91.0	89.5	91.7	91.7	91.0
10	7.5	91.7	93.0	91.0	92.4	92.4	91.7
20	15	92.4	93.0	92.4	92.4	93.0	92.4
25	19	93.0	93.6	93.0	93.0	93.6	93.0
30	22	93.6	94.1	93.0	93.6	93.6	93.0
40	30	94.1	94.1	93.6	94.1	94.1	93.6
50	37	94.1	94.5	93.6	94.1	94.5	94.1
60	45	95.0	95.0	94.1	94.5	95.0	94.1
75	56	95.0	95.0	94.5	95.0	95.4	94.5
100	75	95.0	95.4	94.5	95.4	95.4	95.0
125	93	95.4	95.4	95.0	95.4	95.4	95.4
150	112	95.8	95.8	95.4	95.8	95.8	95.4
200	150	95.4	95.8	95.4	95.8	96.2	95.8
250	190	95.4	96.2	95.8	95.6	96.2	95.9
300	220	95.4	95.0	95.4	95.4	96.1	95.8
350	260	94.5	95.4	95.0	94.5	96.2	94.8
400	300	94.1	95.8	95.0	94.5	95.8	94.5
450	340	94.5	95.4	95.4	94.5	94.5	94.5
500	370	94.5	94.5	94.5	94.5	94.5	94.5

MINIMUM NOMINAL MOTOR EFFICIENCIES

Motors shall be of the following types:

1/3 HP and smaller, single phase - capacitor start

1/2 HP and larger, three-phase - induction squirrel-cage type, NEMA Design B, having normal starting torque and low starting current

Motors shall be designed for across-the-line starting and shall be designed with torque characteristics to carry the specified rated starting load.

Motors shall have factory-sealed ball bearings with an L-10 rated life of not less than 30,000 hours in accordance with AFBMA 9 or AFBMA 11.

Motors for use with variable frequency drives shall be definite purpose inverter-fed type in accordance with Section IV, Part 31, of NEMA MG 1.

2.3 SIZES OF MOTORS

2.3.1 Motors

Motors shall be a sufficient size for the duty to be performed and shall not exceed the full-load rating when the driven equipment is operating at specified capacity under the most severe loading conditions.

2.3.2 Electrically Driven Equipment

When electrically driven equipment differs from that indicated, adjustments shall be made to the motor size, wiring and conduit systems, disconnect devices, and circuit protection to accommodate the equipment actually installed, at no additional cost to the Government. Control and protective devices shall be in accordance with Section 16286, "Overcurrent Protective Devices."

2.4 VOLTAGE RATINGS

Motors shall have the following minimum voltage ratings:

MOTOR SIZE			MOTOR
MOTOR TYPE	HORSEPOWER	SERVICE	VOLTAGE RATING
Fractional horsepower, single-phase	1/3 and smaller	120/208-volt, 3-phase, 4-wire	115-volt, 60-hertz
Fractional and integral horsepower, 3-phase	1/2 and larger	120/208-volt, 3-phase, 4-wire	200-volt, 3-phase 60-hertz
Fractional and integral horsepower, 3-phase	1/2 and larger	480-volt, 3-phase, 3-wire	230/460-volt, 3-phase, 60-hertz

2.5 TEMPERATURE RATING AND INSULATION

Motors shall be designed for continuous operation at the rated full load in an ambient temperature of 104 degrees F.

Insulation level shall be at least Class B.

2.6 MOTOR HOUSINGS

The motor housing shall have a smooth surface in the vertical, horizontal, and axial directions at each bearing housing for attaching a magnet mounted accelerometer in order to monitor the motor vibration. The surface shall be on the bearing housing. The axial surface will be as close to the motor centerline as possible. The surface will have a finish of 63 micro-inch minimum. Diameter of finished surface shall be 2 inch minimum and must be corrosion resistant. As an option sound disks can be used to meet the smooth surface requirement. Disk shall have a minimum thickness of 3/8 inch.

Surface shall be level within 1 degree or .001 inch

The smooth surface shall be identified(using a label or plate) "Vibration data collection point - Do Not Paint"

2.6 MOTOR ENCLOSURES

Motors installed in indoor, clean, dry, nonhazardous locations shall have open-type drip-proof enclosures. Enclosures shall have a hinged access cover at each vibration collection point. Cover must be large enough to enable the placement of a magnet/accelerometer data collection instrument.

Motors installed in indoor, wet, nonhazardous locations shall have open splash-proof enclosures. Enclosures shall have a hinged access cover at each vibration collection point. Cover must be large enough to enable the placement of a magnet/accelerometer data collection instrument.

Motors installed in indoor, nonhazardous locations where it is necessary to protect the motor from dirt, moisture, chemical fumes, or other harmful ingredients in the surrounding atmosphere shall be the totally enclosed type, with either of the following:

Totally enclosed, not fan-cooled, enclosures not equipped for cooling by means external to the enclosing parts.Enclosures shall have a hinged access cover at each vibration collection point. Cover must be large enough to enable the placement of a magnet/accelerometer data collection instrument.

Totally enclosed fan-cooled enclosures for exterior cooling by means of a fan or fans integral with the machine but external to the enclosing parts.Enclosures shall have a hinged access cover at each vibration collection point. Cover must be large enough to enable the placement of a magnet/accelerometer data collection instrument.

Motors installed in outdoor, nonhazardous locations shall have waterproof enclosures.

Motors installed in hazardous locations shall be totally enclosed with enclosures designed to prevent the free exchange of air between the inside

and outside of the case and ignition of the surrounding atmosphere from within the case. Type of enclosure shall be approved for the class and group of hazard in which the motors are located.

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 accessable. Data collection box shall be rated NEMA 4R.

2.7 SERVICE FACTOR

Service factor of general purpose and other open ac motors shall be in accordance with NEMA MG 1.

Totally enclosed ac motors shall have a service factor of 1.15.

2.8 FACTORY TESTS

Motors shall be factory-tested in accordance with the requirements of NEMA MG 1. Polyphase induction motors shall be factory-tested in accordance with IEEE Std 112, Method B. Tests shall consist of measurements of voltage, frequency, speed, and current under no-load conditions; voltage, frequency, and current under locked-rotor conditions; and efficiency, noise, power factor, and thermal protection. Routine tests on wound-rotor induction motors shall include the measurement of wound-rotor open-circuit voltage across the slip rings under locked-rotor conditions. Electrical tests shall consist of winding resistance, insulation resistance, and high-potential tests. Certified copies of Factory test results shall be submitted to the responsible systems engineer for approval prior to shipment from the factory. Previous test reports on identical motors are not acceptable for these tests.

PART 3 EXECUTION

3.1 INSTALLATION

Motors shall be installed, aligned, and connected in accordance with the equipment manufacturer's instructions, and in accordance with Section 01750, "Equipment Alignment and Balancing for RCM".

Alignment of motors shall be rechecked and adjusted as required after the motor has been in operation for not less than 48 hours.

3.2 SITE TESTING

Perform continuity and insulation tests for motors on motor driven equipment after the installation is completed and before the equipment is energized. Motors shall be inspected for damage, moisture, alignment, proper lubrication, oil leaks, phase identification, and cleanliness before conducting tests. Motors shall be completely isolated from the source of supply before conducting the tests.

Insulation tests:

Insulation tests on 480-volt motors shall be conducted using a 1000-volt insulation-resistance test set. Readings shall be recorded

every minute until three equal and consecutive readings are obtained. The resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Insulation tests on motors 300 volts or less shall be conducted using a 500-volt minimum insulation-testing instrument. Readings shall be recorded after 1 minute and until the reading is constant for 15 seconds. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Test data shall include the location and identification of motors and megohm readings versus time.

After the installation has been thoroughly tested and found to be in satisfactory condition, with thermal overload relays in motor controllers properly rated and in place, written authorization shall be obtained from the Contracting Officer prior to energizing the equipment at the system voltage for final operational tests.

Duration of final operational tests to prove satisfactory performance will be determined by the Contracting Officer.

Final test reports shall be provided to the Contracting Officer. Reports shall have 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."

-- End of Section --

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SECTION 16261

VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS
06/97

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.

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 15	Radio Frequency Devices

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 519	(1992) Harmonic Control in Electrical Power Systems
IEEE C62.41	(1991) Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electric Equipment (1000 Volts Maximum)
NEMA ICS 1	(1993) Industrial Control and Systems General Standards
NEMA ICS 3.1	(1990) Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA ICS 7	(1993) Industrial Control and Systems Adjustable-Speed Drives

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 508C	(1996) Power Conversion Equipment

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions", applies to work specified in this section.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for Variable Frequency Drives.

SD-05 Design Data

Equipment and Performance Data shall be submitted for Variable Frequency Drives. Include data indicating variable frequency drive compatibility with motor being driven.

SD-02 Shop Drawings

Submit Schematic Diagrams of the Variable Frequency Drives. Drawings shall show interconnections between components, equipment assemblies, and external interfaces, including power and signal conductors.

SD-02 Shop Drawings

Installation Drawings shall be submitted for Variable Frequency Drives in accordance with the paragraph entitled, "Installation," of this section.

Show Floor Plan of each site, with Variable Frequency Drives and motors indicated. Indicate ventilation requirements, adequate clearances, and cable routes.

SD-08 Manufacturer's 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.

SD-06 Test Reports

Submit Factory Test Reports for Variable Frequency Drives.

Submit Field Test Reports for Variable Frequency Drives.

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for Variable Frequency Drives in accordance with Section 01770, "Task Order Closeout", paragraph titled "Operation and Maintenance Manuals". In addition to the information required in Section 01770, include the final Variable Frequency Drive settings for each individual load following the installation and acceptance of the equipment. Provide instructions on Variable Frequency Drive adjustment, programming, trouble-shooting, and configuration.

1.3.1 Compliance Certification

Submit a complete copy of this specification section and all other related sections with each paragraph and subparagraph marked with either "compliance", "deviation", or "alternate". Submit copy of drawing equipment schedules and related drawings notes marked in the same manner as specified above for specification paragraphs. All deviations and alternates to the specifications and drawings shall be fully described in attached documentation as to what the contractor and manufacturer propose to provide. Approval of deviations is within the sole discretion of the Government. If proposed deviations or alternates are disapproved, the contractor shall provide equipment and materials in full compliance with the specifications, at no additional cost and without schedule extension.

1.4 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.

1.5 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.

1.6 MAINTENANCE

1.6.1 Spare Parts

Manufacturers provide spare parts in accordance with recommended spare parts list.

PART 2 PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES

Provide variable frequency drive (VFD) to control the speed of induction motor(s). VFD's shall be provided as stand-alone units, as indicated. All VFD's provided shall be the product of one manufacturer. In addition, the VFD shall include the following minimum functions, features and ratings:

a. All standard and optional features shall be included within the VFD enclosure, unless otherwise specified. VFD's shall be housed in an all steel, hinged, NEMA 1 enclosure.

b. The VFD shall be provided with a door interlocked, pad-lockable, disconnect switch. The VFD shall be UL listed and rated to withstand a fault condition of 65,000 RMS symmetrical amperes minimum, unless a higher rating is indicated. Provide separate current-limiting fuses (for the drive and the bypass), if required, to maintain the UL listing for the available fault current specified above. Additional fuses shall be provided as required by the manufacturer for protection of the VFD.

c. A rectifier section (per UL 508C) shall convert fixed voltage and frequency to a fixed DC voltage. The rectifier shall utilize power diodes for converting 60-hertz power to a fixed DC voltage on a filtered DC bus. The diodes shall be arranged in a three-phase, full wave bridge design that will allow the controller to maintain a minimum 0.95 displacement power factor lagging under all speed and load conditions and shall be insensitive to phase rotation of the AC line.

d. An inverter section shall invert the DC voltage into a quality output waveform, with adjustable voltage and frequency for step-less motor speed control. The inverter shall be switched in a manner to produce a pulse width modulated (PWM) output waveform that shall maintain a constant volts/hertz ratio throughout the operating speed ranges of the VFD.

e. The VFD shall be microprocessor based and utilize digital input for parameter adjustments.

f. The VFD shall be designed to operate from a 480 or 208 volt, +/- 10 percent, three phase, 60 Hz supply, and control motors with a corresponding voltage rating. The VFD shall have an efficiency of 96 percent or greater at rated output.

g. Line noise shall be limited to that specified by IEEE 519. Point of common coupling shall be the bus from which the VFD is fed.

h. The VFD's full load output ampere rating shall meet or exceed the corresponding horsepower full load currents contained in NEC table 430-150, based on VFD rated horsepower.

i. The VFD shall be capable of operating under the following service conditions:

   1. Ambient Temperature: 0 to 40 degrees C
   2. Humidity: Less than 95 percent (non-condensing)
   3. Altitude: 3300 feet (1000 m)

j. The VFD control adjustment capabilities shall be as follows:

   1. Maximum Speed: 50 to 100 percent
   2. Minimum Speed: 5 to 25 percent
   3. Acceleration Time: 3 to 60 seconds
   4. Deceleration Time: 3 to 60 seconds (provide override circuit to prevent nuisance trips if deceleration time is set too short)
   5. Current Limits: Adjustable to 110 percent of drive rating

k. The VFD shall provide the following self protection and reliability features:

   1. Input transient protection by means of surge suppressors
   2. Short circuit protection
   3. Input power Overvoltage, Undervoltage, Phase Loss, and Reverse phase protection
   4. Individual motor overload
   5. Motor overtemperature fault
   6. Inverter overtemperature, overload, and overcurrent trips

7. Instantaneous line-to-line and line-to-ground overcurrent trips
8. Overvoltage on the DC Bus
9. The VFD shall automatically reset faults due to Overvoltage, Undervoltage, or Phase Loss
10. The VFD shall provide a normal shutdown with the loss or interruption of its speed reference signal. The drive shall be capable of starting into a rotating motor (any speed or direction) and accelerate (or decelerate) to set speed without tripping or component loss.
11. Subjecting the VFD to any of the following conditions shall not result in component failure or the need for fuse replacement: short circuit, ground fault, or open circuit at the controller output; input undervoltage, input overvoltage, loss of input phase, AC line switching transients, 250 percent instantaneous overload, and sustained overload exceeding 115 percent of drive rated current.

l. 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.

m. The VFD shall provide a minimum of four (4) selectable frequency jump points (critical frequency avoidance), in 1.5 Hz increments, to be used to avoid critical resonance frequencies of the mechanical system.

n. Provide a digital operator keypad mounted on the front panel of the VFD. The digital operator keypad shall provide for local control of the VFD, alphanumeric display, and VFD programming. The digital operator keypad shall provide for the following:

1. Hand-Off-Auto (HOA) selection
2. Power on light
3. All VFD programming functions
4. Digital manual speed control (separate local (manual) - remote speed control selection)
5. Monitoring of VFD parameters including, but not limited to, output frequency, output amperes, motor speed (rpm), motor status (running, stop, fault), input voltage and current, kilowatts, elapsed time meter, drive temperature, no load warning, and DC bus voltage.
6. Drive Diagnostic and fault data

Keypad shall include an electronic lock-out feature (via password) to prevent unauthorized personnel from parameter access. Memory shall be non-volatile

o. Provide VFD with bypass/isolation contactors as specified below:

NEMA-rated or IEC-rated manual bypass and output isolation contactors shall provide all circuitry necessary to transfer the motor from the VFD to bypass (AC line power), or from bypass to the VFD. Bypass section shall be completely isolated from the VFD section to permit troubleshooting and repair of the VFD while in bypass operation. Motor thermal overload protection shall be

provided in both the drive and bypass modes. The VFD and the bypass equipment shall be in one overall enclosure. Selection to bypass shall be manual, unless drawings specifically indicate automatic switch to bypass.

