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GENERAL REQUIREMENTS

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SECTION 01 00 00

GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE

Provide supervision, labor, equipment, tools, materials, and supplies to complete the Work per Work Order drawings and specifications, these general specifications, and the General Terms and Conditions.

1.2 FURNISHED DRAWINGS AND SPECIFICATIONS

- a. Two sets of full-size contract drawings and specifications, and pdfs of contract drawings and specifications on a CD, will be furnished without charge. Other reference publications will not be furnished.
- b. Immediately check furnished drawings and specifications, and notify COTR of any discrepancies. Commencement of work shall constitute acceptance of drawings. Field check dimensions of existing facilities on drawings for accuracy and determine exact dimensions for proper fit.
- c. All design, drawings, and calculations shall be in English units.

1.3 SUBMITTALS

Submit the following per Section 01 33 00, SUBMITTAL PROCEDURES

SD-01 Preconstruction Submittals (Work Plan)

Submit at or before the pre-construction conference or as requested by COTR.

SD-09 Reports

Submit **progress reports** per Paragraph 3.5.B.

1.4 HOURS OF WORK

Normal hours for construction work are from 7 a.m. to 5 p.m. Monday through Friday, excluding federal holidays. Requests for additional work hours require written approval in advance from COTR. Contractor's superintendent must be present during all after-hours work.

1.5 OCCUPANCY OF PREMISES

- a. The Government may occupy and use the facilities within and/or adjacent to the areas of Work during the entire construction period.
- b. Provide and coordinate controls for the abatement of dust, noise, and inconvenience to Government personnel during the Work. Arrange with COTR (before work is started) a sequence of Work, means of access, space for material and equipment storage, and use of approaches,

corridors, and stairways. Obtain COTR approval at least three (3) days in advance of starting any activity that will interfere with accessibility or normal work activities of occupants.

- c. Buildings undergoing construction, alteration, or demolition shall be in accordance with Article 87 of the California Fire Code (CFC) and NFPA 1, Chapter 16.

1.6 SECURITY

At all times while on government property, the Contractor, subcontractors, and their employees shall wear badges issued by NASA Security Office. Each individual will be required to sign personally for the badge. The Contractor will be held accountable for these badges and shall return them to the Contracting Officer immediately after completion of the work.

1.7 FINAL ACCEPTANCE

The Contracting Officer will conduct a pre-final inspection or test after the work is complete. Any discrepancies or uncompleted work will be noted and provided to the Contractor. Upon completion of the items, the Contracting Officer will conduct the final inspection or test before the building system is placed into post-construction operation and final payment is made.

PART 2 PRODUCTS

2.1 OPTIONS

The equipment, fixtures, materials, and other products that are specified on the drawings and equipment schedule by manufacturer and model number are those used for the design. Model numbers specified may not include all of the options specified by the manufacturer or required for the installation. Ensure that the products provided do include all options.

2.2 SUBSTITUTIONS

Contractor shall use the specified manufacturer's model(s), or an "equal" with the approval of the COTR. The characteristics that the COTR will use to determine whether a substitute is "equal" include the following:

- a. Performance type, type of construction, capacity, rating, and materials of manufacture, acceptance listing by industry standards organizations and/or national laboratories, and compatibility with existing systems equal to or exceeding those of the specified product.
- b. Size, mounting, appearance, and finish must be comparable to those of the specified model.
- c. Record of performance, ease of maintenance, manufacturer's warranty provisions, interchangeability of parts, and provision for modification or extension must equal or exceed those of the specified product, unless a request by the Contractor is approved by COTR for the reduction in these characteristics.
- d. If a substitute product is approved by COTR, the Contractor shall be responsible for modifying the design (approved by the COTR) of the system and/or supporting structure as required to accommodate the change, and for executing these modifications at Contractor's expense.

Any difficulty or issue arising from the use of an approved substitution shall be resolved by the Contractor to the satisfaction of COTR, at Contractor's expense.

PART 3 EXECUTION

3.1 TEMPORARY FACILITIES

- a. Install and maintain temporary utilities required for construction, and remove them upon completion of the Work. Materials, new or used, shall be adequate for their intended usage, and shall not create unsafe conditions nor violate applicable codes and standards. The Contractor shall furnish required water and electricity (120 V/1 Ph). Connections, distribution, and lighting shall be furnished by the Contractor. Connection methods and locations must be approved in advance by the COTR.
- b. Provide and maintain temporary sanitary facilities, and remove them at the completion of the Work. Construction personnel shall not use existing facilities without COTR approval.
- c. Provide temporary fire protection equipment for the protection of personnel and property. Remove debris and flammable materials daily to minimize hazards.
- d. Provide signs necessary to expedite deliveries, maintain traffic flow, promote safety, and prevent interference with Government operations. Advertisement signs shall not be erected. Contractor shall obtain COTR approval of locations for placement of Contractor-owned or leased trailers and sheds, which shall be at least 30 feet from existing structures.

3.2 TRAFFIC PROVISIONS

Perform Work so as to minimize obstruction of traffic. Maintain traffic flow on at least half of the roadway width at all times. Obtain approval from COTR at least 72 hours in advance of starting any activity that will obstruct traffic. Provide, erect, and maintain lights, barriers, signals, passageways, detours, and other traffic-control items that may be required. Provide flag persons for traffic control when roadways are obstructed during normal working hours, and provide lighted barricades in appropriate locations at roadways obstructed beyond normal working hours.

3.3 PROTECTION OF EXISTING SYSTEMS

- a. Provide a clear record of existing conditions before starting work. This may include photographs or videotape.
- b. Provide temporary coverings to protect existing surfaces and equipment when work is being performed in adjacent areas. Damaged surfaces and equipment shall be repaired or replaced, to the satisfaction of COTR and the Government, at the Contractor's expense.
- c. Protect existing utilities and safety systems from damage. Repair at Contractor's expense utilities and safety systems damaged by the Contractor.
- d. Immediately report to COTR any utilities not previously identified to the Contractor when encountered in the field. The size, type,

location, depth, and direction of these utilities shall be recorded on the as-built drawings, and approved by Inspector prior to covering them.

- e. Structural members shall not be altered unless approved by COTR.
- f. Contact the Ames Fire Marshal/Fire Prevention Office prior to the building's existing fire protections systems and equipment being placed out of service or being restored to service.

3.4 UTILITY OUTAGES AND CONNECTIONS

- a. Schedule utility outages and connections required during the construction process at the convenience of the Government. Schedule Work to hold outages to a minimum. Submit a request to interrupt existing systems to COTR at least seven (7) days in advance.
- b. Take all reasonable steps to minimize the effect and duration of such interruptions.

3.5 PROGRESS CONTROLS

a. Project Meetings

- 1. Attend with all first tier subcontractors performing work on-site a pre-construction conference, if scheduled by the COTR. On-site work shall not commence prior to the conference. Discussion shall include introductions, project orientation, quality control, safety, environmental, administration and temporary utilities and facilities.
- 2. Participate in progress meetings, as scheduled by COTR. Discussion shall include submittals, progress, material delivery, potential delays, interfaces, problems, quality control, safety, and environmental.
- 3. Promptly report construction problems or design deficiencies encountered to COTR. Solutions will be determined by COTR.

b. Construction Schedule and Progress Reports

- 1. Contractor shall submit an original and subsequently updated schedule of Contractor activities and sequence of operations needed for the orderly performance and completion of the Work.
- 2. Contractor shall adhere to the schedule, and shall submit periodic progress reports and proposed schedule changes in the form and manner directed by COTR.

c. Project Closeout

- 1. Complete all required submittals and restore the site as required, including final cleaning.
- 2. Notify COTR in writing when work is complete and ready for acceptance.
- 3. The COTR and Government will conduct reviews, inspections, and tests as needed to satisfy the COTR and Government that the Work conforms to requirements. The COTR will notify Contractor of any

nonconformances.

4. Correct any nonconformances and then repeat the above acceptance procedure as required by the COTR and Government until the Work is accepted.
5. Neither notice of acceptance nor final payment shall constitute waiver of Contractor's guarantee or warranty.

d. Storm Water Pollution Prevention Program

1. The Contractor shall comply with ARC's Storm Water Pollution Prevention Program required by the Industrial Storm Water General Permit. This entails following the Best Management Practices (BMPs) developed to minimize the impact of industrial activities on storm water quality. Copies of any applicable BMPs can be obtained from the NASA Ames Environmental Services Office. Exterior storage of hazardous materials, exterior storage of hazardous waste, or any new construction are common activities that would be covered by a BMP including, but not limited to the following:
 - a. Construction, Demolition and Excavation
 - b. Erosion Control and Site Stabilization
 - c. Good Housekeeping
 - d. Material Handling and Storage
 - e. Outdoor Process Equipment
 - f. Overhead Coverage
 - g. Repair, Remodeling and Construction
 - h. Preventative Maintenance
 - i. Secondary Containment
 - j. Spill Response and Prevention
 - k. Vehicle and Equipment Washing
1. Waste Handling and Recycling
2. If a proposed construction project disturbs less than 1 acre, storm drains located at the site must be protected and/or closed during any construction work. If a proposed construction project disturbs 1 or more acres of soil, or disturbs less than 1 acre but is part of a larger common plan of development that in total disturbs 1 or more acres, the Tenant is required to obtain coverage under the General Permit for Discharges of Storm Water Associated with Construction Activity. Please contact the NASA Ames Environmental Services Office for more information.

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SECTION 01 10 00

SAFETY AND HEALTH

PART 1 GENERAL

1.1 SCOPE

This section applies to all construction work conducted at Ames Research Center under this contract, including all subcontract work.

1.2 REFERENCES

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

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

8 CCR 1509	Injury and Illness Precaution Program
29 CFR 1910	Occupational Safety and Health Standards for General Industry
29 CFR 1926	Safety and Health Regulations for Construction

ENVIRONMENTAL PROTECTION AGENCY (EPA)

CFR Title 40	Protection of Environment
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CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (CAL-OSHA)

CAL-OSHA	CCR Title 8. Division 1, Chapter 4 Construction Safety Orders
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CALIFORNIA CODE OF REGULATIONS (CCR)

CCR Title 26	Toxics
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BAY AREA AIR QUALITY MANAGEMENT DISTRICT (BAAQMD)

Regulation 8	Organic Compounds
Regulation 11, Rule 1	Lead

SANTA CLARA COUNTY HEALTH DEPARTMENT

HMSO	Hazardous Materials Storage Ordinance
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CITY OF MOUNTAIN VIEW

Industrial Waste Ordinance	Provision pertaining to sewer service and sewage disposal
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CITY OF SUNNYVALE

Title 12

Water and Sewers

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

- APR 1700.1 Ames Health and Safety Manual, Latest Edition
- APR 8800.3 Ames Environmental Procedural Requirement
- NASA STD 8719.9 Standard for Lifting Devices and Equipment (Latest Edition)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI Z359.1 Safety Requirements for Personal Fall Arrest Systems (Latest Edition)
- ANSI A90.1 Safety Standard for Manlifts
- ANSI A92.2 Standard for Vehicle Mounted Elevating and Rotating Work Platforms
- ANSI B30.5 Safety Code for Crawler, Locomotive, and Truck Cranes

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 1 Uniform Fire Code
- NFPA 241 Safeguarding Construction, Alteration and Demolition Operations (Latest Edition)
- NFPA 30 Flammable and Combustible Liquids Code (Latest Edition)
- NFPA 70 National Electrical Code
- MIL-STD-271 Requirements for Non-Destructive Testing

1.3 SUBMITTALS

Submit the following per Section 01 33 00, SUBMITTAL PROCEDURES

SD-01 Preconstruction Submittals

Submit amendments or revisions to the General Safety Plan at least 10 days before the planned beginning of on-site work. This Safety Plan and any amendments shall be approved by COTR before such work may commence.

SD-01 Safety Plan

Submit **Safety Plan** and amendments or revisions at least 10 days before the planned beginning of on-site work.

SD-01 Activity Hazard Analysis (AHA)

Submit 48 hours prior to each major phase of work. Submit as amendment or revision to job-specific safety plan. AHA for preparatory phase of work shall be included with the initial Safety Plan.

SD-08 Manufacturer's Instructions

[Material Safety Data Sheets](#) (MSDS's for chemicals to be used in the construction activities.

SD-09 Reports

[Safety Clearance Permit Requests](#), submit at least 24 hours in advance of covered work.

[Toolbox Safety Meeting Reports](#), submit weekly minutes of meetings, copy of attendee sign-in sheet and list of topics discussed.

[Accident Reports and Records](#), as required.

[Crane Inspection Reports](#), submit daily when operated.

[Confined Space Entry Permit](#), submit completed form daily including evaluations following space exit to Contracting Officer, Ames Safety Office, M/S 218-1.

[Crane Compliance Certification](#), submit for each crane 24 hours prior to bringing crane to Ames.

[Crane Lift Plans](#), submit at least 24 hours prior to lifting loads exceeding 75% of rated load capacity.

[Confined Space Training Certificates](#), submit copies of training verification for entrants and attendants at least 48 hours prior to initial entry.

1.4 DEFINITIONS

- a. Competent person. One who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees and who has authorization to take prompt corrective measures to eliminate them.
- b. Safety plan. The safety plan is one distinct part of the work plan. It includes hazard control details required by this section. An IIPP complying with 8 CCR 3202 is an acceptable equivalent, however the requirements in this section for a job-specific safety plan and site specific Activity Hazard Analyses must be provided additionally, prior to start of work.
- c. Job-specific safety plan. A detailed plan that describes anticipated potential hazards and planned controls for this particular project. It comprises the bulk of the safety plan and its specific contents are described in this section.
- d. Activity hazard analysis. A detailed analysis of potential hazards and planned controls for distinct phases of the work. These details are generally beyond the scope of the Job-specific safety plan but are necessary due to potential for significant mishap. Specific contents

are described in this section.

1.5 GENERAL REQUIREMENTS

- a. Provide environmental, safety and health measures to insure a safe, healthy environment for employees, including those of subcontractors, and for other workers, bystanders and visitors in area of Contractor's operations.
- b. Comply with procedures prescribed by the Government for control and safety of visitors to the site.
- c. Familiarize employees and subcontractors with all safety and environmental requirements and enforce them.
- d. Advise COTR of any special safety restrictions established, so that Government personnel can be made aware of them.
- e. Require that superintendent give personal, on site attention to the Safety Plan while any work is in progress.
- f. New Employee Indoctrination. New employees shall be informed of specific site hazards before they begin work. Document in daily log.
- g. Training certificates: Contractor shall maintain a file of certificates for all training required by 29 CFR 1926 and 1910 as applicable for each person engaged in hazardous work. File shall be accessible and upon request made available to the Contracting Officer or appointed representative for review and verification for quality control purposes.
- h. Contractor shall avail Contracting Officer or appointed representative access to contractor's activities to determine adequacy of hazard prevention measures. Contractor shall also provide access for NASA Headquarters and Center safety, and environmental program review teams to conduct selected announced and unannounced reviews of contract operations.
- i. Contractor is responsible for safety requirements compliance by all subcontractors at every tier. All subcontracts pursuant to this contract shall include safety and environmental requirements of this section.
- j. Work requiring confined space entry shall be performed only by contractor's having one year or more experience in similar work. Contractor shall have an implemented confined space program based on a written procedures and responsibilities for testing, entry, permitting, evaluating, hazard control, rescue, qualifications and training.
- k. Notify the COTR and Ames Safety Office immediately upon discovery that OSHA or other regulatory agency is conducting an inspection of the job site.

1.6 EMERGENCY PHONES

Post emergency phone numbers at the jobsite. Report all emergencies and spills or releases of hazardous materials by dialing 911 on Government phones, or (650) 604-5555 on other phones. Ambulance, fire, and police services are available through this number, 24 hours a day.

1.7 FIRST AID FACILITIES

The Ames Health Unit is located on the West end of building N215, on Durand Road, across the street from the north side of the cafeteria. It is open Monday through Friday, between 7:30 a.m. and 4:30 p.m., for emergency care.

1.8 NON-COMPLIANCE

COTR may, at any time, notify the Contractor, in writing, of any non-compliance with the provisions of this section, and may specify corrective actions to be taken. Contractor shall, upon receipt of such notice, immediately take corrective action and report to COTR corrections completed.

PART 2 SPECIFIC REQUIREMENTS

2.1 SAFETY PLAN

Submit a Safety Plan to COTR for approval before proceeding with any site work. This Safety Plan shall include as a minimum, the following:

- a. Code of safe practices, complying with 8 CCR 1509. This must be posted at job site.
- b. Identify detailed contractual and supervisory means for controlling and coordinating safety responsibilities and activities of subcontractors and suppliers in accordance with this section.
- c. Job-specific Safety Plan. Address each of the following. Indicate for each item 4 through 10 if separate AHA will be provided.
 1. Designated responsibilities of contractor's key personnel. Include names, safety qualifications and assignment details for controlling hazards on job site. Indicate name and professional certifications of the point of contact person responsible for safety on the site. This person must have adequate control of resources to abate hazards or stop work. Other key functions requiring responsible persons include reports and logs, exposure data monitoring, accident investigator and reporting. List training certifications required by 29 CFR 1926 and 29 CFR 1910 as applicable for designated key site personnel.
 2. Include a list of safety clearance permits that will be required and a simple table listing anticipated hazards and control measures.
 3. Safety meetings, inspections, and reports to be conducted or made.
 4. Demolition plan.
 5. Excavation plan.
 6. Hazardous energy control plan.
 7. Material and personnel lifting plan.
 8. Fall protection plan.

9. Confined space plan. Identify the qualified person(s), training and experience. Delineate authority to direct work stoppage. Include procedure for rescue.
 10. Asbestos and lead control plan. Incorporate by reference other specialized job specific safety plans required by this contract such as asbestos removal if applicable.
 11. Other potentially hazardous tasks related to scaffolding, machinery, operational equipment, or electrical hazards.
 12. Hazardous materials use. Provision for secondary containment of any liquid hazardous material that will be brought on site. Inventory of materials to be introduced to site. Plan for personnel protection during transport, storage and use including MSDS, labeling and hazard communications plan. Emergency spill plan.
 13. Emergency response plan. Location, telephone numbers of emergency services and location of their posting on the job site. Procedures for securing an accident site until investigation by the government is complete. Procedures for securing work areas and protecting personnel in event of an accident or emergency. Accident reporting procedures.
 14. Alcohol and drug control plan.
 15. Unusual conditions. Power outage and weather contingencies.
 16. Identify AHA's anticipated in course of work.
 17. Hearing Conservation Program.
- d. Safety meetings, inspections, and reports to be conducted or made.
 - e. Location/telephone numbers of emergency services and location of their posting on the job site.
 - f. Accident reporting procedures.
 - g. Procedures for securing an accident site until investigation by the government is complete.
 - h. Procedures for securing work areas and protecting personnel in event of an accident or emergency.
 - i. Provision for secondary containment of any hazardous materials that will be brought on site.
 - j. Job-specific safety plans shall include a list of safety clearances that will be required, and a tabulation of anticipated hazards and measures to be used to control the respective risks to acceptable levels.
 - k. Activity Hazard Analysis for each major phase of work. Submit as modification to safety plan prior to start of work sequence. As a minimum these shall include: preparatory, excavation, erection and roof work phases of construction.

2.2 SAFETY CLEARANCE PERMITS

- a. A specific, written permit is required before conducting operations involving any of the dangerous operations listed below. Contractor shall insure that no such work is conducted prior to obtaining the permit, and that all provisions of the permit requirements are met. Contact COTR at least 24 hours in advance to obtain the required permit. Ensure person(s) is named and designated as competent person(s) and that qualifications and training are included in the Job-specific safety plan or AHA.
- b. The granting of a permit in no way relieves the Contractor of responsibility for any injury or damage that might result from his operation. Contractor shall comply with these requirements and with the fire protection, electrical and construction site safeguarding requirements of **NFPA 241**, sections 5 to 11 at contractor's expense.
 1. OPEN FLAME HEATING DEVICES or OPEN FIRES. Use of these devices requires a permit. Burning of trash, brush, or wood is prohibited.
 2. EXCAVATION. Excavation 6 in. or more beneath the surface requires a permit. Underground high voltage must be de-energized prior to pneumatic or machine powered excavation or subsurface demolition activities in vicinity. Obtain underground ground penetrating radar, sonar, or equivalent scanning type survey to locate and mark ground for all buried utilities and electrical conduits whenever high voltage is suspected to be near planned digging.
 3. CONFINED SPACE ENTRY. Entry or work in confined spaces, including but not limited to manholes and vaults, requires a permit. Provide training certificates for attendant, entrant(s) and rescue personnel at time of request for safety clearance permit.
 4. FACILITY CLOSURE OR OBSTRUCTION. Obstruction of streets, walks, and parking areas, and other facilities occupied and used by the Government requires a permit.
 5. ELECTRICAL WORK. Work on live 480 V. parts is generally prohibited. When impractical to de-energize, work on electrical circuits or equipment of 480 V. or greater requires a safety clearance permit and compliance with special provisions of **APR 1700.1**. Section 11.
 6. WELDING, FLAME CUTTING, AND MELTING. These operations, when performed in an existing or occupied facility, require a permit.
 7. CRANE LIFTS. Permits are required for lifting loads greater than 75% of rated capacity. Provide a lift plan at time of request for safety clearance permit.
- c. Crane Compliance Certification. Provide for each crane entering Ames under this contract. Provide statement on company letterhead indicating that crane and rigging gear meet **29 CFR 1926.555**, 952(c), and 406(a) requirements as applicable. Include operator training and qualification data.

2.3 HOLD OFF AND SPECIAL CONDITIONS TAGS

- a. HOLD OFF DANGER: DO NOT OPERATE and SPECIAL CONDITIONS CAUTION tags are

in general use on the site. They are used whenever equipment lockout or use only under specific, limited conditions is required for a safe working environment. Contractor is required to ALWAYS HONOR THESE TAGS. If Contractor needs to have a tag removed or believes that one should be applied, it shall coordinate with the person who originally signed the tag to effect the application or removal.

- b. A HOLD OFF tag constitutes an order not to operate a piece of equipment. This tag shall be used only during performance of maintenance or repair work on equipment. This tag shall be used in conjunction with lock out.
- c. A SPECIAL CONDITIONS tag specifies the conditions or circumstances under which the equipment may be operated. It constitutes an order not to operate the equipment except under the conditions or circumstances specified. This tag may be used for extended shut down of equipment or circuits when used in conjunction with lock out.

2.4 REPORTS AND RECORDS

- a. Require superintendent to conduct weekly toolbox safety meetings with all Contractor and Subcontractor employees, and maintain copy of the minutes of these meetings in the project file.
- b. Immediately make an oral report to COTR of any accident that results in one of the following: fatality; disabling or lost-time injury; injury requiring medical treatment; property contamination; or property loss of \$10,000 or more. Submit a completed NASA Form 1627 within 24 hours of any accident. Submit a written report to COTR within 5 days of each incident, including investigative findings (but is not required to include an expression of opinion as to the negligence or fault of any employee) and proposed or completed corrective actions.
- c. Maintain a log of safety inspections conducted, employee requests for inspections and verbal reprimands made to employees for safety violations.

2.5 SAFETY INSPECTION

The Contractor's on-site operations are always subject to inspection by the Government's construction safety engineer and by other inspectors. Contractor shall comply with reasonable requests of these individuals, as relates to safety. Contractor shall notify COTR if Contractor believes a change to the project Work is required.

2.6 FALL PROTECTION ANCHORAGE

Personal fall arrest anchorages shall be installed in accordance with ANSI Z359.1 requirements. Permanent anchorages installed under this contract shall remain in place for continued government use. Provide standard primer sealer and finish paint if not galvanized, for corrosion protection purposes.

2.7 PERMANENT SIGNAGE

Provide permanent warning and identification signs in accordance with 29 CFR 1910 and NFPA 70 requirements for potential hazards installed under this contract. These shall include but not be limited to circuit breaker identification, high voltage electrical warning, pipe labeling and confined

space warnings. On new permit required confined spaces, labeling signs shall be integral to or securely attached weather resistant signs on access covers. Coordinate with Contracting Officer for approval of signs differing from similar existing signs installed throughout Ames.

2.8 CHEMICALS AND HAZARDOUS MATERIALS

Chemicals and hazardous materials as defined in 29 CFR 1910.1200 that are integral to new work and remain part and parcel to completed work installed, shall be identified by the contractor. Products containing carcinogens as defined in 29 CFR 1910 Subpart Z or by the State of California shall be approved by the Contracting Officer. Sheet rock and gypsum wallboard products shall be asbestos free. This is intended to restrict certain gypsum products available in the U.S. but manufactured in whole or in part without voluntary manufacturer's asbestos free guidelines and not otherwise regulated in the General Provisions, Buy America clause.

2.9 LIFTING DEVICES

In addition to other requirements specified in this contract, permanently installed lifting devices and associated equipment shall comply with the design safety requirements of the NASA Standard for Lifting Devices and Equipment, NASA STD 8719.9.

2.10 HIGH NOISE LEVEL PROTECTION

Ensure that employees in high noise areas (>85 dBA) use hearing protection devices. Ensure that employees exposed to an 8-hr. time weighted average of 80 dBA measured with a dosimeter or sound level meter participate in a hearing conservation program. Develop a hearing conservation program for employees, as necessary, to include annual hearing conservation training, baseline and annual audiometric testing, and proper hearing protection in accordance with APR 1700.1 Chapter 29, Hearing Conservation Program.

PART 3 EXECUTION

3.1 GENERAL SAFETY RULES

- a. Follow the following safety rules in addition to the requirements of federal OSHA, Cal/OSHA, and other laws and regulations.
- b. Maintain the work area in a clean and tidy condition at all times. Remove debris and rubbish from the site daily or place in an approved dumpster, provided by the Contractor and removed as required. Keep emergency access and egress routes clear at all times.
- c. Tie off and/or brace ladders to prevent movement. Do not permit workers to stand on any of the top three rungs of a stepladder.
- d. Require employees to wear approved hard hats at all times in designated hard hat areas.
- e. Raise and lower all tools and equipment by means of a bucket and/or rope. Do not permit employees to throw or drop items from one level to another.
- f. Require all employees to use safety clothing and equipment appropriate to the work they are performing. Provide all necessary safety clothing and equipment, including: goggles or face shields, protective garments,

ear protection, safety shoes, and safety belts. Train all employees in the proper use of these items. Insure that persons employed in cutting, chipping, burning, and similar operations use proper eye protection.

3.2 FIRE PREVENTION AND PROTECTION

- a. Store and handle flammable and combustible liquids in accordance with Article 79 of the California Fire Code (CFC) and NFPA 1, Chapter 60.
- b. Prohibit smoking in buildings and in dangerous areas, such as paint storage, fuel storage, confined space, and posted "No Smoking" areas.
- c. Provide obstruction-free routing for persons carrying hot substances. Hot substances shall not be carried up or down ladders.
- d. Store and handle flammable compressed gasses in accordance with Article 80 of the California Fire Code (CFC and NFPA 1, Chapter 63).
- e. Provide, maintain, and make available at the site, a minimum of two portable fire extinguishers. For welding and torch-cutting work, these shall be in the immediate vicinity of the work.
- f. Prohibit open fires or salamanders in construction areas.
- g. Maintain building/structure means of egress in accordance with Article 12 of the California Fire Code (CFC) and NFPA 1, Chapter 4.
- h. Maintain existing fire protection systems and equipment in an operable condition at all times.
- i. Familiarize employees and subcontractors with the buildings/structure's evacuation plan.
- j. Report, without delay, the occurrence of a fire or medical emergency, the release of flammable or hazardous materials, or similar conditions to the Ames Fire Department.

3.3 EXCAVATION

- a. Obtain from COTR prior to any excavation the locations of the underground utilities in the area and mark these locations on the ground surface. The elevations and exact locations of all utilities are not known; therefore, exercise caution in all excavation work to avoid damaging existing utilities.
- b. Conduct all excavation under the direct, on-site supervision of a qualified person with experience in earthwork and knowledgeable of the requirements of Article 6 of the California Construction Safety Orders. This person shall be named on the Excavation Permit Request. The competent person shall inspect the excavation daily and after every rainstorm or other hazard-increasing occurrence, before any person is allowed to enter the excavation. If inspection reveals a potential hazard, it shall be mitigated before any person is allowed to enter the excavation. Keep a log of these inspections and submit a copy to COTR with each weekly tool-box meeting minutes.
- c. Shore all excavations 5 ft or more in depth. Shoring shall meet the requirements of OSHA (29 CFR 1926.652(c)). Shoring for excavations

over 12 feet in depth shall be designed by a California registered Civil Engineer, and design shall be submitted to COTR for approval.

- d. When work is being done in trenches deeper than 4 feet, provide ladders or other safe means of egress in the trench, so as to require no more than 25 feet of lateral travel for employees; and provide at least one Contractor employee to stand by above ground, ready to give assistance in an emergency.
- e. Barricade open trenches and excavations to comply with regulations and to the satisfaction of COTR. "Sawhorse" barricades and warning tape do NOT constitute an acceptable barricade. Provide and maintain warning lights at night, and signs. In addition, use safety cones and warning flags to direct traffic around such openings.

3.4 CONFINED SPACE WORK

- a. If entry into confined space(s) is required, implement a confined space entry program compliant with applicable regulations (the federal OSHA confined spaces standard applies in areas of federal jurisdiction, which is most of the Center; the CAL-OSHA confined spaces standard applies for spaces north of Hunsaker Road and west of Lindbergh Road).
- b. Confined spaces are those that have extremely limited provisions for entry and exit, have poor natural ventilation, or contain or may contain hazardous atmosphere.
- c. Blind, block or disconnect all pipelines that may contain flammable or hazardous substances and that enter a confined space, before entry.
- d. If tests determine that hazardous conditions exist, remove all hazardous substances, and/or provide ventilation to the satisfaction of Safety Engineer prior to entry.
- e. When oxygen-consuming or hazardous-substance-producing procedures are to be employed in the confined space, or when the Safety Engineer determines that a hazardous atmosphere may develop during work, provide a qualified person and adequate testing devices to monitor air quality during the entire work period, at Contractor's expense.
- f. Provide at least one employee to stand by outside of the confined space, ready to give assistance in an emergency. When open manholes or vaults are barricaded, provide warning lights at night, and signs. Place rescue and retrieval body lifting device in a ready position above spaces greater than 5 feet in depth.
- g. Whenever it is necessary to work in an area equipped with an automatic CO2 discharge system, lock closed and tag the CO2 isolation valve before entering the area. An audible alarm shall precede the activation of the CO2 discharge system. When the alarm sounds, all personnel shall leave the area immediately. Do not re-enter the area without proper breathing apparatus unless gas detection tests have been made and the area declared safe.
- h. Other specific requirements for confined space work include:
 - 1. Use manhole cover hooks, cover lifters, or recessed handles for removing or replacing manhole covers.