A door interlocked, pad-lockable drive disconnect switch shall be provided to disconnect power from the VFD.

Bypass starters and isolation contactors shall be electrically and mechanically interlocked with the AC drive. A DRIVE-OFF-BYPASS selector switch and a transfer delay timer shall be provided. The isolation contactor shall isolate the drive from the motor when the manual bypass starter is in use. Bypass starters and isolation contactors shall be by the drive manufacturer and integrated into the drive assembly. Indicator lights shall be provided (door mounted) to indicate when the motor is running on the DRIVE and when the motor is running on BYPASS.

The bypass and isolation contactors shall have short circuit withstand ratings equal to or greater than the VFD.

Start-Stop operation and safety interlocks shall be functional in both the VFD and BYPASS modes.

p. Provide VFD with input line reactor to protect the VFD from voltage surges or spikes, to improve true power factor, and to reduce harmonic distortion.

2.2 CONTROL INTERFACES

2.2.1 Inputs

a. Start/Stop: Provide door mounted HAND/OFF/AUTO (HOA) selector switch to start and stop the VFD. Contacts shall be provided for a run signal by external device contact closure. When the HOA switch is in AUTO position, the VFD shall start the motor on contact closure, and stop the motor when contacts are opened. In the HAND position, the VFD shall run regardless of the external device contact position. Safety shutdown controls shall be operable in all selector switch positions.

b. Speed Control: The input follower circuit shall have selectable differential inputs for speed control. The input follower circuit shall accept an external speed command rated at 4 - 20 mA, unless otherwise noted. Where the drawings indicate pneumatic control of the VFD, provide an input for a 3 - 15 psig speed command, as well as a 4 - 20 mA input for future use.

c. Loss of follower signal: In the event of a loss of the external speed signal, the VFD shall go to one of the following user selectable modes:

   1. Run at a preset, constant speed (user adjustable)
   2. Run at a constant speed based on the last speed reference signal received.

   The VFD shall provide an open collector output for customer use, to indicate the loss of reference condition.

d. Safety Interrupts: Provide contacts to stop the motor upon opening of normally-closed relay contacts in freezestats, smoke detectors, or other external devices. Contacts shall permit motor shutdown by the external devices, whether the motor is operating in the variable speed mode or in the bypass mode. Safety interrupts shall not prohibit the motor from running in the smoke purge mode.

e. Smoke Purge: When indicated on the drawings, provide contacts to initiate drive operation in a smoke purge mode, on closure of external relay contacts. Contacts shall permit motor operation in either the variable speed mode or in the bypass mode. When smoke purge in initiated, the VFD shall run the motor at a preset, user adjustable, constant speed.

f. External Reset: When indicated on the drawings, provide all necessary logic and contacts to permit reset of inverter faults by closure of external relay contacts.

2.2.2 Outputs

a. Status/Fault: The VFD shall provide normally open dry contacts for remote indication of the following conditions, as a minimum: drive run, drive fault, including loss of input follower signal as well as internal faults, and bypass operation (if automatic transfer to bypass is provided).

b. Analog Output signals: The VFD shall include a minimum of two analog output signals, 4 - 20 mA and 0 - 10 v, to permit remote monitoring of the following items (user selectable): output frequency, output current, motor voltage, motor speed, and motor power.

2.2.3 Power Supply for External Controls

Provide control circuit transformer and terminals for connection to external controls for drives serving the following equipment: air conditioning unit supply air fans, pumps (chilled water, secondary water, hot water, and domestic water pumps), and other equipment as indicated on the drawings.

Control circuit shall be energized when the motor is operating in either the VFD or bypass mode. Control circuit transformer shall be as specified in Section 16286 under the paragraph "Control-Circuit Transformers".

2.2.4 Communications Links

Unless otherwise indicated, provide the VFD with all required hardware and software to allow communications with a Johnson Controls Metasys system using the Metasys N2 bus and protocol. This link shall permit monitoring or control of all start/stop, drive status and fault, speed commands, and other control functions. Connection from the VFD communications port to the existing Metasys system will be by the UCS contractor.

2.3 ENCLOSURES

Provide equipment enclosures conforming to NEMA 250, NEMA ICS 6.

2.4 WIRES AND CABLES

All wires and cables shall conform to NEMA 250, NEMA ICS 7, NFPA 70.

2.5 NAMEPLATES

Nameplates external to NEMA enclosures, shall conform with the requirements of Section 16003, "General Electrical Provisions". Nameplates internal to enclosures shall be manufacturer's standard, with the exception that they must be permanent.

PART 3 EXECUTION

3.1 INSTALLATION

Per NEMA ICS 3.1, install equipment in accordance with the approved manufacturer's installation drawings, instructions, wiring diagrams, and as indicated on project drawings, specification, and approved shop drawings. VFD shall be installed in accordance with the National Electrical Code. A field representative of the VFD 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.

3.2.1 Electrical Tests

a. Test insulation resistance for each VFD component, feeder, and control circuit.
b. Test continuity of each circuit.

3.2.2 Start-up

Start-up of the VFD shall be provided by a factory certified service technician of the VFD manufacturer. The factory certified service technician shall also provide the training required under this section. Start-up service shall include, but not be limited to, the following:

a. Verify that the VFD installation is in accordance with the manufacturer's instructions, contract drawings, and specifications.
b. Verify that upstream protective device ratings/settings, as well as wire sizes, are in accordance with manufacturers requirements.
c. Verify separation of control wiring from power wiring as recommended by the VFD manufacturer.
d. Verify contractor wire terminations and grounding.
e. Program VFD as required for each individual load. Programming shall include preset speeds, restart attempts and delays, overload settings, frequency avoidance points, etc.
f. Verify proper operation of the VFD, motor, and external interfaces (UCS, smoke purge (if required), etc.).
g. Verification of motor voltage and frequency, proper control input, and setpoint adjustment of minimum speed, maximum speed, acceleration and deceleration rates.
h. Submit test report documenting the VFD start-up.

3.2.3 Operational Readiness Review (ORR)

In accordance with Section 01770, "Task Order Closeout", schedule and perform an ORR of the VFD and its associated mechanical system.

3.3 TRAINING

Provide a minimum of 8 hours of training on the system operation, maintenance, testing, programming, and troubleshooting (including alarm formats and failure recovery procedures) of the VFD. Include a discussion on the general theory of operation of the VFD. Training shall be conducted on-site at GSFC by a factory certified service representative. Operation and Maintenance manuals, and other materials needed shall be provided for training. Coordinate training requirements with the Contracting Officer.

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SECTION 16275

TRANSFORMERS
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C57.12.20	(1988) Overhead-Type Distribution Transformers, 500 kVA and Smaller: High-Voltage, 34 500 Volts and Below; Low Voltage, 7970/13 800 Y Volts and Below
ANSI C57.12.27	(1982) Conformance Requirements for Liquid-Filled Distribution Transformers Used in Pad-Mounted Installations, Including Unit Substations

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C57.12.00	(1993) Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.25	(1992) Standard for Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with Separable Insulated High-Voltage Connectors (34 500-Grd Y/19 920 Volts and Below; Low Voltage, 240/120; 167 kVA and Smaller)
IEEE C57.12.26	(1992) Transformers - Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High Voltage, (34 500 Grd Y/19 920 and Below; 2500 kVA and Smaller)
IEEE C57.12.80	(1978; R 1992) Standard Terminology for Power and Distribution Transformers
IEEE C57.12.90	(1993) Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers and Guide for Short-Circuit Testing of Distribution and Power Transformers

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA ST 1	(1988) Specialty Transformers (Except

	General Purpose Type)
NEMA ST 20	(1992) Dry Type Transformers for General Applications

UNDERWRITERS LABORATORIES (UL)

UL 506	(2000; 12 Ed) UL Standard for Specialty Transformers
UL 1561	(1999; 3rd Ed) Dry-Type General Purpose and Power Transformers

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Connection Diagrams shall be submitted for Distribution Transformers 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.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Distribution Transformers
Paint Materials

SD-05 Design Data

Equipment and Performance Data shall be submitted for Distribution Transformers including resistance measurements, impedance, and voltage and load losses at rated currents.

SD-06 Test Reports

Test Reports shall be submitted for the following tests on distribution transformers in accordance with the paragraph entitled, "Field Testing," of this section.

Insulation Resistance Tests

SD-07 Certificates

Certificates of Compliance of previous tests on similar units under actual conditions may be submitted for impulse tests,

temperature-rise tests, sound tests, power-factory tests, bushing tests, and short-circuit tests in lieu of factory tests on actual units furnished.

1.4 QUALIFICATION TESTING

Tests on transformers shall comprise the manufacturer's standard tests including resistance measurements of all windings; ratio tests; polarity and phase-relation tests; no-load loss at rated voltage; impedance; voltage and load loss at rated current and dielectric tests.

PART 2 PRODUCTS

2.1 EQUIPMENT STANDARDS

2.1.1 Dry-Type Distribution Transformers

General-purpose dry-type transformers for connection to low-voltage distribution circuits of 600 volts or less and the supply of current for lighting and power loads shall be two-winding, 60-hertz, self-contained, self-cooled, Class AA in accordance with NEMA ST 20 and UL 506. Provide transformer primary with a minimum of 4 full capacity 2.5 percent taps, 2 above and 2 below rated voltage.

Insulation system limiting temperature shall be 220 degrees C with a temperature rise of 80 degrees C, unless otherwise noted, above a 40 degree C ambient.

2.1.2 K-Factor Rated Transformers

Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current capability to the degree defined by the designated K-factor. The transformer shall not exceed the temperature rise ratings when carrying full load with harmonic content corresponding to the designated K-factor. The nameplate shall state the designated K-factor of the transformer.

2.1.3 Electrostatic Shielded Transformers

Each transformer winding shall be independently single shielded with a full-width copper electrostatic shield arranged to minimize interwinding capacitance. The coil leads shall be arranged to minimize capacitive coupling between input and output connections. A grounding terminal shall be provided and shall be marked "Shield" for the grounding connection. Electrostatic shield shall meet the following:

- Capacitance: Shield limits capacitance between primary and secondary to a maximum of 33 picofarads over a frequency range of 20 Hz to 1 MHz.

- Common-Mode Noise Attenuation: Minus 120dB minimum, 0.5 to 1.5 kHz; minus 65 dB minimum, 1.5 to 100 kHz.

- Normal-Mode Noise Attenuation: Minus 52 dB minimum, 1.5 to 10 kHz.

2.2 FACTORY FINISH

Transformers shall be provided with the manufacturer's standard paint finish.

PART 3 EXECUTION

3.1 INSTALLATION

Dry type transformers shall be installed on resilient vibration-isolating mountings and connected with flexible metallic conduit to prevent transmission and amplification of sound.

Pad-mounted distribution transformers shall be installed on precast or poured-in-place concrete pads and shall be grounded to a ground grid.

Voltage and kilovolt-ampere (kVA) ratings shall be as noted. Each transformer shall have its kVA rating conspicuously displayed in 3-inch high yellow letters on its tank or enclosure in addition to the complete manufacturer's standard identification plate.

3.2 FIELD TESTING

3.2.1 Insulation-Resistance Tests

Transformer windings shall be given an insulation-resistance test using the following test set versus voltage level criteria:

Dry type 480- to 600-volt transformers - 1,000-volt test set

Dry type 240-volt and below transformers - 500-volt test set

Tests shall be applied for not less than 5 minutes and until three equal consecutive readings, 1 minute apart, are obtained. Readings shall be recorded every 30 seconds during the first 2 minutes and every minute thereafter. Minimum acceptable resistance shall be 100 megohms.

3.2.2 Acceptance

Final acceptance shall depend upon the successful performance of the equipment under test. Transformers shall not be energized until recorded test data have been approved by the Contracting Officer.

-- End of Section --

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SECTION 16286

OVERCURRENT PROTECTIVE DEVICES
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PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C37.16	(1988) Switchgear - Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C37.17	(1979; R 1988) Trip Devices for AC and General-Purpose DC Low-Voltage Power Circuit Breakers
ANSI C78.23	(1989) Electric Lamps - Incandescent Lamps-Miscellaneous Types

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 48/A 48M	(2000) Standard Specification for Gray Iron Castings

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA 443	(1985) Solid State Relays, EIA/NARM, Standard for

FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 15	(1989) Rules and Regulations: Radio Frequency Devices

INSTITUTE FOR INTERCONNECTING AND PACKAGING ELECTRONIC CIRCUITS (IPC)

IPC D330 7.1.3.5	(1973) Switches

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C12.1	(1988; 8th Ed) Code for Electricity Metering
IEEE C37.2	(1996) Standard Electrical Power System Device Function Numbers and Contact Designations
IEEE C37.13	(1990) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.90	(1994) Standard for Relays and Relay Systems Associated With Electric Power Apparatus
IEEE C57.13	(1993) Standard Requirements for Instrument Transformers
IEEE C63.2	(1996) Standard for Instrumentation - Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz - Specifications
IEEE C63.4	(1992) Methods of Measurement of Radio - Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 801-2	(1984) Electromagnetic Compatability of Industrial Process Measurement and Control Equipment Part 2: Electrostatic Discharge Requirements
IEC 801-5	Electromagnetic Compatability of Industrial Process Measurement and Control Equipment Part 5: Surge Immunity Requirements

JOINT INDUSTRIAL COUNCIL (JIC)

JIC-01	(1967) Electrical Standards for Mass Production Equipment

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA 107	(1987; R 1993) Methods of Measurement of Radio Influence Voltage (RIV) of High-Voltage Apparatus
NEMA 250	(1997) Enclosures for Electric Equipment (1000 Volts Maximum)
NEMA AB 1	(1994) Molded Case Circuit Breakers and Molded Case Switches
NEMA AB 3	(1993) Molded Case Circuit Breakers and

	Their Application
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) Industrial Control and Systems General Standards
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC
NEMA ICS 3	(1993) Industrial Control and Systems Factory Built Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA SG 2	(1993) High-Voltage Fuses

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 489	(1996; 9th Ed) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 50	(1995; 11th Ed) UL Standard for Safety - Enclosures for Electrical Equipment
UL 508	(1999; 17th Ed) UL Standard for Safety Industrial Control Equipment

1.2 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Connection Diagrams shall be submitted 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 wiring, and other devices.

Fabrication Drawings shall be submitted for Control Devices and Protective Devices, consisting of fabrication and assembly details to be performed in the factory.

Installation Drawings shall be submitted for Control Devices and Protective Devices in accordance with the paragraph entitled, "Installation," of this section.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Motor Controls
Control Devices
Enclosures
Fuses
Circuit Breakers
Protective Relays
Electronic Power Meter
Instrument Transformers
Indicating Lights

SD-05 Design Data

Equipment and Performance Data shall be submitted for the following items including use life and safety features.

Motor Controls
Control Devices
Fuses
Circuit Breakers
Protective Relays
Electronic Power Meter
Instrument Transformers
Indicating Lights

No change in continuous-current rating, interrupting rating, and clearing or melting time of fuses shall be made unless written permission has first been secured from the Contracting Officer.

SD-06 Test Reports

Test Reports shall be submitted for the following tests on control and protective devices in accordance with the paragraph entitled, "Field Testing, of this section.

Operation Tests
Dielectric Tests

SD-07 Certificates

Certificates of Compliance shall be submitted for Circuit Tests on similar motor-control units under actual conditions. This test data may be submitted in lieu of factory tests on the actual units provided.

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted for Control Devices and Protective Devices, including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

1.3 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

PART 2 PRODUCTS

2.1 MOTOR CONTROL

Motor controllers shall conform to NEMA ICS 1, NEMA ICS 2, and UL 508. Controllers shall have thermal overload protection in each phase.

2.1.1 Manual Motor Controllers

Manual motor controllers for the control and protection of single-phase, 60-hertz, ac fractional-horsepower squirrel-cage induction motors shall be full-voltage, manually operated devices.

Controllers shall be single-throw, single- or double-pole, devices rated not more than 1 horsepower at 115- and 230-volts single phase. Controller shall include a supporting base or body of electrical insulating material with enclosed switching mechanism, yoke, thermal overload relay, and terminal connectors. Controllers shall clearly indicate operating condition.

Manual motor controllers shall be the toggle- or key-operated type as indicated and shall be arranged so that they may be locked with a padlock in the "OFF" position.

Recessed manual motor controllers for single-speed, fractional-horsepower squirrel-cage induction motors shall 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. Surface-mounted manual motor controllers for single-speed, fractional-horsepower squirrel cage induction motors shall include a single controller and indicating light in a NEMA 250, Type 1 general-purpose enclosure, unless otherwise noted.

2.1.2 Magnetic Motor Controllers

2.1.2.1 Full-Voltage Controllers

Magnetic motor controllers for the control and protection of single- and three-phase, 60-hertz, squirrel-cage induction motors shall be full-voltage, full magnetic devices in accordance with NEMA ICS 1, NEMA ICS 2, and UL 508.

Operating coil assembly shall operate satisfactorily between 85 and 110 percent of rated coil voltage. Motor control circuits shall be 120 volts, 60 hertz.

Controller shall be provided 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.

Solderless pressure wire terminal connectors shall be provided for line-and load-connections to controllers.

Overcurrent protection shall include three manual reset thermal overload devices, one in each pole of the controller. Thermal overload relays shall be melting-alloy, bimetallic nonadjustable, orbimetallic adjustable type, as indicated, with continuous current ratings and service-limit current ratings and shall have a plus or minus 15 percent adjustment to compensate

for ambient operating conditions.

An externally operable manual-reset button shall be provided to re-establish control power to the holding coil of the electromagnet. After the controller has tripped from overload, resetting the motor-overload device shall not restart the motor.

Enclosure shall be in accordance with NEMA 250, Type 1, unless otherwise noted.

2.1.2.2 Reduced-Voltage Starters

Reduced-voltage starters shall conform to the requirements for full-voltage controllers, except for voltage, and to the following additional requirements.

Overload devices, one in each motor leg, shall fully protect the motor during all phases of motor starting. Starter contacts shall be rated to withstand the switching surges during selector to full voltage. Starter shall contain the necessary sensing and timing devices to monitor motor operation and select the correct time for selector to full voltage.

Resistors and autotransformers used for starting shall be adequately ventilated. Solid-state starters shall be ventilated for starting cycles as well as any follow-on restart-run cycles. External control circuits or solid-state starters shall operate at 120 volts ac, maximum.

For solid-state starters, starting torque shall be adjustable from 0 to 50 percent of applied voltage, minimum. Autotransformer starters shall have a minimum of three taps, with the lowest tap at 50 percent reduced voltage.

2.1.3 Combination Motor Controllers

The following requirements are in addition to the requirements specified for magnetic motor controller:

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 shall be in accordance with NEMA ICS 1, NEMA ICS 2, and JIC-01.

Combination motor controllers shall include magnetic motor controllers and molded-case circuit breaker or disconnect switch in metal enclosures in accordance with NEMA 250 or motor-control center draw-out assemblies with control-circuit transformers, selector switches, pushbuttons, and indicating lights as follows:

Magnetic motor controllers and enclosures shall be full-voltage, full-magnetic devices as specified in this section under paragraph entitled, "Remote-Control Station Enclosures."

Molded-case circuit breakers shall be thermal-magnetic breakers as specified in paragraph entitled "Molded-Case Circuit Breakers". Disconnect Switches shall be in accordance with Section 16150, paragraph entitled "Safety Switches".

Control-circuit transformers 120-volt ac maximum, selector switches, pushbuttons, and pilot lights shall be as required.

Combination motor controllers shall be identified with identification plates affixed to front cover of the controller.

2.1.3.1 Nonreversing Combination Motor Controllers

The following requirements are in addition to the requirements for magnetic motor controllers:

Nonreversing combination motor controllers for the control and protection of single-speed squirrel-cage induction motors shall include a magnetic controller with molded-case circuit breaker or disconnect switch with selector switch or start/stop pushbutton and indicating light in the cover of the enclosure.

Rating of single and three-phase single-speed full-voltage magnetic controllers for nonplugging and nonjogging duty shall be in accordance with NEMA ICS 1 and NEMA ICS 2.

Wiring and connections for full-voltage single-speed magnetic controllers shall be in accordance with NEMA ICS 1 and NEMA ICS 2.

2.1.3.2 Reversing Combination Motor Controllers

The following requirements are in addition to the requirements for magnetic motor controllers:

Reversing combination motor controllers for the control and protection of single-speed squirrel-cage induction motors shall include two interlocked magnetic controllers with molded-case circuit breaker or disconnect switch, with selector switch or forward/reverse/stop pushbutton and two indicating lights in the cover of the enclosure. Indicating lights shall indicate the forward and reverse running connection of the motor controller.

Rating of single and three-phase single-speed full-voltage magnetic controllers for plug-stop, plug-reverse, or jogging duty shall be in accordance with NEMA ICS 1 and NEMA ICS 2.

Wiring and connections for full-voltage single-speed magnetic controllers shall be in accordance with NEMA ICS 1 and NEMA ICS 2.

2.1.3.3 Two-Speed Combination Motor Controllers

The following requirements are in addition to the requirements for magnetic motor controllers:

Two-speed combination motor controllers for the control and protection of single- and two-winding, two-speed, three-phase, squirrel-cage induction motors shall include two magnetic controllers with molded-case circuit breaker or disconnect switch, with selector switch or fast/slow/stop pushbutton and two indicating lights in the cover of the enclosure. Indicating lights shall indicate the high- and low-speed running connection of the motor controller.

Rating of three-phase, two-speed, full-voltage, magnetic controllers for nonplugging and nonjogging duty for constant- and variable-torque motors shall be in accordance with NEMA ICS 1 and NEMA ICS 2.

Rating of three-phase, two-speed, full-voltage, magnetic controllers for nonplugging and nonjogging duty for constant-horsepower motors

shall be in accordance with NEMA ICS 1 and NEMA ICS 2.

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 shall be in accordance with NEMA ICS 1 and NEMA ICS 2.

2.1.4 Medium-Voltage Motor Controllers

Medium-voltage motor controllers for the control and protection of squirrel-cage induction motors, wound-rotor induction motors, and synchronous machines rated 2.4 through 7.2 kilovolts, three-phase, shall be NEMA ICS 2, Class E2, type as required.

Unless enclosed within a switchgear or unit-substation cubicle, medium-voltage motor controllers shall be housed in floor-mounted structures of the NEMA type indicated, approximately 90 inches high, 30 inches wide, and 30 inches deep, with suitable draw-out compartments. Structure shall include provisions for padlocking the doors.

Structure shall be subdivided into low-voltage control compartment with separate door, medium-voltage compartment with separate door, ac bus compartment, and cable-entrance compartment.

Controller shall be isolated by externally operated draw-out stabs with shutter mechanism. Isolating device shall also open the secondary of the control-power transformer. Interlocks shall be provided to prevent inadvertent operation of the isolating mechanism under load, opening the medium-voltage compartment door without isolating the starter, and closing the line contactor with door open. An isolating switch assembly shall be included.

For overload protection, ambient-compensated thermal overload relays, hand reset, shall be included in all three phases. Solid-state multifunction overload protection may be utilized when approved.

Controllers shall be the fused type employing current-limiting power fuses of the interrupting rating indicated. Single-phase anti-trip protection shall be provided. Starters shall employ magnetic, 3 pole, vacuum contactors. Control circuit shall have provisions for external testing of 120-volt control circuit and a minimum of two sets of normally open and normally closed auxiliary contacts.

Power fuses on ac systems above 600 volts shall be in accordance with NEMA SG 2.

2.2 CONTROL DEVICES

2.2.1 Magnetic Contactors

Magnetic contactors 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 shall be in accordance with NEMA ICS 1 and NEMA ICS 2 as required.

Core-and-coil assembly shall operate satisfactorily with coil voltage between 85 and 110 percent of its voltage rating.

Contactor shall be designed with a normally open holding circuit auxiliary

contact for control circuits. Rating of the auxiliary contact shall be in accordance with NEMA ICS 1 and NEMA ICS 2.

Solderless pressure wire terminal connectors shall be furnished or made available for line-and-load connections to contactors in accordance with NEMA ICS 1 and NEMA ICS 2.

Rating of magnetic contactors shall be in accordance with NEMA ICS 1 and NEMA ICS 2.

2.2.2 Control-Circuit Transformers

Control-circuit transformers shall be provided within the enclosure of magnetic contactors and motor controllers when the line voltage is in excess of 120 volts. Transformer shall be encapsulated dry type, single-phase, 60-hertz, with a 120-volt isolated secondary winding.

Rated primary voltage of the transformer shall be not less than the rated voltage of the controller. Rated secondary current of the transformer shall be not less than the continuous-duty current of the control circuit.

Voltage regulation of the transformer shall be such that, with rated primary voltage and frequency, the secondary voltage shall not be less than 95 percent nor more than 105 percent of rated secondary voltage.

Source of supply for control-circuit transformers shall be the load side of the main disconnecting device. Secondary winding of the transformer and control-circuit wiring shall be protected against overloads and short circuits with fuses selected in accordance with JIC-01. Secondary winding of the control-circuit transformer shall be grounded in accordance with JIC-01.

2.2.3 Magnetic Control Relays

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 shall be in accordance with NEMA ICS 1 and NEMA ICS 2.

Core-and-coil assembly shall operate satisfactorily with coil voltages between 85 and 110 percent of their voltage rating.

Relays shall be designed to accommodate normally open and normally closed contacts.

Magnetic control relays shall be 120-volt, 60-hertz, Class devices 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.

2.2.4 Pushbuttons and Switches

2.2.4.1 Pushbuttons

Pushbuttons for low-voltage ac full-voltage magnetic controllers shall be 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. Color code for pushbuttons shall be in accordance with JIC-01.

Pushbuttons shall be designed with normally open, circuit-closing contacts; normally closed circuit-opening contacts; or two-circuit normally open and normally closed circuit-closing and -opening contacts, as indicated. Pushbutton-contact ratings shall be in accordance with NEMA ICS 1 and NEMA ICS 2 with contact designation A600.

Pushbuttons in remote control stations shall be provided with identification plates affixed to the front cover in a prominent location. Identification plate shall carry the identification of the system being controlled.

2.2.4.2 Selector Switches

Selector switches for low-voltage control circuits shall be heavy-duty oiltight maintained-contact devices with the number of positions and the marking of identification plates in accordance with NEMA ICS 1 and NEMA ICS 2.

Selector switches in remote control stations shall be provided with engraved identification plates affixed to front cover in a prominent location. Identification plate shall carry the identification of the system being controlled.

2.2.4.3 Miscellaneous Switches

Float, limit, door, pressure, proximity, and other types of switches shall be in accordance with IPC D330 7.1.3.5 and of the types and classes indicated.

2.2.5 Power Supply for External Controls

Provide control-circuit transformer and terminals for connection to external controls for motor controllers serving the following equipment: air conditioning unit supply air fans, pumps (chilled water, secondary water, hot water, and domestic water pumps), and other equipment as indicated on the drawings.

Control-circuit transformer shall be as specified under the paragraph entitled "Control Circuit Transformers".

2.3 FUSES

A complete set of fuses for all switches and switchgear shall be provided. Fuses shall have a voltage rating not less than the circuit voltage.

Fuses rated 30 amperes, 125 volts or less shall be the nonrenewable cartridge type. Fuses rated above 30 amperes, 600 volts or less shall be the renewable cartridge type with time-delay dual elements, except where otherwise indicated. Fuses shall conform to NEMA FU 1.

Fuses shall be labeled showing UL class, interrupting rating, and time-delay characteristics, when applicable.

Fuse holders field-mounted in a cabinet or box shall be porcelain. Field installation of fuse holders made of such materials as ebony asbestos, Bakelite, or pressed fiber shall not be used.

2.4 ENCLOSURES

2.4.1 Equipment Enclosures

Enclosures for equipment shall be in accordance with NEMA 250.

Equipment installed inside, clean, dry locations shall be contained in NEMA Type 1, general-purpose sheet-steel enclosures.

Equipment installed in wet locations shall be contained in NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosures, constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 for Type 4 enclosures.

Equipment installed in industrial locations shall be contained in NEMA Type 12 industrial use, sheet-steel enclosures constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

Equipment installed in Class I, Division I, Group A, B, C, and D, hazardous locations shall be contained in NEMA Type 7 enclosures approved for the specific flammable gas or vapor which is or may be present under normal operating conditions.

Equipment installed in Class II, Division I, Group E, F and G, hazardous locations shall be contained in NEMA Type 9 enclosures approved for use where combustible dust is or may be present under normal operating conditions.

Sheet-steel enclosures shall be fabricated from uncoated carbon-steel sheets of commercial quality, with box dimensions and thickness of sheet steel in accordance with UL 50.

Steel enclosures shall be fabricated from corrosion-resistant, chromium-nickel steel sheet conforming to ASTM A 167 Type 300 series with ASM No. 4 general-purpose polished finish. Box dimensions and thickness of sheet steel shall be in accordance with UL 50.