2. Enter and exit manholes by means of a ladder whenever possible. Manhole covers and gratings shall be properly seated when replaced.
3. Use only NEC-approved lighting units for illumination when working in confined spaces.
4. Prohibit matches and smoking in confined spaces.
5. Ground all air-driven tools used around energized cables.
6. Return expired entry permits and exit evaluations to Contracting Officer, Ames Safety Office, M/S 218-1.

3.5 FACILITY CLOSURE OR OBSTRUCTION

Adequately barricade any closure or obstruction of streets, walks or other facilities that provide and maintain warning signs and lights (at night). Ensure that the closure or obstruction is of the minimum practical duration.

3.6 ELECTRICAL SAFETY

- a. Before maintaining, repairing, or performing any work on any electrical equipment or system, it shall be disconnected from the power source, locked/tagged out, and tested. Properly ground any electrical equipment or circuit before working on it. Unless prior approval has been given by COTR, it shall be disconnected from the power source.
- b. Protect portable electric tools with standard 3-prong grounding plugs or use double-insulated tools. Unplug tools when not in use.
- c. Use ground fault interrupters on all temporary electrical lines and cables. Route temporary wiring and cables to prevent tripping hazards and protect from damage.
- d. When permanently removing equipment or circuits, the wiring, conduit, and boxes shall be removed back to the source, unless otherwise specified.

3.7 WELDING, FLAME CUTTING, AND MELTING

Provide protection during flame cutting and welding to prevent splatter from damaging facilities or causing fire. When these operations are performed above or below ground level, provide at least one employee to stand by at the ground with firefighting equipment, ready to give assistance in an emergency.

3.8 RADIATION FOR NONDESTRUCTIVE TESTING

- a. Use of radioactive materials, radiation producing machines, or particle accelerator equipment is not allowed on-site, UNLESS written authorization has been obtained from the NASA Radiation Safety Officer. Ames Research Center is a federal site under the jurisdiction of the Nuclear Regulatory Commission (NRC).
- b. All non-NRC licensed radiographers shall obtain a reciprocity agreement with the NRC prior to bringing sources on site. A copy of the radiography contractor's license to conduct radiography and its company safety manual shall be kept on file with the NASA Radiation Safety Officer.

- c. Conduct permitted radiation operations only under the surveillance of a NASA representative. Conspicuously post the area and erect barriers, as required by Title 10, Code of Federal Regulations, Part 34.42. During hours of darkness, the signs shall be conspicuously illuminated with an amber or white light. Maintain direct surveillance of the area to protect against unauthorized entry. Maintain a properly calibrated survey meter on site and conduct periodic monitoring.
- d. Unless otherwise specified, non-destructive testing shall be in accordance with MIL-STD-271, modified by deletion of all reference to Bureau of Ships and other Navy agencies and substitution of NASA therefore. Radiographs shall be performed in a manner consistent with Title 10, CFR and approved by the COTR, and in the presence of an approved radiographer. Radiography shall normally be required to be performed outside of normal working hours. Immediately report to the RSO any loss of radioactive material or any radiological health hazard or emergency. Upon completion of radiological operations, notify the RSO and remove warning signs and ropes.
- e. Conduct any photoprocessing of radiographic film per the requirements of the City of Mountain View Industrial Waste Ordinance and the City of Sunnyvale Title 12. The Radiation Safety Permit Request shall contain an annotation of the volume of waste water anticipated to be discharged and the location of proposed discharge. If the permit request is not so annotated, the Contractor shall NOT perform on-site photoprocessing.

3.9 EXPLOSIVES

Explosives shall not be used or stored on site.

3.10 ASBESTOS

- a. Unless otherwise specified, no asbestos-containing materials are to be used by the Contractor.
- b. All materials to be encountered on the site may contain asbestos unless specifically identified otherwise. If unspecified material is encountered, immediately inform the COTR. Do not break, burn, or disturb any materials containing asbestos. If COTR determines it necessary, arrange for removal, disposal, and/or isolation of the material. Perform such work for the lowest cost while meeting regulatory requirements.
- c. Handle asbestos-containing materials as specified in Section 02080, Asbestos Abatement.
- d. Specifically address asbestos in Safety Plan and discuss the operations and precautions planned to mitigate worker exposure to the fibers.

3.11 LEAD

- a. Existing painted structural and miscellaneous steel and steel pipe shall be assumed to be coated with lead-based material, unless otherwise specified. All requirements for lead-containing materials and lead-producing operations, contained in the referenced regulations shall be met, as shall the additional requirements below.
- b. Demolition and abatement of lead-based paint shall be performed as

specified in Section 02 09 00.

- c. Burning or welding through lead-based paint is prohibited. Vacuum-blasting operations is permitted, provided that the operator wears approved respiratory protection. General blasting shall be contained to prevent lead levels in excess of the General Industry standard outside of the containment. Ground level concentrations of lead outside of the immediate work area shall not exceed the limit specified by the Bay Area Air Quality Management District (BAAQMD) in Regulation 11, Rule 1, Lead.
- d. The Government may elect to conduct air monitoring to assure itself that the Contractor is complying with the requirements of Cal-OSHA, federal OSHA, and BAAQMD. This testing shall not relieve the Contractor of any of the employer's responsibilities under these regulations. If requested by the Government, the Contractor shall allow its personnel to wear air-sampling devices (provided by the Government), at Contractor's expense. If Government testing/monitoring shows non-compliance with regulatory requirements, the Contractor shall alter its work procedures/personnel protections so as to come into compliance, at Contractor's expense.
- e. Blasting material (including water from water-blasting) shall be contained, removed from the surroundings, and disposed of in accordance with the characterization results. Contractor shall provide testing and certification by an independent testing agency that demonstrates that it is not classified as hazardous.

3.12 PRESSURE SYSTEMS

Work on systems designed for gas pressures above 140 psi or liquid pressures above 80 psi, is subject to special provisions of APR 1700-1, in addition to those of this section.

3.13 POLLUTION PREVENTION

- a. Contractor shall ensure that construction, demolition, and excavation practices do not cause pollutant discharges on Ames Research Center and Moffett Federal Airfield.
 - 1. Staging Area - The Staging Area, to the maximum extent practicable, shall not be located near catch basins, gutters, drainage ditches, and creeks. Routine inspection of the jobsites shall be performed periodically to ensure that construction, demolition, and excavation materials (liquid or solid) are not entering the storm drain system or causing pollution. The jobsite shall be kept orderly. Storm drain catch basins shall be covered to prevent pollutants and sediments from entering the storm drain system. Scrap, debris, and nonhazardous waste material shall be collected and disposed of properly.
 - 2. Street Sweeping/Catchbasins - Roadways and on-site paved areas involved in or impacted by the project shall be cleaned and swept daily. Use of water to flush down streets in place of street sweeping is prohibited. Catch basins impacted by the project shall be inspected and vacuumed, if necessary, at project completion.
 - 3. Dumpsters/Bin - Dumpsters shall be periodically inspected for

leaks. Leaking dumpsters shall be replaced or repaired. Discharging water on-site from cleaning dumpsters is prohibited. Waste collection shall be scheduled before the dumpster overflows.

4. Hazardous Material/Waste Storage - Hazardous materials such as pesticides, paints, thinners, solvents, and fuels; and hazardous wastes such as waste oil and antifreeze; shall be labeled and stored in secondary containment in accordance with the Santa Clara County HMSO and applicable State and Federal regulations. These hazardous materials and hazardous wastes shall be covered wherever practicable.
- b. An accurate inventory of hazardous materials and hazardous wastes, including Material Safety Data Sheets (MSDSs), shall be maintained to assist emergency response personnel in the event of a hazardous materials incident.
1. Usage - The manufacturer's instructions regarding uses, application, protective equipment, ventilation, safety precautions, and mixing of chemicals shall be followed.
 2. Disposal - Hazardous wastes generated by the project, including light ballasts, shall be handled and managed properly. Contractor shall transfer hazardous wastes to a designated location at the Center for disposal by the Government.
 3. Spill Prevention and Control - Spill cleanup materials (such as rags or absorbents) shall be maintained and be readily accessible. Releases shall be immediately contained and measures implemented to prevent leaks and spills from entering storm drains. Releases are prohibited from being washed into streets, gutters, and storm drains. Releases shall be reported to COTR and Ames Codes QH, and QE.
 4. Contractor Training and Awareness - Employees/subcontractors shall be trained on the pollution prevention requirements contained in these specifications. The Contractor shall inform subcontractors of the pollution prevention contract requirements, and shall include appropriate subcontract provisions to ensure that these requirements are met.
 5. Painting - Painting products shall conform to Regional Air District (BAAQMD) Regulation 8 for VOC contents. Before project commencement, Material Safety Data Sheets shall be submitted to Ames Code QH/QE for review and approval of the products to be used. Solvent usage shall be monitored, and the amounts used shall be reported to Ames Code QH/QE.
 - a. Water-Based Paint - Remove as much excess paint as possible from brushes, rollers, and equipment before starting cleanup. To the maximum extent practicable, measures shall be implemented to dispose of wash water from aqueous cleaning of equipment and tools to the sanitary sewer. Otherwise, cleaning of painting equipment and tools shall be conducted in a designated area that will not allow run-on of stormwater or runoff of spills. The rinsate shall be contained for subsequent discharge. Cleaning equipment, vehicles, or tools over catch basins, into streets, gutters, storm drains, or creeks is prohibited. Dispose of dry, empty paint cans/buckets, old dry brushes, dry rollers, dry rags, and dry drop

cloths in the trash.

b. Oil-Based Paint - Remove as much excess paint as possible from brushes, rollers, and equipment before starting cleanup. To the maximum extent practicable, filter paint thinner and solvents for reuse. Dispose of waste thinner and solvent, and sludge from cleaning of equipment and tools as a Hazardous Waste. Dispose of dry, empty paint cans/buckets in the trash. Discarded items including material containers, old brushes, rollers, rags, and drop cloths shall be disposed of as a hazardous waste if they are heavily contaminated.

3.14 LIFTING

- a. Personnel Lifts. Occupied scissor lifts shall be lowered prior to horizontal relocation. Hard hats shall be worn while in lifts. Personal fall restraint devices shall be utilized. Personnel lifting shall comply with ANSI A90.1 and ANSI A92.2.
- b. Materials Lifting. Comply with rigging requirements of ANSI B30.5 and APR 1700.1 sections 17.4.5 to 17.8. Tandem lifting is prohibited. Each load shall be rigged and attached independently to the hook or master-link in such a fashion that the load cannot slide or otherwise become detached. Lifting of multiple rigged materials on a single hook or master-link, also known as Christmas-tree lifting or tandem lifting is prohibited.
- c. Loads shall not be positioned above occupied buildings or within 10 ft of windows in occupied buildings.

3.15 DEMOLITION

Avoid production of dust during concrete demolition. Wet concrete before demolition. If dust is visible from concrete demolition, provide additional wetting of concrete. Concrete cutting waters must not enter storm drain.

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SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Upon receipt of Government Furnished Equipment, the Contractor shall submit records in accordance with paragraph entitled, "Government Furnished Property," of this section.

Submit the following items to the Contracting Officer:

Utility Outage Requests
Utility Connection Requests
Borrow Permits
Excavation Permits
Welding Permits
Burning Permits

1.2 WORK COVERED BY CONTRACT DOCUMENTS

1.2.1 Project Description

Base Bid:

Base bid includes NOx Emission Reduction System and all other work on plans, except that work which is specifically identified as a bid additive, including:

- a. Remove (E) foundations and pads as necessary for the installation of new NOx Emission Reduction System.
- b. Design and install SVS NOx Emission Reduction System with associated columns, pumps and piping.
- c. Install cooling tower and heat exchanger with associated pumps and piping, if required for NOx Emission Reduction System.
- d. Install storage building with secondary containment to enclose NOx gas analyzer, chemical feed pumps, control panel, motor control panel, and eye wash station.
- e. Install NOx emission chart recorder and remote control and alarm inside control room of Bldg. N234A boiler plant with required connections from NOx emission analyzer to record NOx emissions, and for NOx Emission System remote operation.

- f. Provide and install chemical tanks for NOx Emission Reduction System.
- g. Perform commissioning and acceptance testing of all new systems.
- h. Install 18" blind paddle after NOx Emission Reduction System is completely installed and tested.
- i. Install lighting on cooler tower (if cooling tower is required) and NOx Emission Reduction System.
- j. Submit system hazard analysis.

Bid Additive:

- a. Design and install access and maintenance platforms and catwalks for the new NOx Emission Reduction System..

1.2.2 Location

The work shall be located at the NASA Ames Research Center, approximately as indicated. The exact location will be shown by the Contracting Officer.

1.3 CONTRACT DRAWINGS

The following drawings accompany this specification and are a part thereof.

Drawing No.	Drawing Title
A334A-1001-G1	Title Sheet
A334A-1001-G2	Notes, Abbreviations, Legend and Symbols
A334A-1001-D1	Overall Demolition Plan
A334A-1001-D2	Demolition Photos
A334A-1001-D3	Demolition Photos
A334A-1001-S1	Structural Notes and Abbreviations
A334A-1001-S2	Foundation Plan
A334A-1001-S3	Enlarged Foundation Plan
A334A-1001-M1	Mechanical Notes
A334A-1001-M2	Equipment Schedules
A334A-1001-M3	Site Plan
A334A-1001-M4	Enlarged Site Plan
A334A-1001-M5	Partial Site Plan - Cooling Tower
A334A-1001-M6	Photos & Details
A334A-1001-M7	Process Piping Diagram
A334A-1001-M8	Pipe Support Details
A334A-1001-M9	Pipe Support Details
A334A-1001-M10	Future Pipe and Pipe Support Location
A334A-1001-E1	Electrical Notes, Symbols & Abbreviations
A334A-1001-E2	Electrical Site Plan - Existing/Demo and New Work
A334A-1001-E3	'MCC 231' Single Line Diagram -- Existing/Demolition
A334A-1001-E4	'MCC 231' Single Line Diagram -- New Work
A334A-1001-E5	'MCC 1' Single Line Diagram -- Existing/Demolition
A334A-1001-E6	'MCC 1' Single Line Diagram -- New Work

Reference Drawing No.	Drawing Title
A331-5903-M0	12 Inch Hypersonic Helium Tunnel General Arrangement
A331-5903-M1	General Plan 2-76'-3'-4" O Vacuum Spheres

A331-5903-M2	Shell Plate Details 75'-3'4" O Vacuum Spheres
A331-5903-M3	12 Inch Hypersonic Helium Tunnel Vacuum Storage Vessels & Piping Layout & Details
A331-5903-M5	Column Detail for 75" - 3'4" O Horton Sphere
A331-5903-M6	Internal Movable Ladder 75' - 3'4" ID Horton Sphere Ames Aeronautical Laboratory
A331-5903-M7	Internal Movable Ladder & Truss 75' - 3'4" ID Horton Sphere Ames Aeronautical Laboratory
A331-5903-M15	12 Inch Hypersonic Helium Tunnel Foundations for Vacuum Spheres
A334A-7201-S1	Nitrogen Oxide Removal System Foundation Details
A334A-8134-S1	Vacuum Pump System Foundation

Two (2) sets of full size contract drawings, maps, and specifications will be furnished to the Contractor without charge. Reference publications will not be furnished.

Contractor shall immediately check furnished drawings and notify the Government of any discrepancies.

1.4 WORK RESCHEDULING

Contractor shall allow for a maximum of 7 calendar days where construction activity is prohibitive. Further allowance for 7 calendar days of excavation and subsurface activity abeyance shall be imposed where other construction activities are permitted. Government will provide 24 hour notification each time the restrictions are invoked.

Normal duty hours for work shall be from 7 a.m. to 5 p.m., Monday through Friday. Requests for additional work shall require written approval from the Contracting Officer 7 days in advance of the proposed work period.

1.5 OCCUPANCY OF PREMISES

Building(s) will be occupied during performance of work under this Contract.

Before work is started, the Contractor shall arrange with the Contracting Officer a sequence of procedure, means of access, space for storage of materials and equipment, and use of approaches, corridors, and stairways.

1.6 EXISTING WORK

In addition to "FAR 52.236-9, Protection of Existing Vegetation, Structures, Equipment, Utilities, and Improvements":

- a. Remove or alter existing work in such a manner as to prevent injury or damage to any portions of the existing work which remain.
- b. Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as approved by the Contracting Officer. At the completion of operations, existing work shall be in a condition equal to or better than that which existed before new work started.

1.7 ON-SITE PERMITS

1.7.1 Utility Outage Requests and Utility Connection Requests

Notify the Contracting Officer at least 48 hours prior to starting excavation work. Contractor is responsible for marking and verifying all utilities not marked.

The Contractor shall verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated or specified to be removed. Locations to be transversed by piping, ducts, and other work to be installed shall be indicated.

Work shall be scheduled to hold outages to a minimum.

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.

Contracting Officer may permit utility outages at his discretion.

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

Requests for utility outages and connections shall be made in writing to the Contracting Officer at least 2 calendar days in advance of the time required. Each request shall state the system involved, area involved, approximate duration of outage, and the nature of work involved.

1.7.2 Borrow, Excavation, Welding, and Burning Permits

<u>ACTIVITY</u>	<u>SUBMISSION DATE</u>
Borrow Permits	3 calendar days prior to work
Burning Permits	3 calendar days prior to work
Excavation Permits	3 calendar days prior to work
Welding Permits	3 calendar days prior to work

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

Burning of trash or rubbish is not permitted on project site.

1.8 LOCATION OF UNDERGROUND FACILITIES

Obtain digging permits prior to start of excavation by contacting the Contracting Officer 15 calendar days in advance. Scan the construction site with Ground Penetrating Radar and electromagnetic or sonic equipment, and mark the surface of the ground, where existing underground utilities are discovered. Verify the elevations of existing piping, utilities, and any type of underground or encased obstruction not indicated to be specified or removed but indicated or discovered during scanning in locations to be traversed by piping, ducts, and other work to be conducted or installed. Verify elevations before installing new work closer than nearest manhole or other structure at which an adjustment in grade can be made.

1.8.1 Notification Prior to Excavation

Notify the Contracting Officer at least 48 hours prior to starting excavation work.

1.9 GOVERNMENT-FURNISHED MATERIAL AND EQUIPMENT

1.9.1 Delivery Schedule

Notify the Contracting Officer in writing at least 5 calendar days in advance of the date on which the materials and equipment are required. Pick up materials and equipment no later than 30 calendar days after such date. When materials and equipment are not picked up by the 30th day, the Contractor will be charged for storage at the rate of 100 per 100 pounds per month or fraction thereof.

1.10 SALVAGE MATERIAL AND EQUIPMENT

Items designated by the Contracting Officer to be salvaged shall remain the property of the Government.

The salvaged property shall be segregated, itemized, delivered, and off-loaded at the Government designated storage area located within 50 miles of the construction site.

Contractor shall maintain property control records for material or equipment designated as salvage. Contractor's system of property control may be used if approved by the Contracting Officer. Contractor shall be responsible for storage and protection of salvaged materials and equipment until disposition by the Contracting Officer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

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SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

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

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

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

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

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

1.1 DEFINITIONS

1.1.1 Submittal Descriptions (SD)

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

SD-01 Preconstruction Submittals

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

Certificates of insurance

Surety bonds

List of proposed Subcontractors

List of proposed products
Construction Progress Schedule
Network Analysis Schedule (NAS)
Submittal register
Schedule of prices
Health and safety plan
Work plan
Quality control(QC) plan
Environmental protection plan
Activity Hazard Analysis (AHA)
Schedules

SD-02 Drawings

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

Diagrams and instructions from a manufacturer or fabricator for use in producing the product and as aids to the Contractor for integrating the product or system into the project.

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

- Coordinataion Drawings
- Design-Build Drawings
- As-Built Drawings
- Shop Drawings

SD-03 Product Data

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

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

Manufacturer's Catalog Data

SD-04 Samples

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

Color samples from the manufacturer's standard line (or custom color

samples if specified) to be used in selecting or approving colors for the project.

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

SD-05 Design Data

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

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

SD-06 Test Reports and Records

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

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

Report which includes finding of a test made at the job site or on sample taken from the job site, on portion of work during or after installation.

Record document required of the Contractor, or the manufacturer of a product, documenting procedures, qualifications, or other verification of quality.

Training Records.

Records of Wasterwater Discharge.

Spill Cleanup Records.

Record of Existing Conditions.

Investigation reports.

Daily logs and checklists.

Final acceptance test and operational test procedure.

SD-07 Certificates

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

Document required of Contractor, or of a manufacturer, supplier,

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

Confined space entry permits.

Text of posted operating instructions.

Welding Procedures and Qualifications.

SD-08 Manufacturer's Instructions

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

SD-09 Manufacturer's Field Reports

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

Factory test reports.

SD-10 Operation and Maintenance Data

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

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

SD-11 Closeout Submittals

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

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

Interim "DD Form 1354" with cost breakout for all assets 30 days prior to facility turnover.

1.1.2 Approving Authority

Office or designated person authorized to approve submittal.

1.1.3 Work

As used in this section, on- and off-site construction required by contract documents, including labor necessary to produce submittals, construction, materials, products, equipment, and systems incorporated or to be incorporated in such construction.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with this section.

SD-01 Preconstruction Submittals

Submittal Register; G

1.3 SUBMITTAL CLASSIFICATION

Submittals are classified as follows:

1.3.1 Designer of Record Approved (DA)

Designer of Record (DOR) approval is required for extensions of design, critical materials, any deviations from the solicitation, the accepted proposal, or the completed design, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction," they are considered to be "shop drawings." Contractor to provide the Government with the number of copies designated hereinafter of all DOR approved submittals. The Government may review any or all Designer of Record approved submittals for conformance to the Solicitation, Accepted Proposal and the completed design. The Government will review all submittals designated as deviating from the Solicitation or Accepted Proposal, as described below. Generally, design submittals should be identified as SD-05 Design Data submittals.

1.3.2 Government Approved

Government approval is required for extensions of design, critical materials, deviations, equipment whose compatibility with the entire system must be checked, and other items as designated by the Contracting Officer. Government approval is required for any deviations from the Solicitation or Accepted Proposal and other items as designated by the Contracting Officer. Within the terms of the Contract Clause entitled, "Specifications and Drawings for Construction," they are considered to be "shop drawings."

1.3.3 Government Conformance Review of Design (CR)

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

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

1.3.4.1 Deviations to the Accepted Design

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

1.3.4.2 Substitutions

Unless prohibited or provided for otherwise elsewhere in the Contract, where the accepted contract proposal named products, systems, materials or equipment by manufacturer, brand name and/or by model number or other specific identification, and the Contractor desires to substitute manufacturer or model after award, submit a requested substitution for Government concurrence. Include substantiation, identifying information and the DOR's approval, as meeting the contract requirements and that it is equal in function, performance, quality and salient features to that in the accepted contract proposal.

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

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

1.3.6 Information Only

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

1.4 FORWARDING SUBMITTALS REQUIRING GOVERNMENT APPROVAL

1.4.1 Submittals Required from the Contractor

As soon as practicable after award of contract, and before procurement of

fabrication, forward to the COTR submittals required in the technical sections of this specification, including shop drawings, product data and samples. One copy of the transmittal form for all submittals shall be forwarded to the Resident Officer in Charge of Construction.

The COTR's technical representative will review and approve for the Contracting Officer those submittals reserved for Contracting Officer approval to verify submittals comply with the contract requirements.

1.4.1.1 O&M Data

The COTR's technical representative will review and approve for the Contracting Officer O&M Data to verify the submittals comply with the contract requirements; submit data specified for a given item within 30 calendar days after the item is delivered to the contract site.

In the event the Contractor fails to deliver O&M Data within the time limits specified, the Contracting Officer may withhold from progress payments 50 percent of the price of the item with which such O&M Data are applicable.

1.5 PREPARATION

1.5.1 Transmittal Form

Transmit submittals with transmittal form prescribed by Contracting Officer and standard for project. On the transmittal form identify Contractor, indicate date of submittal, and include information prescribed by transmittal form and required in paragraph entitled. "Identifying Submittals," of this section. Process transmittal forms to record actions regarding sample installations.

1.5.2 Identifying Submittals

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

Identify submittals, except sample installations and sample panels, with the following information permanently adhered to or noted on each separate component of each submittal and noted on transmittal form. Mark each copy of each submittal identically, with the following:

- a. Project title and location.
- b. Construction contract number.
- c. Date of the drawings and revisions.
- d. Name, address, and telephone number of subcontractor, supplier, manufacturer and any other subcontractor associated with the submittal.
- e. Section number of the specification section by which submittal is required.
- f. Submittal description (SD) number of each component of submittal.
- g. When a resubmission, add alphabetic suffix on submittal description, for example, submittal 18 would become 18A, to indicate resubmission.

h. Product identification and location in project.

1.5.3 Format for SD-02 Shop Drawings

Shop drawings are not to be less than 11 by 17 inches nor more than 30 by 42 inches, except for full size patterns or templates. Prepare drawings to accurate size, with scale indicated, unless other form is required. Drawings are to be suitable for reproduction and be of a quality to produce clear, distinct lines and letters with dark lines on a white background.

Present A4 8 1/2 by 11 inches sized shop drawings as part of the bound volume for submittals required by section. Present larger drawings in sets.

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

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

Reserve a blank space, no smaller than 4 inches on the right hand side of each sheet for the Government disposition stamp.

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

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

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

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

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

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

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

Where equipment or materials are specified to conform to industry and technical society reference standards of the organizations such as American

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

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

Submit manufacturer's instructions prior to installation.

1.5.5 Format of SD-04 Samples

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

- a. Sample of Equipment or Device: Full size.
- b. Sample of Materials Less Than 2 by 3 inches: Built up to A4 8 1/2 by 11 inches.
- c. Sample of Materials Exceeding A4 8 1/2 by 11 inches: Cut down to A4 8 1/2 by 11 inches and adequate to indicate color, texture, and material variations.
- d. Sample of Linear Devices or Materials: 10 inch length or length to be supplied, if less than 10 inches. Examples of linear devices or materials are conduit and handrails.
- e. Sample of Non-Solid Materials: Pint. Examples of non-solid materials are sand and paint.
- f. Color Selection Samples: 2 by 4 inches. Where samples are specified for selection of color, finish, pattern, or texture, submit the full set of available choices for the material or product specified. Sizes and quantities of samples are to represent their respective standard unit.
- g. Sample Panel: 4 by 4 feet.
- h. Sample Installation: 100 square feet.

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

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

condition at time of use.

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

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

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

Provide design data and certificates on 8 1/2 by 11 inches paper. Provide a bound volume for submittals containing numerous pages.

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

Provide reports on 8 1/2 by 11 inches paper in a complete bound volume.

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

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

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

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

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

1.6 QUANTITY OF SUBMITTALS

1.6.1 Number of Copies of SD-02 Shop Drawings

Submit four (4) copies of submittals of shop drawings requiring review and approval only by QC organization and four (4) copies of shop drawings requiring review and approval by Contracting Officer.

1.6.2 Number of Copies of SD-03 Product Data and SD-08 Manufacturer's Instructions

Submit in compliance with quantity requirements specified for shop drawings.

1.6.3 Number of Samples SD-04 Samples

- a. Submit two (2) samples, or two (2) sets of samples showing range of variation, of each required item. One approved sample or set of samples will be retained by approving authority and one will be returned to Contractor.
- b. Submit one sample panel or provide one sample installation where directed. Include components listed in technical section or as directed.

- c. Submit one sample installation, where directed.
- d. Submit one sample of non-solid materials.

1.6.4 Number of Copies SD-05 Design Data and SD-07 Certificates

Submit in compliance with quantity requirements specified for shop drawings.

1.6.5 Number of Copies SD-06 Test Reports and SD-09 Manufacturer's Field Reports

Submit in compliance with quantity and quality requirements specified for shop drawings other than field test results that will be submitted with QC reports.

1.6.6 Number of Copies of SD-10 Operation and Maintenance Data

Submit five (5) copies of O&M Data to the Contracting Officer for review and approval.

1.6.7 Number of Copies of SD-01 Preconstruction Submittals and SD-11 Closeout Submittals

Unless otherwise specified, submit three (3) sets of administrative submittals.

1.7 VARIATIONS / SUBSTITUTION REQUESTS

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

1.7.1 Considering Variations

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

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

1.7.2 Proposing Variations

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

1.7.3 Warranting That Variations Are Compatible

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

1.8 SUBMITTAL REGISTER AND DATABASE

Prepare and maintain submittal register, as the work progresses. Do not change data which is output in columns (c), (d), (e), and (f) as delivered by Government; retain data which is output in columns (a), (g), (h), and (i) as approved. A submittal register showing items of equipment and materials for which submittals are required by the specifications is provided as an attachment. This list may not be all inclusive and additional submittals may be required. The Government will provide the initial submittal register with the following fields completed, to the extent that will be required by the Government during subsequent usage.

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

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

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

Column (f): Indicate approving authority for each submittal.

The database and submittal management program will be furnished to Contractor on a Writable Compact Disk (CD-R), for operation on Windows based personal computer.

Thereafter, the Contractor is to track all submittals by maintaining a complete list, including completion of all data columns, including dates on which submittals are received and returned by the Government.

1.8.1 Use of Submittal Register

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

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

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

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

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

1.8.2 Contractor Use of Submittal Register

Update the following fields with each submittal throughout contract.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (j) Action Code (k): Date of action used to record Contractor's review when forwarding submittals to QC.

Column (l) List date of submittal transmission.

Column (q) List date approval received.

1.8.3 Approving Authority Use of Submittal Register

Update the following fields.

Column (b) Transmittal Number: Contractor assigned list of consecutive numbers.

Column (l) List date of submittal receipt.

Column (m) through (p) List Date related to review actions.

Column (q) List date returned to Contractor.

1.8.4 Contractor Action Code and Action Code

Entries for columns (j) and (o), are to be used are as follows (others may be prescribed by Transmittal Form):

NR - Not Received

AN - Approved as noted

A - Approved

RR - Disapproved, Revise, and Resubmit

1.8.5 Copies Delivered to the Government

Deliver one copy of submittal register updated by Contractor to Government with each invoice request.

1.9 SCHEDULING

Schedule and submit concurrently submittals covering component items forming a system or items that are interrelated. Include certifications to be submitted with the pertinent drawings at the same time. No delay damages or time extensions will be allowed for time lost in late submittals. An additional 30 calendar days will be allowed and shown on the register for review and approval of submittals for NOx Emission Reduction System.

- a. Coordinate scheduling, sequencing, preparing and processing of submittals with performance of work so that work will not be delayed by submittal processing. Allow for potential resubmittal of requirements.
- b. Submittals called for by the contract documents will be listed on the register. If a submittal is called for but does not pertain to the contract work, the Contractor is to include the submittal in the register and annotate it "N/A" with a brief explanation. Approval by the Contracting Officer does not relieve the Contractor of supplying submittals required by the contract documents but which have been

omitted from the register or marked "N/A".

- c. Re-submit register and annotate monthly by the Contractor with actual submission and approval dates. When all items on the register have been fully approved, no further re-submittal is required.
- d. Carefully control procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."
- e. Except as specified otherwise, allow review period, beginning with receipt by approving authority, that includes at least 10 working days for submittals for QC Manager approval and 20 working days for submittals for Contracting Officer approval. Period of review for submittals with Contracting Officer approval begins when Government receives submittal from QC organization.
- f. For submittals requiring review by fire protection engineer, allow review period, beginning when Government receives submittal from QC organization, of 20 working days for return of submittal to the Contractor.
- g. Period of review for each resubmittal is the same as for initial submittal.

Within 20 calendar days of notice to proceed, provide, for approval by the Contracting Officer, the following schedule of submittals:

- a. A schedule of shop drawings and technical submittals required by the specifications and drawings. Indicate the specification or drawing reference requiring the submittal; the material, item, or process for which the submittal is required; the "SD" number and identifying title of the submittal; the Contractor's anticipated submission date and the approval need date.
- b. A separate schedule of other submittals required under the contract but not listed in the specifications or drawings. Schedule will indicate the contract requirement reference; the type or title of the submittal; the Contractor's anticipated submission date and the approved need date (if approval is required).

1.10 GOVERNMENT APPROVING AUTHORITY

When approving authority is Contracting Officer, the Government will:

- a. Note date on which submittal was received from QC Manager.
- b. Review submittals for approval within scheduling period specified and only for conformance with project design concepts and compliance with contract documents.
- c. Identify returned submittals with one of the actions defined in paragraph entitled, "Review Notations," of this section and with markings appropriate for action indicated.

Upon completion of review of submittals requiring Government approval, stamp and date approved submittals. Two (2) copies of the approved submittal will be retained by the Contracting Officer and two (2) copies of the submittal will be returned to the Contractor. If the Government

performs a conformance review of other Designer of Record approved submittals, the submittals will be so identified and returned, as described above.

1.10.1 Review Notations

Contracting Officer review will be completed within 14 calendar days after date of submission. Submittals will be returned to the Contractor with the following notations:

- a. Submittals marked "approved" or "accepted" authorize the Contractor to proceed with the work covered.
- b. Submittals marked "approved as noted" "or approved except as noted, resubmittal not required," authorize the Contractor to proceed with the work covered provided he takes no exception to the corrections.
- c. Submittals marked "not approved" or "disapproved," or "revise and resubmit," indicate noncompliance with the contract requirements or design concept, or that submittal is incomplete. Resubmit with appropriate changes. No work shall proceed for this item until resubmittal is approved.
- d. Submittals marked "not reviewed" will indicate submittal has been previously reviewed and approved, is not required, does not have evidence of being reviewed and approved by Contractor, or is not complete. A submittal marked "not reviewed" will be returned with an explanation of the reason it is not reviewed. Resubmit submittals returned for lack of review by Contractor or for being incomplete, with appropriate action, coordination, or change.

1.11 DISAPPROVED OR REJECTED SUBMITTALS

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

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

1.12 APPROVED/ACCEPTED SUBMITTALS

The Contracting Officer's approval or acceptance of submittals is not to be construed as a complete check, and indicates only that the general method of construction, materials, detailing and other information are satisfactory design, general method of construction, materials, detailing and other information appear to meet the Solicitation and Accepted Proposal. Approval or acceptance will not relieve the Contractor of the responsibility for any error which may exist, as the Contractor under the Contractor Quality Control (CQC) requirements of this contract is responsible for dimensions, the design of adequate connections and details, and the satisfactory construction of all work. After submittals have been

approved or accepted by the Contracting Officer, no resubmittal for the purpose of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary.

1.13 APPROVED SAMPLES

Approval of a sample is only for the characteristics or use named in such approval and is not be construed to change or modify any contract requirements. Before submitting samples, the Contractor to assure that the materials or equipment will be available in quantities required in the project. No change or substitution will be permitted after a sample has been approved.

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

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

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

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

1.14 WITHHOLDING OF PAYMENT

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

1.15 PROGRESS SCHEDULE

1.15.1 Bar Chart

- a. Submit the progress chart, for approval by the Contracting Officer, at the Preconstruction Conference in one reproducible and 4 copies.
- b. Prepare the progress chart in the form of a bar chart utilizing form "Construction Progress Chart" 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. A line item showing contract finalization task which includes punch list, clean-up and demolition, and final construction drawings.
 4. A materials bar and a separate labor bar for each line item. Both bars will show the scheduled percentage complete for any given date within the contract performance period. Labor bar will also show the number of men (man-load) expected to be working on any given date within the contract performance period.
 5. The estimated cost and percentage weight of total contract cost for each materials and labor bar on the chart.
 6. Separate line items for mobilization and drawing submittal and approval. (These items are to show no associated costs.)
- d. Update the progress schedule in one reproduction and 4 copies every 30 calendar days throughout the contract performance period.

1.15.2 Project Network Analysis

Submit the initial progress schedule within 21 calendar days of notice to proceed. Schedule is to be updated and resubmitted monthly beginning 7 calendar days after return of the approved initial schedule. Updating to entail complete revision of the graphic and data displays incorporating changes in scheduled dates and performance periods. Redlined updates will only be acceptable for use as weekly status reviews.

Contractor to provide a single point contact from his on-site organization as his Schedule Specialist. Schedule Specialist is to have the responsibility of updating and coordinating the schedule with actual job conditions. Schedule Specialist to participate in weekly status 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.

Include the following in the project network analysis:

- a. Graphically display with the standard network or arrow diagram capable of illustrating the required data. Drafting to be computer generated on standard 24 by 36 inch (nominal size) drafting sheets or on small (11 by 17 inch minimum) sheets with separate overview and detail breakouts. Provide a project network analysis that is legible with a clear, consistent method for continuations and detail referencing. Clearly delineate the critical path on the display. Clearly indicate the contract milestone date on the project network analysis graphic display.
- b. Data is to be presented as a separate printout on paper or, where feasible, may be printed on the same sheet as the graphic display. Data is to be organized in a logical coherent display capable of periodic updating.
- c. Include within the data verbal activity descriptions with a numerical ordering system cross referenced to the graphic display. Additionally,

costs (broken down into separate materials and costs), duration, early start date, early finish date, late start date, late finish date, and float are to be detailed for each activity. A running total of the percent completion based on completed activity costs versus total contract cost is to be indicated. A system for indicating scheduled versus actual activity dates and durations is also to be provided.

- d. Sufficient detail to facilitate the Contractor's control of the job and to allow the Contracting Officer to readily follow progress for portions of the work should be shown within the schedule.

1.16 STATUS REPORT ON MATERIALS ORDERS

Within 21 calendar days after notice to proceed, submit, for approval by the Contracting Officer, an initial material status report on all materials orders. This report will be updated and re-submitted every 7 calendar days as the status on material orders changes.

Report to include list, in chronological order by need date, materials orders necessary for completion of the contract. The following information will be required for each material order listed:

- a. Material name, supplier, and invoice number.
- b. Bar chart line item or CPM activity number affected by the order.
- c. Delivery date needed to allow directly and indirectly related work to be completed within the contract performance period.
- d. Current delivery date agreed on by supplier.
- e. When item d exceeds item c, the effect that delayed delivery date will have on contract completion date.
- f. When item d exceeds item c, a summary of efforts made by the Contractor to expedite the delayed delivery date to bring it in line with the needed delivery date, including efforts made to place the order (or subcontract) with other suppliers.

1.17 STAMPS

Stamps used by the Contractor on the submittal data to certify that the submittal meets contract requirements is to be similar to the following:

CONTRACTOR (Firm Name)
_____ Approved
_____ Approved with corrections as noted on submittal data and/or attached sheets(s)
SIGNATURE: _____
TITLE: _____
DATE: _____

For design-build construction, both the Contractor Quality Control System Manager and the Designer of Record are to stamp and sign to certify that the submittal meets contract requirements.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

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SECTION 01 40 00

QUALITY CONTROL

PART 1 GENERAL

1.1 SCOPE

- a. This section applies to, and is a component part of, each section of the specifications.
- b. The work to be performed under this specification shall be accomplished in strict accordance with professionally recognized standards for building construction. The Contractor is solely responsible for the quality of construction and for making those submittals, inspections, and tests specified by the technical sections of this specification as the Contractor's responsibility. Contractor is also responsible for documentation and notifying COTR of the results of tests required.
- c. Contractor's in-house Quality Control program shall be used to the maximum extent possible, subject to meeting the requirements of this specification.

1.2 SUBMITTALS

The following shall be submitted per Section 01 33 00, SUBMITTAL PROCEDURES:

SD-01 Quality Control Plan

Within 7 days of the Notice to Proceed. No production or on-site work shall begin before COTR's approval to proceed.

SD-05 Mix Designs

At least 14 days before commencement of concrete, pavement, or masonry work, mix designs for concrete asphalt concrete and/or mortar shall be submitted. Use of a mix shall not begin before COTR's approval to proceed.

SD-06 Test Reports

Test reports for **Contractor-conducted tests** will be submitted within one working day of completion of the test. Test reports for construction materials will be submitted at least 14 days prior to inclusion of the materials in the work. Reports are required for imported fill, asphalt concrete materials, masonry units, structural steel, and reinforcing steel.

SD-07 Certificates

Certificates of Compliance for each item of mechanical or electrical equipment shall be submitted prior to incorporating that piece of equipment into the work.

SD-07 Welding Procedures and Qualifications

Two (2) complete sets. Production welding shall not begin until COTR's approval to proceed. Each weld shall be stamped with the identification number of operator making that weld.

SD-07 Certificates

Delivery Certificates shall be submitted within one working day of delivery of materials to the site. Certificates are required for imported fill, ready-mixed asphalt concrete, asphalt concrete materials, ready-mixed concrete, concrete materials, metal decking, and roofing materials.

1.3 DEFINITIONS

- a. Inspection - Examination and test of supplies, services, materials, components, or assemblies to determine contract performance.
- b. Testing - Element of inspection that determines the properties or functional operation of materials or components, by the application of established scientific principles and procedures.
- c. Independent Testing Agency - An organization, approved by COTR, engaged to perform specific inspections or tests of work, either at the construction site, or elsewhere, and report the results.

PART 2 PRODUCTS

2.1 MANUFACTURE

- a. Materials, equipment, and fixtures to be provided shall be the standard catalog products of manufacturers regularly engaged in their manufacture; shall meet the specified and the detailed requirements; shall be suitable for the installation shown, and shall represent products that have been in satisfactory use for at least 2 years.
- b. Where two or more units of the same class are furnished, the units shall be from the same manufacturer and shall be interchangeable. Products shall be new, free from defects, and of the size, make, type, and quality specified and indicated in the manufacturer's catalog data.

2.2 DELIVERY AND STORAGE

- a. Materials, equipment, and fixtures shall be delivered to the site in their original, unopened containers, bearing labels identifying the manufacturer's name, brand name, and material, and while stored at the site, shall be fully protected from damage, dirt, debris, and weather.
- b. Products provided with a factory finish shall be fully protected during construction and shall be maintained free of dust, dirt, and other foreign matter. Dents, marred finishes, and other damage shall be repaired to the satisfaction of COTR, or the product shall be replaced at Contractor's expense.

PART 3 EXECUTION

3.1 GENERAL

- a. Conduct all inspections and tests, required by the specifications, on material and equipment fabricated off-site. Submit records of such tests and inspections to COTR at least 24 hours before incorporating the materials/equipment in the project.
- b. Unless otherwise specified, inspections and tests of on-site work, required by the specifications, of on-site work, shall be made by the Government inspector, who will provide a copy of the report to the Contractor.
- c. On-site tests conducted by the Contractor will be witnessed by the Government inspector. At least 1 hour shall be allowed for Government inspection prior to any test. Should inspection reveal that corrective measures are required or that work is not complete, an additional 1 hour will be allowed to complete the Government inspection after all problems have been corrected and preparation has been completed.

3.2 DAILY INSPECTION

The work will be conducted under the general surveillance of COTR and Government inspectors to ensure compliance with the terms of the Contract. No inspector is authorized to change any provision of the specifications or other portion of the Contract Documents without written consent of Contracting Officer nor shall the presence or absence of an inspector relieve the Contractor from the requirements of the Contract.

3.3 SCHEDULED INSPECTIONS/TESTS

- a. Inspections and tests, other than day-to-day monitoring of field work, whether conducted by the Contractor or the Government, will be scheduled by the Contractor, with designated inspector, at least 24 hours in advance. Contractor shall provide time and access to conduct the inspection/test. Contractor shall not cover any work requiring inspection/test before that work has been approved by the Inspector. Failure to comply with this requirement may require the re-exposure of such work and recovering and repair, all at Contractor's expense.
- b. Scheduled Inspections - The following scheduled inspections are required, and will be performed by the Government. These are in addition to any required by other sections of this specification:
 1. Site utilities - Performed after piping, conduit, etc., is in place and bedded, but before it is encased or backfilled.
 2. Formwork/reinforcement - Performed after excavations, forms and reinforcement are complete, and before any concrete is placed.
 3. Underfloor - Performed after all in-slab or under-floor building service equipment, conduit, piping, accessories, and other ancillary items are in place, and before any concrete is placed or floor sheathing installed.
 4. Bolting/welding - Performed after all bolting/welding has been completed, but before it is covered by other work.

5. Rough-out - Performed after light framing, rough plumbing, rough electrical, and ductwork is complete, and before sheathing, lath and drywall are applied.
 6. Sheathing - Performed after all sheathing, wallboard and lath are in place, but before roofing, taping, or other finishes are applied.
- c. Tests - The following tests are required, in addition to any required by other sections of the specification.
1. Hydraulic testing of piping - Performed after piping is in place, but before it is covered. Hydraulic testing shall be performed by the Contractor.
 2. Grounding/meggering - Required of all circuits designed for 480 V or more. Performed after all conductors are in place, but before final connection to the power source.
 3. Slump test - Required of each load of concrete, prior to and during placement in the forms. In addition, sampling for compressive testing will be conducted when specified 28-day compressive strength is 2901 psi or more.
 4. Density test - Required of each lift of backfill.

3.4 REPORTING

- a. Inspection/Test reports for Contractor-conducted tests shall be submitted within one working day of completion of the test.
- b. Inspection/Test reports for Government conducted tests will be transmitted to Contractor within one working day of completion of the test.
- c. Contractor shall not cover any item of work subject to inspection/test before results of inspection are satisfactory.

3.5 CORRECTIVE ACTION

Contractor shall promptly correct conditions that have resulted or could result in submission to the Government of supplies and/or services that do not conform to all of the quality assurance provisions of this specification, inspections/tests required, and other requirements to substantiate product conformance.

3.6 GOVERNMENT INSPECTION AT SUBCONTRACTOR OR VENDOR FACILITIES

The Government may inspect, at the source, all supplies or services not manufactured or performed at the site. Government inspection shall in no way replace Contractor inspection or otherwise relieve the Contractor of his responsibility to furnish an acceptable end item. When inspection at subcontractors' plants is performed by the Government, such inspection shall not be used by the Contractor as evidence of effective inspection by such subcontractors.

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SECTION 01 50 00

ENVIRONMENTAL COMPLIANCE AND POLLUTION PREVENTION

PART 1 GENERAL

1.1 SUMMARY

- a. The pollution prevention, environmental compliance, and sustainability provisions described in this section apply to all work conducted on Ames Research Center and Moffett Federal Airfield under this contract.
- b. The information in this section is in addition to the requirements provided in the detailed sections.
- c. Sustainable or green building materials, practices and design will be utilized to the maximum extent possible to reduce pollution and facility impacts on natural resources while maximizing occupant health, safety and productivity. Project results will be evaluated using the Leadership in Energy and Environmental Design (LEED) Green Building Rating System.
- d. Contractor will consider the environmental life cycle costs of the project and proceed in a manner that minimizes these costs as well as preventing pollution, reducing facility impacts on natural resources and promoting environmentally sustainable solutions.

1.2 REFERENCES

Items marked with an asterisk are available for review in the Ames Research Center Main Library, Building N202.

BAY AREA AIR QUALITY MANAGEMENT DISTRICT (BAAQMD)

BAAQMD Rules and Regulations	Air Quality
BAAQMD Regulation 8, Rule 3	VOC Content, Architectural Coating Limits
BAAQMD Regulation 8, Rule 49	VOC Content, Aerosol Coatings
BAAQMD Regulation 8, Rule 51	Volatile Organic Compounds, Adhesives and Sealants
BAAQMD Regulation 2, Rule 1	Permit Requirements
BAAQMD Regulation 11, Rules 1 & 2	Hazardous Air Pollutants Lead and Asbestos
BAAQMD Regulation 9, Rule 7	Boilers
BAAQMD Regulation 12, Rule 3	Asphalt Air Blowing
BAAQMD Regulation 12, Rule 4	Sandblasting

CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.120 Emergency Response Awareness
Level/Operators Training

29 CFR 1910.1200 Hazard Communication Training

29 CFR 1910.132 General Requirements

40 CFR 82 Protection of Stratospheric Ozone

40 CFR 112 Oil Pollution Prevention

40 CFR 1500 National Environmental Policy Act

40 CFR 260 Proper Management of Hazardous Waste

40 CFR 265.16 Generator Training

49 CFR Transportation

50 CFR 402 Endangered Species Act Regulations

40 CFR Part 247 Comprehensive Procurement Guidelines

10 CFR Part 435 Energy Conservation

CALIFORNIA CODE OF REGULATIONS (CCR)

CCR Title 22 Section 66260, etal Hazardous Waste Management

CCR Title 22 Section 66265.16 California Hazard Waste Generator Course

CCR Title 22 Division 19 State Fire Marshal

CCR Title 22 Division 19.1 Office of Emergency Services

CCR Title 23 Waters

CCR Title 24, Part 6 California's Energy Efficiency Standard

CCR 66265.16 Generator Training

UNITED STATES CODES (USC)

16 USC 703 Migratory Bird Treaty

42 USC 6901 Resource Conservation and Recovery Act

42 USC 8251 Federal Energy Management

42 USC 13101- 13109 Pollution Prevention Act of 1990

NASA POLICY AND PLANS AND EXECUTIVE ORDERS

* AHB 8800.3 Ames Environmental Handbook

* APR 8800.3 Ames Procedural Requirements

- * SWPPP and BMPs Storm Water Pollution Prevention Plan and Best Management Practices
- * SPCC Ames Spill Control and Countermeasures Plan
- * June 20, 1990 NASA Policy on CFC and Halon Compounds
- * EO 13101 Greening the Government through Waste Prevention
- * EO 13123 Greening the Government through Energy Efficiency
- * EO 13148 Greening the Government through Leadership
- * EO 13150 Federal Workforce Transportation

SANTA CLARA COUNTY

- * NS-517.31 Santa Clara County Hazardous Materials Storage Permit Ordinance
- * Sunnyvale Municipal Code 12 City of Sunnyvale Waters and Sewer Ordinance
- * Palo Alto Chapter 16 City of Palo Alto Sewer Use Ordinance
- * CAG6 12001 General Industrial Storm Water Discharge Permit
- * SCC NS-517.44 Santa Clara County Toxic Gas Ordinance

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00, SUBMITTAL PROCEDURES:

SD-01 Statements

Hazardous Waste Disposal Subcontractors before project proposed commencement.

Hazardous Waste Profiles, and supporting analytical data before disposal.

SD-03 Data

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

Request for Industrial Wastewater discharge form, at least 7 working days before commencement of discharge.

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

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

SD-06 Records

Training records, before project commencement and personnel changes.

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

Spill Cleanup Records, as necessary.

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

1.4 GENERAL RESPONSIBILITIES

The Contractor shall conduct project activities in a manner that protects surface/ground water and air quality, conserves resources, and minimizes the use of toxic chemicals and hazardous materials.

1.5 DEFINITIONS

- a. Hazardous Material - As defined by Chapter 6.95 of the State of California Health and Safety Code, any material that poses a significant present or potential hazard to human health and safety or to the environment if released into the workplace or the environment. Common examples are oil, fuel, caustic and acid cleaners, mineral spirits, petroleum distillate based solvents, oil based paints, aerosol spray paints, coolants and antifreeze, and solvents/cleaners containing chlorinated compounds.
- b. Solid Waste - Includes rubbish, debris, garbage, and other discarded solid materials resulting from industrial, commercial, construction, and agricultural operations, and from community activities.
- c. Reclamation - As defined by California Code of Regulations, Title 22, Section 66260.10 means that a material is processed to recover a usable product, or that it is regenerated. Examples are recovery of lead from spent batteries and regeneration of spent solvents.
- d. Hazardous Waste - As defined in California Code of Regulation Title 22, Section 66261.3. Hazardous Waste, includes extremely hazardous waste, acutely hazardous waste, RCRA hazardous waste, non-RCRA hazardous waste and special waste. Examples include waste paint, solvents, PCB transformers, contaminated soil, and oil.
- e. Non-Sewerable - Wastewater that contains at least one contaminant above the allowable discharge limit set by the Publicly Owned Treatment Works (POTWs) for discharge to the sanitary sewer.
- f. Recycle - to take something that would otherwise be thrown away and make it into something that can be used again. Examples include fluorescent light tubes and cardboard boxes.
- g. Sustainability - design and green building principles, which call for buildings that are designed, constructed, renovated, and reused in a resource and energy efficient manner.

PART 2 MATERIALS

2.1 AFFIRMATIVE PROCUREMENT - USE OF ENVIRONMENTALLY PREFERABLE PRODUCTS

- a. All products purchased for federal projects with federal funds, including contractors, are required by Executive Order 13101 and the Federal Acquisition Regulations (FAR) to assess and give preference to those products and services that are environmentally preferable. Environmentally preferable products are of recycled content, recyclable, of low toxicity, reusable, locally produced, low-polluting, have long life cycles, are harvested on a sustained yield basis, and biobased.
- b. In addition, Executive Order 13101 and RCRA 6002 require the U.S. EPA to maintain the Comprehensive Procurement Guidelines (CPG), a list of products that MUST be purchased at the maximum recycled-content level specified. CPG items include: building insulation, carpet, carpet cushion, cement, concrete, latex paint, floor tiles, flowable fill, laminated paperboard, modular threshold ramps, non-pressure pipe, patio blocks, roofing materials, shower and restroom dividers/partitions, plastic lumber landscaping timbers and posts, plastic fencing, playground equipment, playground surfaces, blasting grit, industrial drums, manual grade strapping, mats, pallets, signage, bike racks, and structural fiberboard.
- c. If federal funds, including contractors, purchase one of these products, the product must be purchased at the highest recycled content level practicable.
- d. The complete up-to-date list of CPG products and required recycled content levels is at <http://www.epa.gov/cpg/>.
- e. If this product is unacceptable based on quality, availability, or cost, a waiver must be filed with the Environmental Services Division. The waiver is available at http://q.arc.nasa.gov/qe/forms/recycle_waiver_req.pdf.
- f. For guidance on finding specific products that meet these requirements, please contact the Environmental Services Division.

2.2 AIR QUALITY

- a. Construction operations and materials used on the project shall be in compliance with the Rules and Regulations for Air Quality of the Bay Area Air Quality Management District (BAAQMD).
- b. Adhesives and Sealants - Adhesive and sealant products shall conform to Bay Area Air Quality Management District (BAAQMD) Regulation 8, Rule 51 for Volatile Organic Compound (VOC) content - Adhesives and Sealants.
- c. Architectural Coatings - Architectural coatings and paints shall conform to BAAQMD Regulation 8, Rule 3 for VOC content - Architectural Coating Limits.
- d. Spray Paints - Spray paints shall conform to BAAQMD Regulation 8, Rule 49 for VOC content - Aerosol Coatings.

2.3 STORAGE AREAS

a. Hazardous Materials Storage

1. Hazardous materials storage shall be in accordance with Santa Clara County Hazardous Materials Storage Ordinance No. NS-517.31, and the General Storm Water Permit. Hazardous materials shall be handled in manner that minimizes the potential for releases. All liquid hazardous materials must be secondarily contained. Adequate spill response equipment shall be readily available.
2. Hazardous materials and hazardous wastes shall be labeled, handled properly, and stored in secondary containment at the end of each work day. Secondary containment shall be of adequate size and compatible with the materials stored. Storage areas shall be properly labeled and secured.
3. At the beginning of the project, an accurate inventory of hazardous materials and hazardous wastes to be generated including the estimated maximum quantity of each hazardous material to be brought on-site shall be provided to the COTR. Material Safety Data Sheets (MSDSs) for hazardous materials shall be maintained by the Contractor so they are immediately available to assist emergency response personnel in the event of a hazardous materials incident.

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

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

d. Refuse Bins - Refuse bins shall not be overloaded. Liquid materials shall not be placed in dumpsters or bins. Leaking dumpsters shall be replaced. Dumpsters and bins shall not be cleaned on-site. Dumpsters and bins shall be kept closed except when loading or emptying.

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

f. Site Inspections - In accordance with Santa Clara County Hazardous Materials Storage Ordinance No. NS-517.31 the project site and all hazardous materials storage areas shall be inspected weekly by the Government to ensure compliance. In accordance with the project specific SWPPP, the Government shall conduct inspections prior to any forecasted storm event, every 24 hour period during extended rain events and after every storm event to ensure required BMPs were implemented and remained effective. The Contractor shall conduct daily inspections of roadways and on-site paved areas impacted by the project. Any visible debris, dirt or sediment shall be swept or vacuumed up. The Contractor shall implement corrective actions to the satisfaction of the Contracting Officer. Compliance status shall be verified by the Contractor using the applicable portion of the checklist in Attachment A, or equal. The checklists shall be submitted to Code QE, mail stop 218-1, within 48 hours following the inspection.

2.4 CHEMICAL USAGE AND HANDLING

- a. Hazardous material shall be used only as described on the Material Safety Data Sheet. The Contractor shall wear the protective equipment recommended by the manufacturer. Containers of hazardous materials and hazardous wastes shall be kept closed except when in use. Containers of liquid hazardous materials shall be stored in secondary containment at the end of each work shift.
- b. Reclamation of Equipment Containing Hazardous Material Residues - The Contractor shall disclose to COTR the facility to which equipment containing hazardous material residues are shipped for reclamation, such as electrical wire wrapped with asbestos and electrical panels containing asbestos. The disclosure shall be documented on the Bill of Lading or by other written means.
- c. Disposal of Non-Hazardous Waste Containing Hazardous Material Residue - The Contractor shall disclose to COTR the facility to which equipment containing hazardous material residues are shipped for disposal, such as steel coated with lead paint. The disclosure shall be documented on the Bill of Lading or by other written means. Supporting analytical data shall be included to document the equipment is not hazardous waste.
- d. Labeling
 1. Containers, drums, vessels, tanks, and associated piping containing hazardous materials shall be labeled in accordance with California Code of Regulations Title 8 Section 5194 and the most recent edition of the Uniform Fire Code.
 2. Label containers with description of contents, percentages of components (if not pure), hazardous properties, name of contact person or waste generator, phone number, and date. If material is a waste, container shall have a hazardous waste accumulation label.

2.5 SUSTAINABILITY

The Contractor shall conduct its activities in a manner that conserves resources and minimizes pollution in accordance with Executive Order 13101 "Greening the Government Through Waste Prevention, Recycling and Federal Acquisition", Executive Order 13123 "Greening the Government Through Efficient Energy Management", Executive Order 13148 "Greening the Government Through Leadership in Environmental Management", and the Presidential Memorandum on Environmentally and Economically Beneficial Landscape Practices on Federal Landscaped Grounds.

- a. Minimize the amount of energy required during construction and operation by using resource efficient construction techniques, building systems (including HVAC, heating, electrical, water, lighting, heat-pumps and boilers), insulation, fixtures, appliances, and controls.
- b. Whenever possible, utilize energy efficient office equipment through the Environmental Protection Agency's Energy Star labeling program (<http://www.epa.gov/energystar/>).
- c. Use automated monitors and controls for energy, water, waste, temperature, moisture, and ventilation.

- d. Conserve water with systems that reduce consumption and recycle water through reclamation and treatment systems.
- e. Maximize the reduction, reuse, recycling or composting of waste and scrap materials.
- f. Minimize waste, spillage, pilferage, spoil, and misuse of building materials.
- g. Consider adaptive reuse, rather than demolition whenever possible.
- h. Follow federal Comprehensive Procurement Guidelines (@ <http://www.epa.gov/epaoswer/non-hw/procure/>) for building materials and products, and select materials that have a long-life cycle; select least toxic materials; select recyclable materials; select materials that are resource-efficient; select materials with the maximum recycled content; select materials harvested on a sustained yield basis; select products causing the least pollution during their manufacture, use and reuse.
- i. Reduce, reuse, and recycle to minimize consumption and waste in business operations.
- j. Utilize environmental life cycle cost analysis in the development process.
- k. Utilize LEEDS (Leadership in Energy and Environmental Design Green Building System) in building design and construction. LEEDS, developed by the U.S. Green Building Council, evaluates a building's environmental performance over its life cycle, and assigns credits to projects for satisfying a list of criteria. The System provides a definitive standard for what constitutes a "green building" by awarding different levels of green building certification based on the total credits earned. Strive for the highest possible LEEDS rating in building design, and meet at least the minimum required score to achieve LEEDS Certification.