Cast-iron enclosures shall be gray-iron castings conforming to ASTM A 48/A 48M with tensile-strength classification recognized as suitable for the application. Cast-metal enclosures shall be 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.

Ferrous-metal surfaces of electrical enclosures shall be cleaned, phosphatized, and painted with the manufacturer's standard finish.

2.4.2 Remote-Control Station Enclosures

Remote-control station enclosures for pushbuttons, selector switches, and indicating lights shall be in accordance with the appropriate articles of NEMA ICS 6 and NEMA 250.

Remote-control stations installed in indoor, clean, dry locations shall be contained in NEMA Type 1 general-purpose, sheet-steel enclosures. Recessed remote-control stations shall be contained in standard wall outlet boxes with matching corrosion-resistant steel flush cover plate.

Remote-control stations installed in wet locations shall be contained 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.

Remote-control stations installed in wet locations shall be contained 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.

Remote-control stations installed in dry noncombustible dust-laden atmospheres shall be contained in NEMA Type 12 dusttight, cast-iron enclosures with gaskets or their equivalent to prevent the entrance of dust.

Remote-control stations installed in industrial locations shall be contained in NEMA Type 12 industrial-use, sheet-steel enclosures constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

Remote-control stations installed in industrial locations shall be contained in NEMA Type 12 industrial-use, cast-iron enclosures constructed to prevent the entrance of dust, lint, fibers, flyings, oil, and coolant seepage.

Remote-control stations installed in Class I, Division I, Group A, B, C, and D, hazardous locations shall be contained in NEMA Type 7 enclosures approved for the specific flammable gas or vapor which is or may be present under normal operating conditions.

Remote-control stations installed in Class II, Division I, Group E, F and G, hazardous locations shall be contained in NEMA Type 9 enclosures approved for use where combustible dust is or may be present under normal operating conditions.

Sheet-steel enclosures shall be fabricated from uncoated carbon-steel sheets of commercial quality with box dimensions and thickness of sheet steel in accordance with UL 50.

Steel enclosures shall be fabricated from corrosion-resistant, chromium-nickel steel sheet conforming to ASTM A 167, Type 300 series with ASM No. 4 general-purpose polished finish. Box dimensions and thickness of sheet steel shall be in accordance with UL 50.

Cast-iron enclosures shall be gray-iron castings conforming to ASTM A 48/A 48M, with tensile-strength classification recognized as suitable for this application. Cast-metal enclosures shall be 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.

Ferrous-metal surfaces of remote-control-station enclosures shall be cleaned, phosphatized, and painted with the manufacturer's standard finish.

Remote-control stations shall be installed with the centerline 48 inches above the finished floor or as indicated on the contract drawings.

2.5 MOLDED CASE CIRCUIT BREAKERS

Molded case circuit breakers shall conform to UL 489, NEMA AB 1, and NEMA AB 3.

Circuit breakers shall be molded case, manually operated, trip-free, with

inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection as required. Circuit breakers shall be completely enclosed in a molded case, with the calibrated sensing element factory-sealed to prevent tampering.

Thermal-magnetic tripping elements shall be located in each pole of the circuit breaker and shall provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit protection. Instantaneous magnetic tripping element shall be adjustable and accessible from the front of the breaker on frame sizes larger than 100 amperes.

Breaker size shall be as required for the continuous current rating of the circuit. Breaker class shall be as required.

Interrupting capacity of the power and lighting branch circuit breakers shall be sufficient to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Circuit breaker interrupting capacities shall be a minimum of 10,000 amperes for 120/208 volt systems and 25,000 amperes for 277/480 volt systems, and shall conform to NEMA AB 3.

Multipole circuit breakers shall be of the common-trip type having a single operating handle and shall have two-position on/off indication. Circuit breakers shall have temperature compensation for operation in an ambient temperature of 104 degrees F. Circuit breakers shall 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).

Breaker body shall be of phenolic composition. Breakers shall be capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.

Circuit breakers used for motor-circuit disconnects shall meet the applicable requirements of NFPA 70.

Circuit breakers used as service disconnects shall be the enclosed circuit-breaker type with external handle for manual operation. Enclosures shall be sheet metal with a hinged cover suitable for surface mounting.

2.5.1 Enclosed Molded-Case Circuit Breakers

Enclosed circuit breakers shall be thermal-magnetic, molded-case circuit breakers in surface-mounted, nonventilated enclosures conforming to the appropriate articles of NEMA 250 and NEMA AB 1.

Enclosed circuit breakers in nonhazardous locations shall be as follows:

Circuit breakers installed inside, clean, dry locations shall be contained in NEMA Type 1, general purpose sheet steel enclosures.

Circuit breakers installed in unprotected outdoor locations shall be contained in NEMA Type 3R, weather-resistant sheet steel enclosures that are splashproof, weatherproof, sleetproof, and moisture resistant.

Circuit breakers installed in wet locations shall be contained in NEMA Type 4, watertight corrosion-resistant sheet steel enclosures constructed to prevent entrance of water.

Circuit breakers installed in wet locations shall be contained in NEMA Type 4, watertight cast-iron enclosures constructed to prevent entrance of water when tested in accordance with NEMA ICS 1 for Type 4 enclosures.

Circuit breakers installed in dry, noncombustible dust-laden atmospheres shall be contained in NEMA Type 5, dusttight corrosion-resistant sheet steel enclosures with gaskets or their equivalent to prevent the entrance of dust.

Circuit breakers installed in dry, noncombustible, dust-laden atmospheres shall be contained in NEMA Type 5, dusttight cast-iron enclosures with gaskets or their equivalent to prevent the entrance of dust.

Circuit breakers installed in industrial locations shall be contained 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.

Steel enclosures shall be fabricated from corrosion-resistant steel sheet conforming to ASTM A 167, 300 series corrosion-resistant steel. Box dimensions and thickness of sheet steel shall be in accordance with UL 50.

Cast-iron enclosures shall be gray-iron castings conforming to ASTM A 48/A 48M with tensile strength classification suitable for this application. Cast-metal enclosures shall be 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.

2.6 POWER CIRCUIT BREAKERS

Power Circuit Breakers shall be provided for all main, tie, and feeder circuit breakers rated 600 volts and below, required for secondary unit substations.

Breakers installed in secondary unit substations shall be the drawout type.

Power circuit breakers shall conform to IEEE C37.13 and ANSI C37.16. Each breaker element shall consist of a three-pole electrically and mechanically trip free power circuit breaker with self-aligning primary and secondary disconnecting contacts, arc quenchers, electrical stored energy closing mechanism, and position indicator.

Electrical stored-energy closing mechanisms shall employ the stored energy principle by interposing an energy storage spring between the operator and the breaker contacts. This spring provides constant closing speed not influenced by the operator or control power voltage level.

Draw out power circuit breakers shall be provided with position indicators. Each position shall be clearly identified by an indicator on the circuit breaker front panel. Positions shall be as follows:

Connected position
Test position
Disconnected position

Alarms, auxiliary switches, interlocks, and similar devices shall be

supplied as required.

Breakers shall have a removable operating handle and provision for padlocking.

2.6.1 Main and Tie Circuit Breakers

Breaker frame size and sensor rating shall be as indicated on the contract drawings.

Main and tie circuit breakers shall be electrically operated utilizing a motor or solenoid to automatically charge the closing springs. An electrical close push button shall be mounted on the breaker escutcheon. A manual charging handle shall be provided for the main and tie circuit breakers.

Main and tie circuit breakers shall be provided with a control switch equipped with pistol grip handle and engraved escutcheon plate. Standard target shall be red (closed) and green (trip). Switch shall have spring return to normal position. Electroswitch series 24 or approved equal.

Provide red and green indicating lights to indicate breaker contact position. Indicating lights shall be equipped with "push-to-test" feature.

Main and tie circuit breakers shall be equipped with solid state static-type trip devices as specified under the paragraph, "Solid-State Static Trip Device". Breakers shall be provided with protective relays and devices as indicated on the contract drawings and as required to perform the functions indicated on the contract drawings.

Main circuit breakers shall be provided with electronic metering as specified under the paragraph, "Electronic Metering and Monitoring".

Main circuit breakers shall be kirk key-interlocked with the transformer primary switch.

2.6.1.1 Current Limiting Power Circuit Breakers

Current limiting power circuit breakers shall be provided as indicated, or where required to limit the available fault current to downstream equipment (or when the available fault current exceeds the interrupting rating of the circuit breaker alone).

Circuit breakers shall be equipped with current limiting fuses and coordinated with trip devices so that faults within the rating of the circuit breaker will be interrupted by the breaker itself, while faults in excess of the breaker rating will be interrupted by the fuses.

Separately mounted fuses shall be mounted inside a drawout carriage similar to that used for the breaker. A hinged panel made of perforated steel shall be positioned in front of the fuses so that they cannot be reached if the compartment door is opened. The perforated steel shall be so interlocked to prevent it from being swung open unless the fuse rollout is fully withdrawn. A key interlock system shall be installed in the associated breaker compartment and fuse rollout compartment so as to keep the fuse rollout carriage in the connected or disconnected position unless the breaker associated with it is locked open. The fuse rollout carriage compartment shall be equipped with shutters to cover the line and load disconnects when the carriage is removed from its compartment. A rejection

feature shall be furnished so that only the correct carriage can be inserted in a compartment.

Fused breakers shall be equipped with open fuse lock-out device and indicator to protect against single phase and prevent reclosing until lockout device is reset.

2.6.2 Feeder Circuit Breakers

Feeder breaker frame size shall be 800 amps unless otherwise indicated on the contract drawings. Sensor rating shall be as indicated on the contract drawings.

Feeder circuit breakers shall be equipped with solid-state static type trip devices as specified under the paragraph, "Solid-State Static Trip Devices".

Feeder circuit breakers shall be manually operated with operating handle.

2.6.2.1 Current Limiting Power Circuit Breakers

Current limiting power circuit breakers shall be provided as indicated, or where required to limit the available fault current to downstream equipment (or when the available fault current exceeds the interrupting rating of the circuit breaker alone).

Circuit breakers shall be equipped with current limiting fuses and coordinated with trip devices so that faults within the rating of the circuit breaker will be interrupted by the breaker itself, while faults in excess of the breaker rating will be interrupted by the fuses.

Separately mounted fuses shall be mounted inside a drawout carriage similar to that used for the breaker. A hinged panel made of perforated steel shall be positioned in front of the fuses so that they cannot be reached if the compartment door is opened. The perforated steel shall be so interlocked to prevent it from being swung open unless the fuse rollout is fully withdrawn. A key interlock system shall be installed in the associated breaker compartment and fuse rollout compartment so as to keep the fuse rollout carriage in the connected or disconnected position unless the breaker associated with it is locked open. The fuse rollout carriage compartment shall be equipped with shutters to cover the line and load disconnects when the carriage is removed from its compartment. A rejection feature shall be furnished so that only the correct carriage can be inserted in a compartment.

Fused breakers shall be equipped with open fuse lock-out device and indicator to protect against single phase and prevent reclosing until lockout device is reset.

2.7 SOLID-STATE STATIC TRIP DEVICE

Solid-state static-type trip devices (microprocessor based electronic trip) for low-voltage power circuit breakers shall be in accordance with EIA 443 and ANSI C37.17.

Trip unit shall employ a combination of discreet components and integrated circuits to provide the time-current protection functions required in a modern selectively coordinated distribution system.

Complete system selective coordination shall be provided by utilizing a

combination of the following time-current curve-shaping adjustments:

Rating Plug
Ampere setting
Long-time delay
Short-time pickup
Short-time delay
Instantaneous pickup
Ground fault pickup
Ground fault delay

Instantaneous and ground fault trips shall be switchable or easily defeatable.

Adjustments shall be made using non-removable, discrete step, highly reliable switching plugs for precise settings. A sealable, transparent cover shall be provided over the adjustments to prevent tampering.

Trip devices shall be furnished with three visual indicators to denote the automatic tripping mode of the breaker including:

Overload
Short Circuit
Ground Fault

Trip unit shall be wired to appropriate terminals whereby an optional remote automatic trip accessory can be utilized to provide the same indication.

A series of optional automatic trip relays shall be available for use with the trip unit to provide remote alarm and lockout circuits.

Trip unit for all feeder breakers and the tie breaker shall be provided with a digital display (LED or LCD) for the following metering functions:

Phase Voltage
Phase Current

The trip unit digital display is not required for the main circuit breakers.

Trip units shall be provided 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 PROTECTIVE RELAYS

2.8.1 General

Electrical power apparatus relays for use in protective or auxiliary circuits shall be of a type specifically designed for use on power switchgear or associated electric power apparatus. Relays shall be properly coordinated with each other and with any power fuses. Relay device numbers shall correspond to the function names and descriptions of IEEE C37.2 unless otherwise shown.

Relays shall be suitable for operation on the voltage to which they are shown connected. Relays shall be of the semiflush, rectangular, back-connected, dustproof switchgear type. Cases shall have a black finish and window-type removable covers capable of being sealed against tampering.

Relays shall be of a type that can be withdrawn, through approved sliding contacts, from fronts of panels or doors without opening current transformer secondary circuits, disturbing external circuits, or requiring disconnection of any relay leads. Necessary test devices shall be incorporated within each relay and shall provide means for testing either from an external source of electric power or from associated instrument transformers. Each relay shall be provided with either two electrically independent relay contacts, or with an operation indicator and an external target reset device. Relays shall have necessary auxiliaries for proper operation. Relays and auxiliaries shall be suitable for operation with the instrument transformer ratios and connections provided.

Solid state devices may be substituted for electromagnetic type only on Secondary Unit Substations (less than 600 volt buses). All solid state relays shall meet the U.L., EIA, and ANSI/IEEE standards and shall have five years field proven records of their performance.

Protective relays shall be designed for operation on AC control circuit, unless otherwise noted. Control voltage shall be 120 volts ac unless otherwise noted.

2.8.2 Undervoltage/Phase Sequence Relay, (ANSI device 27/47 and device 47)

Undervoltage/Phase Sequence Relays shall conform to IEEE C37.90.

Undervoltage/Phase Sequence Relays shall be three phase induction type or solid-state type inverse time for loss of voltage, protection against undervoltage, loss of phase, (Secondary Unit Substations only) and phase reversal. Relays shall have an adjustable time delay. GE type ICR relay, Basler type BE1 relay, or approved equal.

2.8.3 Multicontact Auxiliary Relay, (ANSI device #86)

Relays shall be high-speed multicontact with hand reset. Relay shall meet the requirements of IEEE C37.90. Electroswitch series 24 or approved equal.

2.8.4 Directional Overcurrent Relays (ANSI Device #67)

Directional overcurrent relays shall be in accordance with IEEE C37.90.

Directional overcurrent relays for protection against reverse direction faults shall be single-phase induction type or solid-state type with adjustable time-delay and instantaneous trip attachments. Relay shall be removable type with inverse-time directional and overcurrent units with built-in testing facilities. Basler type BE1 or approved equal.