PART 3 OPERATIONS

3.1 WASTEWATER DISCHARGE PERMITS

- a. In accordance with the Clean Water Act, the City of Sunnyvale Water and Sewers Ordinance, and the City of Palo Alto Sewer Use Ordinance, a specific written Incidental Sewer Discharge permit is required before discharging wastewater to the sanitary sewer system from project activities such as excavation dewatering, saw cutting coolant water, cleaning operations, and decontamination water.
- b. The Contractor shall complete and submit a Request for Incidental Sewer Discharge form to the COTR at least 7 work days before the planned discharged of groundwater or other wastewater. The request shall include the estimated discharge volume, discharge rate, source of the wastewater and the duration of discharge. The Government will sample the wastewater and obtain the discharge approval.
- c. Wastewater Discharge
 - 1. With the exception of groundwater from excavation, wastewater from Contractor operations shall be containerized by the Contractor

until the Contractor is notified a discharge permit has been obtained.

2. The Contractor shall record and submit information specified in the discharge permit issued to the project including, but not limited to, the dates of discharge, quantity of water discharged, source of the wastewater, dates wastewater was sampled and analyzed (if required), and filtering method (if required).
 3. Non-sewerable wastewater shall be disposed of by the Government in accordance with Paragraph 3.9, Government Disposal.
 4. Non-sewerable wastewater shall be treated, managed, and disposed of properly by the Contractor in accordance with Paragraph 3.10, Contractor Disposal.
- d. Groundwater Discharge - Groundwater from excavations shall be discharged in accordance with Section 02 20 00, SITE PREPARATION AND EARTHWORK.
- 3.2 TRAINING REQUIREMENTS
- a. All personnel shall be trained in the hazards and safe work practices for their tasks.
 - b. Personnel performing hazardous operations shall receive training as specified in applicable regulations.
 1. Personnel handling hazardous materials shall have received Hazard Communication Training per 29 CFR 1910.1200 and CCR Title 8 Section 5194 and Emergency Response Awareness Level training per 29 CFR 1910.120. Employee training documents shall be kept at the jobsite.
 2. Personnel containing spills or conducting cleanup of small spills shall have received First Responder Operations level training per 29 CFR 1910.120.
 3. Personnel generating hazardous waste shall receive training on the proper management of hazardous waste per 40 CFR 265.16 and CFR Title 22 Section 265.16.
 4. Personnel using personal protective equipment (PPE) shall receive training on its proper use per 29 CFR 1910.132.
 - c. Personnel handling hazardous materials shall have received Hazard Communication Training per 29 CFR 1910.1200 and CCR Title 8 Section 5194 and Emergency Response Awareness Level training per 29 CFR 1910.120. Employee training documents shall be kept at the jobsite.
 - d. Personnel containing spills or conducting cleanup of small spills shall have received First Responder Operators level training per 29 CFR 1910.120.
 - e. Personnel generating hazardous waste shall have receive training on the proper management of hazardous waste per 40 CFR 265.16 and CCR Title 22 Section 6265.16.
 - f. All Contractor personnel involved in operations with potential to

impact storm water quality or the storm drain system shall have awareness training regarding the project specific SWPPP and the applicable BMPs. Documentation of this training shall be provided to the Government.

3.3 SITE OPERATIONS AND MAINTENANCE

- a. Site Operations shall be conducted in accordance with the Clean Water Act and Ames Storm Water Pollution Prevention Plan.
- b. Equipment Fueling and Maintenance - In accordance with the applicable BMP, equipment fluid changes and fueling shall be conducted over drip pans to prevent spilled materials from contacting the ground surface. The operator of leaking equipment shall contain and control the leak. All other maintenance and repairs of Contractor equipment is prohibited on-site.
- c. Paint Clean-up
 1. Painting operations must be conducted in accordance with Ames Storm Water Pollution Prevention Plan and applicable BAAQMD requirements.
 2. Water Based Paints
 - a. The Contractor shall paint out as much excess paint as possible from brushes, rollers, and equipment before starting clean up. Rinse brushes, rollers, and other tools over a sink that drains to the sanitary sewer using water only. Tools and equipment shall not be cleaned into streets, gutters, storm drains, or creeks. Dispose of dry brushes, rollers, rags, and drop cloths as solid waste.
 - b. Disposal of containers with any liquids as a solid waste is prohibited. These materials must be used elsewhere or handled as a hazardous waste and disposed of in accordance with Paragraph 3.10, Contractor Disposal.
 3. Oil Based Paints
 - a. The Contractor shall paint out as much excess paint as possible from brushes, rollers, and equipment before starting clean up. Cleaning wash water shall be containerized and disposed of as hazardous waste. Reuse thinners and solvents by pouring back into original container through a filter.
 - b. Dispose of waste thinners, solvents, paint sludge, and wash water from cleaning of equipment and tools as hazardous waste. Containers with residual product shall be managed as a hazardous waste and disposed of in accordance with Paragraph 3.10, Contractor Disposal.
 - c. Paving Operations
 1. Catch basins and manholes shall be protected when paving or applying seal coat, tack coat, slurry seal, or fog seal. Sweeping or washing down excess sand (from applying sand seals or covering excess oil) into gutters, storm drains, or creeks is prohibited. Excess materials shall either be collected and returned to the

stockpile or disposed of properly.

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

- e. Concrete/Asphalt Cutting and Core Drilling - In accordance with the applicable BMP, the Contractor shall not allow slurry run-off from saw cutting or core drilling to enter the storm or sanitary sewer collection systems. Catch basins and drains shall be protected. The Contractor shall sweep/shovel up slurry cutting waste from work areas before leaving an area or at the end of each work day, whichever is sooner. If saw-cut slurry enters a drain, the Contractor shall remove the slurry and notify the COTR immediately.
- f. Concrete Truck/Wash Out - In accordance with the applicable BMP, washing out concrete trucks or equipment into streets, gutters, storm drains, or creeks is prohibited. Trucks may be washed out on the ground surface in a location approved by the COTR.
- g. Sweeping - Roadways and on-site paved areas impacted by the project shall be cleaned as necessary to the satisfaction of the COTR and swept at the end of each phase or at project completion. Hosing down paved areas and streets is prohibited.
- h. Reclaimed Water - The Contractor shall use reclaimed water for dust control and other construction site operations unless an exception is granted by the COTR. Reclaimed water is available at no cost from a hydrant located on Moffett Federal Airfield approximately 328 ft west of the intersection of Macon Road and Fifth Avenue.
- i. Storm Drain Management
 - 1. In accordance with the applicable BMP, catch basins near the project shall be protected to prevent debris, pollutants, sediments and releases from entering the storm drain system. Catch basins shall be inspected and cleaned out to the satisfaction of the COTR at the end of each phase or at project completion.
 - 2. In accordance with the applicable BMP, the Contractor shall control soil erosion and storm runoff from the Contractor's site to the satisfaction of the COTR.
- j. Broken/Ruptured Pipes - If the Contractor breaks a utility pipe, or observes any broken or leaking pipes, it shall immediately notify the COTR. The Contractor shall immediately notify Ames Environmental Office if the pipe contained any liquid except potable water. The Contractor shall berm the area to prevent run-off from releases of non-potable water from entering the storm drain.
- k. Draining, Tanks, Piping, and Equipment
 - 1. Tanks, piping, and equipment shall be drained as required. Devices to properly contain the product shall be provided by the Contractor. Storm drains in the vicinity shall be covered during drainage operations.
 - 2. The Government will conduct the sampling of drained fluid in order

to determine disposal options unless there is sufficient generator knowledge to determine disposal options.

3. The Government will obtain the necessary sanitary sewer discharge permits if the discharge is sewerable. Non-sewerable water shall be treated to a level to allow discharge to the sanitary sewer or managed and disposed of properly.
4. Disposal of drained fluid and associated costs shall be by the Government in accordance with Paragraph 3.9, Disposal.

1. Contaminated Soil Management

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

2. Contaminated soil shall be transferred to a designated on-site location for disposal by the Government in accordance with Paragraph 3.9, Disposal or properly disposed of by the contractor in accordance with paragraph 3.10.

m. Authorized Non-Storm Water Discharges

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

a. Potable water including drinking water and water related to the operation, maintenance or testing of potable water systems provided that the water does not become contaminated with soil or sediment (muddy).

b. Atmospheric condensate including refrigeration, air conditioning and compressor condensate.

c. Irrigation drainage and landscape watering.

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

e. Water from fire hydrant flushing or testing.

f. Water from fire fighting activities.

1. To the extent practicable, authorized non-storm water discharges shall be minimized. Additionally, the Environmental Services Office shall be notified of all authorized non-storm water discharges so that they may be observed and/or documented as required by the Industrial General Storm Water Permit.

3.4 SPILL PREVENTION, CONTROL, AND REPORTING

- a. All liquid petroleum products must be secondarily contained in accordance with Ames Spill Prevention Control and Countermeasures Plan and 40 CFR 112, spill clean-up materials (such as rags, absorbent booms/pads), and tools (such as shovels and brooms) shall be maintained at the project site and be readily accessible. Releases of hazardous materials to the environment shall be contained and measures implemented to prevent leaks and spills from entering storm drains.

Spills of hazardous materials to unpaved surfaces in excess of 1 ounce shall immediately be reported to Ames Environmental Office.

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

3.5 BURROWING OWL HABITAT

- a. The Contractor shall conduct its activities in a manner that does not negatively impact fauna or flora, in accordance with 40 CFR 1500, 50 CFR 402, and Ames Environmental Procedural Requirement, APR 8800.3.
- b. The Contractor shall comply with the "Burrowing Owl Management Policy for Ames Research Center."

3.6 LEAD ABATEMENT

As specified in Section 02 09 00, LEAD PAINT ABATEMENT/DEMOLITION.

3.7 ASBESTOS ABATEMENT

There is no asbestos abatement in this project.

3.8 GOVERNMENT DISPOSAL

- a. The Contractor shall label, package, and secondarily contain hazardous wastes before submitting the hazardous wastes to the Government for subsequent disposal.
- b. Hazardous Waste Manifest
 - 1. NASA Ames Research Center shall be designated as the generator on the manifest and only approved Ames Environmental Office personnel shall sign the Uniform Hazardous Waste Manifests. Contractors shall not sign hazardous waste manifests.
 - 2. NASA Ames Research Center Environmental Office shall be designated as the emergency contact.

3.9 CONTRACTOR DISPOSAL

- a. Hazardous wastes generated by materials brought on site by the Contractor shall be properly handled, shipped, and disposed of as required by federal, state, and local regulations. No hazardous materials shall remain at the worksite upon completion of the project unless specified otherwise. The Government shall sample waste streams for purposes of waste characterization. Waste Profiles shall be submitted to the COTR. Hazardous wastes shall be disposed of at a permitted Treatment, Storage, and Disposal Facility (TSDF) authorized to accept the specific waste to be shipped. Use of deep well injection as a treatment or disposal method is prohibited.
- b. Hazardous Waste Manifest
 - 1. NASA Ames Research Center shall be designated as the generator on the manifest and only approved Ames Environmental Office personnel shall sign the Uniform Hazardous Waste Manifests. Contractors shall not sign hazardous waste manifests.

2. NASA Ames Research Center Environmental Office shall be designated as the emergency contact.
 3. The Contractor shall perform disposal services in compliance with 49 CFR. The Contractor shall meet the removal and disposal time frames established by law.
 4. The Contractor shall use only disposal facilities that have a valid permit to manage hazardous waste, and shall be responsible for determining that permit allows for the type of management and disposal intended for that waste. The Contractor shall be responsible for ensuring that any party handling hazardous waste, including subcontractors, transporters, and TSDFs are in compliance with applicable federal, state, and local regulations.
- c. Treatment, Storage, And Disposal Facility List - The Contractor shall provide a list of storage and disposal facilities (TSDF) that perform treatment, storage, or disposal services under this contract. Each facility shall have, as a minimum, EPA RCRA interim status or state approval as a treatment or disposal facility and be in good standing with the regulatory community. Recycling facilities shall meet applicable federal, state, and local regulations. The Contractor agrees that no facility other than those initially approved for use under this contract will be used, without first obtaining the written approval of the COTR.
 - d. Hazardous Waste Liability - For the purpose of this contract, the Contractor shall be responsible for any release or threatened release of the materials or substances handled under this contract, as well as any liabilities resulting or arising from or related to this contract, and shall bear all costs pertaining to such releases including, but not limited to, responses, remediation, testing, or disposal costs, and further shall defend and indemnify the Government for any costs including, but not limited to, any judgments, penalties, assessments, litigation, or attorney fees.
 - e. Hazardous Waste Transportation - Certified Waste Haulers shall be utilized. Government directed waste shall be transported to the disposal facility or interim storage facility without delay, in accordance with Department of Transportation (DOT) manifest regulations. The Contractor shall notify the Government if 10 days or more have elapsed during shipment.
 - f. Containerized Hazardous Waste - Hazardous wastes and other materials picked up by the Contractor from other facilities may not be added to any container of Government hazardous waste.
 - g. Bulk Hazardous Waste - Bulk hazardous waste shipments shall be weighed to confirm shipping weight.
 - h. Fluorescent Light Tubes - Fluorescent light tubes removed by the Contractor shall be turned over to the Government for recycling.

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SECTION 02 05 00

ALTERATIONS AND DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

This section specifies work involving alteration, demolition, and/or removal of existing buildings, materials, equipment, or utilities.

1.2 SUBMITTALS

Submit the following per Section 01 33 00, SUBMITTAL PROCEDURES:

SD-01, Work Plan

SD-06, Record of Existing Conditions

1.3 TEMPORARY PROTECTION

Provide temporary enclosures and partitions before starting work to prevent unauthorized entry, to protect personnel from noise and construction operations, and to protect existing materials, finishes, equipment, and building components from damage by construction operations.

PART 2 PRODUCTS

Products are not required for this section.

PART 3 EXECUTION

3.1 DISCONNECTING EXISTING UTILITIES

- a. Install temporary utility services before disconnecting existing utilities. Maintain temporary services during period of construction, and remove them only after permanent utilities have been installed, tested, and are in operation.
- b. All electrical power in areas within scope of work will be de-energized, locked/tagged out, with coordination between the Contractor and the Government (Ames Research Center Plant Engineering Branch). The Contractor shall apply his locks in conjunction with the Government's to assure mutual safety.

3.2 PRECAUTION AGAINST MOVEMENT

Provide shoring and bracing or other supports to prevent movement, settlement, or collapse of facilities adjacent to areas requiring alteration and removal.

3.3 SALVAGE AND REUSE

- a. The Government will designate materials and equipment to be salvaged.

- b. Remove salvageable materials and equipment so as to cause the least possible damage thereto. Handle, sort by type and size, store off ground, and protect salvaged items that will be reused in Work or will be retained by the Government. Provide identification tags indicating type, size, and quantity of materials for items boxed or placed in containers.
- c. Recondition salvaged materials and equipment required for reuse in areas of new construction before installation. Repair or replace, as necessary, items damaged during removal and salvage operations.

3.4 DEMOLITION

- a. CONCRETE DEMOLITION- Perform concrete demolition using wet methods to eliminate visible dust, which can result in excessive silica inhalation. If visible dust occurs, perform silica dust personal air monitoring to confirm the adequacy of controls.
- b. COATED WOOD DEMOLITION- If the wood is coated in paint contaminated with heavy metals, the wood shall be managed as hazardous waste. The wood shall be contained and the container kept closed except when being loaded. The containers shall be verified as closed at the end of each work day.

3.5 DISPOSAL

- a. Debris, rubbish, scrap, and other materials not designated to be salvaged or reused in Work become Contractor's property. Remove such materials and dispose of them legally off worksite.
- b. Burning of materials is prohibited on Government property.
- c. For mechanical piping, equipment, and fixtures containing oil, the oil shall be drained (and managed as hazardous waste) prior to removal.
- d. Aboveground storage tanks and associated piping containing hazardous materials shall be certified as clean in accordance with Title 22, Chapter 32, Management of Tanks, before being sent to a metals recycler on a bill of lading. The Contractor's work plan shall address the cleaning process to be used for the piping and tank(s).

3.6 ALTERATION

- a. Where required to patch or extend existing construction, match existing materials and exposed surfaces. Employ experienced mechanics for cutting, patching, repairing and other alteration work.
- b. Recycling of scrap metal and concrete from large demolition projects shall be conducted to the maximum extent practical.

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SECTION 02 09 00

LEAD PAINT ABATEMENT/DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

- a. Contractor shall furnish all labor, materials, services, and equipment necessary for the removal and approved disposal of lead-based paint and/or items covered with lead-based paint located at the jobsite and lead-contaminated materials resulting from the work performed.
- b. This work includes manual demolition, saw-cutting, hand-tool cleaning, use of heat guns, chemical strippers, and power-tool cleaning with dust collection systems. Abrasive blasting, water blasting, dry scrapping, heat greater than 1100°F and power-tool cleaning without high efficiency particulate air (HEPA) dust collection systems shall not be used, unless pre-approved. Torch-cutting, burning, and welding within 6 in. of a material containing lead is prohibited.
- c. Work shall be performed per documents referenced herein, and with all applicable federal, state, and local regulations. Nothing specified herein shall be construed as waiving any legal requirements. All painted surfaces at NASA Ames Research Center are assumed to contain lead unless specified otherwise. Disturbance of any painted surface must comply with this specification and [APR 1700.1](#), Chapter 35.
- d. All HEPA-filtered air pressure differential machines and vacuums shall be DOP certified. This certification must accompany all HEPA filtration systems (negative air machines and vacuums) brought onto NASA property. The DOP test must have been conducted within the last 30 days, and must be retested every 30 calendar days. Copies of all DOP certifications shall be submitted to the COTR.
- e. All workers disturbing lead covered by this specification shall wear, at a minimum, half face, HEPA-filtered, negative pressure respirators.

1.2 REFERENCES

Contractor shall abide by the provisions and recommendations of the following:

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

[APR 1700.1](#) Ames Health and Safety Manual, Latest Edition

U.S. DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION (OSHA)

[29 CFR 1910.1025](#) Lead Regulations

[29 CFR 1926.1101](#) Asbestos

29 CFR 1926.62 Construction Lead Regulations

29 CFR 1910.134 Respirator Regulations

Toxic Substances Control Act (TSCA), Title 4

California Labor Code Sections 6501.5, 6501.7, 6501.8, and 6505.5

CALIFORNIA CODE OF REGULATIONS (CCR)

Title 8, Section 5216 Lead Regulations

Title 8, Section 1532.1 Construction Lead Regulations

Title 8 Sections 5141 & 5144 Respirator Regulations

Title 17 Division 1, Chapter 8 Accreditation, Certification, and Work Practices for Lead-Based Paint and Lead Hazards

DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT (HUD)

Guidelines for the Evaluation and Control of Lead-Based Paint Hazards in Housing

RESOURCE CONSERVATION RECOVERY ACT (RCRA)

Health and Safety Code Section 25914

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z.9.2 Fundamentals Governing the Design & Operation of Local Exhaust Systems

National Electrical Code

National Plumbing Code

California Business & Professions Code Section 7058.5

UL 586 High Efficiency, Particulate, Air Filter Units

1.3 SUBMITTALS

Prior to start of work, submit the following per Section 01 33 00, SUBMITTAL PROCEDURES:

SD-01, Work Plan

- a. Written plan for containment and waste removal, including the number and location of negative air machines, and quantity and location of on-site waste storage containers.
- b. Written lead compliance program per 29 CFR 1926.62.

- c. Copy of initial exposure assessment per 29 CFR 1926.62, if required to support the work plan.
- d. Description of the proposed waste disposal site (name, location, and phone number).

Provide and post in the clean room the decontamination and work procedures to be used by all workers and visitors.

Submit the following during and after the work, per Section 01 33 00, SUBMITTAL PROCEDURES.

SD-02, Shop Drawings

Shop Drawings, showing the layout of work areas, and emergency egress routing and exits, and showing locations of clean room/change area, shower (if any), equipment room, equipment, and negative air machines.

SD-03, Data

Data, including copy of Contractor-performed risk assessment per 29 CFR 1926.62, to be approved before any reductions in controls.

SD-06, Records

- a. Documented proof that the employees have successfully completed the required training. Copy of certificates for each employee from the CA DHS approved trainer that the employee has received Lead Worker training.
- b. Documented proof that the workers have been recently fit tested for respirators within the past year.
- c. Copy of results of blood tests for lead taken within the past 6 months.
- d. Documented proof that the on-site supervisor meets the criteria for a "competent person" as set forth in 29 CFR 1926.1101.
- e. Copy of all applicable permits and licenses (per paragraph entitled "Permits & Licenses").
- f. Copy of medical certification of physical examination on all employees engaged in the operation clearly showing medical qualification for lead-related work and ability to wear a respirator.

SD-06, Records

- a. Copies of Contractor-performed air monitoring tests to be submitted with 24 hours of the sampling.
- b. Original records of "negative-air pressure" measurements in containments from recording manometers to be submitted daily and final paperwork within five days of completion of work.
- c. Copies of all manifests for lead containing waste to be submitted within five days of completion of work. All waste shall be

accompanied by certified weight slips.

- d. All updated training, medical, and fit-test documents to be submitted within 24 hours of expiration.

SD-08, Instructions

Instructions, including Material Safety Data Sheets (MSDS's) for chemicals brought onto the site.

- a. [Material Safety Data Sheets](#) (MSDS's) for chemicals brought onto the site.
- b. [Decontamination and work procedures](#) to be used by all workers and visitors.
- c. Copy of [respirator program](#) complying with [29 CFR 1910.134](#).
- d. Procedure(s) for evacuation of injured workers (aid for seriously injured workers shall not be delayed for reasons of decontamination).

All other submittals shall be submitted within 5 days of project completion.

1.4 QUALIFICATIONS AND TRAINING

- a. The supervisor for the Contractor actually performing the work must be a "competent person", as defined by [29 CFR 1926.62](#) (b).
- b. Each worker must have received training per [29 CFR 1926.62](#) (1), including the wearing and fitting of respirators.
- c. The Contractor's supervisor must complete the required DHS-approved lead training course and be DHS certified. A certified supervisor must remain at the work location when work is being performed with asbestos-containing material. The DHS certification must remain valid for the duration of such work.
- d. Contractor's workers must complete the required DHS approved lead training course and be DHS certified. This certification must remain valid for the duration of the project.
- e. Necessary and proper licensing and training per the requirements and regulations of the State of California shall be a minimum requirement for workers and supervisors on this job.

1.4 SIGNS AND LABELS

- a. Provide and post adequate warning signs at designated entrances to the regulated area, as required by Cal/OSHA, Proposition 65 (Title 26, Division 21.5), and the EPA.
- b. Provide appropriate warning labels and placards pre-printed on all lead waste bags, and affix the same labels on other types of waste containers immediately after lead waste is placed in the containers.

PART 2 PRODUCTS

2.1 WORK CLOTHING

Provide for each person present at the jobsite (workers, supervisors, inspectors, and others) work clothing consisting of full body disposable coveralls, disposable head covers, boots (chemical resistant as necessary), protective gloves (chemical resistant as necessary), goggles (eye protection), and respirators. Other safety clothing shall be available as appropriate.

2.2 MISCELLANEOUS EQUIPMENT

- a. Equip all vacuum cleaners with HEPA filters meeting [UL 586](#) requirements.
- b. All equipment brought onto NASA property must be free of visible dust and debris.
- c. All negative air machine exhaust ducting shall be wire reinforced.

PART 3 EXECUTION

3.1 REQUIREMENTS BY TYPE OF OPERATION

- a. Use chemical strippers in strict accordance with the approved manufacturer's instructions, including all recommended precautions. Caustic strippers shall not be used in occupied areas. If used, provide ventilation to remove all fumes and odors from the work area until the project is complete. Use of strippers containing volatile organic compounds shall be in accordance with BAAQMD Regulation 11, Rule 1. Use of caustic strippers containing chlorinated products is prohibited.
- b. Use respiratory protection at least as stringent as specified by [29 CFR 1926.62](#)(d)(2) "Protection of Employees during assessment of exposure," until a risk assessment demonstrating a lower hazard is approved by COTR and a DHS certified inspector.

3.2 WORK AREA ISOLATION

- a. A work area is defined as the room, corridor, or other space in which the work is being performed, from floor to ceiling, and between walls or other full-height partitions. The work area specifically includes the dumpster or other container in which unwrapped debris is to be placed and the path to that container.
- b. Establish the work area as a regulated area, with signage per [29 CFR 1926.62](#)(m), 8CCR 1532.1, and Proposition 65. In addition to isolation required by OSHA, use the procedures specified in the following paragraphs.
- c. Preparation
 1. Seal all critical barriers using, as a minimum, 6 mil thick fire-retardant polyethylene sheeting taped securely in place. Take care in sealing off lighting fixtures to avoid burning or melting the plastic sheeting.
 2. Turn off and tag out all air handling systems affecting the

regulated area during the abatement operation (where feasible).

3. Disconnect and tag out all electrical power in the work area, unless a GFCI-protected circuit is used at the point of connection to the electrical systems.
4. Secure all openings into the work area to separate the work area from other occupied spaces and prevent unauthorized entry, and post proper signs at the openings.
5. Seal HVAC ducts into the work area with at least one layer of 6 mil thick fire-rated plastic.
6. Remove all furniture and equipment from the area as feasible, and cover any furniture or equipment left in the work area with two layers of 6 mil thick fire-retardant plastic taped securely in place.

d. Clean all work areas at the end of each work day.

3.3 DECONTAMINATION

- a. Provide protective clothing in accordance with 29 CFR 1926.62 (g) for all workers and visitors, including NASA lead consultant.
- b. Decontaminate personnel in accordance with 29 CFR 1926.62 (i).
- c. Provide and post in the clean room, the decontamination and work procedures to be used by all workers and visitors.
- d. Prepare and distribute procedures for evacuation of injured workers. Aid for seriously injured worker will not be delayed for reasons of decontamination. The procedure shall be submitted to the COTR for approval.
- e. Seal and clean the outside of containers so they are free of all visible dust, dirt, or debris prior to removing from the work area.

3.4 AIR MONITORING

- a. The Contractor shall be fully responsible for personal air monitoring needed to demonstrate compliance with DHS, OSHA, and CAL-OSHA regulations and standards of good practice in worker protection. The Contractor will be required to collect air samples on its work force for the duration of the project, and must obtain written approval from the COTR and the onsite Lead Professional prior to discontinuing personal air monitoring.
- b. If, at any time, the personal air samples collected inside the work area exceed the Action Level, all active abatement work shall stop immediately. The Contractor shall re-evaluate existing engineering controls and implement new, COTR-approved engineering controls in conjunction with cleaning the work area. If the Action Level is exceeded three times on the same contracted project, the Contractor shall implement the use of Type C respirators (air supplied) for all workers entering the work area.
- c. The Government may conduct area air monitoring, at its sole discretion. The techniques employed will be consistent with regulatory

requirements. The number and location of air samples will be at the sole discretion of the onsite Lead Professional.

3.5 CLEANUP/CLEARANCE

- a. Properly package, label, and remove all waste containing lead from the work area to the holding area or hazardous waste bin. Remove all unnecessary equipment and materials from the work area. Allow the work area must be allowed to settle for one hour. After the area has settled, HEPA vacuum, wet wipe (with a detergent solution), and HEPA vacuum the space. The contractor will notify the Lead Professional when the work area is ready for inspection.
- b. A DHS-certified inspector will determine if clearance wipe samples are necessary. Required clearance levels for wipe samples are:
 1. 400 ug/ft² on interior surfaces
 2. 40 ug/ft² on surfaces with high potential for hand to mouth contact
 3. In child occupied facilities (the child care center), public and residential buildings, the current CA DHS, US EPA, or HUD regulations, whichever applies will be followed (excluding soil)
 4. Soil must be less than 400 ppm where children may be present
 5. Soil must be less than 1,000 ppm in other areas
- c. After all barriers/enclosures have been removed, wet clean and HEPA vacuum the surfaces/areas that were covered.
- d. If clearance samples collected in the work area do not meet the established clearance criteria, the contractor shall wet wipe and HEPA vacuum the entire work area again. A new set of clearance samples will be collected.
- e. After visual inspection and or clearance sampling indicates the remediation and cleaning is acceptable barriers and enclosures can be removed.

3.6 DISPOSAL

- a. Contain, remove from the surroundings, and properly handle dust, chips, and abrasive as hazardous waste. Note: if all such is contained in the HEPA vacuums, it may be removed still in the vacuums and disposed of later by the Contractor.
- b. Other debris is unlikely to be considered as hazardous, and may be disposed as construction debris, transported in a covered container. Plastic, suits, and other protective material must be HEPA vacuumed prior to disposal.
- c. Clean, sealed bags/containers may be stored in a holding area adjacent to the work area until a sufficient volume has accumulated for disposal, but not longer than 30 days. The holding area shall be prominently marked, and waste containers shall be covered with plastic sheeting and protected from damage.
- d. Carefully handle lead waste containers to prevent rupture and release.

Workers loading or unloading the waste shall wear approved respirators.

- e. Contractor shall be fully responsible for all costs for lead waste characterization, profiling, and testing, and for hauling lead wastes to a designated on-site location for Government disposal. The disposal of waste in an approved landfill, in accordance with the rules and regulations of the California Department of Health Services, the Regional Water Quality Control Board, and any other applicable agencies. Removal from the site shall be by a licensed hazardous waste hauler, and the manifest shall be signed by a civil servant representative of NASA's Safety, Environmental, and Mission Assurance Directorate (Code Q).

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SECTION 02 20 00

SITE PREPARATION AND EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

This section specifies work involving site preparation and earthwork, including definitions of soils materials used under other sections of this specification. It does not include actual installation of site utilities.