The case shall be semiflush-mounted to the hinged instrument panel and shall have matching cover.

2.8.5 Synchronizing Check Relay (ANSI Device #25)

Synchronizing check relay shall be in accordance with IEEE C37.90.

The synchronizing check relay shall be the type that permits closure when the two sources are synchronized elsewhere and the voltages vary by no more than plus or minus 3 percent and the sources are no more than 20 degrees out of phase for an adjustable time period. In addition, the relay shall allow closure on a dead bus. Synchronizing check relay shall be induction type or solid-state type. Basler type BE1 or approved equal.

The case shall be semi-flush mounted to the hinged instrument panel and shall have matching cover.

2.8.6 Time Delay (ANSI Device #62)

Time delay relays shall be in accordance with IEEE C37.90.

Provide a time delay relay that serves in conjunction with the device that initiates the trip signal to delay operation of the circuit breakers for a predetermined period of time. Time settings shall be from 1/2 to 11 cycles or as indicated.

2.8.7 Auxiliary Control Relays

Auxiliary control relays shall be in accordance with IEEE C37.90, and shall be provided as required to implement the protective functions and interlocking as indicated. Auxiliary relays shall have controls rated to carry 30 amperes for one minute, and 12 amperes continuously. Coils shall be long life design with a projected service life of 40 years.

Auxiliary relays used for tripping circuit breakers shall be multicontact, high speed relays operating in one-half cycle or less.

Auxiliary relays for functions other than tripping circuit breakers shall be normal speed relays operating in two cycles or less.

Auxiliary timing relays shall be electro-pneumatic used with relays for tripping circuit breakers, and shall have contacts rated for at least the level they are controlling.

2.9 ELECTRONIC METERING AND MONITORING

Meters shall be microprocessor based monitoring devices that display the following parameters:

Phase currents
Line to line voltages
Line to neutral voltages
Watts
Watt hours
VARS
VA
VAR hour
Demand KW
Demand VA
THD, Current (%)
Frequency
Power factor
Peak demand power
THD, Voltage (%)
k-Factor

All values shall be available for local readout and shall be capable of being transmitted to a remote computer via the existing RS485 network at GSFC. Measuring accuracies for current and voltage shall be at least 1 percent; watts, vars, and watt-hours 2 percent; frequency 0.5 percent; and power factor 4.0 percent. Voltage and current readings shall be true RMS through at least the 7th harmonic.

Meters inputs shall be rated 5 amperes, 120 volts, and shall be connected for operation on 3 phase, 4 wire circuit. Meters shall operate at +20 percent of nominal voltage, in temperatures from 0 to 50 degrees C, and from 0 to 90 percent relative humidity. Watthour and demand readings shall be maintained in non-volatile memory in the event of loss of power.

The power supply input to the meter shall be derived from the load side of the control power circuit contactor (ANSI Device #83).

Meters shall include a KYZ pulse relay consisting of form C contacts for future connection to the GSFC Utility Control System.

The case shall be semiflush-mounted to the hinged instrument panel and shall have a matching cover.

The meter shall have the following features:

Full Instrumentation
RS-485 Communications Port
Front Panel Optical Communication Port
0.2% Accuracy Class
Alarm/Relay Functions
On-board Data Logging
Downloadable Firmware
Date/Time for Each Min/Max
12-cycle Waveform Capture
Event Logging
Extended Memory
Surge/Sag Detection

The meter will be made part of the existing PMCS System/Powerlogic PMCS by Square D Company at GSFC. Tie-in to the existing system will be by others.

The meter model shall be "Square D" Circuit Monitor, Model CM-2350. Provide "Square D" I/O module, model IOM-44, for each meter.

The meter shall be connected to monitor the status (open/closed) of the main and tie breakers via an "a" contact on each breaker. The meter shall also be connected to monitor the status of Device #43, auto/manual switch, via a spare contact on the switch.

The RS485 communication port shall be factory wired to a central location in the switchgear instrumentation compartment. The communication port shall be clearly labeled for future connection to the GSFC PMCS network.

The meter shall comply with:

FCC Part 15, Class A
IEC 801-2
IEC 801-5
UL 508

2.10 INSTRUMENT TRANSFORMERS

Instrument transformers shall comply with the interference requirements listed below, measured in accordance with IEEE C63.2, IEEE C63.4, and NEMA 107.

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
5.0	60	4.16	2.64	3.34	250	250
15L or 15H	95-110	14.40	9.14	9.41	1000	250
34.5	200	34.50	21.90	23.00	....	650

2.10.1 Current Transformers

Current transformers shall conform to IEEE C57.13 for installation in metal-clad switchgear. Standard 5-amp secondary transformer shall be used.

Transformers shall be wound, bushing, bar, or window type, as indicated.

Transformers shall have single or multiple tap secondary winding, as indicated.

Transformers shall be complete with secondary short-circuiting device.

Window-type current transformers shall be indoor dry type construction with secondary current ratios as indicated on the contract drawings. Burden, frequency, and accuracy shall be as required to provide +/- 1 percent accuracy at 60 Hertz. Minimum C-200 accuracy class is required.

2.10.2 Potential Transformers

Potential transformers shall conform to IEEE C57.13 for installation in metal-clad switchgear. Standard 120-volt secondary transformers shall be used.

Transformers shall have single, tapped, or double secondary, as indicated.

Burden, frequency, and accuracy shall be as required to provide +/- 1 percent accuracy at 60 Hertz.

Disconnecting potential transformers with integral fuse mountings and current-limiting fuses shall be indoor dry type two-winding construction with primary and secondary voltage ratings as required.

2.11 INDICATING LIGHTS

2.11.1 General-Purpose Type

Indicating lights shall be 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. Color code for indicating lights shall be in accordance with JIC-01.

Indicating lights shall be provided in remote-control stations when pushbuttons and selector switches are out of sight of the controller.

2.11.2 Switchboard Indicating Lights

Indicating lights shall be the manufacturer's standard transformer type units 120-volt input utilizing low-voltage lamps and convex lenses of the colors indicated. Indicating lights shall be 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. Lights shall be equipped with "push-to-test" feature.

2.12 FACTORY TESTING

Factory tests on control and protective devices shall be performed in accordance with the manufacturer's recommendations.

Short-circuit tests shall be in accordance with Section 2 of NEMA ICS 1.

PART 3 EXECUTION

3.1 INSTALLATION

Control and protective devices not factory installed in equipment shall be installed in accordance with the manufacturer's recommendations and shall be field adjusted and tested for operation. Installations shall conform to NFPA 70, NEMA ICS 1, NEMA ICS 2, and NEMA ICS 3 requirements for installation of control and protective devices.

3.2 FIELD TESTING

Control and protective devices not factory installed in equipment shall be demonstrated to operate as indicated.

Reduced-voltage starting devices shall be field adjusted to obtain optimum operating conditions. Test meters and instrument transformers shall conform to IEEE C12.1 and IEEE C57.13.

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SECTION 16345

MOTOR CONTROL

09/97

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SECTION 16345

MOTOR CONTROL
09/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 845	(1995; 4th Ed) UL Standard for Safety Motor Control Centers

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Connection Drawings shall be submitted 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.

Installation Drawings shall be submitted for Control Devices and Protective Devices in accordance with the paragraph entitled, "Installation," of this section.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Motor-Control Centers

Motor Control Units
Accessories

SD-07 Certificates

Certificates of Compliance shall be submitted for Circuit Tests on similar motor-control or motor-circuit protector (MCP) units under actual conditions may be submitted in lieu of factory tests on the actual units provided.

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted for Control Devices and Protective Devices including special provisions required to install equipment components and system packages. Special notices shall detail hazards and safety precautions.

1.4 SHIPPING

Motor control centers longer than 8 feet shall be shipped in coordinated subassemblies for field connection. Maximum shipping length shall be as approved.

PART 2 PRODUCTS

2.1 EQUIPMENT

Motor-control centers shall conform to NEMA ICS 2, UL 845 and NFPA 70.

2.2 CONFIGURATION

Motor-control centers shall be NEMA ICS 2, Class I, Type B, totally enclosed, free-standing, dead-front distribution type with one or more vertical sections in which combination motor-control units, transformers, panels, and associated control equipment units are group-mounted in an integrated assembly.

2.3 CONSTRUCTION

Motor-control centers shall be accessible from the front only and shall be suitable for mounting two units or groups of units back to back, unless otherwise noted.

Provisions shall be made for leveling the entire assembled motor-control center sections and bolting them together so that they form a contiguous structural enclosure.

Motor-control centers shall contain electrical interlocks, unit control terminal blocks, master control terminal blocks, unit wiring to terminal blocks and unit interconnections, and power connection terminal blocks as required. A minimum of 2 normally open auxiliary contacts shall be provided in addition to the seal-in contact.

Covers for motor-control centers shall be fabricated from cold-rolled carbon-steel sheets of commercial quality with stretcher-level flatness. Vertical sections shall be reinforced to form a rigid structure.

Lifting angles shall be 7 gage, and shall be provided on the top of each section, and shall extend the entire width of the section, and shall be

capable of supporting the entire weight of the motor-control center section without distortion. Base channels shall be provided with holes to facilitate floor mounting and leveling.

Design of the motor-control centers shall allow addition of sections with the same height and width without major modifications. Top cover shall not sag or be deformed.

Top and sides shall have removable covers secured with bolts or fasteners. Covers shall permit access from the rear to the main bus and bus-tap connections in each vertical section. Access doors to motor-control drawout units, wiring channels, and the protective cover of the main horizontal bus shall provide dead front construction.

Horizontal wiring channels shall be provided in the top and bottom of motor-control centers for wiring between vertical sections. Wiring channels shall extend the entire length of the motor-control center and shall allow space for duct and conduit entrances. Vertical wiring channels shall be provided in each vertical section for side wiring to individual motor-control units. Vertical wiring channels shall extend the entire length of each vertical section. Covers of motor-control units and vertical wiring channels shall be side-hinged to the vertical section and fastened in the closed position with captive bolts, screws, or latches. Horizontal wiring channels shall be removable and fastened in place with captive bolts or screws. A removable steel-plate barrier shall be provided at the tip of each vertical structure to isolate the main horizontal bus from the horizontal wireway.

Horizontal bus structure shall extend the entire length of the motor-control center and shall be tinned copper with a continuous rating as indicated on the drawings.

All vertical sections shall be completely bused (600-ampere rating)and electrically interconnected with silver-plated solid copper busbars to accommodate plug-in starter units with main horizontal and vertical buses uniformly positioned and phase sequenced. Main horizontal buses shall be readily accessible for connection of future vertical sections at either end.

Vertical sections shall have a width not less than 20 inches and a depth of 20 inches.

Buses shall be supported and braced to withstand the short-circuit currents indicated. Contact surfaces of main buses shall be silver plated and bolted together to ensure conductivity.

Main incoming lug compartments shall be provided for terminations of cable as indicated on the drawings.

A continuous rigid tin-plated copper ground bus shall extend through the bottom of the entire assembly and shall ground the stationary structure and equipment. Ground bus shall be capable of carrying the rated short-circuit current available in the motor-control center.

After fabrication, steel surfaces of motor-control centers shall be cleaned and phosphatized prior to the application of paint. External and internal surfaces shall be finished with baked enamel or a fast air-drying enamel. Color of internal and external finishes shall be the manufacturer's standard. Nonpainted parts shall be cadmium plated or coated with zinc chromate.

2.4 COMBINATION MOTOR-CONTROL UNITS

Combination motor-control units for the control and protection of single-and three-phase, 60-hertz squirrel-cage induction motors with branch-circuit disconnection and protective devices shall include magnetic motor-controllers, molded-case circuit breakers, or motor-control circuit protectors in compartmentalized draw-out unit construction with fused control-power transformers, selector switches, pushbuttons, and indicating lights, as indicated. Motor control and protective devices shall conform to the requirements of Section 16286, "Overcurrent Protective Devices."

Unit spaces in vertical sections shall be provided with guide rails for the support and alignment of motor-control draw-out units. Latches shall be provided to ensure complete electrical connection of the draw-out unit with the main bus and to allow removal of the draw-out unit from the motor-control center. Plug-in units shall be interchangeable.

Draw-out unit shall be provided with spring-loaded, silver-plated, plug-in stabs for connection to the main bus on the line side of the motor-control unit and fixed terminal blocks for the load-side connections. Wiring shall be accessible from the front. No wiring shall extend into the bus compartment. Unit terminal blocks shall be the split type, allowing unit removal without disturbing outgoing wires.

Motor-control units shall be provided with a single separate hinged door interlocked with its associated disconnecting device to prevent access to draw-out units when the circuit breaker contacts are closed and the operating handle is in the "ON" position. Doors shall swing open a minimum of 112 degrees. An interlock release shall be provided, however, to defeat the interlocking mechanism and permit access to the draw-out unit using a simple hand tool.

Doors shall be provided with openings for the operating handle of molded-case circuit breakers, thermal-overload relay reset buttons, indicating lights, selector switches, and pushbuttons as required.

Disconnect switch overload reset button, selector switches, and any indicating lights and pushbuttons shall be operable with the compartment door closed. The ON-OFF position of the main disconnect method shall be clearly indicated with the door closed.

Feeder tap units shall include externally operable molded-case circuit breakers in combination motor-control unit enclosures for the protection of non-motor loads or remotely located magnetic motor-controllers. Not more than two molded-case circuit breakers shall be contained in feeder tap units.

Compartments for future combination motor-control units shall be complete with hardware, buses, and hinged doors ready to receive future draw-out units. Compartments for spare combination motor-control units shall be complete with buses, hinged doors, and draw-out units but without load terminal connections. Spare spaces shall be complete with buses and screwed-on front cover plates.

Combination motor-control units shall be identified with identification plates affixed to the front hinged door or cover plate of each compartment. Identification plate shall identify the connected load.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment and materials shall be installed in accordance with all applicable listings. Sealing of penetrations of the fire rated walls, partitions, ceilings and floors shall be in accordance with Section 07840, "Firestopping and Smokestopping."

Complete assembly shall be electrically and mechanically connected and assembled from coordinated subassemblies shipped in complete sections from the manufacturer. Installation shall be aligned, leveled, and secured to the supporting construction in accordance with the manufacturer's recommendations.

3.2 FIELD TESTING

Motor-control centers shall be subjected to continuity and insulation tests after the installation has been completed and before the motor-control center is energized.

Contractor shall provide test equipment, labor, and personnel to perform the tests required. Continuity tests shall be conducted using a dc device with bell or buzzer.

Motor-control centers shall be completely isolated from extraneous electrical connections. Substation feeder breakers, circuit breakers in switchboards, and other disconnecting devices shall be used to isolate the motor-control center under test.

Insulation tests on 480-volt motor-control centers shall be conducted using a 1,000-volt insulation-resistance test set. Readings shall be recorded every minute until three equal and consecutive readings are obtained. Resistance between phase conductors and between phase conductors and ground shall be not less than 50 megohms.