1.2 REFERENCES

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO T2 Sampling of Aggregates

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D1557 Laboratory Compaction Characteristics of
Soil Using Modified Effort (56,000
ft-lbf/ft)

ASTM D2487 Classification of Soils for Engineering
Purposes (Unified Soil Classification
System)

ASTM D2922 Density of Soil and Soil-Aggregate in
Place by Nuclear Methods (Shallow Depth)

ASTM D3017 Water Content of Soil and Rock in Place by
Nuclear Methods (Shallow Depth)

U.S. DEPARTMENT OF LABOR, OCCUPATIONAL SAFETY AND HEALTH
ADMINISTRATION (OSHA)

29 CFR1926 Safety and Health Standards for the
Construction Industry

AMERICAN CONCRETE INSTITUTE (ACI)

ACI229R - 94 Guidance on using flowable fill mixtures

1.3 SUBMITTALS

Submit the following per Section 01 33 00, SUBMITTAL PROCEDURES:

SD-04, Material Samples

Material Samples, of soil materials. Two 30 lbs sacks of each
material, submitted at least 10 days in advance of intended use.

SD-06, Record of Existing ConditionsSD-06, Records

Records, of quantity and location of groundwater disposal each day.
Provide report weekly.

SD-07, Certificates

Certificates, for manufactured materials

1.4 QUALITY CONTROL

a. Testing Service - Soil testing service will be provided by the Government. Submit samples of materials proposed for use in project, including in-situ materials.

b. Testing Requirements

<u>MATERIAL</u>	<u>REQUIREMENT</u>	<u>TEST METHOD</u>	<u>NUMBER OF TESTS</u>
Soil materials	Sampling	AASHTO T2	One per type and source, whenever there is any apparent change.
	Classification	ASTM D2487	
	Moisture-density relations	ASTM D1557, Method D	
Fill and backfill	Density	ASTM D2922	Three per lift in-place or layer
	Moisture Content	ASTM D3017	
Spoil	Fuel/solvent contamination	EPA Methods	One per 99 cy ³ , at least one per site, whenever contamination is known or suspected.

c. Evaluation of Test Results

1. Test spoil. Consider spoil a satisfactory fill/backfill material unless otherwise determined by COTR. If COTR determines that spoil is unsuitable because of contamination by fuel or solvents, use borrow material and haul unsatisfactory spoil to a designated site on Ames Research Center; the cost thereof will be borne by the Government.
2. Results of soil-in-place tests are considered satisfactory if:
 - a) Average density equals or exceeds that specified
 - b) No density test is less than 2 percent below specified density
 - c) Moisture content tests are within 2 percent of optimum

1.5 DEFINITIONS

- a. Subgrade - Top surface of a backfill or fill, or uppermost surface of an excavation, graded to conform to required subgrade elevation, and compacted.
- b. Suitable Topsoil - Friable clay loam surface soil to be used as a base for grass planting. Occurs as a thin soil layer covering naturally well-drained land covered by a heavy growth of grass, or which has been covered with a heavy growth of grass during the latest growing period before start of construction. Free of subsoil, clay lumps, brush, weeds, and other litter, and free of stones, stumps, objects larger than 2 in. in any dimension, roots, and other objectionable material.
- c. Degree of Compaction - Expressed as a percentage of maximum density obtained by test procedure in [ASTM D1557](#), Methods B or D.
- d. Satisfactory Soil Materials - Those meeting classification for intended use; are uncontaminated by fuel and solvents; and are free of organic matter, trash, stones greater than 3 in. in any dimension, and any other deleterious substances.
- e. Spoil - Material, below level of topsoil, removed from excavations on jobsite.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

Conform to following designation:

<u>MATERIAL DESIGNATION</u>	<u>MAXIMUM PARTICLE SIZE, in.</u>	<u>UNIFIED SOIL CLASSIFICATION</u>
Borrow	3	SW, SW-SM, SW-SC, SM, SC, GW-GM, GW-GC, GM, GC
Sub-base	1.5	SW, SW-SM, SW-SC, GW, GW-GM, GW-GC
Base	1.5	GW-GM, GW-GC
Sand, bedding material	0.2	SP
Gravel, filter material	0.5	GP (less than 5% passing 0.2 sieve)
Clay, impervious fill	0.02	CL, CM

2.2 USE OF SOIL MATERIALS

<u>AREA CLASSIFICATION</u>	<u>SOIL MATERIALS</u>	<u>PERCENT COHESIVE</u>	<u>PERCENT NON-COHESIVE</u>
Fill and backfill, unless otherwise specified	Clean soil borrow	90	90

Within 24 inches below structures, steps, walks, or pavement	Clean spoil or borrow	95	95
Against face of structures, where drains are specified, to a distance equal to three drain diameters	Filter material	N/A	95
In foundation subdrain trenches	Filter material	N/A	95
Against surfaces having applied waterproofing, for a minimum distance of 6 in.	Sand	N/A	95
Within 6 in. below building slabs	Sand	N/A	95
Within 6 in. below structures and pavements	Subbase	95	90
Within 8 in. below structures and pavements	Base	N/A	95
Below subdrains	Impervious fill	100	N/A

2.3 FLOWABLE FILL

- a. Contractor shall use flowable fill containing coal fly ash and/or ferrous foundry sands for backfill and other fill applications. Specific content levels will depend on the specifics of the job, including the type of coal fly ash (Class C or Class F) or foundry sand used, strength, set time, flowability needed, bleeding, and shrinkage.
- b. The following table provides the recommended trial mixture for this specification:

<u>Component</u>	<u>Quantity per Cubic Yard</u>
Cement	50 lbs.
Coal fly ash	250 lbs.
Foundry sand	2,850 lbs.
Water	500 lbs.

PART 3 EXECUTION

3.1 GENERAL

- a. Before earthwork is started, carefully verify location of underground utilities by hand methods. Protect from damage utilities to be left in place.
- b. All earth disturbance shall be done with sufficient wetting of the soil to prevent visible airborne dust, thereby controlling silica dust inhalation.
- c. Where excavations cut through paved areas, saw-cut pavement to provide

a clean edge. Pavement removed from excavation site is classified as debris - dispose of this pavement legally. Patch resulting cut with similar material in accordance with Section 02 50 00, ASPHALT-CONCRETE PAVING AND MARKINGS, or Section 03 30 00, CAST-IN-PLACE CONCRETE, as applicable.

- d. Pile spoil backfill in an orderly manner, shape to drain, and place at 2 ft minimum from excavations to prevent overloading, slides, and cave-ins.
- e. Protect trenches and excavations from inflow of surface water. Prevent flooding of jobsite and surrounding area.
- f. Keep contaminated soil segregated from uncontaminated soil throughout course of Work.

3.2 SURFACE PREPARATION

- a. Remove trees, stumps, roots, brush, and other vegetation in areas to be cleared, except those indicated or directed to be left standing. Trees to be left standing - Trim of dead branches 1.5 in. diameter or larger and of live branches to indicated height; neatly cut close to bole of tree or main branches. Paint cuts with tree-wound paint. Protect trees and vegetation to be left standing by erecting barriers or by other means as required.
- b. Remove stumps, roots, and organic or other debris to a minimum depth of 8 in. below surface level of original ground. Do not use mechanical grubbing equipment inside drip lines of trees indicated to remain standing.
- c. Strip topsoil from surface of areas to receive fills or embankments, or to be excavated. Transport topsoil to, and stockpile in, designated storage areas.
- d. Fill depressions resulting from grubbing operations with acceptable backfilling material, unless further excavation is required. Before filling, ensure that subgrade surfaces of depressions are free of standing water, frost, or frozen material. Remove unsatisfactory soil materials.

3.3 EXCAVATION

- a. Shoring and Bracing
 - 1. Shore excavations 5 ft or more in depth. Shore excavations when sides are subjected to vibrations from vehicular traffic, from operation of machinery, or from any other source. Shore and brace trenches over 2 ft in depth that will remain open for seven days or more. Shore and sheet any trench that has been open seven days, regardless of how much longer that trench is to remain open. Conform to OSHA 29 CFR 1926.652(c). For excavations over 12 ft in depth, ensure that shoring is designed by a California-licensed civil engineer, and submit design to COTR for approval.
 - 2. Trench shields and backsloping are not acceptable in any developed area of Ames Research Center.

3. Wherever subsequent removal of sheet piling would permit lateral movement of soil under adjacent structures, use and permanently leave in place steel sheet piling or pressure-treated timber sheet piling, cut off as required.

b. Dewatering

1. Do not allow water to accumulate in excavations. Provide a dewatering system, as required, to convey water to approved disposal areas. Water from excavations is not allowed into the storm drain system. Provide and maintain temporary drainage ditches and other diversions as necessary outside of excavation limits. Dewatering system and method of disposal requires approval by NASA Safety Office. Continue dewatering until construction subjected to water pressure has obtained full-specified strength and backfill is completed.
2. Groundwater in area of work may be contaminated with petroleum products. Provide a sample of groundwater for analysis by the Government at least 10 days before starting dewatering operations. Depending on results of this analysis, groundwater may be disposed of into sanitary sewer or into Government-provided decontamination equipment. In either case, keep detailed records of quantity, by date, of groundwater removed, and provide a copy of these records to the Government with each payment request.
3. Groundwater may be encountered at approximately 7 ft to 9 ft below surface in developed areas of Ames-Moffett, and 12 inches to 3 ft below surface in undeveloped areas, unless otherwise indicated.
4. Do not use trench excavations for utilities as temporary drainage ditches.

c. Excavation for Structures

1. Conform to dimensions and elevations indicated within a tolerance of ± 1.2 in., and 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.
2. In excavating for footings and foundations, do not disturb bottom of excavation.
3. For pile foundations, stop excavation at an elevation 6 in. to 1 ft above bottom of footing before piles are driven. After pile driving has been completed, remove loose and displaced material and perform excavation to final grade, leaving a solid bed to receive concrete.

- d. Excavation of Ditches, Gutters, and Channels - Accomplish excavation by cutting accurately to cross sections, grades, and elevations indicated. Backfill excessive open-ditch or gutter excavation with approved materials to grade at no additional cost.

e. Trench Excavation

1. Provide side slopes of trenches as nearly vertical as practicable. Grade bottoms of trenches accurately, at an

elevation allowing for specified bedding or filter material. Dig bell holes and depressions for joints after trench bottom has been graded, and only to length, depth, and width required to make joint. Except as specified for wet or otherwise unstable material, backfill overdepths with materials specified for backfilling lower portion of trenches.

2. Sequence trenching for underground utilities to minimize time a trench is open. If any area of trench is left open more than seven days, desist from further trenching until existing trenches are completely backfilled.
- f. Excavation for Subdrainage System - Provide excavation for foundation subdrainage system, except for footing drains, with vertical sides for a distance of at least twice pipe diameter above bottom of pipe; make excavation suitably wide to allow 6 in. to 9 in. clear on each side of pipe. Grade bottom of trench excavations to obtain required slope, and tamp to provide a firm bed for drain pipe bedding material.
- g. Removal of Unsatisfactory Soil Materials - Excavate unsatisfactory soil materials that extend below required elevations to depth directed by COTR.
- h. Unauthorized Excavation
 1. Unauthorized excavation is removal of materials beyond indicated subgrade elevations or side dimensions specified without specific direction. Replace unauthorized excavation material as specified at no additional cost.
 2. Fill unauthorized excavation under foundations or retaining walls by lowering bottom elevation of footing or base to excavation bottom without altering approved top elevation. Elsewhere, backfill unauthorized excavations and compact as specified for authorized excavations of same classification.
- i. Removal of Existing Underground Utilities - Demolish and remove from excavation existing underground utilities indicated to be removed. Permanently close open ends of existing underground utilities with masonry bulkheads, threaded galvanized metal caps, plastic plugs, or other suitable, approved method. Wood plugs are not permitted.

3.4 FILLING, BACKFILLING AND COMPACTION

- a. Backfill excavations as promptly as work permits, but not until completion of following:
 1. Removal of concrete formwork, shoring, and bracing.
 2. Completion of concrete waterproofing and subdrainage system.
 3. Inspection, testing, and approval of underground utilities, subdrains, and other construction.
4. Removal of trash and debris.
- b. Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials before placement of fill material. Sloped surfaces steeper than 1:4 (vertical:horizontal) - Plow, strip, or break

up so that fill material will bond with existing material. Scarify, condition, and compact existing ground surface to required depth (minimum 6 in.) and percent of maximum density.

- c. Place backfill and fill material in layers of maximum 8 in. in loose depth; moisten or aerate as necessary to provide optimum moisture content; and then compact to specified density. Do not place backfill or fill material on surfaces that are muddy, frozen, icy, or contain frost.
- d. Bring up backfill and fill materials adjacent to structures evenly around structure. Compact with power-driven hand tampers within a horizontal distance equal to depth of backfill or fill.

3.5 GRADING

- a. Uniformly grade areas within limits of grading, including adjacent transition areas. Ensure that finished surface is smooth and even, compacted, is free of voids, has uniform levels or slopes, and is 1 in. maximum above or below indicated subgrade elevations (except below walks where the limits are 0 above and 1 in. below). Maximum deviation of 1 in. when tested with a 10 ft straightedge.
- b. Hand grade areas adjacent to structure to drain away from structure and to prevent ponding of water after rains.

3.6 MAINTENANCE

Protect newly graded areas from traffic and erosion, and maintain them free of trash and debris. Where disturbed by subsequent construction operations or adverse weather, scarify, reshape, and compact surface as specified to required density before proceeding with further construction.

3.7 DISPOSAL OF EXCESS AND WASTE MATERIALS

Waste soil that is clean and meets the requirements for acceptable soil material may be transported to and spread, as directed, on Government property. Waste soil that is clean, except for contamination by petroleum products - dispose of on Government property as directed by COTR. Other waste soil - legally dispose of off Government property. Other waste materials, trash, and debris - remove from Government property and legally dispose of.

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SECTION 02 50 00

ASPHALT-CONCRETE PAVING AND MARKINGS

PART 1 GENERAL

1.1 SUMMARY

This section specifies requirements for asphalt concrete paving.

1.2 REFERENCES

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO M247 Glass Beads Used in Traffic Paint

AASHTO M248 Ready-Mixed White and Yellow Traffic Paints

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D692 Coarse Aggregate for Bituminous Paving
Mixtures

ASTM D1073 Fine Aggregate for Bituminous Paving
Mixtures

STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS)

CalTrans Spec Standard Specification

1.3 SUBMITTALS

Refer to Section 01 33 00, SUBMITTAL PROCEDURES. Submit the following:

SD-03, Manufacturer's Catalog Data

Manufacturer's Catalog Data for paint and other manufactured materials.

SD-05, Mix Designs

Mix Designs for asphalt concrete mixes, including compaction curve.

SD-06, Delivery Dockets

Delivery Dockets for asphalt concrete.

SD-07, Certificates

Certificates for asphalt binder, prime coat and tack coat.

PART 2 PRODUCTS

2.1 ASPHALT CONCRETE MATERIALS

- a. Asphalt Concrete - Type B, $\frac{1}{2}$ in. maximum, medium gradation, 1992 CalTrans Spec Section 39, Asphalt Concrete.
- b. Asphalt Binder - Steam-refined paving asphalt, Grade AR 4000, 1992 CalTrans Spec Section 92, Asphalts.
- c. Prime Coat - Liquid asphalt, Grade SC-70, 1992 CalTrans Spec Section 93, Liquid Asphalts.
- d. Tack Coat - Asphalt emulsion, RS 1, 1992 CalTrans Spec Section 94, Asphaltic Emulsions.
- e. Coarse Aggregate - ASTM D692. Fine aggregate - ASTM D1073. Sand equivalent value: 30, minimum.

2.2 PAVEMENT MARKING

- a. Paint - AASHTO M248, Type S. Parking lanes and crosswalks white, and traffic lanes yellow.
- b. Glass Beads for Reflectorized Paint - AASHTO M247, Type 1.

PART 3 EXECUTION

3.1 GENERAL

- a. Weather Limitations
 1. Apply bituminous prime and tack coat only when ambient temperature in shade is above 50°F and when temperature has not been below 35.6°F for 12 hours immediately before application. Start application when aggregate base course is dry or contains moisture not in excess of amount permitting uniform distribution and required penetration.
 2. Construct asphalt concrete courses only when ambient temperature is above 39°F and underlying base course is dry.
 3. Paving and marking operations must be suspended if rain is forecasted prior to materials being allowed to sufficiently dry.
- b. Transportation of Mixtures
 1. Transport asphalt-concrete mixtures from mixing plant to jobsite in trucks with tight, clean, smooth beds coated with a minimum amount of a concentrated solution of hydrated lime and water to prevent adhesion of mixture to truck beds.
 2. Cover each load of mixture with canvas or similar material sufficiently large and heavy to retard heat loss and to protect mixture from weather.
 3. In cool weather or for long hauls, insulate entire contact area of each truck bed. Securely fasten covers.

4. Deliver mixture so that minimum temperature of mixture at time of dumping into paver is 300°F.
5. Ensure that trucks do not travel on mixture until compaction is complete and until asphalt concrete pavement surface will support traffic without measurable deformation.

3.2 PREPARATION

- a. Surface Preparation - Remove loose or other objectionable materials from aggregate base course surface or other contact surface immediately before applying bituminous prime coat.
- b. Priming Base Course Surface
 1. Uniformly apply bituminous prime coat to prepared base course surface. Rate of application: 26.5 fl. ounce/yd² to 53.0 fl. ounce/yd² of surface. Temperature of bituminous material at time of application: 106°F to 180°F.
 2. Squeegee excess prime coat material from surface. Treat areas missed by bituminous prime coat distributor with prime coat material using hand sprayers.
 3. After applying prime coat material, allow surface to dry undisturbed for 48 hours, minimum. Blotting prime coat with fine aggregate is not permitted.
- c. Priming Other Contact Surfaces
 1. For contact surfaces of curbs, gutters, manholes, and other structures projecting into or abutting concrete pavement apply a thin, uniform coating of bituminous tack coat material before placing asphalt-concrete mixture.
 2. After applying tack coat, allow surface to dry until suitably tacky to receive asphalt-concrete mixture. Squeegee excess tack coat material from surface.

3.3 PLACING ASPHALT-CONCRETE

- a. Place asphalt-concrete mixture on prepared surface, spread uniformly, and strike off. Place asphalt-concrete in layers of approximately equal thickness; 2 in. maximum thickness of layer after compaction. When width of paved area is less than 5 ft (such as in trench repair or patching), material may be placed in one course.
- b. Pavement Placing - Begin placing along centerlines of areas to be paved on a crowned section, at high side of a section with a one-way slope, and in direction of traffic flow. Place mixture for each course in strips 10 ft wide minimum. Progressively place strips after rolling first strip. Extend rolling to overlap preceding strips. Place continuously.
- c. Hand Placing
 1. In areas where machine spreading is not practicable, spread and finish with heated hand tools.

2. Dump mixture on approved dump boards, and distribute into place in a uniformly loose layer of a thickness that will, when compacted, conform to required grade and thickness. Dump mixture at a rate that can be handled properly by shovelers and rakers.

d. Joints

1. Ensure that joints have same texture, density, and smoothness as other sections of course. Make joints between old and new pavements, or between successive days' work, so as to ensure a continuous bond between old and new sections of pavement.
2. Offset transverse joints in succeeding courses 2 ft minimum. Cut back edge of previously placed course to expose an even vertical surface over full thickness of course.
3. Offset longitudinal joints in succeeding courses 6 in. minimum. When edges of longitudinal joints are irregular or do not conform to specifications, cut back edge to expose an even vertical surface over the thickness of course.

3.4 COMPACTION

- a. Start compaction as soon after placing as asphalt-concrete mixture will bear weight of roller without undue displacement.
- b. During rolling, keep wheels moist with minimum amount of water required to avoid picking up asphalt-concrete mixture.
- c. In places not accessible to the rollers, compact mixture with hot hand tampers.
- d. Start rolling longitudinally at extreme sides of lanes, and proceed towards center of pavement, except on superelevated curves. On superelevated curves, start rolling on low side and progress to high side, overlapping on successive trips by at least one-half width of rear wheel of roller.
- e. Make alternate trips of roller of slightly different lengths.
- f. Ensure that rollers move at a slow but uniform speed, with drive roll or wheel nearest paver. Maximum speed: 3 mph for steel-wheeled rollers, 5 mph for pneumatic-tired rollers.
- g. Rolling
 1. Initial rolling - Perform immediately after rolling longitudinal joints and edges. Operate rollers as close to paver as possible without causing undue displacement. Make preliminary tests of crown, grade and smoothness immediately after initial rolling.
 2. Second rolling - Perform as closely as possible after initial rolling, while mixture is hot and suitable for proper compaction. Make rolling continuous (at least three complete coverages) until mixture has been compacted. Undue displacement is not permitted.
 3. Finish rolling - Perform while mixture is suitably warm for removal of roller marks. Continue rolling until roller marks are

eliminated and course has specified density.

h. Patching Deficient Areas

1. Saw-cut and remove asphalt concrete mixtures that become mixed with foreign materials or that are defective (such as low areas or "bird-baths"), replace with fresh asphalt-concrete mixture to obtain required grade and smoothness for finished surface, and compact to specified density.
2. Remove pavement in deficient areas to full thickness of asphalt-concrete course, cut sides perpendicular and parallel to direction of traffic, and make edges vertical. Spray edges with bituminous tack coat material.
3. Skin patching an area that has been rolled is not permitted.

- i. Protection of Pavement - After final rolling, do not allow vehicular traffic on pavement until pavement has cooled and hardened, and in no case sooner than 6 hours.

3.5 QUALITY CONTROL

- a. The Government may extract 3 in. diameter pavement specimens of each completed asphalt concrete. Repair test holes. Ensure that thickness does not vary from plan thickness by more than $\frac{1}{8}$ in. for base course and $\frac{1}{8}$ in. for surface course.
- b. Finished surface of each asphalt-concrete course will be tested for smoothness with a 10 ft straightedge applied parallel with, and at right angles to, centerline of paved area. Maximum allowable variation from straightedge: $\frac{1}{8}$ in. for lower course surface, $\frac{1}{16}$ in. for wearing course surface.
- c. Crown of each asphalt-concrete course will be tested for conformance to required cross section with a crown template centered on, and at right angles to, centerline of crown. Maximum allowable variation of finished crown surface from crown template: $\frac{1}{8}$ in. for each asphalt-concrete course.
- d. Ensure that final surface has a uniform texture and conforms to required grade and cross section. Immediately correct low or defective areas by cutting out and replacing faulty areas.

3.6 PAVEMENT MARKING

- a. Cure new pavement surfaces for 7 days before applying marking materials. Where oil or grease are present on old pavement, scrub affected areas with approved detergent or degreaser, and rinse thoroughly.
- b. Apply paint at a rate recommended by manufacturer, when air and pavement temperatures are between 39°F and 95°F, and maximum relative humidity is 85 percent for one hour after application.
- c. Where reflectorized paint is specified, dispense glass beads uniformly at a rate of 12.0 lbs/gallon of paint.
- d. Markings - Sharply outlined and of uniform thickness. Strip widths -

as indicated. If discoloration of paint occurs due to bleeding of bitumen, apply paint in two coats. Place traffic control markers along newly painted lines to protect lines from damage. Rinse water shall be collected and disposed of properly.

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SECTION 03 30 00

CAST-IN-PLACE CONCRETE

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.

ACI INTERNATIONAL (ACI)

- ACI/MCP-1** (2009) Manual of Concrete Practice Part 1:
ACI 104-71R-97 to 223-98
- ACI/MCP-2** (2009) Manual of Concrete Practice Part 2
- ACI 224R-01 to ACI 313R-97
- ACI/MCP-3** (2009) Manual of Concrete Practice Part 3
- ACI 315-99 to ACI 343R-95
- ACI/MCP-4** (2009) Manual of Concrete Practice Part 4
- ACI 345R-05 to 355.2R-04

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

- AASHTO M 182** (2005) Standard Specification for Burlap
Cloth Made from Jute or Kenaf and Cotton
Mats
- AASHTO M 322M/M 322** (2007) Standard Specification for
Rail-Steel and Axle-Steel Deformed Bars
for Concrete Reinforcement

AMERICAN HARDBOARD ASSOCIATION (AHA)

- AHA A135.4** (2004) Basic Hardboard

AMERICAN WELDING SOCIETY (AWS)

- AWS D1.4/D1.4M** (2005; Errata 2005) Structural Welding
Code - Reinforcing Steel

ASTM INTERNATIONAL (ASTM)

- ASTM A 123/A 123M** (2009) Standard Specification for Zinc
(Hot-Dip Galvanized) Coatings on Iron and
Steel Products
- ASTM A 185/A 185M** (2007) Standard Specification for Steel
Welded Wire Reinforcement, Plain, for
Concrete

ASTM A 496/A 496M	(2007) Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497/A 497M	(2007) Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 615/A 615M	(2009) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 706/A 706M	(2009) Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 767/A 767M	(2009) Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
ASTM A 775/A 775M	(2007b) Standard Specification for Epoxy-Coated Steel Reinforcing Bars
ASTM A 780/A 780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 82/A 82M	(2007) Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
ASTM A 934/A 934M	(2007) Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars
ASTM A 996/A 996M	(2009) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement
ASTM C 1017/C 1017M	(2007) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1107/C 1107M	(2008) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1116/C 1116M	(2008a) Standard Specification for Fiber-Reinforced Concrete
ASTM C 1240	(2005) Standard Specification for Silica Fume Used in Cementitious Mixtures
ASTM C 1260	(2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

ASTM C 143/C 143M	(2009) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM C 156	(2005) Standard Test Method for Water Retention by Concrete Curing Materials
ASTM C 1567	(2008) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)
ASTM C 171	(2007) Standard Specification for Sheet Materials for Curing Concrete
ASTM C 172	(2008) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 173/C 173M	(2009) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(2007) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(2009a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 233	(2007) Standard Test Method for Air-Entraining Admixtures for Concrete
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 295	(2008) Petrographic Examination of Aggregates for Concrete
ASTM C 309	(2007) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 31/C 31M	(2009) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 311	(2007) Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete
ASTM C 33/C 33M	(2008) Standard Specification for Concrete Aggregates
ASTM C 330	(2005) Standard Specification for Lightweight Aggregates for Structural Concrete

ASTM C 39/C 39M	(2005e1e2) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42/C 42M	(2004) Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 494/C 494M	(2008a) Standard Specification for Chemical Admixtures for Concrete
ASTM C 567	(2005a) Determining Density of Structural Lightweight Concrete
ASTM C 595/C 595M	(2008a) Standard Specification for Blended Hydraulic Cements
ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C 881/C 881M	(2002) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM C 932	(2006) Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering
ASTM C 94/C 94M	(2009) Standard Specification for Ready-Mixed Concrete
ASTM C 989	(2009a) Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 990	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
ASTM C 990M	(2009) Standard Specification for Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants (Metric)
ASTM D 1190	(1997) Standard Specification for Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1557	(2007) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft ³) (2700 kN-m/m ³)
ASTM D 1751	(2004; R 2008) Standard Specification for Preformed Expansion Joint Filler for

	Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(2004a; R 2008) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion
ASTM D 2103	(2008) Standard Specification for Polyethylene Film and Sheeting
ASTM D 2628	(1991; R 2005) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 4397	(2009) Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications
ASTM D 5759	(1995; R 2005) Characterization of Coal Fly Ash and Clean Coal Combustion Fly Ash for Potential Uses
ASTM D 7116	(2005) Standard Specification for Joint Sealants, Hot Applied, Jet Fuel Resistant Types, for Portland Cement Concrete
ASTM E 1155	(1996; R 2008) Standard Test Method for Determining Floor Flatness and Floor Levelness Numbers
ASTM E 329	(2008) Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
ASTM E 648	(2009a) Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
CONCRETE REINFORCING STEEL INSTITUTE (CRSI)	
CRSI 10MSP	(2001; 27Ed) Manual of Standard Practice
FOREST STEWARDSHIP COUNCIL (FSC)	
FSC STD 01 001	(2000) Principles and Criteria for Forest Stewardship
NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)	
NIST PS 1	(2007) Construction and Industrial Plywood
U.S. ARMY CORPS OF ENGINEERS (USACE)	
COE CRD-C 572	(1974) Specifications for Polyvinylchloride Waterstops

U.S. DEPARTMENT OF COMMERCE (DOC)

PS1 (1995) Construction and Industrial Plywood
(APA V995)

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS LLL-B-810 (Rev B) Building Board, (Hardboard) Hard
Pressed, Vegetable Fiber

FS MMM-A-001993 (1978) Adhesive, Epoxy, Flexible, Filled
(For Binding, Sealing, and Grouting)

FS SS-S-1614 (Rev A; Am 1) Sealants,
Joint, Jet-Fuel-Resistant, Hot-Applied, for
Portland Cement and Tar Concrete Pavements

FS SS-S-200 (Rev E; Am 2) Sealant, Joint,
Two-Component, Jet-Blast-Resistant,
Cold-Applied, for Portland Cement Concrete
Pavement

FS UU-B-790 (Rev A) Building Paper, Vegetable Fiber:
(Kraft, Waterproofed, Water Repellent and
Fire Resistant)

U.S. GREEN BUILDING COUNCIL (USGBC)

LEED (2002; R 2005) Leadership in Energy and
Environmental Design(tm) Green Building
Rating System for New Construction
(LEED-NC)

1.2 DEFINITIONS

- a. "Cementitious material" as used herein must include all portland cement, pozzolan, fly ash, ground granulated blast-furnace slag.
- b. "Exposed to public view" means situated so that it can be seen from eye level from a public location after completion of the building. A public location is accessible to persons not responsible for operation or maintenance of the building.
- c. "Chemical admixtures" are materials in the form of powder or fluids that are added to the concrete to give it certain characteristics not obtainable with plain concrete mixes.
- d. "Workability (or consistence)" is the ability of a fresh (plastic) concrete mix to fill the form/mould properly with the desired work (vibration) and without reducing the concrete's quality. Workability depends on water content, chemical admixtures, aggregate (shape and size distribution), cementitious content and age (level of hydration).

1.3 SUBMITTALS

Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fabrication Drawings for concrete formwork must be submitted by the Contractor in accordance with paragraph entitled, "Shop Drawings," of this section, to include the following:

Formwork
Column Forms
Wall Forms
Floor Forms
Ceiling Forms
Special Construction

Reinforcing steel

Reproductions of contract drawings are unacceptable.

Provide erection drawings for concrete **Formwork** that show placement of reinforcement and accessories, with reference to the contract drawings.

SD-03 Product Data

Materials for curing concrete
Joint sealants; (LEED)

Submit manufacturer's product data, indicating VOC content. Manufacturer's catalog data for the following items must include printed instructions for admixtures, bonding agents, epoxy-resin adhesive binders, waterstops.

Joint filler; (LEED)
Plastic Forms
Carton Forms
Recycled Aggregate Materials; (LEED)
Cement; (LEED)
Portland Cement
Ready-Mix Concrete
Water-Vapor Barrier Subgrade Cover
Bonding Materials
Floor Finish Materials
Concrete Curing Materials
Reinforcement; (LEED)
Reinforcement Materials
Liquid Chemical Floor Hardener

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

Vapor retarder

Epoxy bonding compound

Waterstops

Wood Forms

Biodegradable Form Release Agent

Submit documentation indicating type of biobased material in product and biobased content. Indicate relative dollar value of biobased content products to total dollar value of products included in project.

SD-04 Samples

Slab finish sample

Submit the following samples:

Three samples of each type waterstop, 1/2 inch long.

Dumbbell Type

Rubber

Polyvinylchloride (PVC)

SD-05 Design Data

Concrete mix design

Thirty days minimum prior to concrete placement, submit a mix design for each strength and type of concrete. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, pozzolans, ground slag, and admixtures; and applicable reference specifications. Provide mix proportion data using at least three different water-cement ratios for each type of mixture, which produce a range of strength encompassing those required for each class and type of concrete required. If source material changes, resubmit mix proportion data using revised source material. Provide only materials that have been proven by trial mix studies to meet the requirements of this specification, unless otherwise approved in writing by the Contracting Officer. Indicate clearly in the submittal where each mix design is used when more than one mix design is submitted. Submit additional data regarding concrete aggregates if the source of aggregate changes. Submit copies of the fly ash and pozzolan test results, in addition. The approval of fly ash and pozzolan test results must be within 6 months of submittal date. Obtain acknowledgement of receipt prior to concrete placement.

SD-06 Test Reports

Concrete mix design

Fly ash

Pozzolan

Ground granulated blast-furnace slag

Aggregates

Tolerance report

Compressive strength tests

Air Content

Slump

Air Entrainment

SD-07 Certificates

Curing concrete elements

Pumping concrete

Form removal schedule

VOC Content for form release agents, curing compounds, and concrete penetrating sealers

Material Safety Data Sheets

SD-08 Manufacturer's Instructions

Fly ash

Ground granulated blast-furnace slag

Welding Procedures must be in accordance with AWS D1.4/D1.4M.

Submit mill certificates for Steel Bar according to the paragraph entitled, "Fabrication," of this section.

Provide certificates for concrete that are in accordance with the paragraph entitled, "Classification and Quality of Concrete," of this section. Provide certificates that contain project name and number, date, name of Contractor, name of concrete testing service, source of concrete aggregates, material manufacturer, brand name of manufactured materials, material name, values as specified for each material, and test results. Provide certificates for Welder Qualifications that are in accordance with the paragraph entitled, "Qualifications for Welding Work," of this section.

Welding Procedures

SD-11 Closeout Submittals

1.4 MODIFICATION OF REFERENCES

Accomplish work in accordance with ACI publications except as modified herein. Consider the advisory or recommended provisions to be mandatory. Interpret reference to the "Building Official," the "Structural Engineer," and the "Architect/Engineer" to mean the Contracting Officer.

1.5 DELIVERY, STORAGE, AND HANDLING

Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. ACI/MCP-2 for job site storage of materials. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed. Do not store concrete curing compounds or sealers with materials that have a high

capacity to adsorb volatile organic compound (VOC) emissions. Do not store concrete curing compounds or sealers in occupied spaces.

1.5.1 Reinforcement

Store reinforcement of different sizes and shapes in separate piles or racks raised above the ground to avoid excessive rusting. Protect from contaminants such as grease, oil, and dirt. Ensure bar sizes can be accurately identified after bundles are broken and tags removed.

1.6 QUALITY ASSURANCE

1.6.1 Drawings

1.6.1.1 Shop Drawings

[Fabrication Drawings](#) for concrete formwork for [Reinforcement Materials](#), [Column Forms](#), [Wall Forms](#), [Floor Forms](#), [Ceiling Forms](#) and for [Special Construction](#) must indicate concrete pressure calculations with both live and dead loads, along with material types. Provide all design calculations in accordance with [ACI/MCP-2](#) and [ACI/MCP-3](#).

1.6.1.2 [Formwork](#)

Drawings showing details of formwork including, but not limited to; joints, supports, studding and shoring, and sequence of form and shoring removal. Reproductions of contract drawings are unacceptable.

Design, fabricate, erect, support, brace, and maintain formwork so that it is capable of supporting without failure all vertical and lateral loads that may reasonably be anticipated to be applied to the formwork.

1.6.1.3 [Reinforcing Steel](#)

[ACI/MCP-4](#). Indicate bending diagrams, assembly diagrams, splicing and laps of bars, shapes, dimensions, and details of bar reinforcing, accessories, and concrete cover. Do not scale dimensions from structural drawings to determine lengths of reinforcing bars.

1.6.2 Control Submittals

1.6.2.1 [Curing Concrete Elements](#)

Submit proposed materials and methods for curing concrete elements.

1.6.2.2 [Pumping Concrete](#)

Submit proposed materials and methods for pumping concrete. Submittal must include mix designs, pumping equipment including type of pump and size and material for pipe, and maximum length and height concrete is to be pumped.

1.6.2.3 [Form Removal Schedule](#)

Submit schedule for form removal indicating element and minimum length of time for form removal.

1.6.2.4 VOC Content for form release agents, curing compounds, and concrete penetrating sealers

Submit certification for the form release agent, curing compounds, and concrete penetrating sealers that indicate the VOC content of each product.

1.6.2.5 Material Safety Data Sheets

Submit Material Safety Data Sheets (MSDS) for all materials that are regulated for hazardous health effects. Prominently post the MSDS at the construction site.

1.6.3 Test Reports

1.6.3.1 Concrete Mix Design

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix must be suitable for the job conditions. Include mill test and all other test for cement, aggregates, and admixtures in the laboratory test reports. Provide maximum nominal aggregate size, gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Submit test reports along with the concrete mix design. Obtain approval before concrete placement.

1.6.3.2 Fly Ash and Pozzolan

Submit test results in accordance with ASTM C 618 for fly ash and pozzolan. Submit test results performed within 6 months of submittal date. Submit manufacturer's policy statement on fly ash use in concrete.

1.6.3.3 Ground Granulated Blast-Furnace Slag

Submit test results in accordance with ASTM C 989 for ground granulated blast-furnace slag. Submit test results performed within 6 months of submittal date. Submit manufacturer's policy statement on slag use in concrete.

1.7 ENVIRONMENTAL REQUIREMENTS

Provide space ventilation according to manufacturer recommendations, at a minimum, during and following installation of concrete curing compound and sealer. Maintain one of the following ventilation conditions during the curing compound/sealer curing period or for 72 hours after installation:

- a. Supply 100 percent outside air 24 hours a day.
- b. Supply airflow at a rate of 6 air changes per hour, when outside temperatures are between 55 degrees F and 84 degrees F and humidity is between 30 percent and 60 percent.
- c. Supply airflow at a rate of 1.5 air changes per hour, when outside air conditions are not within the range stipulated above.

1.7.1 Submittals for Environmental Performance

- a. Provide data indication the percentage of post-industrial pozzolan (fly ash, blast furnace slag) cement substitution as a percentage of the full product composite by weight.

- b. Provide data indicating the percentage of post-industrial and post-consumer recycled content aggregate.
- c. Provide product data indicating the percentage of post-consumer recycled steel content in each type of steel reinforcement as a percentage of the full product composite by weight.
- d. Provide product data stating the location where all products were manufactured
- e. For projects using FSC certified formwork, provide chain-of-custody documentation for all certified wood products.
- f. For projects using reusable formwork, provide data showing how formwork is reused.
- g. Provide MSDS product information data showing that form release agents meet any environmental performance goals such as using vegetable and soy based products.
- h. Provide MSDS product information data showing that concrete adhesives meet any environmental performance goals including low emitting, low volatile organic compound products.

1.8 QUALIFICATIONS FOR CONCRETE TESTING SERVICE

Perform concrete testing by an approved laboratory and inspection service experienced in sampling and testing concrete. Testing agency must meet the requirements of [ASTM E 329](#).

1.9 QUALIFICATIONS FOR WELDING WORK

[Welding procedures](#) must be in accordance with [AWS D1.4/D1.4M](#).

Verify that [Welder qualifications](#) are in accordance with [AWS D1.4/D1.4M](#) or under an equivalent qualification test approved in advance. Welders are permitted to do only the type of welding for which each is specifically qualified.

1.10 CONCRETE SAMPLING AND TESTING

Testing by the Contractor must include sampling and testing concrete materials proposed for use in the work and testing the design mix for each class of concrete. Perform quality control testing during construction.

Sample and test concrete aggregate materials proposed for use in the work in accordance with [ASTM C 33/C 33M](#).

Sample and test portland cement in accordance with [ASTM C 150/C 150M](#).

Sample and test air-entraining admixtures in accordance with [ASTM C 233](#).

Testing must be performed by a Grade I Testing Technician.

PART 2 PRODUCTS

2.1 MATERIALS FOR FORMS

Provide wood, plywood, or steel. Use plywood or steel forms where a smooth form finish is required.

2.1.1 Wood Forms

Provide lumber that is square edged or tongue-and-groove boards, free of raised grain, knotholes, or other surface defects. Provide plywood that complies with PS1, B-B concrete form panels or better or AHA A135.4, hardboard for smooth form lining. Submit data verifying that composite wood products contain no urea formaldehyde resins.

2.1.1.1 Concrete Form Plywood (Standard Rough)

Provide plywood that conforms to NIST PS 1, B-B, concrete form, not less than 5/8-inch thick.

2.1.1.2 Overlaid Concrete Form Plywood (Standard Smooth)

Provide plywood that conforms to NIST PS 1, B-B, high density form overlay, not less than 5/8-inch thick.

2.1.2 Steel Forms

Provide steel form surfaces that do not contain irregularities, dents, or sags.

2.2 FORM TIES AND ACCESSORIES

The use of wire alone is prohibited. Provide form ties and accessories that do not reduce the effective cover of the reinforcement.

2.2.1 Polyvinylchloride Waterstops

COE CRD-C 572.

2.2.2 Dovetail Anchor Slot

Preformed metal slot approximately 1 by 1 inch of not less than 22 gage galvanized steel cast in concrete. Coordinate actual size and throat opening with dovetail anchors and provide with removable filler material.

2.3 CONCRETE

2.3.1 Contractor-Furnished Mix Design

ACI/MCP-1, ACI/MCP-2, and ACI/MCP-3 except as otherwise specified. Indicate the compressive strength (f'c) of the concrete for each portion of the structure(s) and as specified below.

Location	f'c (Min. 28- Day Comp. Strength) (psi)	ASTM C 33/C 33M Maximum Nominal Aggregate (Size No.)	Range of Slump (inches)	Maximum Water- Cement Ratio (by weight)	Air Entr. (percent)
All areas	3,000	67	4	0.45	--

Maximum slump shown above may be increased 1 inch for methods of consolidation other than vibration. Slump may be increased to 8 inches when superplasticizers are used. Provide air entrainment using air-entraining admixture. Provide air entrainment within plus or minus 1.5 percent of the value specified.

2.3.1.1 Mix Proportions for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified are the responsibility of the Contractor. Base mixture proportions on compressive strength as determined by test specimens fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M. Samples of all materials used in mixture proportioning studies must be representative of those proposed for use in the project and must be accompanied by the manufacturer's or producer's test report indicating compliance with these specifications. Base trial mixtures having proportions, consistencies, and air content suitable for the work on methodology described in ACI/MCP-1. In the trial mixture, use at least three different water-cement ratios for each type of mixture, which must produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratio required must be based on equivalent water-cement ratio calculations as determined by the conversion from the weight ratio of water to cement plus pozzolan, and ground granulated blast-furnace slag by weight equivalency method. Design laboratory trial mixture for maximum permitted slump and air content. Each combination of material proposed for use must have separate trial mixture, except for accelerator or retarder use can be provided without separate trial mixture. Report the temperature of concrete in each trial batch. For each water-cement ratio, at least three test cylinders for each test age must be made and cured in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39/C 39M for 7 and 28 days. From these results, plot a curve showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, plot a curve showing the relationship between 7 and 28 day strengths.

2.3.1.2 Required Average Strength of Mix Design

The selected mixture must produce an average compressive strength exceeding the specified strength by the amount indicated in ACI/MCP-2. When a concrete production facility has a record of at least 15 consecutive tests, the standard deviation must be calculated and the required average compressive strength must be determined in accordance with ACI/MCP-2. When a concrete production facility does not have a suitable record of tests to establish a standard deviation, the required average strength must follow ACI/MCP-2 requirements.

2.3.2 Ready-Mix Concrete

Provide concrete that meets the requirements of [ASTM C 94/C 94M](#).

Ready-mixed concrete manufacturer must provide duplicate delivery tickets with each load of concrete delivered. Provide delivery tickets with the following information in addition to that required by [ASTM C 94/C 94M](#):

Type and brand cement

Cement content in 95-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

2.3.3 Concrete Curing Materials

2.3.3.1 Absorptive Cover

Provide burlap cloth cover for curing concrete made from jute or kenaf, weighing 10 ounces plus or minus 5 percent per square yard when clean and dry, conforming to [ASTM C 171](#), Class 3; or cover may be cotton mats as approved.

2.3.3.2 Moisture-Retaining Cover

Provide waterproof paper cover for curing concrete conforming to [ASTM C 171](#), regular or white, or polyethylene sheeting conforming to [ASTM C 171](#), or polyethylene-coated burlap consisting of a laminate of burlap and a white opaque polyethylene film permanently bonded to the burlap; burlap must conform to [ASTM C 171](#), Class 3, and polyethylene film must conform to [ASTM C 171](#). When tested for water retention in accordance with [ASTM C 156](#), weight of water lost 72 hours after application of moisture retaining covering material must not exceed 0.039 gram per square centimeter of the mortar specimen surface.

2.3.3.3 Membrane-Forming Curing Compound

Provide liquid type compound conforming to [ASTM C 309](#), Type 1, clear, Type 1D with fugitive dye for interior work and Type 2, white, pigmented for exterior work.

2.4 MATERIALS

2.4.1 Cement

[ASTM C 150](#), Type I or II.

2.4.1.1 Fly Ash and Pozzolan

[ASTM C 618](#), Type N, F, or C, except that the maximum allowable loss on ignition must be 6 percent for Types N and F. Add with cement. Fly ash content must be a minimum of 25 percent by weight of cementitious material, provided the fly ash does not reduce the amount of cement in the concrete mix below the minimum requirements of local building codes. Where the use of fly ash cannot meet the minimum level, provide the maximum amount of fly

ash permissible that meets the code requirements for cement content. Report the chemical analysis of the fly ash in accordance with [ASTM C 311](#). Evaluate and classify fly ash in accordance with [ASTM D 5759](#).

High contents of supplementary cementitious materials can have some detrimental effects on the concrete properties, such as slowing excessively the strength gain rate, and delaying and increasing the difficulty of finishing. The recommended maximum content (by weight of the total cementitious material) for these materials are:

- a. For GGBF slag: 25 percent
- b. For fly ash or natural pozzolan: 25 percent (25 percent in cold climates)

2.4.1.2 Ground Granulated Blast-Furnace Slag

[ASTM C 989](#), Grade 80. Slag content must be a minimum of 25 percent by weight of cementitious material.

2.4.1.3 Portland Cement

Provide cement that conforms to [ASTM C 150/C 150M](#), Type I, IA, II, or IIA. Use one brand and type of cement for formed concrete having exposed-to-view finished surfaces.

2.4.2 Water

Minimize the amount of water in the mix. The amount of water must not exceed 45 percent by weight of cementitious materials (cement + pozzolans), and in general, improve workability by adjusting the grading rather than by adding water. Water must be fresh, clean, and potable; free from injurious amounts of oils, acids, alkalis, salts, organic materials, or other substances deleterious to concrete.

2.4.3 Aggregates

[ASTM C 33/C 33M](#), except as modified herein. Furnish aggregates for exposed concrete surfaces from one source. Provide aggregates that do not contain any substance which may be deleteriously reactive with the alkalis in the cement.

2.4.3.1 Aggregates/Combined Aggregate Gradation (Floor Slabs Only)

[ASTM C 33/C 33M](#), uniformly graded and as follows: Nominal maximum aggregate size of 1 inch. A combined sieve analysis must indicate a well graded aggregate from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 (0.3mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3mm). Provide sand that is at least 50 percent natural sand.

2.4.4 Nonshrink Grout

[ASTM C 1107/C 1107M](#).

2.4.5 Admixtures

[ASTM C 494/C 494M](#): Type A, water reducing; Type B, retarding; Type C,

accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures.

2.4.5.1 High Range Water Reducer (HRWR) (Superplasticizers)

ASTM C 494/C 494M, Type F and ASTM C 1017/C 1017M.

2.4.5.2 Pozzolan

Provide fly ash or other pozzolans used as admixtures that conform to ASTM C 618.

2.4.6 Vapor Retarder

ASTM D 4397 polyethylene sheeting, minimum 10 mil thickness.

Waterproof Paper. Kraft paper, glass reinforcing fibers and layers of polyethylene laminated under heat and pressure to form a single layer meeting the requirements of FS UU-B-790, Type I, Grade A, Style 4; or waterproof paper, regular, conforming to ASTM C 171, consisting of two sheets of kraft paper cemented together with bituminous material in which are embedded cords or strands of fiber running in both directions not more than 1 1/4 inch apart.

Consider plastic vapor retarders and adhesives with a high recycled content, low toxicity low VOC (Volatile Organic Compounds) levels.

2.4.6.1 Water-Vapor Barrier Subgrade Cover

Provide cover that is water-resistant barrier paper, uncreped and reinforced, conforming to FS UU-B-790, Type I, Grade B, Style 4; or clear polyethylene sheeting, 6-mil, conforming to ASTM D 2103 and ASTM D 4397

2.4.7 Materials for Curing Concrete

Use water-based curing compounds, sealers, and coatings with zero VOC content.

Consider the use of water based or vegetable or soy based curing agents in lieu of petroleum based products. Consider agents that are not toxic and emit low or no Volatile Organic Compounds (VOC). Consider the use of admixtures that offer high performance to increase durability of the finish product but also have low toxicity and are made from bio-based materials such as soy, and emit low levels of Volatile Organic Compounds (VOC).

2.4.7.1 Impervious Sheeting

ASTM C 171; waterproof paper, clear or white polyethylene sheeting, or polyethylene-coated burlap.

2.4.7.2 Pervious Sheeting

AASHTO M 182.

2.4.7.3 Liquid Membrane-Forming Compound

ASTM C 309, white-pigmented, Type 2, Class B.

2.4.8 Expansion/Contraction Joint Filler

ASTM D 1751, ASTM D 1752, cork or 100% post-consumer paper meeting ASTM D 1752 (subparagraphs 5.1 to 5.4). Material must be 1/2 inch thick, unless otherwise indicated.

2.4.8.1 Preformed Joint Filler Strips

Provide nonextruding and resilient nonbituminous type filler strips conforming to ASTM D 1752, Type I or II.

2.4.9 Joint Sealants

Use concrete penetrating sealers with a low (maximum 100 grams/liter, less water and less exempt compounds) VOC content.

2.4.9.1 Vertical Surfaces Greater Than 3 Percent Slope

ASTM C 920, Type M, Grade NS, Class 25, Use T.

2.4.9.2 Waterstops

Provide waterstops that are flat dumbbell type, not less than 3/16 inch for widths up to 5 inches, and not less than 3/8 inch for widths 5 inches and over.

Provide waterstops made of rubber and that conform to ASTM D 1752.

2.4.9.3 Joint Sealant Compound

Provide cold-applied, two-component, elastomeric polymer type compound conforming to FS SS-S-200.

2.4.10 Epoxy Bonding Compound

ASTM C 881/C 881M. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete. Provide Grade 1 or 2 for horizontal surfaces and Grade 3 for vertical surfaces. Provide Class A if placement temperature is below 40 degrees F; Class B if placement temperature is between 40 and 60 degrees F; or Class C if placement temperature is above 60 degrees F.

2.4.11 Biodegradable Form Release Agent

Provide form release agent that is colorless, biodegradable, and rapeseed oil-based, soy oil-based, water-based, with a zero VOC content. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent that does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene.

2.5 REINFORCEMENT

2.5.1 Reinforcing Bars

ACI/MCP-2 unless otherwise specified. Use deformed steel. ASTM A 615/A 615M and AASHTO M 322M/M 322 with the bars marked A, S, W,

Grade 60.

2.5.1.1 Weldable Reinforcing Bars

Provide weldable reinforcing bars that conform to [ASTM A 706/A 706M](#) and [ASTM A 615/A 615M](#) and Supplement S1, Grade 60, except that the maximum carbon content must be 0.55 percent.

2.5.2 Mechanical Reinforcing Bar Connectors

[ACI/MCP-2](#). Provide 125 percent minimum yield strength of the reinforcement bar.

2.5.3 Wire

[ASTM A 82/A 82M](#) or [ASTM A 496/A 496M](#).

2.5.3.1 Welded Wire Fabric

[ASTM A 185/A 185M](#) or [ASTM A 497/A 497M](#). Provide flat sheets of welded wire fabric for slabs and toppings.

2.5.3.2 Steel Wire

Wire must conform to [ASTM A 82/A 82M](#).

2.5.4 Reinforcing Bar Supports

Provide bar ties and supports of coated or non corrodible material.

2.5.5 Supports for Reinforcement

Supports include bolsters, chairs, spacers, and other devices necessary for proper spacing, supporting, and fastening reinforcing bars and wire fabric in place.

Provide wire bar type supports conforming to [ACI/MCP-3](#) and [CRSI 10MSP](#).

Legs of supports in contact with formwork must be hot-dip galvanized, or plastic coated after fabrication, or stainless-steel bar supports.

2.6 BONDING MATERIALS

2.6.1 Concrete Bonding Agent

Provide aqueous-phase, film-forming, nonoxidizing, freeze and thaw-resistant compound agent suitable for brush or spray application conforming to [ASTM C 932](#).

2.6.2 Epoxy-Resin Adhesive Binder

Provide two-component, epoxy-polysulfide polymer type binder with an amine-type curing-agent conforming to [FS MMM-A-001993](#), Type I or [ASTM C 881/C 881M](#).

2.7 CLASSIFICATION AND QUALITY OF CONCRETE

2.7.1 Concrete Classes and Usage

Provide concrete classes, compressive strength, requirements for air entrainment, and usage as follows:

<u>CONCRETE CLASS</u>	<u>MIN. 28-DAY COMPRESSIVE STRENGTH POUNDS PER SQ. IN.</u>	<u>REQUIREMENT FOR AIR ENTRAINMENT</u>	<u>USAGE</u>
3N	3,000	Nonair-entrained	For foundation concrete work not exposed to freezing and thawing or subjected to hydraulic pressure, such as footings, pile caps, foundation mats. For interior slabs on ground to be covered with resilient flooring

2.7.2 Limits for Concrete Proportions

Provide limits for maximum water/cement ratio and minimum cement content for each concrete class as follows:

<u>CONCRETE CLASS</u>	<u>MAX. WATER/CEMENT RATIO BY WEIGHT</u>	<u>MIN. CEMENT FOR 3- TO 4-INCH SLUMP, (NO. OF 94-POUND SACKS) PER CU. YD.</u>
3N	0.45	5.25

* Weight of water to weight of cement in pounds in one cubic yard of concrete

2.7.3 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, must be as follows:

<u>MAXIMUM SIZE OF AGGREGATE</u>	<u>ASTM C 33/C 33M SIZE NUMBER</u>	<u>TYPE OF CONSTRUCTION</u>
3/4 inch	67	Reinforced walls, columns, girders, beams, and other formed sections having a dimension between forms of not less than 6 inches and clear distance between reinforcing bars or reinforcing bar and face of form of not less than 1 inch

Maximum size of aggregate may be that required for most critical type of

construction using that concrete class.

2.7.4 Slump

Provide slump for concrete at time and in location of placement as follows:

<u>TYPE OF CONSTRUCTION</u>	<u>SLUMP</u>
Footings, unreinforced walls	Not less than 1 inch nor more than 3 inches
Columns, beams, reinforced walls, monolithic slabs	Not less than 1 inch nor more than 4 inches
Ramps and other sloping surfaces	0 nor more than 3 inches

PART 3 EXECUTION

3.1 EXAMINATION

Do not begin installation until substrates have been properly constructed; verify that substrates are plumb and true.

If substrate preparation is the responsibility of another installer, notify Architect/Engineer of unsatisfactory preparation before processing.

Check field dimensions before beginning installation. If dimensions vary too much from design dimensions for proper installation, notify Architect/Engineer and wait for instructions before beginning installation.

3.2 PREPARATION

Determine quantity of concrete needed and minimize the production of excess concrete. Designate locations or uses for potential excess concrete before the concrete is poured.

3.2.1 General

Surfaces against which concrete is to be placed must be free of debris, loose material, standing water, snow, ice, and other deleterious substances before start of concrete placing.

Remove standing water without washing over freshly deposited concrete. Divert flow of water through side drains provided for such purpose.

3.2.2 Subgrade Under Foundations and Footings

When subgrade material is semiporous and dry, sprinkle subgrade surface with water as required to eliminate suction at the time concrete is deposited. When subgrade material is porous, seal subgrade surface by covering surface with specified water barrier subgrade cover; this may also be used over semiporous, dry subgrade material instead of water sprinkling.

3.2.3 Subgrade Under Slabs on Ground

Before construction of slabs on ground, have underground work on pipes and conduits completed and approved.

Previously constructed subgrade or fill must be cleaned of foreign materials and inspected by the Contractor for adequate compaction and surface tolerances as specified.

Actual density of top 12 inches of subgrade soil material-in-place must not be less than the following percentages of maximum density of same soil material compacted at optimum moisture content in accordance with ASTM D 1557.

<u>SOIL MATERIAL</u>	<u>PERCENT MAXIMUM DENSITY</u>
Drainage fill	100
Cohesionless soil material	100
Cohesive soil material	95

Finish surface of drainage fill under interior slabs on ground must not show deviation in excess of 1/4 inch when tested with a 10-foot straightedge parallel with and at right angles to building lines.

Finished surface of subgrade or fill under exterior slabs on ground must not be more than 0.02-foot above or 0.10-foot below elevation indicated.

Cover drainage fill surface under interior slabs on ground with specified water-vapor barrier subgrade cover immediately prior to placing reinforcement. Install subgrade cover to avoid puncture or tear. Patch punctures or tears over 12 inches with separate sheets lapped not less than 6 inches. Seal all punctures or tears less than 12 inches with pressure-sensitive vapor barrier tape not less than 2-inches wide. Seal lapped joints with vapor barrier adhesive or pressure-sensitive vapor barrier tape not less than 2-inches wide. Lay subgrade cover sheets with not less than a 6-inch lap at edges and ends and in direction in which concrete is to be placed.

Prepare subgrade or fill surface under exterior slabs on ground as specified for subgrade under foundations and footings.

3.2.4 Formwork

Complete and approve formwork. Remove debris and foreign material from interior of forms before start of concrete placing.

3.2.5 Edge Forms and Screed Strips for Slabs

Set edge forms or bulkheads and intermediate screed strips for slabs to obtain indicated elevations and contours in finished slab surface and must be strong enough to support vibrating bridge screeds or roller pipe screeds if nature of specified slab finish requires use of such equipment. Align concrete surface to elevation of screed strips by use of strike-off templates or approved compacting-type screeds.

3.2.6 Reinforcement and Other Embedded Items

Secure reinforcement, joint materials, and other embedded materials in position, inspected, and approved before start of concrete placing.

3.3 FORMS

ACI/MCP-2. Provide forms, shoring, and scaffolding for concrete placement. Set forms mortar-tight and true to line and grade. Chamfer above grade exposed joints, edges, and external corners of concrete **0.75 inch** unless otherwise indicated. Provide formwork with clean-out openings to permit inspection and removal of debris. Forms submerged in water must be watertight.

3.3.1 General

Construct forms to conform, within the tolerances specified, to shapes dimensions, lines, elevations, and positions of cast-in-place concrete members as indicated. Forms must be supported, braced, and maintained sufficiently rigid to prevent deformation under load.

3.3.2 Design and Construction of Formwork

Provide formwork design and construction that conforms to and **ACI/MCP-2**, Chapter 4.

Provide forms that are tight to prevent leakage of cement paste during concrete placing.

Support form facing materials by structural members spaced close to prevent deflection of form facing material. Fit forms placed in successive units for continuous surfaces to accurate alignment to ensure a smooth completed surface within the tolerances specified. Where necessary to maintain the tolerances specified, such as long spans where immediate supports are not possible, camber formwork for anticipated deflections in formwork due to weight and pressure of fresh concrete and to construction loads.

Chamfer exposed joints, edges, and external corners a minimum of **3/4 inch** by moldings placed in corners of column, beam, and wall forms.

Provide shores and struts with a positive means of adjustment capable of taking up formwork settlement during concrete placing operations. Obtain adjustment with wedges or jacks or a combination thereof. When adequate foundations for shores and struts cannot be secured, provide trussed supports.

Provide temporary openings in wall forms, column forms, and at other points where necessary to permit inspection and to facilitate cleaning.

Provide forms that are readily removable without impact, shock, or damage to concrete.

3.3.3 Coating

Before concrete placement, coat the contact surfaces of forms with a nonstaining mineral oil, nonstaining form coating compound, or two coats of nitrocellulose lacquer. Do not use mineral oil on forms for surfaces to which adhesive, paint, or other finish material is to be applied.

3.3.4 Reshoring

Reshore concrete elements where forms are removed prior to the specified time period. Do not permit elements to deflect or accept loads during form stripping or reshoring. Forms on columns, walls, or other load-bearing

members may be stripped after 2 days if loads are not applied to the members. After forms are removed, reshore slabs and beams over 10 feet in span and cantilevers over 4 feet for the remainder of the specified time period in accordance with paragraph entitled "Removal of Forms." Perform reshoring operations to prevent subjecting concrete members to overloads, eccentric loading, or reverse bending. Provide reshoring elements with the same load-carrying capabilities as original shoring and spaced similar to original shoring. Firmly secure and brace reshoring elements to provide solid bearing and support.