Insulation tests on motor-control centers 600 volts or less shall be conducted using a 500-volt insulation-resistance test set. Readings shall be recorded after 1 minute and until the reading is constant for 15 seconds. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Phase-rotation tests shall be conducted on all three-phase circuits using a phase-rotation indicating instrument. Phase rotation of electrical connections to motors and other connected equipment shall be clockwise.

Test data shall be recorded and shall include location and identification of motor-control centers and megohm readings versus time.

Final acceptance shall depend upon the satisfactory performance of the motor-control centers under test. No motor-control center shall be energized until recorded test data have been approved by the Contracting Officer.

-- End of Section --

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SECTION 16446

PANELBOARDS

03/97

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SECTION 16446

PANELBOARDS
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA 416	(1981) Filters, Radio Interference
EIA 46	(1987) Test Procedure for Resistance to Soldering (Vapor Phase Technique) for Surface Mount Devices

FEDERAL STANDARDS (FED-STD)

FED-STD 595	(Rev B) Colors Used in Government Procurement

MILITARY HANDBOOKS (MIL-HDBK)

MIL-HDBK 232	(Rev A) Red/Black Engineering Installation Guidelines

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electric Equipment (1000 Volts Maximum)
NEMA AB 1	(1994) Molded Case Circuit Breakers and Molded Case Switches
NEMA PB 1	(1990) Panelboards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 67	(1993; 11th Ed) Panelboards

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the

specification:

SD-02 Shop Drawings

Outline Drawings for Panelboards shall indicate overall physical features, dimensions, ratings, service requirements, and weights of equipment.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Panelboards
Directory Card and Holder
Filtered Panelboard

SD-06 Test Reports

Test Reports shall be submitted for the following tests in accordance with the paragraph entitled, "Site Testing," of this section. Panelboards shall not be energized until the recorded test data have been submitted to and approved by the Contracting Officer.

Continuity Tests
Insulation Tests

SD-07 Certificates

Statements signed by responsible officials of a manufacturer of a product, system, or material attesting that the product, system or material meet specified requirements. Statements must be dated after the award of this contract, name the project, and list the specific requirements which it is intended to address.

SD-08 Manufacturer's Instructions

Manufacturer's Instructions shall be submitted for Panelboards including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

SD-11 Closeout Submittals

Panelboard keys shall then be properly tagged and delivered to the Contracting Officer.

PART 2 PRODUCTS

2.1 PANELBOARDS

Power-distribution panelboards and lighting and appliance branch-circuit panelboards shall be totally enclosed in a steel cabinet, dead-front circuit breaker type with copper buses, surface- or flush-mounted as indicated. Panelboards shall conform to NEMA PB 1 and NEMA AB 1. Branch circuit panels shall have buses fabricated for bolt-on type circuit breakers.

An outer door or cover, hinged on one side, shall be provided on surface-mounted panelboards to provide gutter space access. A center door shall be provided for circuit breaker/switch access only.

Voltage and current rating, number of phases, and number of wires shall be as indicated. Four-wire distribution panelboards and lighting and appliance branch-circuit panelboards shall be provided with an isolated full-capacity neutral bus. A 200 percent neutral bus shall be provided where indicated. Panelboards shall be rated for 120/208-volt, three-phase or 277/480-volt, three-phase, 60-hertz.

Three-phase, 4-wire panelboards shall be provided with an isolated full-capacity bus providing spaces for single-pole circuit breakers/switches and spaces indicated as spare. Provide spare circuit breakers as indicated.

Panelboards shall be provided with a separate grounding bus bonded to the enclosure. Grounding bus shall be a solid bus bar of rectangular cross section equipped with binding screws for the connection of equipment grounding conductors.

Each panelboard, as a complete unit, shall have a short-circuit current rating equal to or greater than the integrated equipment rating shown on the panelboard schedule or as indicated. Breakers shall be fully rated.

Panelboards and main lugs or main breaker shall have current ratings as shown on the panelboard schedule.

Bus bar connections to the branch circuit breakers shall be the "distributed phase" or "phase sequence" type. Three-phase, four-wire busing shall be such that when any three adjacent single-pole breakers are individually connected to each of the three different phases, two- or three-pole breakers can be installed at any location. Current-carrying parts of the bus assembly shall be plated. Mains ratings shall be as shown.

Mechanical lugs furnished with panelboards shall be cast copper or copper alloys of sizes suitable for the conductors indicated to be connected thereto.

Boxes shall have the manufacturer's standard knockouts and shall be galvanized code-gage sheet steel. Fronts shall be of code-gage sheet steel furnished with hinged doors with adjustable trim clamps for securing the fronts to the boxes.

Panelboard enclosures shall be NEMA 250, Type 1. Enclosures shall be provided with hinged fronts and corrosion-resistant steel pin-tumbler cylinder locks. Locks shall be keyed alike, and two keys shall be provided for each enclosure.

Panelboards shall be finished with baked enamel. Finish color shall be No. 61 gray conforming to FED-STD 595.

2.2 CIRCUIT BREAKERS

Circuit breakers shall be the molded-case type as specified in Section 16286, "Overcurrent Protective Devices." Frame and trip ratings shall be as indicated.

Interrupting rating of circuit breakers shall be as indicated. If not

shown, the interrupting rating for circuit breakers in 120/208-volt panelboards shall be not less than 10,000 amperes rms symmetrical, and that for breakers in 277/480-volt panelboards shall be not less than 25,000 amperes rms symmetrical.

Circuit breakers shall be bolt-on type. Plug-in type shall not be acceptable.

Shunt trips shall be provided where indicated.

In branch circuit panelboards, branch circuit breakers feeding convenience outlets shall have sensitive instantaneous trip settings of not more than 10 times the trip rating of the breaker to prevent repeated arcing shorts resulting from frayed appliance cords. Single-pole 20-ampere circuit breakers shall be UL listed as "Switching Breakers" at 120 volts ac and 277 volts ac. UL Class A (5-milliampere sensitivity) ground fault circuit protection shall be provided on 120-volt ac branch circuit as indicated. This protection shall be an integral part of the branch circuit breaker that also provides overload and short-circuit protection for branch circuit wiring. Tripping of a branch circuit breaker containing ground fault circuit interruption shall not disturb the feeder circuit to the panelboard. A single-pole circuit breaker with integral ground fault circuit interruption shall require no more panelboard branch circuit space than a conventional slide pole circuit breaker.

Connections to the bus shall be bolt-on type.

When multiple wires per phase are specified, the circuit breakers shall be furnished with connectors made to accommodate multiple wires.

Circuit breaker spaces called out on the drawings shall be complete with mounting hardware to permit ready installation of the circuit breakers.

2.3 DIRECTORY CARD AND HOLDER

A directory card shall be mounted on the inside of hinged fronts and doors under 0.030-inch thick minimum plastic in a metal frame, with spaces for circuit numbers, outlets controlled, and room numbers. Directory card shall identify each branch circuit with its respective and numbered circuit breaker.

2.4 FACTORY TESTING

Complete panelboards shall be tested in accordance with UL 67.

2.5 PRECAUTIONARY LABEL

To ensure persons are aware of immediate or potential hazard in the application, installation, use, or maintenance of panelboards, each panelboard shall be consipicuously marked on the trim or dead front shield with the text (or equivalent) **DANGER** symbol. If the panel is supplied with a door, the label shall be visible when the door is in the open position.

PART 3 EXECUTION

3.1 INSTALLATION

Panelboards shall be installed as indicated and in accordance with the manufacturer's instructions. Panels shall be fully aligned and mounted so

that the height of the top operating handle will not exceed 72-inches above the finished floor.

Directory-card information shall be typewritten in capital letters to indicate outlets controlled and final room numbers served by each circuit and shall be mounted in holders behind protective covering.

3.2 SITE TESTING

Each panelboard enclosure key shall be shown to operate the enclosure locks in the presence of the Contracting Officer.

Panelboards shall be given continuity and insulation tests after the installation has been completed and before the panelboard is energized.

Test equipment, labor, and personnel shall be provided by the Contractor as required to perform the tests as specified. Continuity tests shall be conducted using a dc device with bell or buzzer.

Insulation tests on 480-volt panelboards shall be conducted using a 1,000-volt insulation-resistance test set. Readings shall be recorded every minute until three equal and consecutive readings have been obtained. Resistance between phase conductors and between phase conductors and ground shall be not less than 50 megohms.

Insulation tests on panelboards rated 300 volts or less shall be conducted using a 500-volt minimum insulation-resistance test set. Readings shall be recorded after 1 minute and until the reading is constant for 15 seconds. Resistance between phase conductors and between phase conductors and ground shall be not less than 25 megohms.

Test data shall be recorded and shall include the location and identification of panelboards and megohm readings versus time.

-- End of Section --

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SECTION 16511

FLUORESCENT LUMINAIRES

03/97

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SECTION 16511

FLUORESCENT LUMINAIRES
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C62.11	(1993) Metal-Oxide Surge Arresters for Alternating Current Power Circuits
ANSI C62.41	(1991) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
ANSI C78.1	(1991; C78.1a-1992) Dimensional and Electrical Characteristics of Fluorescent Lamps - Rapid Start Types
ANSI C78.3	(1991) Dimensional and Electrical Characteristics of Fluorescent Lamps - Instant-Start and Cold-Cathode Types
ANSI C82.1	(1985; C82.1a-1990; c82.1b-1990; C82.1c-1990) Ballasts for Fluorescent Lamps
ANSI C82.11	(1993) High-Frequency Fluorescent Lamp Ballasts
ANSI C82.2	(1984; R 1989) Fluorescent Lamp Ballasts - Methods of Measurement

FEDERAL COMMUNICATIONS COMMISSION (FCC)

FCC Part 18	RF Lighting Devices

NATIONAL ELECTRICAL MANUFACTURER'S ASSOCIATION (NEMA)

NEMA 270	(1988) Procedure for Fluorescent Lamp/Ballast/Fixture Performance Comparison

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1570	(1988; 3rd Ed; Rev thru May 25, 1990) Fluorescent Lighting Fixtures
UL 844	(1995; 11th Ed) UL Standard for Safety Electric Lighting Fixtures for Use in Hazardous (Classified) Locations

UL 935 (2001; 10th Ed) Fluorescent-Lamp Ballasts

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

Fluorescent fixture performance requirements shall be rated in accordance with NEMA 270.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-02 Shop Drawings

Outline Drawings shall be submitted for the Fluorescent Fixtures indicating overall physical features, dimensions, ratings, service requirements, and weights of equipment.

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Fluorescent Lighting Fixtures
Fluorescent Lamp Ballast
Fluorescent Lamps
Accessories

SD-05 Design Data

Lighting-Distribution Curves for each type of fixture shall be prepared utilizing the fixture manufacturer's own facilities or those of an independent nationally recognized laboratory, in accordance with the standard procedure developed by the Illuminating Engineering Society.

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

Fluorescent lighting fixtures shall conform to UL 1570 and as specified. Fixtures in hazardous areas shall conform to UL 844.

Lighting fixtures shall be furnished completely assembled with wiring and mounting devices and ready for installation at the locations indicated. Recessed fixtures in suspended ceilings shall be designed and equipped for installation in the type of ceiling in which the fixture is to be installed. Fixtures shall be designed to be supported independent of the ceiling and shall be equipped with the lamps indicated.

2.2 COMMERCIAL FIXTURES

Commercial fluorescent lighting fixtures shall conform to UL 1570 and include recessed, surface-mounted, and pendant-mounted luminaires as

indicated and herein specified.

Lighting fixtures shall include wiring channel, end plates, end caps, side panels, top reflectors, bottom closures, lampholders, lamps, ballasts, suspension stems, wiring, and other necessary materials and devices.

Ballasts and wiring shall be completely enclosed in the wiring channel and shall be easily accessible. Ballast shall be replaceable without removing the fixture from its mounting. Lamps shall be replaceable without the use of tools and without removal of other lamps and equipment.

Wiring channel, end plates, and other sheet steel enclosure components shall be cold-rolled carbon-steel sheet of commercial quality not less than 20 gage.

When two or more fixtures are joined together in continuous rows, the wiring channel shall form an open and continuous wireway.

2.2.1 Surface-Mounted Fixtures

Surface-mounted fixtures shall be designed to be fastened to wall or ceiling flush-mounted outlet boxes. When two or more fixtures are joined together in continuous rows, the wiring channel shall form an open and continuous wireway.

2.2.2 Recessed Fixtures

Recessed fixtures in suspended ceilings shall be equipped with frames, yokes, and adjustable mounting brackets designed for the type of ceiling construction in which the fixture is to be installed. Bottom closure shall be hinge framed with chromium or nickel-plated latching devices.

2.2.3 Pendant-Mounted Fixtures

Pendant-mounted fixtures shall be equipped with stems, swivel, ball-and-socket self-aligning hangers, ceiling canopies, and fixture-leveling devices. Stems shall be not less than 1/2 inch in diameter, made from seamless corrosion-resistant steel tubing. Stem length, material, and finish shall be as indicated.

2.2.4 Combination Light and Air-Handling Troffers

Combination light and air-handling troffers recessed in suspended ceilings shall be in accordance with UL 1570 and shall conform to the requirements for commercial fluorescent lighting fixtures, as indicated.

Electrical equipment, except lamps and lampholders, shall be completely separated from the air path through the fixture and from the air space in the plenum.

Joints in the wiring channel shall be sealed to prevent air leakage and the infiltration of lint and dirt into the wiring compartment.

Air-handling fixtures shall be equipped with bottom flanges, air trim openings, metal filler strips, and single or double air-diffuser side units. Inlet connections shall be located on the side of single units and on the top or side of double units.

Supply-terminal air devices shall be equipped with adjustable air pattern

controllers in outlets and with volume controls in housings. Both controls shall be accessible from the face of the outlet without disturbing the lamp enclosure. Pattern- and volume-control devices shall be positive locking in all positions. Return-air units shall be equipped with volume controls.

Air-diffuser assemblies shall be constructed of mill-galvanized steel. Interior surfaces exposed to view and the metal filler strips shall be finished with a matte-black enamel. Filler strips shall be used to close unused air-trim openings.

2.2.5 Compact Fluorescent Fixtures

Compact fluorescent fixtures shall be 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. Fixtures shall use lamps as indicated.

2.3 INDUSTRIAL FIXTURES

Industrial fluorescent lighting fixtures shall conform to UL 1570 and shall be as indicated.

Lower edge of the reflector shall be formed into a flange or bead to provide stiffness and shall be completely covered by the finish. Each reflector shall be removable and securely maintained in position with latch fastening devices. Reflector shall form the bottom of the wiring-channel enclosure.

Direct-lighting fixture reflectors shall be so shaped that the ratio of the candlepower at 55 degrees nadir to the candlepower at nadir shall be not less than 55 percent. Upward component of light shall be a minimum of 8 percent and a maximum of 20 percent of the total light output.