3.3.5 Reuse

Reuse forms providing the structural integrity of concrete and the aesthetics of exposed concrete are not compromised.

3.3.6 Forms for Standard Rough Form Finish

Give rough form finish concrete formed surfaces that are to be concealed by other construction, unless otherwise specified.

Form facing material for standard rough form finish must be the specified concrete form plywood or other approved form facing material that produces concrete surfaces equivalent in smoothness and appearance to that produced by new concrete form plywood panels.

For concrete surfaces exposed only to the ground, undressed, square-edge, 1-inch nominal thickness lumber may be used. Provide horizontal joints that are level and vertical joints that are plumb.

3.3.7 Forms for Standard Smooth Form Finish

Give smooth form finish concrete formed surfaces that are to be exposed to view or that are to be covered with coating material applied directly to concrete or with covering material bonded to concrete, such as waterproofing, dampproofing, painting, or other similar coating system.

Form facing material for standard smooth finish must be the specified overlaid concrete form plywood or other approved form facing material that is nonreactive with concrete and that produce concrete surfaces equivalent in smoothness and appearance to that produced by new overlaid concrete form plywood panels.

Maximum deflection of form facing material between supports and maximum deflection of form supports such as studs and wales must not exceed 0.0025 times the span.

Provide arrangement of form facing sheets that are orderly and symmetrical, and sheets that are in sizes as large as practical.

Arrange panels to make a symmetrical pattern of joints. Horizontal and vertical joints must be solidly backed and butted tight to prevent leakage and fins.

3.3.8 Form Ties

Provide ties that are factory fabricated metal, adjustable in length, removable or snap-off type that do allow form deflection or do not spall concrete upon removal. Portion of form ties remaining within concrete after removal of exterior parts must be at least 1-1/2 inches back from

concrete surface. Provide form ties that are free of devices that leave a hole larger than 7/8 inch or less than 1/2 inch in diameter in concrete surface. Form ties fabricated at the project site or wire ties of any type are not acceptable.

3.3.9 Tolerances for Form Construction

Construct formwork to ensure that after removal of forms and prior to patching and finishing of formed surfaces, provide concrete surfaces in accordance with tolerances specified in ACI/MCP-1 and ACI/MCP-2.

3.3.10 Removal of Forms and Supports

After placing concrete, forms must remain in place for the time periods specified in ACI/MCP-4. Do not remove forms and shores (except those used for slabs on grade and slip forms) until the client determines that the concrete has gained sufficient strength to support its weight and superimposed loads. Base such determination on compliance with one of the following:

a. The plans and specifications stipulate conditions for removal of forms and shores, and such conditions have been followed, or

b. The concrete has been properly tested with an appropriate ASTM standard test method designed to indicate the concrete compressive strength, and the test results indicate that the concrete has gained sufficient strength to support its weight and superimposed loads.

Prevent concrete damage during form removal. Clean all forms immediately after removal.

3.3.10.1 Special Requirements for Reduced Time Period

Forms may be removed earlier than specified if ASTM C 39/C 39M test results of field-cured samples from a representative portion of the structure indicate that the concrete has reached a minimum of 85 percent of the design strength.

3.4 WATERSTOP SPLICES

Fusion weld in the field.

3.5 FORMED SURFACES

3.5.1 Preparation of Form Surfaces

Coat contact surfaces of forms with form-coating compound before reinforcement is placed. Provide a commercial formulation form-coating compound that does not bond with, stain, nor adversely affect concrete surfaces and impair subsequent treatment of concrete surfaces that entails bonding or adhesion nor impede wetting of surfaces to be cured with water or curing compounds. Do not allow excess form-coating compound to stand in puddles in the forms nor to come in contact with concrete against which fresh concrete is placed. Make thinning of form-coating compound with thinning agent of the type, in the amount, and under the conditions recommended by form-coating compound manufacturer's printed or written directions.

3.5.2 Tolerances

ACI/MCP-4 and as indicated.

3.5.3 As-Cast Form

Provide form facing material producing a smooth, hard, uniform texture on the concrete. Arrange facing material in an orderly and symmetrical manner and keep seams to a practical minimum. Support forms as necessary to meet required tolerances. Do not use material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which can impair the texture of the concrete surface.

3.6 PLACING REINFORCEMENT AND MISCELLANEOUS MATERIALS

ACI/MCP-2. Provide bars, wire fabric, wire ties, supports, and other devices necessary to install and secure reinforcement. Reinforcement must not have rust, scale, oil, grease, clay, or foreign substances that would reduce the bond. Rusting of reinforcement is a basis of rejection if the effective cross-sectional area or the nominal weight per unit length has been reduced. Remove loose rust prior to placing steel. Tack welding is prohibited.

3.6.1 General

Provide details of reinforcement that are in accordance with, and ACI/MCP-4 and as specified.

3.6.2 Vapor Barrier

Provide beneath the on-grade concrete floor slab. Use the greatest widths and lengths practicable to eliminate joints wherever possible. Lap joints a minimum of 12 inches and tape or cement joints. Remove torn, punctured, or damaged vapor barrier material and provide with new vapor barrier prior to placing concrete. Concrete placement must not damage vapor barrier material.

3.6.3 Reinforcement Supports

Place reinforcement and secure with galvanized or non corrodible chairs, spacers, or metal hangers. For supporting reinforcement on the ground, use concrete or other non corrodible material, having a compressive strength equal to or greater than the concrete being placed.

3.6.4 Splicing

As indicated. For splices not indicated ACI/MCP-2. Do not splice at points of maximum stress. Overlap welded wire fabric the spacing of the cross wires, plus 2 inches. AWS D1.4/D1.4M. Approve welded splices prior to use.

3.6.5 Future Bonding

Plug exposed, threaded, mechanical reinforcement bar connectors with a greased bolt. Provide bolt threads that match the connector. Countersink the connector in the concrete. Calk the depression after the bolt is installed.

3.6.6 Cover

ACI/MCP-2 for minimum coverage, unless otherwise indicated.

3.6.7 Setting Miscellaneous Material

Place and secure anchors and bolts, pipe sleeves, conduits, and other such items in position before concrete placement. Plumb anchor bolts and check location and elevation. Temporarily fill voids in sleeves with readily removable material to prevent the entry of concrete.

3.6.8 Construction Joints

Locate joints to least impair strength. Continue reinforcement across joints unless otherwise indicated.

3.6.9 Expansion Joints and Contraction Joints

Provide expansion joint at edges of interior floor slabs on grade abutting vertical surfaces, and as indicated. Make expansion joints 1/2 inch wide unless indicated otherwise. Fill expansion joints not exposed to weather with preformed joint filler material. Completely fill joints exposed to weather with joint filler material and joint sealant. Do not extend reinforcement or other embedded metal items bonded to the concrete through any expansion joint unless an expansion sleeve is used. Provide contraction joints, either formed or saw cut or cut with a jointing tool, to the indicated depth after the surface has been finished. Complete saw joints within 4 to 12 hours after concrete placement. Protect joints from intrusion of foreign matter.

3.6.10 Fabrication

Shop fabricate reinforcing bars to conform to shapes and dimensions indicated for reinforcement, and as follows:

Provide fabrication tolerances that are in accordance with ACI/MCP-1, ACI/MCP-2 and ACI/MCP-3.

Provide hooks and bends that are in accordance with and ACI/MCP-3.

Reinforcement must be bent cold to shapes as indicated. Bending must be done in the shop. Rebending of a reinforcing bar that has been bent incorrectly is not be permitted. Bending must be in accordance with standard approved practice and by approved machine methods.

Tolerance on nominally square-cut, reinforcing bar ends must be in accordance with ACI/MCP-3.

Deliver reinforcing bars bundled, tagged, and marked. Tags must be metal with bar size, length, mark, and other information pressed in by machine. Marks must correspond with those used on the placing drawings.

Do not use reinforcement that has any of the following defects:

- a. Bar lengths, depths, and bends beyond specified fabrication tolerances
- b. Bends or kinks not indicated on drawings or approved shop drawings
- c. Bars with reduced cross-section due to rusting or other cause

Replace defective reinforcement with new reinforcement having required shape, form, and cross-section area.

3.6.11 Placing Reinforcement

Place reinforcement in accordance with [ACI/MCP-4](#).

For slabs on grade (over earth or over capillary water barrier) and for footing reinforcement, support bars or welded wire fabric on precast concrete blocks, spaced at intervals required by size of reinforcement, to keep reinforcement the minimum height specified above the underside of slab or footing.

For slabs other than on grade, supports for which any portion is less than [1 inch](#) from concrete surfaces that are exposed to view or to be painted must be of precast concrete units, plastic-coated steel, or stainless steel protected bar supports. Precast concrete units must be wedge shaped, not larger than [3-1/2 by 3-1/2 inches](#), and of thickness equal to that indicated for concrete protection of reinforcement. Provide precast units that have cast-in galvanized tie wire hooked for anchorage and blend with concrete surfaces after finishing is completed.

Contractor must cooperate with other trades in setting of anchor bolts, inserts, and other embedded items. Where conflicts occur between locating reinforcing and embedded items, the Contractor must notify the Contracting Officer so that conflicts may be reconciled before placing concrete. Anchors and embedded items must be positioned and supported with appropriate accessories.

Provide reinforcement that is supported and secured together to prevent displacement by construction loads or by placing of wet concrete, and as follows:

Provide supports for reinforcing bars that are sufficient in number and sufficiently heavy to carry the reinforcement they support, and in accordance with [ACI/MCP-4](#) and [CRSI 10MSP](#). Do not use supports to support runways for concrete conveying equipment and similar construction loads.

Equip supports on ground and similar surfaces with sand-plates.

Support welded wire fabric as required for reinforcing bars.

Secure reinforcements to supports by means of tie wire. Wire must be black, soft iron wire, not less than [16 gage](#).

With the exception of temperature reinforcement, tied to main steel approximately [24 inches](#) on center, reinforcement must be accurately placed, securely tied at intersections with [18-gage](#) annealed wire, and held in position during placing of concrete by spacers, chairs, or other approved supports. Point wire-tie ends away from the form. Unless otherwise indicated, numbers, type, and spacing of supports must conform to [ACI/MCP-3](#).

Bending of reinforcing bars partially embedded in concrete is permitted only as specified in [and ACI/MCP-4](#).

3.6.12 Spacing of Reinforcing Bars

Spacing must be as indicated. If not indicated, spacing must be in accordance with the [ACI/MCP-3](#).

Reinforcing bars may be relocated to avoid interference with other reinforcement, or with conduit, pipe, or other embedded items. If any reinforcing bar is moved a distance exceeding one bar diameter or specified placing tolerance, resulting rearrangement of reinforcement is subject to approval.

3.6.13 Concrete Protection for Reinforcement

Concrete protection must be in accordance with the [ACI/MCP-4](#), [ASTM E 648](#), and [ACI/MCP-3](#).

3.6.14 Welding

Welding must be in accordance with [AWS D1.4/D1.4M](#).

3.7 BATCHING, MEASURING, MIXING, AND TRANSPORTING CONCRETE

[ASTM C 94/C 94M](#), and [ACI/MCP-2](#), except as modified herein. Batching equipment must be such that the concrete ingredients are consistently measured within the following tolerances: 1 percent for cement and water, 2 percent for aggregate, and 3 percent for admixtures. Furnish mandatory batch ticket information for each load of ready mix concrete.

3.7.1 Measuring

Make measurements at intervals as specified in paragraphs entitled "Sampling" and "Testing."

3.7.2 Mixing

[ASTM C 94/C 94M](#) and [ACI/MCP-2](#). Machine mix concrete. Begin mixing within 30 minutes after the cement has been added to the aggregates. Place concrete within 90 minutes of either addition of mixing water to cement and aggregates or addition of cement to aggregates if the air temperature is less than 84 degrees F. Reduce mixing time and place concrete within 60 minutes if the air temperature is greater than 84 degrees F except as follows: if set retarding admixture is used and slump requirements can be met, limit for placing concrete may remain at 90 minutes. Additional water may be added, provided that both the specified maximum slump and water-cement ratio are not exceeded. When additional water is added, an additional 30 revolutions of the mixer at mixing speed is required. Dissolve admixtures in the mixing water and mix in the drum to uniformly distribute the admixture throughout the batch.

3.7.3 Transporting

Transport concrete from the mixer to the forms as rapidly as practicable. Prevent segregation or loss of ingredients. Clean transporting equipment thoroughly before each batch. Do not use aluminum pipe or chutes. Remove concrete which has segregated in transporting and dispose of as directed.

3.8 PLACING CONCRETE

Place concrete as soon as practicable after the forms and the reinforcement

have been inspected and approved. Do not place concrete when weather conditions prevent proper placement and consolidation; in uncovered areas during periods of precipitation; or in standing water. Prior to placing concrete, remove dirt, construction debris, water, snow, and ice from within the forms. Deposit concrete as close as practicable to the final position in the forms. Do not exceed a free vertical drop of 3 feet from the point of discharge. Place concrete in one continuous operation from one end of the structure towards the other. Position grade stakes on 10 foot centers maximum in each direction when pouring interior slabs and on 20 foot centers maximum for exterior slabs.

3.8.1 General Placing Requirements

Deposit concrete continuously or in layers of such thickness that no concrete is placed on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If a section cannot be placed continuously, provide construction joints as specified. Perform concrete placing at such a rate that concrete which is being integrated with fresh concrete is still plastic. Deposit concrete as nearly as practical in its final position to avoid segregation due to rehandling or flowing. Do not subject concrete to procedures which cause segregation.

Concrete to receive other construction must be screeded to proper level to avoid excessive skimming or grouting.

Do not use concrete which becomes nonplastic and unworkable or does not meet quality control limits as specified or has been contaminated by foreign materials. Use of retempered concrete is permitted. Remove rejected concrete from the site.

3.8.2 Footing Placement

Concrete for footings may be placed in excavations without forms upon inspection and approval by the Contracting Officer. Excavation width must be a minimum of 4 inches greater than indicated.

3.8.3 Vibration

ACI/MCP-2. Furnish a spare, working, vibrator on the job site whenever concrete is placed. Consolidate concrete slabs greater than 4 inches in depth with high frequency mechanical vibrating equipment supplemented by hand spading and tamping. Consolidate concrete slabs 4 inches or less in depth by wood tampers, spading, and settling with a heavy leveling straightedge. Operate internal vibrators with vibratory element submerged in the concrete, with a minimum frequency of not less than 6000 impulses per minute when submerged. Do not use vibrators to transport the concrete in the forms. Insert and withdraw vibrators approximately 20 inches apart. Penetrate the previously placed lift with the vibrator when more than one lift is required. Place concrete in 20 inch maximum vertical lifts. Use external vibrators on the exterior surface of the forms when internal vibrators do not provide adequate consolidation of the concrete.

3.8.4 Application of Epoxy Bonding Compound

Apply a thin coat of compound to dry, clean surfaces. Scrub compound into the surface with a stiff-bristle brush. Place concrete while compound is stringy. Do not permit compound to harden prior to concrete placement. Follow manufacturer's instructions regarding safety and health precautions

when working with epoxy resins.

3.8.5 Pumping

ACI/MCP-2. Pumping must not result in separation or loss of materials nor cause interruptions sufficient to permit loss of plasticity between successive increments. Loss of slump in pumping equipment must not exceed **2 inches**. Do not convey concrete through pipe made of aluminum or aluminum alloy. Avoid rapid changes in pipe sizes. Limit maximum size of course aggregate to 33 percent of the diameter of the pipe. Limit maximum size of well rounded aggregate to 40 percent of the pipe diameter. Take samples for testing at both the point of delivery to the pump and at the discharge end.

3.8.6 Cold Weather

ACI/MCP-2. Do not allow concrete temperature to decrease below **50 degrees F**. Obtain approval prior to placing concrete when the ambient temperature is below **40 degrees F** or when concrete is likely to be subjected to freezing temperatures within 24 hours. Cover concrete and provide sufficient heat to maintain **50 degrees F** minimum adjacent to both the formwork and the structure while curing. Limit the rate of cooling to **37 degrees F** in any 1 hour and **50 degrees F** per 24 hours after heat application.

3.8.7 Hot Weather

Maintain required concrete temperature using Figure 2.1.5 in **ACI/MCP-2** to prevent the evaporation rate from exceeding **0.2 pound of water per square foot** of exposed concrete per hour. Cool ingredients before mixing or use other suitable means to control concrete temperature and prevent rapid drying of newly placed concrete. Shade the fresh concrete as soon as possible after placing. Start curing when the surface of the fresh concrete is sufficiently hard to permit curing without damage. Provide water hoses, pipes, spraying equipment, and water hauling equipment, where job site is remote to water source, to maintain a moist concrete surface throughout the curing period. Provide burlap cover or other suitable, permeable material with fog spray or continuous wetting of the concrete when weather conditions prevent the use of either liquid membrane curing compound or impervious sheets. For vertical surfaces, protect forms from direct sunlight and add water to top of structure once concrete is set.

3.8.8 Follow-up

Check concrete within 24 hours of placement for flatness, levelness, and other specified tolerances. Adjust formwork and placement techniques on subsequent pours to achieve specified tolerances.

3.8.9 Placing Concrete in Forms

Deposit concrete placed in forms in horizontal layers not exceeding **24 inches**.

Remove temporary spreaders in forms when concrete placing has reached elevation of spreaders.

Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping. Design vibrators to operate with vibratory element submerged in concrete and maintain a speed of not less than 9,000 impulses per minute when submerged in concrete.

Provide vibrating equipment adequate in number of units and power of each unit to properly consolidate concrete. Vibration of forms and reinforcement is not be permitted. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced points not farther apart than visible effectiveness of machine. Do not insert vibrator into lower courses of concrete that have begun to set. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of concrete mix.

Do not start placing of concrete in supporting elements until concrete previously placed in columns and walls is no longer plastic and has been in place a minimum of 2 hours.

3.8.10 Placing Concrete Slabs

Place and consolidate concrete for slabs in a continuous operation, within the limits of approved construction joints until placing of panel or section is completed.

During concrete placing operations, consolidate concrete by mechanical vibrating equipment so that concrete is worked around reinforcement and other embedded items and into corners. Consolidate concrete placed in beams and girders of supported slabs and against bulkheads of slabs on ground by mechanical vibrators as specified. Consolidate concrete in remainder of slabs by vibrating bridge screeds, roller pipe screeds, or other approved method. Limit consolidation operations to time necessary to obtain consolidation of concrete without bringing an excess of fine aggregate to the surface. Concrete to be consolidated must be as dry as practical and surfaces thereof must not be manipulated prior to finishing operations. Bring concrete correct level with a straightedge and struck-off. Use bull floats or darbies to smooth surface, leaving it free of humps or hollows. Sprinkling of water on plastic surface is not permitted.

Provide finish of slabs as specified.

3.8.11 Bonding

Surfaces of set concrete at joints, except where bonding is obtained by use of concrete bonding agent, must be roughened and cleaned of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner that exposes the aggregate uniformly and does not leave laitance, loosened particles of aggregate, nor damaged concrete at the surface.

Obtain bonding of fresh concrete that has set as follows:

At joints between footings and walls or columns, between walls or columns and the beams or slabs they support, and elsewhere unless otherwise specified; roughened and cleaned surface of set concrete must be dampened, but not saturated, immediately prior to placing of fresh concrete.

At joints in exposed-to-view work; at vertical joints in walls; at joints near midpoint of span in girders, beams, supported slabs, other structural members; in work designed to contain liquids; the roughened and cleaned surface of set concrete must be dampened but not saturated and covered with a cement grout coating.

Provide cement grout that consists of equal parts of portland cement and fine aggregate by weight with not more than 6 gallons of water per sack of cement. Apply cement grout with a stiff broom or brush to a minimum thickness of 1/16 inch. Deposit fresh concrete before cement grout has attained its initial set.

Bonding of fresh concrete to concrete that has set may be obtained by use of a concrete bonding agent. Apply such bonding material to cleaned concrete surface in accordance with approved printed instructions of bonding material manufacturer.

3.9 SURFACE FINISHES EXCEPT FLOOR, SLAB, AND PAVEMENT FINISHES

3.9.1 Defects

Repair formed surfaces by removing minor honeycombs, pits greater than 1 square inch surface area or 0.25 inch maximum depth, or otherwise defective areas. Provide edges perpendicular to the surface and patch with nonshrink grout. Patch tie holes and defects when the forms are removed. Concrete with extensive honeycomb including exposed steel reinforcement, cold joints, entrapped debris, separated aggregate, or other defects which affect the serviceability or structural strength will be rejected, unless correction of defects is approved. Obtain approval of corrective action prior to repair. The surface of the concrete must not vary more than the allowable tolerances of ACI/MCP-4. Exposed surfaces must be uniform in appearance and finished to a smooth form finish unless otherwise specified.

3.9.2 Not Against Forms (Top of Walls)

Surfaces not otherwise specified must be finished with wood floats to even surfaces. Finish must match adjacent finishes.

3.9.3 Formed Surfaces

3.9.3.1 Tolerances

ACI/MCP-1 and as indicated.

3.9.3.2 As-Cast Rough Form

Provide for surfaces not exposed to public view. Patch these holes and defects and level abrupt irregularities. Remove or rub off fins and other projections exceeding 0.25 inch in height.

3.9.3.3 Standard Smooth Finish

Finish must be as-cast concrete surface as obtained with form facing material for standard smooth finish. Repair and patch defective areas as specified; and all fins and remove other projections on surface.

3.10 FLOOR, SLAB, AND PAVEMENT FINISHES AND MISCELLANEOUS CONSTRUCTION

ACI/MCP-2, unless otherwise specified. Slope floors uniformly to drains where drains are provided. Where straightedge measurements are specified, Contractor must provide straightedge.

3.10.1 Finish

Place, consolidate, and immediately strike off concrete to obtain proper

contour, grade, and elevation before bleedwater appears. Permit concrete to attain a set sufficient for floating and supporting the weight of the finisher and equipment. If bleedwater is present prior to floating the surface, drag the excess water off or remove by absorption with porous materials. Do not use dry cement to absorb bleedwater.

3.10.1.1 Floated

Use for exterior slabs where not otherwise specified. After the concrete has been placed, consolidated, struck off, and leveled, do not work the concrete further, until ready for floating. Whether floating with a wood, magnesium, or composite hand float, with a bladed power trowel equipped with float shoes, or with a powered disc, float must begin when the surface has stiffened sufficiently to permit the operation. During or after the first floating, check surface with a 10 foot straightedge applied at no less than two different angles, one of which is perpendicular to the direction of strike off. Cut down high spots and fill low spots during this procedure to produce a surface level within 1/4 inch in 10 feet.

3.10.1.2 Broomed

Use on surfaces of exterior walks, platforms, patios, and ramps, unless otherwise indicated. Perform a floated finish, then draw a broom or burlap belt across the surface to produce a coarse scored texture. Permit surface to harden sufficiently to retain the scoring or ridges. Broom transverse to traffic or at right angles to the slope of the slab.

3.10.1.3 Pavement

Screed the concrete with a template advanced with a combined longitudinal and crosswise motion. Maintain a slight surplus of concrete ahead of the template. After screeding, float the concrete longitudinally. Use a straightedge to check slope and flatness; correct and refloat as necessary. Obtain final finish by belting. Lay belt flat on the concrete surface and advance with a sawing motion; continue until a uniform but gritty nonslip surface is obtained.

3.10.2 Concrete Walks

Provide 4 inches thick minimum. Provide contraction joints spaced every 5 linear feet unless otherwise indicated. Cut contraction joints one inch deep with a jointing tool after the surface has been finished. Provide 0.5 inch thick transverse expansion joints at changes in direction where sidewalk abuts curb, steps, rigid pavement, or other similar structures; space expansion joints every 50 feet maximum. Give walks a broomed finish. Unless indicated otherwise, provide a transverse slope of 1/48. Limit variation in cross section to 1/4 inch in 5 feet.

3.10.3 Pits and Trenches

Place bottoms and walls monolithically or provide waterstops and keys.

3.10.4 Curbs

Provide contraction joints spaced every 10 feet maximum unless otherwise indicated. Cut contraction joints 3/4 inch deep with a jointing tool after the surface has been finished. Provide expansion joints 1/2 inch thick and spaced every 100 feet maximum unless otherwise indicated. Perform pavement finish.

3.10.5 Splash Blocks

Provide at outlets of downspouts emptying at grade. Splash blocks may be precast concrete, and must be 24 inches long, 12 inches wide, and 4 inches thick, unless otherwise indicated, with smooth-finished countersunk dishes sloped to drain away from the building.

3.11 CURING AND PROTECTION

ACI/MCP-2 unless otherwise specified. Begin curing immediately following form removal. Avoid damage to concrete from vibration created by blasting, pile driving, movement of equipment in the vicinity, disturbance of formwork or protruding reinforcement, and any other activity resulting in ground vibrations. Protect concrete from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks, and oil stains. Do not allow concrete to dry out from time of placement until the expiration of the specified curing period. Do not use membrane-forming compound on surfaces where appearance would be objectionable, on any surface to be painted, where coverings are to be bonded to the concrete, or on concrete to which other concrete is to be bonded. If forms are removed prior to the expiration of the curing period, provide another curing procedure specified herein for the remaining portion of the curing period. Allow curing compound/sealer installations to cure prior to the installation of materials that adsorb VOCs.

3.11.1 General

Protect freshly placed concrete from premature drying and cold or hot temperature and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of cement and proper hardening of concrete.

Start initial curing as soon as free water has disappeared from surface of concrete after placing and finishing. Keep concrete moist for minimum 72 hours.

Final curing must immediately follow initial curing and before concrete has dried. Continue final curing until cumulative number of hours or fraction thereof (not necessarily consecutive) during which temperature of air in contact with the concrete is above 50 degrees F has totaled 168 hours. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, final curing may be terminated when the average compressive strength has reached 70 percent of the 28-day design compressive strength. Prevent rapid drying at end of final curing period.

3.11.2 Moist Curing

Remove water without erosion or damage to the structure. Prevent water run-off.

3.11.2.1 Ponding or Immersion

Continually immerse the concrete throughout the curing period. Water must not be more than 50 degrees F less than the temperature of the concrete. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.11.2.2 Fog Spraying or Sprinkling

Apply water uniformly and continuously throughout the curing period. For temperatures between 40 and 50 degrees F, increase the curing period by 50 percent.

3.11.2.3 Pervious Sheeting

Completely cover surface and edges of the concrete with two thicknesses of wet sheeting. Overlap sheeting 6 inches over adjacent sheeting. Provide sheeting that is at least as long as the width of the surface to be cured. During application, do not drag the sheeting over the finished concrete nor over sheeting already placed. Wet sheeting thoroughly and keep continuously wet throughout the curing period.

3.11.2.4 Impervious Sheeting

Wet the entire exposed surface of the concrete thoroughly with a fine spray of water and cover with impervious sheeting throughout the curing period. Lay sheeting directly on the concrete surface and overlap edges 12 inches minimum. Provide sheeting not less than 18 inches wider than the concrete surface to be cured. Secure edges and transverse laps to form closed joints. Repair torn or damaged sheeting or provide new sheeting. Cover or wrap columns, walls, and other vertical structural elements from the top down with impervious sheeting; overlap and continuously tape sheeting joints; and introduce sufficient water to soak the entire surface prior to completely enclosing.

3.11.3 Liquid Membrane-Forming Curing Compound

Seal or cover joint openings prior to application of curing compound. Prevent curing compound from entering the joint. Apply in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. Provide and maintain compound on the concrete surface throughout the curing period. Do not use this method of curing where the use of Figure 2.1.5 in ACI/MCP-2 indicates that hot weather conditions cause an evaporation rate exceeding 0.2 pound of water per square foot per hour.

3.11.3.1 Application

Unless the manufacturer recommends otherwise, apply compound immediately after the surface loses its water sheen and has a dull appearance, and before joints are sawed. Mechanically agitate curing compound thoroughly during use. Use approved power-spraying equipment to uniformly apply two coats of compound in a continuous operation. The total coverage for the two coats must be 200 square feet maximum per gallon of undiluted compound unless otherwise recommended by the manufacturer's written instructions. The compound must form a uniform, continuous, coherent film that does not check, crack, or peel. Immediately apply an additional coat of compound to areas where the film is defective. Re-spray concrete surfaces subjected to rainfall within 3 hours after the curing compound application.

3.11.3.2 Protection of Treated Surfaces

Prohibit pedestrian and vehicular traffic and other sources of abrasion at least 72 hours after compound application. Maintain continuity of the coating for the entire curing period and immediately repair any damage.

3.11.4 Curing Periods

ACI/MCP-2 except 10 days for retaining walls, pavement or chimneys, 21 days for concrete that is in full-time or intermittent contact with seawater, salt spray, alkali soil or waters. Begin curing immediately after placement. Protect concrete from premature drying, excessively hot temperatures, and mechanical injury; and maintain minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing are subject to approval by the Contracting Officer.

3.11.5 Curing Methods

Accomplish curing by moist curing, by moisture-retaining cover curing, by membrane curing, and by combinations thereof, as specified.

Moist curing:

Accomplish moisture curing by any of the following methods:

Keeping surface of concrete wet by covering with water

Continuous water spraying

Covering concrete surface with specified absorptive cover for curing concrete saturated with water and keeping absorptive cover wet by water spraying or intermittent hosing. Place absorptive cover to provide coverage of concrete surfaces and edges with a slight overlap over adjacent absorptive covers.

Moisture-cover curing:

Accomplish moisture-retaining cover curing by covering concrete surfaces with specified moisture-retaining cover for curing concrete. Place cover directly on concrete in widest practical width, with sides and ends lapped at least 3 inches. Weight cover to prevent displacement; immediately repair tears or holes appearing during curing period by patching with pressure-sensitive, waterproof tape or other approved method.

Membrane curing:

Accomplish membrane curing by applying specified membrane-forming curing compound to damp concrete surfaces as soon as moisture film has disappeared. Apply curing compound uniformly in a two-coat operation by power-spraying equipment using a spray nozzle equipped with a wind guard. Apply second coat in a direction at right angles to direction of first coat. Total coverage for two coats must be not more than 200 square feet per gallon of curing compound. Respray concrete surfaces which are subjected to heavy rainfall within 3 hours after curing compound has been applied by method and at rate specified. Maintain continuity of coating for entire curing period and immediately repair damage to coating during this period.