Semidirect lighting-fixture reflectors shall be so shaped that the ratio of the candlepower at 45 degrees nadir to the candlepower at nadir shall be not less than 60 percent. Upward component of light shall be a minimum of 20 percent and a maximum of 30 percent of the total light output.

Lighting-fixture unit, when viewed at any angle from the minimum shielding angle to the horizontal plane, shall have a brightness no greater than 40 percent of the brightness of the bare lamp.

Pendant-mounted fixtures shall be equipped with straps, brackets, conduit stems, ball-and-socket self-aligning hangers, ceiling canopies, slide-clamp fixture hangers, and leveling devices. Stems shall be not less than 1/2 inch in diameter, seamless brass, steel, or aluminum tubing. Stem length and finish shall be as indicated. When two or more fixtures are joined together, the wiring channel shall form an open and continuous wireway.

Chain-supported fixtures shall be equipped with straps, brackets, ceiling-mounted chain hangers, chain, hooks, and slide-clamp fixture hangers.

2.4 FLUORESCENT LAMP ELECTRONIC BALLAST

Fluorescent lamp ballasts shall be thermally protected and be Class P in accordance with ANSI C82.1, ANSI C82.2, ANSI C82.11, and UL 935.

All fluorescent fixtures shall be provided with electronic ballasts, unless otherwise noted.

The input voltage to the ballast shall be as indicated on the drawings.

The ballast shall be solid-state electronic, instant start, and shall be capable of operating one or more F32T8 energy saving lamps or other energy saving lamps as indicated.

Cold weather ballasts shall be provided for fixtures not located in air-conditioned space and where temperatures will bet below 50 degrees F.

The ballast shall be designed to operate at an input frequency of 60 Hz. The solid-state electronic ballast shall invert the low frequency to a high frequency (20 KHz to 40 KHz) and apply this to the lamp. Lamp flicker shall be less than 5 percent, unless specified otherwise.

The audible noise levels shall be equivalent to the Class A rating of CBM certified ballasts.

The ballast shall meet the requirements of FCC Part 18.

The ballast shall have a rated life of not less than 10 years or 30,000 hours.

The ballast shall withstand line transients as defined in ANSI C62.41, Category A.

The power factor of the ballast shall not be less than 95 percent, and the Total Harmonic Distortion (THD) of the line current shall not exceed 15 percent.

Ballast enclosure size shall conform to standards of electromagnetic ballasts. Ballast shall have circuit diagrams and lamp connections displayed on ballast packages. Ballast shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed.

The ballast case temperature shall not exceed 45 degrees F rise above a 105 degree F ambient.

The ballast shall be marked to indicate the input voltage, input frequency, operating frequency, line current, input watts and power factor. The value of the open circuit voltage of the ballast shall also be indicated.

The lamp crest factor shall be less than or equal to 1.7.

Ballasts shall not contain polychlorinated biphenyls's (PCB's) and shall be labeled "NO PCB'S".

The ballast shall safely and reliably start and operate in a room temperature from 50 degrees F to 105 degrees F. The ballast shall operate at an input voltage of either 120 volts or 277 volts (input voltage as indicated on the project design drawings), plus or minus 10 percent (of rated voltage). The light output shall not vary by more than 15 percent for a 10 percent variation of the input voltage about the rated voltage. The ballast shall operate the lamps in a manner that will not adversely curtail the normal life of the lamps. The ballast and the fixture shall meet all UL temperature limitations.

2.4.1 Fluorescent Lamp Electronic Dimming Ballast

The electronic ballast shall as a minimum meet the following characteristics:

Ballasts shall comply with UL 935, ANSI C62.11, and NFPA 70, unless specified otherwise. Ballast dimming capability range shall be from 100 to 10 percent (minimum range) of light output, flicker free. Ballasts shall start lamp at any preset light output setting. Ballasts shall be designed for the wattage of the lamps used in the indicated application. Ballasts shall be designed to operate on the voltage system to which they are connected.

Power factor shall be 0.95 (minimum) at full light output, and 0.90 (minimum) over the entire dimming range.

Ballasts shall operate at a frequency of 20,000 Hertz (minimum).

Ballast factor at full light output shall be between 0.85 (minimum) and 1.00 (maximum). Current crest factor shall be 1.7 (maximum).

Ballasts shall be UL listed Class P with a sound rating of "A".

Ballasts shall have circuit diagrams and lamp connections displayed on the ballast. Ballast shall operate lamps in a parallel circuit configuration that permits the operation of remaining lamps if one or more lamps fail or are removed.

Ballasts shall operate in a rapid start mode.

Ballasts shall be capable of starting and maintaining operation at a minimum of 50 degrees F for F32T8 lamps, unless otherwise indicated.

Total harmonic distortion (THD) shall be 15 percent (maximum) over the entire dimming range.

2.5 FLUORESCENT LAMPS

Lamps shall conform to ANSI C78.1, ANSI C78.3, and shall be the energy-efficient type with a minimum starting temperature of 50 degrees F.

2.5.1 F32T8 Lamp

The 32-watt, extra-high efficiency fluorescent lamp shall have a minimum efficiency of 91 lumens per watt and shall be designed to operate on a two, three, or four-lamp, electronic ballast.

Lamps shall have bulb designation T-8 with a nominal length of 48 inches, a base configuration of medium bi-pin contact.

Lamps shall have an average rated life at 3 hours per start of 20,000 hours. Initial lumens after 100 hours burning shall be 2,850 (minimum) with 2,600 (minimum) lumens at 40 percent of lamp life.

Bulb color shall be 4100 degrees K (Cool White), unless otherwise noted, with a minimum color rendering index (CRI) of 75, unless otherwise noted. Lamp dimensions shall be in accordance with ANSI C78.1.

2.5.2 F17T8 Lamp

The 17 watt (maximum) fluorescent lamp shall have a nominal length of 24 inches, 1300 initial lumens, CRI of 38 (minimum), color temperature of 4100 degrees K, and an average rated life of 20,000 hours.

2.5.3 T-8 U Shaped Fluorescent Lamp

The T-8, U shaped fluorescent lamp, shall be 31 watts (maximum), 2600 initial lumens (minimum), 4100 degrees K, 85 CRI (minimum), 20,000 hours average rated life when used on rapid start circuits.

2.5.4 Compact Fluorescent Lamps

Compact fluorescent lamps shall be 4100 degrees K, 10,000 hours average rated life, and as follows. Average rated life is based on 3 hours operating per start.

T-4, twin tube, rated 13 watts, 825 initial lumens (minimum).

T-4, double twin tube, rated 13 watts, 900 initial lumens (minimum), or 26 watts, 1800 initial lumens (minimum) as indicated

PART 3 EXECUTION

3.1 INSTALLATION

Fluorescent fixtures shall be installed in accordance with UL 1570.

A fixture shall be installed at each outlet indicated, and lamps of the proper type and wattage shall be installed in each fixture.

New lamps shall be installed immediately prior to completion of the project.

Fixtures shall be installed parallel and perpendicular to major axes of structures and shall be plumb and aligned to a tolerance of 1/2 inch in 10 feet.

Supports for recessed fixtures shall have a minimum capacity of 150 pounds, and all parts of the support shall be arranged to prevent them from vibrating free.

Supports for recessed fixtures in suspended ceilings shall be so arranged that each corner of each fixture is supported by a hanger wire anchored to a structural member or to the structure. Supports for recessed fixtures in suspended ceilings shall be totally independent of the ceiling support wires and support system.

Surface-mounted fixtures shall be attached securely to structural members or to metal supports that span structural members. Fixtures shall be fastened near each end and, when over 4-feet long, shall also be fastened at the center. When surface-mounted fixtures are not UL approved for direct mounting on combustible ceilings, suitable spacers shall be installed.

Fixtures located in equipment rooms shall be so installed that they clear all obstructions such as duct, piping, bracing, and supports.

3.2 FIELD TESTING

Fluorescent lighting fixtures shall be demonstrated to operate satisfactorily in the presence of the Contracting Officer.

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SECTION 16512

HIGH INTENSITY DISCHARGE (HID) LUMINAIRES

03/97

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SECTION 16512

HIGH INTENSITY DISCHARGE (HID) LUMINAIRES
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.1375	(1990) Metal-Halide 400-watt, M59 Single-Ended Lamps
ANSI C78.1376	(1990) Metal-Halide Lamp, 1000-watt, M47
ANSI C78.388	(1990) Electric Lamps - High Pressure Sodium Lamps
ANSI C82.4	(1985; C82.4a-1988) Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple Supply Type)
ANSI C82.5	(1990) Reference Ballasts - High-Intensity-Discharge and Low Pressure Sodium Lamps
ANSI C82.9	(1988) High-Intensity-Discharge and Low-Pressure Sodium Lamps, Ballasts and Transformers - Definitions

CODE OF FEDERAL REGULATIONS (CFR)

21 CFR 1040	(1995) Performance Standards for Light-Emitting Products

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1572	(1991; 3rd Ed) High Intensity Discharge Lighting Fixtures
UL 844	(1995; 11th Ed) UL Standard for Safety Electric Lighting Fixtures for Use in Hazardous (Classified) Locations

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Commercial Lighting Fixtures
Industrial Lighting Fixtures
Lamp Ballasts
Lamps
Lighting-Distribution Curves

SD-06 Test Reports

Test Reports shall be submitted for Operational Tests on HID lighting fixtures in accordance with the paragraph entitled, "Field Testing," of this section.

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

High-intensity-discharge (HID) lighting fixtures shall conform to UL 1572 and as indicated. Fixtures in hazardous areas shall conform to UL 844.

Lighting fixtures shall be furnished completely assembled with wiring and mounting devices and ready for installation at the locations indicated. Recessed fixtures in suspended ceilings shall be designed and equipped for installation in the type of ceiling in which the fixture is to be installed. Fixtures shall be designed to be supported independent of the ceiling. Fixtures shall be equipped with the lamps indicated.

2.2 COMMERCIAL FIXTURES

Commercial HID lighting fixtures shall be of the types and designs indicated, completely assembled, wired, and ready for connection to the building lighting-distribution system.

2.3 INDUSTRIAL FIXTURES

Fixture assembly shall include a detachable or non detachable reflector, gaskets, porcelain lampholder, and cast-aluminum flange and capnut, with a threaded pipe fitting suitable for stem mounting. Reflector shall be seamless aluminum porcelain-enameled steel with beaded bottom edge completely covered by the finish. Porcelain lampholder shall be attached to the flange with mounting screws. Reflector shall be rigidly supported between the threaded lower flange and threaded capnut with gaskets to protect the reflector finish. A threaded, molded, porcelain-lampholder cover shall provide access to the lampholder wiring terminals. Lampholder screw shells shall be designed for the medium- or mogul-base lamp indicated.

2.4 LAMP BALLASTS

2.4.1 Multiple-Circuit Ballasts

Multiple-circuit ballasts shall include a two-winding core-and-coil assembly with a saturated-iron regulating element and capacitors impregnated with an insulating material in accordance with ANSI C82.4, ANSI C82.5, and ANSI C82.9.

Ballast shall maintain correct lamp operation over a voltage-input range of plus or minus 13 percent of rated voltage. Capacitors shall provide a power-factor lamp load not less than 95 percent.

Ballasts shall be voltage rated for operation on 277 or 480-volt, single-phase, 60-hertz lighting-distribution systems, as indicated.

Ballasts shall be designed for a minimum lamp starting temperature of minus 20 degrees F and a maximum ambient temperature of 105 degrees F.

Ballasts shall be of the constant wattage type. The starting current shall not exceed the operating current of the ballast.

Solid state ballasts shall be used when indicated.

2.5 LAMPS

Lamps shall be certified to be automatically self-extinguishing and in conformance with 21 CFR 1040, Section 30, when HID lamps are used in a populated area.

HID lamps shall be as indicated with low-pressure sodium lamps conforming to ANSI C82.9, high-pressure sodium lamps conforming to ANSI C78.388, and metal halide lamps conforming to ANSI C78.1375 and ANSI C78.1376.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be performed in accordance with NFPA 70.

HID fixtures shall be installed at each outlet indicated, and lamps of the proper type, voltage, and wattage shall be installed in each fixture.

New lamps shall be installed immediately prior to completion of the project. Lamps shall be installed with the light center at the focal point of the reflector and in the proper burning position.

High-bay fixtures shall be so installed that they clear obstructions such as crane rails, piping, and bracing that could impede operation of lowering devices.

3.2 FIELD TESTING

HID lighting fixtures and their accessories, including lowering devices, shall be demonstrated to operate satisfactorily in the presence of the Contracting Officer.

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SECTION 16513

INCANDESCENT LUMINAIRES

03/97

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SECTION 16513

INCANDESCENT LUMINAIRES
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 1571	(1991; 3rd Ed) UL Standard for Safety Incandescent Lighting Fixtures
UL 844	(1995; 11th Ed) UL Standard for Safety Electric Lighting Fixtures for Use in Hazardous (Classified) Locations

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Commercial Incandescent Lighting Fixtures
Industrial Incandescent Lighting Fixtures
Enclosed and Gasketed Vapor-Tight Fixtures
Incandescent Lamps
Lighting-Distribution Curves

SD-06 Test Reports

Test Reports shall be submitted for Operational Tests on incandescent lighting fixtures in accordance with the paragraph entitled, "Field Testing," of this section.

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

Incandescent lighting fixtures shall conform to UL 1571. Fixtures in hazardous areas shall conform to UL 844.

Lighting fixtures shall be furnished completely assembled with wiring and mounting devices and ready for installation at the locations noted. Recessed fixtures in suspended ceilings shall be designed and equipped for installation in the type of ceiling in which the fixture is to be installed. Fixtures shall be designed to be supported independent of the ceiling. Fixtures shall be equipped with the lamps required.

2.2 COMMERCIAL FIXTURES

Commercial incandescent lighting fixtures include recessed, surface mounted, and pendant-mounted luminaires.

Metal parts of lighting fixtures shall be corrosion-resistant nonferrous metal or sheet steel with corrosion-resistant finish. Solder or self-threading sheet metal screws shall not be used in the construction of the fixture enclosure.

Fixtures rated up to and including 300 watts shall be equipped with medium screw-base lampholders. Fixtures rated in excess of 300 watts but not more than 1,500 watts shall be equipped with mogul screw-base lampholders. Screw shells of lampholders shall be electrically connected to the metal part of lighting fixtures or equipment grounding-circuit conductor.

2.2.1 Surface-Mounted Fixtures

Surface-mounted fixtures shall be designed to be fastened to wall or ceiling flush-mounted outlet boxes. Combustible ceiling materials shall not be subject to temperatures in excess of 195 degrees F.

2.2.2 Recessed Fixtures

Recessed fixtures in suspended ceilings shall be designed for the type of ceiling construction in which the fixture is to be installed. Combustible ceiling materials shall not be subject to temperatures in excess of 195 degrees F. Where recessed fixtures are supported on suspended ceilings, the ceiling shall have a minimum of four support rods per fixture with no support further than 6 inches from the edge of the fixture. Fixtures shall not be supported by acoustic panels.

2.2.3 Pendant-Mounted Fixtures

Pendant-mounted fixtures shall be equipped 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. Stems shall be seamless brass, aluminum, steel, corrosion-resistant steel tubing, or steel conduit not less than 1/2-inch in diameter. Stem length, material, and finish shall be as noted.

2.3 INDUSTRIAL FIXTURES

Industrial incandescent lighting fixtures shall be provided with industrial porcelain-enameled seamless dome reflectors with ventilated necks and hoods

tapped for 1/2-inch conduit for swivel suspension pendant mounting. Lampholders shall have medium or mogul bases as applicable, furnished with incandescent lamps having the wattage rating indicated. Fixtures shall meet the requirements of UL 1571. Reflectors and sockets shall be easily detached as a unit without the use of tools but shall be so arranged that they cannot inadvertently come loose.

2.4 ENCLOSED AND GASKETED VAPOR-TIGHT FIXTURES

Enclosed and gasketed vapor-tight fixtures suitable for wet or damp locations shall consist 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 1571 and NFPA 70.

Exposed outlet boxes for wall- and ceiling-mounted fixtures shall be furnished with the fixtures and shall be cast aluminum with four tapped hubs 90 degrees apart circumferentially, with three cast-aluminum threaded pipe plugs to fit the tapped holes. Boxes shall have ears or lugs for surface mounting to wall or ceiling. Body shall be provided 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. Fixture body shall be provided with mounting screws and gasket to ensure a vapor-tight joint between the body and outlet box.

Body and cap for pendant-mounted fixtures shall be sealed with a gasket at the joint. Cap shall be cast aluminum with top hub tapped for 1/2-inch tapered iron pipe threads.

Exposed outlet boxes for pendant-mounted fixtures shall be furnished with the fixtures and shall be cast aluminum with four tapped hubs 90 degrees apart circumferentially, with three cast-aluminum threaded pipe plugs to fit the tapped holes. Boxes shall have ears or lugs for surface mounting to the ceiling. Outlet-box covers for concealed and exposed outlet boxes shall be cast aluminum with the center hub tapped for 1/2-inch tapered iron pipe threads. Cover and outlet box shall be provided with mounting screws and gasket to ensure a vapor-tight joint between the cover and outlet box. Stem for pendant-mounted fixtures shall be 1/2-inch galvanized rigid steel conduit.

Glass enclosing globe shall be clear nondiffusing heat-resistant glass molded in one piece into a cylindrical shape with a closed bowl-shaped bottom and an open molded top bead or thread. Edges of the open end shall be 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.

Cast-aluminum guard shall be the same shape as the glass enclosing globe and shall be fastened to the fixture body with threads or setscrews.

2.5 INCANDESCENT LAMPS

General-purpose lamps shall be clear or frosted inside. Lamps with wattage ratings up to and including 300 watts shall have medium brass screw bases. Lamps with wattage ratings in excess of 300 watts shall have mogul brass screw bases.

Special-purpose lamps include PAR and R lamps. PAR lamps shall have clear, molded, heat-resistant, hard-glass bulbs with parabolic, aluminized, inner-bulb wall reflector for spot- or flood-lighting applications. R lamps shall have clear, soft, blown-glass bulbs with silver-deposited, inner-bulb wall reflector for spot or floodlighting applications. Lamps shall be designed for operation on 120 volts.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be performed in accordance with NFPA 70 and in accordance with the manufacturer's installation instructions.

A fixture shall be installed at each outlet indicated, and lamps of the proper type, voltage, and wattage shall be installed in each fixture.

New lamps shall be installed immediately prior to completion of the project. Lamps shall be installed with the light center at the focal point of the reflector and in the proper burning position.

Fixtures located in equipment rooms shall be so installed that they clear all obstructions such as duct, piping, bracing, and supports.

3.2 FIELD TESTING

Incandescent lighting fixtures and their accessories, including lowering devices, shall be demonstrated to operate satisfactorily in the presence of the Contracting Officer.

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SECTION 16529

PHOTO CONTROL DEVICES

03/97

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PART 2 PRODUCTS

2.1 PHOTOCONDUCTIVE CONTROL DEVICES

PART 3 EXECUTION

3.1 INSTALLATION
3.2 FIELD TESTING

-- End of Section Table of Contents --

SECTION 16529

PHOTO CONTROL DEVICES
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C136.10	(1988) Roadway Lighting Equipment-Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IES LM-48	(1984) Guide for Calibration of Photoelectric Control Devices

UNDERWRITERS LABORATORIES (UL)

UL 773	(1995; 4th Ed) UL Standard for Safety Plug-In, Locking Type Photocontrols for Use With Area Lighting

1.2 REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for Photoconductive Control Devices.

SD-06 Test Reports

Test Reports shall be submitted for System Operation Tests in the presence of the Contracting Officer.

SD-08 Manufacturer's Instructions

Operational Instructions shall be submitted for Light-Sensitive Control Devices consisting of the manufacturer's recommended procedures for operation.

PART 2 PRODUCTS

2.1 PHOTOCONDUCTIVE CONTROL DEVICES

Photoelectric control devices shall be in accordance with ANSI C136.10 and UL 773.

Photoconductive control devices for natural daylight and darkness control of incandescent, fluorescent, and mercury-vapor outdoor lighting luminaires shall include a photoconductive cell, thermal actuator, snap-action switch in a weatherproof housing.

Switch mechanism shall consist of a heavy-duty general-purpose precision snap-acting switch. Switch shall be 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.

Time delay in excess of 5 seconds shall be an available option.

Housing for light-sensitive control devices shall be molded from translucent butyrate or acrylic plastic materials and shall be fastened to the base with screws.

Control device, when attached to its mounting, shall be weatherproof and constructed to exclude beating rain, snow, dust, and insects and shall be capable of withstanding 96 percent relative humidity at 122 degrees F for 48 hours under operating conditions.

Light-sensitive control devices shall be physically and electrically interchangeable with three-pole, 3-wire locking plug and receptacle connections to the line, load, and neutral conductors of the lighting circuit.

Device shall turn 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.

Device shall be adjusted to operate within the limits of 0.8 to 1.2 foot-candles, but shall be capable of calibration of the turn-on light level over a minimum range from 0.5 to 3.0 foot-candles, and shall be adaptable for calibration up to 10 foot-candles. Ratio of turn-off light level to turn-on light level shall not exceed 5.

Instrument accuracy shall be maintained by proper calibration in accordance with IES LM-48.

Devices shall be rated at 120 or 277 volts, 60 hertz. Rated ambient temperature shall be 25 plus or minus 5 degrees C.

PART 3 EXECUTION

3.1 INSTALLATION

Photoconductive control devices shall be installed in accordance with the manufacturer's installation instructions.

3.2 FIELD TESTING

Photoconductive control devices shall be demonstrated to operate satisfactorily in the presence of the Contracting Officer.

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SECTION 16535

EMERGENCY LIGHTING

03/97

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SECTION 16535

EMERGENCY LIGHTING
03/97

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Safety to Life from Fire in Buildings and Structures
NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 924	(1995; 8th Ed) UL Standard for Safety - Emergency Lighting and Power Equipment

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Manufacturer's Catalog Data shall be submitted for the following items:

Emergency Lighting Egress Units
Batteries
Accessories

Material, Equipment, and Fixture Lists shall be submitted showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

SD-06 Test Reports

Test Reports shall be submitted showing results of System Operational Tests for emergency lighting systems.

SD-07 Certificates

Certificates of Compliance shall be submitted for the following showing conformance with the referenced standards contained in

this section.

Emergency Lighting Egress Units
Batteries
Accessories

PART 2 PRODUCTS

2.1 PRODUCT STANDARDS

Emergency lighting units shall conform to UL 924 and NFPA 101.

Emergency lighting units shall be furnished completely assembled with wiring and mounting devices and ready for installation at the locations indicated. Fixtures shall be equipped with lamps.

2.2 EMERGENCY LIGHTING EGRESS UNITS

Emergency lighting units shall be complete self-contained units with batteries, battery charger, one or more local or remote lamp heads with lamps, under-voltage relay, indicator lights, and test switch, in accordance with UL 924 for Type I (emergency light set), Class I (rechargeable storage-battery-powered unit), Style D (nonrefillable nickel-cadmium battery), as indicated.

Batteries shall be rated not less than 6-12 volts.

Battery charger shall include 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 24 hours after continuous discharge of 1-1/2 hours through the connected lampload.

Batteries shall have capacity and rating to supply the lamp load with maintained 87.5-percent power, minimum, for 1.5 hours, or the battery-lamp combination shall maintain 60-percent, minimum, illumination. Batteries shall be maintenance-free lead acid or nickel-cadmium type. Minimum normal life shall be 10 years.

Unit enclosure shall be fabricated from sheet steel not less than 18 gage. Cover shall provide access to the battery and battery-charger compartments and shall have a full-length piano hinge and a latching device. Component parts within the enclosure shall be protected from dust, moisture, and oxidizing fumes from the battery. Interior and exterior surfaces of enclosure shall be coated with a corrosion-resistant gray baked-enamel finish.

Lampheads shall be mounted on the top of the unit enclosure except where otherwise indicated and shall be fully adjustable in the horizontal and vertical planes. The lamphead mounting assembly shall be steel construction with nickel or chromium plating. Exterior housing of the lamp shall be formed from nickel or cadmium-plated sheet steel.

Lamps shall be the sealed-beam type PAR-36, rated not less than 12 watts at the specified dc voltage.

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 shall be mounted on the cover of

the unit enclosure. The amber indicating light shall indicate, when illuminated, that the unit is electrically connected to the normal ac supply source and that the battery is fully charged. The red indicating light shall indicate, when illuminated, that the battery is being recharged. The momentary-contact pushbutton test switch shall transfer unit from normal supply to battery supply and shall test operation of equipment under simulated ac source power failure.

The under-voltage relay shall be the self-clearing type and shall automatically connect the lampload to the battery supply upon failure of the alternating current supply. An on-off toggle switch shall be mounted inside the unit enclosure to disconnect the battery from the lampload when the unit is taken out of service for maintenance purposes. The relay shall energize when the ac supply falls to 80 percent of nominal voltage or below.

Emergency lighting units shall be suitable for operation on the ac supply circuit to which they are to be electrically connected.

PART 3 EXECUTION

3.1 INSTALLATION

Emergency lighting unit shall be permanently fixed in place and shall have wiring to each unit installed in accordance with NFPA 70. The branch circuit feeding the unit equipment shall be the same branch circuit as that serving the normal lighting in the area and shall be connected ahead of area switches. Emergency lighting fixtures that are remotely connected to the emergency lighting unit shall have circuit wiring kept independent of all other wiring and equipment and shall not enter the same conduit, cable, box, or cabinet with other wiring unless the fixture is supplied from two sources.

Mounting heights of emergency lighting units and remote lamps shall be a minimum of 7-feet above the finished floor.

3.2 FIELD TESTING

Emergency lighting units shall be demonstrated to operate satisfactorily in the presence of the Contracting Officer.

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DIVISION 16 - ELECTRICAL

SECTION 16536

EXIT LIGHTING

08/94

PART 1 GENERAL

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1.4 PERFORMANCE REQUIREMENTS
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2.1 LED EXIT SIGNS
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PART 3 EXECUTION

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SECTION 16536

EXIT LIGHTING
08/94

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this section to the extent referenced:

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101	(2000) Safety to Life from Fire in Buildings and Structures
NFPA 70	(1999) National Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 924	(1995; 8th Ed) UL Standard for Safety - Emergency Lighting and Power Equipment

1.2 GENERAL REQUIREMENTS

Section 16003, "General Electrical Provisions," applies to work specified in this section.

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01330, "Submittals," in sufficient detail to show full compliance with the specification:

SD-03 Product Data

Submit Manufacturer's Catalog Data describing Exit Sign Units, components, electrical characteristics, and finishes.

SD-06 Test Reports

Submit Test Reports showing results of exit lighting system Operational Tests.

SD-07 Certificates

Submit Manufacturer's Certification that Exit Sign Units comply with the referenced standards and requirements specified.

1.4 PERFORMANCE REQUIREMENTS

Provide Light Emitting Diode (LED) exit signs which perform as follows:

Visibility: Minimum luminance level of 0.06 footlamberts.

UL Rating: Suitable for damp locations.

1.5 REGULATORY REQUIREMENTS

Exit signs shall be listed and classified by UL 924, and conform to the requirements of NFPA 70 and NFPA 101.

1.6 WARRANTY

Provide manufacturer's warranty agreeing to replace exit signs, including batteries (if provided) and lights, which fail in materials or workmanship for a period of five years after date of Substantial Completion.

PART 2 PRODUCTS

2.1 LED EXIT SIGNS

Provide LED exit signs, electrically operated, with battery back-up, completely assembled with wiring and mounting devices, and ready for installation at locations indicated.

2.1.1 Fabrication

Fabricate exit signs with removable stenciled face plates and polycarbonate shields, single or double-faced as indicated, and conforming to the following criteria:

Size: Approximately 7-1/2 inches high x 12 inches wide x 3 inches deep.

Mounting Brackets: Universal type for top, back, or end mounting to wall or ceiling conditions, and suitable for securing sign to a 4-inch outlet box.

Letters/Arrows: Knock-out chevron type, red color.

Finish: White polycarbonate housing and stenciled face plate color.

2.1.2 Electrical Characteristics and Components

Circuitry: Solid state components, with voltage regulation to protect LED display.

Transformer: Dual input type, 120/277 volt, 60 Hertz with a unity power factor.

Normal Operating Rate: Not to exceed 7 watts for single-faced units and 12 watts for double-faced units.

2.1.3 Battery Backup

Provide exit signs with battery backup, unless otherwise noted, comprised of comparator-based charging and low voltage disconnect (LVD) circuitry, and conforming to the following criteria:

Battery: Nickel-cadmium type, maintenance free for a period of not less than 5 years under normal operating conditions.

Battery Operating Time: Minimum 2 hours.

Recharge Time: Not to exceed 12 hours.

PART 3 EXECUTION

3.1 EXAMINATION

Verify that surfaces and substrates are ready to receive exit signs and that electric power is available and of the correct characteristics.

3.2 INSTALLATION

Secure exit signs plumb, square, and level with ceiling, walls and doors, in accordance with manufacturer's instructions. Support ceiling mounted units independent of acoustical ceiling panels.

3.3 FIELD TESTING

Demonstrate that exit signs operated satisfactorily in presence of the Contracting Officer. Provide the Contracting Officer two days advanced notice of dates and times of field tests. Verify normal operation of each exit sign after installation and demonstrate proper operation of exit lighting when electrical energy is interrupted. Include tests for low battery voltage shut-down, normal transfer to battery source, and low supply voltage transfer.

Replace or repair malfunctioning signs and components, and retest. Repeat procedure until all units operate properly.

-- End of Section --