Membrane-curing compounds must not be used on surfaces that are to be covered with coating material applied directly to concrete or with a covering material bonded to concrete, such as other concrete, liquid floor hardener, waterproofing, dampproofing, membrane roofing, painting, and other coatings and finish materials.

3.11.6 Curing Formed Surfaces

Accomplish curing of formed surfaces, including undersurfaces of girders, beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed before end of curing period, accomplish final curing of formed surfaces by any of the curing methods specified above, as applicable.

3.11.7 Curing Unformed Surfaces

Accomplish initial curing of unformed surfaces, such as monolithic slabs, floor topping, and other flat surfaces, by membrane curing.

Unless otherwise specified, accomplish final curing of unformed surfaces by any of curing methods specified above, as applicable.

Accomplish final curing of concrete surfaces to receive liquid floor hardener of finish flooring by moisture-retaining cover curing.

3.11.8 Temperature of Concrete During Curing

When temperature of atmosphere is 41 degrees F and below, maintain temperature of concrete at not less than 55 degrees F throughout concrete curing period or 45 degrees F when the curing period is measured by maturity. When necessary, make arrangements before start of concrete placing for heating, covering, insulation, or housing as required to maintain specified temperature and moisture conditions for concrete during curing period.

When the temperature of atmosphere is 80 degrees F and above or during other climatic conditions which cause too rapid drying of concrete, make arrangements before start of concrete placing for installation of wind breaks, of shading, and for fog spraying, wet sprinkling, or moisture-retaining covering of light color as required to protect concrete during curing period.

Changes in temperature of concrete must be uniform and not exceed 37 degrees F in any 1 hour nor 80 degrees F in any 24-hour period.

3.11.9 Protection from Mechanical Injury

During curing period, protect concrete from damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration and from damage caused by rain or running water.

3.11.10 Protection After Curing

Protect finished concrete surfaces from damage by construction operations.

3.12 FIELD QUALITY CONTROL

3.12.1 Sampling

ASTM C 172. Collect samples of fresh concrete to perform tests specified. ASTM C 31/C 31M for making test specimens.

3.12.2 Testing

3.12.2.1 Slump Tests

ASTM C 143/C 143M. Take concrete samples during concrete placement. The maximum slump may be increased as specified with the addition of an approved admixture provided that the water-cement ratio is not exceeded. Perform tests at commencement of concrete placement, when test cylinders are made, and for each batch (minimum) or every 20 cubic yards (maximum) of concrete.

3.12.2.2 Temperature Tests

Test the concrete delivered and the concrete in the forms. Perform tests in hot or cold weather conditions (below 50 degrees F and above 80 degrees F) for each batch (minimum) or every 20 cubic yards (maximum) of concrete, until the specified temperature is obtained, and whenever test cylinders and slump tests are made.

3.12.2.3 Compressive Strength Tests

ASTM C 39/C 39M. Make five test cylinders for each set of tests in accordance with **ASTM C 31/C 31M.** Take precautions to prevent evaporation and loss of water from the specimen. Test two cylinders at 7 days, two cylinders at 28 days, and hold one cylinder in reserve. Take samples for strength tests of each mix design of and for each concrete placed each day not less than once a day, nor less than once for each 50 cubic yards of concrete, nor less than once for each 5400 square feet of surface area for slabs or walls. For the entire project, take no less than five sets of samples and perform strength tests for each mix design of concrete placed. Each strength test result must be the average of two cylinders from the same concrete sample tested at 28 days. If the average of any three consecutive strength test results is less than f'c or if any strength test result falls below f'c by more than 450 psi, take a minimum of three **ASTM C 42/C 42M** core samples from the in-place work represented by the low test cylinder results and test. Concrete represented by core test is considered structurally adequate if the average of three cores is equal to at least 85 percent of f'c and if no single core is less than 75 percent of f'c. Retest locations represented by erratic core strengths. Remove concrete not meeting strength criteria and provide new acceptable concrete. Repair core holes with nonshrink grout. Match color and finish of adjacent concrete.

3.12.2.4 Strength of Concrete Structure

Compliance with the following is considered deficient if it fails to meet the requirements which control strength of structure in place, including following conditions:

Failure to meet compressive strength tests as evaluated

Reinforcement not conforming to requirements specified

Concrete which differs from required dimensions or location in such a manner as to reduce strength

Concrete curing and protection of concrete against extremes of temperature during curing, not conforming to requirements specified

Concrete subjected to damaging mechanical disturbances, particularly load stresses, heavy shock, and excessive vibration

Poor workmanship likely to result in deficient strength

3.12.2.5 Testing Concrete Structure for Strength

When there is evidence that strength of concrete structure in place does not meet specification requirements, make cores drilled from hardened concrete for compressive strength determination in accordance with **ASTM C 42/C 42M**, and as follows:

Take at least three representative cores from each member or area of concrete-in-place that is considered potentially deficient. Location of cores will be determined by the Contracting Officer.

Test cores after moisture conditioning in accordance with **ASTM C 42/C 42M** if concrete they represent is more than superficially wet under service.

Air dry cores, (60 to 80 degrees F with relative humidity less than 60 percent) for 7 days before test and test dry if concrete they represent is dry under service conditions.

Strength of cores from each member or area are considered satisfactory if their average is equal to or greater than 85 percent of the 28-day design compressive strength of the class of concrete.

Core specimens will be taken and tested by the Government. If the results of core-boring tests indicate that the concrete as placed does not conform to the drawings and specification, the cost of such tests and restoration required must be borne by the Contractor.

Fill core holes solid with patching mortar and finished to match adjacent concrete surfaces.

Correct concrete work that is found inadequate by core tests in a manner approved by the Contracting Officer.

3.13 WASTE MANAGEMENT

As specified in the Waste Management Plan and as follows.

3.13.1 Mixing Equipment

Before concrete pours, designate Company-owned site meeting environmental standards for cleaning out concrete mixing trucks. Minimize water used to wash equipment.

3.13.2 Reinforcing Steel

Collect reinforcing steel and place in designated area for recycling.

3.13.3 Other Waste

Identify concrete manufacturer's or supplier's policy for collection or return of construction waste, unused material, deconstruction waste, and/or packaging material. Return excess cement to supplier. Institute deconstruction and construction waste separation and recycling for use in

manufacturer's programs. When such a program is not available, seek local recyclers to reclaim the materials.

3.14 JOINTS

3.14.1 Construction Joints

Make and locate joints not indicated so as not to impair strength and appearance of the structure, as approved. Locate construction joints as follows:

- a. In walls at not more than 60 feet in any horizontal direction; at top of footing; at top of slabs on ground; at top and bottom of door and window openings or where required to conform to architectural details; and at underside of deepest beam or girder framing into wall
- b. In columns or piers, at top of footing; at top of slabs on ground; and at underside of deepest beam or girder framing into column or pier
- c. Near midpoint of spans for supported slabs, beams, and girders unless a beam intersects a girder at the center, in which case construction joints in girder must offset a distance equal to twice the width of the beam. Make transfer of shear through construction joint by use of inclined reinforcement.
- d. In slabs on ground, so as to divide slab into areas not in excess of 1,200 square feet

Provide keyways at least 1-1/2-inches deep in construction joints in walls and slabs and between walls and footings; approved bulkheads may be used for slabs.

Joints must be perpendicular to main reinforcement. Reinforcement must be continued across construction joints.

3.14.2 Waterstops

Provide waterstops in construction joints as indicated.

Install waterstops to form a continuous diaphragm in each joint. Make adequate provisions to support and protect waterstops during progress of work. Make field joints in waterstops in accordance with waterstop manufacturer's printed instructions, as approved. Protect waterstops protruding from joints from damage.

3.14.3 Isolation Joints in Slabs on Ground

Provide joints at points of contact between slabs on ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

Fill joints with premolded joint filler strips 1/2 inch thick, extending full slab depth. Install filler strips at proper level below finish floor elevation with a slightly tapered, dress-and-oiled wood strip temporarily secured to top of filler strip to form a groove not less than 3/4 inch in depth where joint is sealed with sealing compound and not less than 1/4 inch in depth where joint sealing is not required. Remove wood strip after concrete has set. Contractor must clean groove of foreign matter and loose particles after surface has dried.

3.14.4 Control Joints in Slabs on Ground

Provide joints to form panels as indicated.

Under and on exact line of each control joint, cut 50 percent of welded wire fabric reinforcement before placing concrete.

Joints must be 1/8-inch wide by 1/5 to 1/4 of slab depth and formed by inserting hand-pressed fiberboard strip into fresh concrete until top surface of strip is flush with slab surface or by cutting the concrete with a saw after the concrete has set. After concrete has cured for at least 7 days, the Contractor must remove inserts and clean groove of foreign matter and loose particles.

3.14.5 Sealing Joints in Slabs on Ground

Isolation and control joints which are to receive finish flooring material must be sealed with joint sealing compound after concrete curing period. Slightly underfill groove with joint sealing compound to prevent extrusion of compound. Remove excess material as soon after sealing as possible.

Sealing is not required for isolation and control joints to be covered with finish flooring material. Groove must be left ready to receive filling material that is provided as part of finish floor covering work.

3.15 INSTALLATION OF ANCHORAGE DEVICES

3.15.1 General

Anchorage devices and embedded items required for other work that is attached to, or supported by, set and build in cast-in-place concrete as part of the work of this section, using setting drawings, instructions, and directions for work to be attached thereto.

3.15.2 Placing Anchorage Devices

Anchorage devices and embedded items must be positioned accurately and supported against displacement. Fill openings in anchorage devices such as slots and threaded holes with an approved, removable material to prevent entry of concrete into openings.

3.16 CONCRETE CONVEYING

3.16.1 Transfer of Concrete At Project Site

Handle concrete from point of delivery and transfer to concrete conveying equipment and to locations of final deposit as rapidly as practical by methods which prevent segregation and loss of concrete mix materials.

3.16.2 Mechanical Equipment for Conveying Concrete

Equipment must ensure a continuous flow of concrete at delivery end, as approved. Provide runways for wheeled concrete-conveying equipment from concrete delivery point to locations of final deposit. Interior surfaces of concrete conveying equipment must be free of hardened concrete, debris, water, snow, ice, and other deleterious substances.

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STRUCTURAL STEEL

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.

THE ALUMINUM ASSOCIATION (AA)

AA ADM-105 (2010) Aluminum Design Manual

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325 (2005) Steel Construction Manual

AISC 326 (2009) Detailing for Steel Construction

ANSI/AISC 341 (2005; Suppl No. 1 2005) Seismic Provisions for Structural Steel Buildings

ANSI/AISC 360 (2005) Specification for Structural Steel Buildings, with Commentary

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (2010) Minimum Design Loads for Buildings and Other Structures

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4 (2007) Standard Symbols for Welding, Brazing and Nondestructive Examination

AWS D1.1/D1.1M (2008; Errata 2008) Structural Welding Code - Steel

AWS D1.2/D1.2M (2008) Structural Welding Code - Aluminum

ASME INTERNATIONAL (ASME)

ASME B46.1 (2002) Surface Texture, Surface Roughness, Waviness and Lay

ASME BPVC SEC IX (2010) BPVC Section IX - Welding and Brazing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM A 108 (2007) Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

ASTM A 123/A 123M	(2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 143/A 143M	(2007) Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
ASTM A 153/A 153M	(2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 242/A 242M	(2004; R 2009) Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A 276	(2008a) Standard Specification for Stainless Steel Bars and Shapes
ASTM A 307	(2007b) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 325	(2009) Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(2009a) Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)
ASTM A 36/A 36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A 490	(2009) Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
ASTM A 490M	(2009a) Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 500/A 500M	(2009) Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(2007) Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 563	(2007a) Standard Specification for Carbon and Alloy Steel Nuts

ASTM A 563M	(2007) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A 6/A 6M	(2009) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 780/A 780M	(2009) Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
ASTM A 992/A 992M	(2006a) Standard Specification for Structural Steel Shapes
ASTM C 1107/C 1107M	(2008) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 827	(2001a; R 2005) Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
ASTM F 1554	(2007a) Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ASTM F 436	(2009) Hardened Steel Washers
ASTM F 436M	(2009) Hardened Steel Washers (Metric)
ASTM F 844	(2007a) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959	(2009) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
ASTM F 959M	(2007) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners (Metric)

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC PA 1	(2000; E 2004) Shop, Field, and Maintenance Painting of Steel
SSPC PS 13.01	(1982; E 2004) Epoxy Polyamide Painting System
SSPC Paint 25	(1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II
SSPC SP 3	(1982; E 2004) Power Tool Cleaning
SSPC SP 6/NACE No.3	(2007) Commercial Blast Cleaning

1.2 SYSTEM DESCRIPTION

Provide the structural steel system, including galvanizing, complete and

ready for use. Structural steel systems including design, materials, installation, workmanship, fabrication, assembly, erection, inspection, quality control, and testing shall be provided in accordance with ANSI/AISC 360 and ANSI/AISC 341 except as modified in this contract.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Erection Plan, including description of temporary supports; G

Fabrication drawings including description of connections; G

Detail drawings; G

SD-03 Product Data

Shop primer

Welding electrodes and rods

Welding of structural steel; G

Welding of aluminum; G

Non-Shrink Grout

Material lists; G

Structural steel welding repairs; G

Supply the certified manufacturer's mill reports which clearly show the applicable ASTM mechanical and chemical requirements for the supplied fasteners.

SD-06 Test Reports

Test, inspections, and verifications

Bolts, nuts, and washers

SD-07 Certificates

Steel

Bolts, nuts, and washers

Galvanizing

Welding procedures and qualifications

1.4 SEISMIC PROVISIONS

The structural steel system shall be provided in accordance with [ASCE 7](#).

1.5 QUALITY ASSURANCE

1.5.1 Drawing Requirements

Submit [fabrication drawings](#) for approval prior to fabrication. Prepare in accordance with [AISC 326](#) and [AISC 325](#). Fabrication drawings shall not be reproductions of contract drawings. Sign and seal fabrication drawings by a professional engineer registered in the State where the project is located. Include complete information for the fabrication and erection of the structure's components, including the location, type, and size of bolts, welds, member sizes and lengths, connection details, blocks, copes, and cuts. Double connections that require an erection seat to comply with OSHA 1926.756(c)(1) shall be shown on the shop drawings, reviewed and approved by the structural engineer of record. Use [AWS A2.4](#) standard welding symbols. Shoring and temporary bracing shall be designed and sealed by a registered professional engineer and submitted for record purposes, with calculations, as part of the drawings. Member substitutions of details shown on the contract drawings shall be clearly highlighted on the fabrication drawings. Explain the reasons for any deviations from the contract drawings.

1.5.2 Certifications

1.5.2.1 [Welding Procedures and Qualifications](#)

Prior to welding, submit certification for each welder stating the type of welding and positions qualified for, the code and procedure qualified under, date qualified, and the firm and individual certifying the qualification testing accordance with the requirements of [AWS D1.1/D1.1M](#), Section 4, or [ASME BPVC SEC IX](#), Section IX.

- a. List the qualified welders by name and specify the code and procedures under which qualified and the date of qualification within the certification. Prior qualification will be accepted if welders have performed satisfactory work under the code for which qualified within the preceding three months. Welders are required to repeat the qualifying tests when their work indicates a reasonable doubt as to proficiency. Those passing the requalification tests will be recertified. Those not passing will be disqualified until passing. The Contractor incurs all expenses in connection with qualification and requalification.
- b. Perform welding of aluminum conforming to [AA ADM-105](#) or [AWS D1.2/D1.2M](#), Sections 1 through 7, 9 and 10. The welding process and welding operators shall be prequalified as required by [AWS D1.2/D1.2M](#), Section 5 or [AA ADM-105](#), Subsection 7.2.4 in accordance with the methods described in [ASME BPVC SEC IX](#), Section IX. Furnish for approval a certified report giving the results of the qualifying tests, and a complete schedule of the welding process for each aluminum fabrication to be welded prior to commencing fabrication prior to commencing welding.
- c. Maintain an approved inspection system and perform required inspections in accordance with Contract Clause CONTRACTOR INSPECTION SYSTEM. Welding will be subjected to inspection to determine conformance with

the requirements of [AWS D1.1/D1.1M](#), the approved welding procedures and provisions stated in other sections of these specifications.

PART 2 PRODUCTS

2.1 STEEL

2.1.1 Structural Steel

[ASTM A 36/A 36M](#).

2.1.2 High-Strength Structural Steel

2.1.2.1 Low-Alloy Steel

[ASTM A 992/A 992M](#).

2.1.3 Structural Steel Tubing

[ASTM A 500/A 500M](#), Grade B.

2.1.4 Steel Pipe

[ASTM A 53/A 53M](#), Type E or S, Grade B.

2.2 BOLTS, NUTS, AND WASHERS

Provide the following unless indicated otherwise.

2.2.1 Structural Steel

2.2.1.1 Bolts

[ASTM A 307](#), Grade A; [ASTM A 325/ASTM A 325M](#), Type 1. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturer's identification mark, the strength grade and type specified by ASTM specifications. Maximum hardness of galvanized [ASTM A 325](#) bolts not to exceed Rockwell C-32.

2.2.1.2 Nuts

[ASTM A 563](#), Grade and Style for applicable ASTM bolt standard recommended.

2.2.1.3 Washers

[ASTM F 844](#) washers for [ASTM A 307](#) bolts, and [ASTM F 436/ASTM F 436M](#) washers for [ASTM A 325/ASTM A 325M](#).

2.2.2 High-Strength Structural Steel and Structural Steel Tubing

2.2.2.1 Bolts

[ASTM A 325](#), Type 1, maximum hardness of galvanized bolts not to exceed Rockwell C-32.

2.2.2.2 Nuts

[ASTM A 563](#), Grade and Style as specified in the applicable ASTM bolt standard.

2.2.2.3 Washers

ASTM F 436, plain carbon steel.

2.2.3 Weathering Structural Steel

2.2.3.1 Bolts

ASTM A 325, Type 3; ASTM A 490, Type 3.

2.2.3.2 Nuts

ASTM A 563, heavy hex style, Grade DH3, except Grade C3 may be furnished for ASTM A 325 bolts.

2.2.3.3 Washers

ASTM F 436, weathering steel.

2.2.4 Foundation Anchorage

2.2.4.1 Anchor Bolts

ASTM F 1554.

2.2.4.2 Anchor Nuts

ASTM A 563, Grade A, hex style.

2.2.4.3 Anchor Washers

ASTM F 844.

2.2.4.4 Anchor Plate Washers

ASTM A 36/A 36M.

2.3 STRUCTURAL STEEL ACCESSORIES

2.3.1 Welding Electrodes and Rods

AWS D1.1/D1.1M.

2.3.2 Non-Shrink Grout

ASTM C 1107/C 1107M, with no ASTM C 827 shrinkage. Grout shall be nonmetallic.

2.3.3 Welded Shear Stud Connectors

AWS D1.1/D1.1M.

2.4 SHOP PRIMER

SSPC Paint 25, (alkyd primer) or SSPC PS 13.01 epoxy-polyamide, green primer (Form 150) type 1, except provide a Class B coating in accordance with AISC 325 for slip critical joints. Primer shall conform to Federal, State, and local VOC regulations. If flash rusting occurs, re-clean the

surface prior to application of primer.

2.5 GALVANIZING

ASTM A 123/A 123M or ASTM A 153/A 153M, as applicable, unless specified otherwise galvanize after fabrication where practicable.

2.6 FABRICATION

2.6.1 Markings

Prior to erection, members shall be identified by a painted erection mark. Connecting parts assembled in the shop for reaming holes in field connections shall be match marked with scratch and notch marks. Do not locate erection markings on areas to be welded or on surfaces of weathering steels that will be exposed in the completed structure. Do not locate match markings in areas that will decrease member strength or cause stress concentrations. Affix embossed tags to hot-dipped galvanized members.

2.6.2 Shop Primer

Shop prime structural steel, except as modified herein, in accordance with SSPC PA 1. Do not prime steel surfaces embedded in concrete, galvanized surfaces, or surfaces within 0.5 inch of the toe of the welds prior to welding (except surfaces on which metal decking is to be welded). Slip critical surfaces shall be primed with a Class B coating. Prior to assembly, prime surfaces which will be concealed or inaccessible after assembly. Do not apply primer in foggy or rainy weather; when the ambient temperature is below 45 degrees F or over 95 degrees F; or when the primer may be exposed to temperatures below 40 degrees F within 48 hours after application, unless approved otherwise by the Contracting Officer.

2.6.2.1 Cleaning

SSPC SP 6/NACE No.3, except steel exposed in spaces above ceilings, attic spaces, furred spaces, and chases that will be hidden to view in finished construction may be cleaned to SSPC SP 3 when recommended by the shop primer manufacturer. Maintain steel surfaces free from rust, dirt, oil, grease, and other contaminants through final assembly.

2.6.2.2 Primer

Apply primer to a minimum dry film thickness of 2.0 mil except provide the Class B coating for slip critical joints in accordance with the coating manufacturer's recommendations. Repair damaged primed surfaces with an additional coat of primer.

2.7 DRAINAGE HOLES

Adequate drainage holes shall be drilled to eliminate water traps. Hole diameter shall be 1/2 inch and location shall be indicated on the detail drawings. Hole size and location shall not affect the structural integrity.

2.8 MATERIALS

2.8.1 Materials List

Submit a list of the materials to be used in the fabrication of each item at the time of submittal of detail drawings.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of **AISC 325**. Fabrication and assembly shall be done in the shop to the greatest extent possible.

Compression joints depending on contact bearing shall have a surface roughness not in excess of **500 micro inch** as determined by **ASME B46.1**, and ends shall be square within the tolerances for milled ends specified in **ASTM A 6/A 6M**.

Shop splices of members between field splices will be permitted only where indicated on the Contract Drawings. Splices not indicated require the approval of the Contracting Officer.

3.2 ERECTION

Provide for drainage in structural steel. After final positioning of steel members, provide full bearing under base plates and bearing plates using nonshrink grout. Place nonshrink grout in accordance with the manufacturer's instructions.

3.2.1 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

3.3 CONNECTIONS

Except as modified in this section, connections not detailed shall be designed in accordance with **ANSI/AISC 360**. Build connections into existing work. Do not tighten anchor bolts set in concrete with impact torque wrenches. Punch, subpunch and ream, or drill bolt holes perpendicular to the surface of the member. Holes shall not be cut or enlarged by burning. Bolts, nuts, and washers shall be clean of dirt and rust, and lubricated immediately prior to installation.

3.3.1 Common Grade Bolts

ASTM A 307 bolts shall be tightened to a "snug tight" fit. "Snug tight" is the tightness that exists when plies in a joint are in firm contact. If firm contact of joint plies cannot be obtained with a few impacts of an impact wrench, or the full effort of a man using a spud wrench, contact the Contracting Officer for further instructions.

3.3.2 High-Strength Bolts

ASTM A 325 bolts shall be fully tensioned to 70 percent of their minimum tensile strength. Bolts shall be installed in connection holes and initially brought to a snug tight fit. After the initial tightening procedure, bolts shall then be fully tensioned, progressing from the most rigid part of a connection to the free edges.

3.4 GAS CUTTING

Use of gas-cutting torch in the field for correcting fabrication errors

will not be permitted on any major member in the structural framing. Use of a gas cutting torch will be permitted on minor members not under stress only after approval has been obtained from the Contracting Officer.

3.5 WELDING

AWS D1.1/D1.1M. Provide **AWS D1.1/D1.1M** qualified welders, welding operators, and tackers.

The Contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval.

3.6 SHOP PRIMER REPAIR

Repair shop primer in accordance with the paint manufacturer's recommendation for surfaces damaged by handling, transporting, cutting, welding, or bolting.

3.6.1 Field Priming

Field priming of steel exposed to the weather, or located in building areas without HVAC for control of relative humidity. After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

3.7 GALVANIZING REPAIR

Provide as indicated or specified. Galvanize after fabrication where practicable. Repair damage to galvanized coatings using **ASTM A 780/A 780M** zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.8 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment, and incidentals required for testing. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts, and washers within 7 working days of the date of weld inspection.

3.8.1 Welds

3.8.1.1 Visual Inspection

AWS D1.1/D1.1M. Furnish the services of AWS-certified welding inspectors for fabrication and erection inspection and testing and verification inspections. Welding inspectors shall visually inspect and mark welds, including fillet weld end returns.

3.8.1.2 Nondestructive Testing

The welding is subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop do not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification

requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment. Submit all records of nondestructive examination in accordance with paragraph "Acceptance Requirements".

AWS D1.1/D1.1M. Test locations shall be selected by the Contracting Officer. If more than 20 percent of welds made by a welder contain defects identified by testing, then all welds made by that welder shall be tested by radiographic or ultrasonic testing, as approved by the Contracting Officer. When all welds made by an individual welder are required to be tested, magnetic particle testing shall be used only in areas inaccessible to either radiographic or ultrasonic testing. Retest defective areas after repair.

3.8.2 High-Strength Bolts

3.8.2.1 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested. Retest new bolts after installation.

3.8.3 Testing for Embrittlement

ASTM A 143/A 143M for steel products hot-dip galvanized after fabrication.

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DIVISION 15 -

SECTION 15 00 00

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- 3.3 CUTTING AND PATCHING
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SECTION 15 00 00

GENERAL MECHANICAL

PART 1 GENERAL

1.1 SUMMARY

This section specifies requirements for general mechanical construction work.

1.2 REFERENCES

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A13.1 Scheme for the Identification of Piping Systems

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM B 766 Electrodeposited Coatings of Cadmium

FEDERAL SPECIFICATIONS (FS)

FF QQ-P-416 Plating, Cadmium (Electrodeposited)

CALIFORNIA CODE OF REGULATIONS (CCR)

CCR Title 24 Section 6 Energy Efficiency Standards for Residential and Nonresidential Buildings

CALIFORNIA BUILDING STANDARDS COMMISSION

CPC California Plumbing Code

CMC California Mechanical Code

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 Minimum Design Loads for Buildings and Other Structures

1.3 QUALITY ASSURANCE

- a. Where materials and equipment are specified to conform to standards of Underwriters Laboratories, UL label or listing will be acceptable as sufficient evidence that items conform to Underwriters Laboratories requirements. Instead 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 items have been tested and that units conform to specified

requirements, and outlining methods of testing used.

- b. Where materials or equipment are specified to be constructed or tested, or both, in accordance with standards of American Society for Testing and Materials (ASTM), American Society of Mechanical Engineers (ASME), or other standards, a manufacturer's certificate of compliance of each item, or published catalog data certifying compliance, will be acceptable as proof of compliance.
- c. Conformance to such agency requirements does not relieve the Contractor from ensuring that items comply with other requirements of these specifications.
- d. Mechanical work shall comply with **CPC**, **CMC**, and **CCR Title 24 Section 6**.

1.4 MECHANICAL SYSTEMS IDENTIFICATION

- a. Diagrams - Provide a diagram and listing of equipment for each mechanical system at the domestic water pump and fire pump station. List equipment by design drawing designation, manufacturer, model, and capacities such as flow rates, pressure and temperature differences, heating and cooling capacities, kilowatt rating, pipe sizes, and voltage and current characteristics. Diagrams - Provide neat mechanical drawings, minimum **8½ inches x 11 inches**, with extruded aluminum frames and **0.112 inch** acrylic plastic protection. Locate as directed by COTR.
- b. Identification Tags - Install identification tags of brass or aluminum indicating function of a valve, control or similar component on such system devices. Tags: **2 inch** diameter, stamped marking, wired to valve or equipment items with 12 ga stainless steel wire.
- c. Service Labeling in accordance with **ASME A13.1**. In addition:
 - 1. Label exposed piping, including pipe concealed in accessible spaces and insulated, bare, and painted pipe designating service and flow direction. Separately identify similar services with different temperatures or pressures. Where system pressure may exceed 145 psi (gage), include this pressure in label. Provide labels for the following:
 - a. At each point of entry and exit of pipe passing through walls
 - b. At each change in direction, i.e., elbows, tees
 - c. In congested or hidden areas and at access panels at each point required to clarify service or indicated hazard.
 - d. In long straight runs; locate labels at distances within eyesight of each other but maximum **74 feet** on center.
 - 2. Label lettering: 2 inches high. Where pipes, bare or insulated, are **2½ inches** outside diameter or less, attach labels on 16 ga. aluminum sheet to pipe with 12 ga. stainless steel wire. Ensure that labels are visible from primary service and operating area.
- d. Equipment Identification Plates
 - 1. Provide standard manufacturer's identification plates for each

piece of equipment.

2. In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates designate function of equipment. Submit designation with shop drawings.
- e. Color Coding. The following colors shall be used in painting (color coding) of mechanical systems, piping, and equipment. Exact shades shall match existing colors and shades as designated by the Government.

<u>Description</u>	<u>Color</u>
Make-up water	blue
SVS pipe	gray
Compressed air	light blue-green
Fire protection systems	red
Cooling tower piping	light blue
Water	Green

Color coding (painting) of outside surface of piping insulation, lagging, or jacketing is not required. All components and piping shall be labeled with equipment/piping function and direction of flow, self-stick-on labeling. Labeling shall be at each point of entry and exit of piping through walls, at each change in direction in congested or hidden areas, and at all access panels to clarify service or indicated hazard. Labels shall be located at distances within eyesight of each other, which shall not exceed 20 ft. All labels shall be visible and legible from primary service and operating areas.

1.5 COORDINATION

Coordinate work of different trades so that interferences between piping, equipment, Ductwork, structural, and electrical work are avoided. Furnish offsets in piping and fittings complete in place.

1.6 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS

- a. Design drawings are diagrammatic and do not show all offsets, bends, elbows, or other specific elements that may be required for proper installation of Work. Provide additional bends, offsets, and pipe required by vertical and horizontal equipment, fixture locations, or other job conditions to complete Work at no additional cost to the Government.
- b. Provide, and keep up-to-date, a complete record set of drawings showing every change in red from original specifications and drawings; obtain prints from COTR; keep this set of prints on Worksite, and use only as a record set. Record set will be retained by the Government.

1.7 PREVENTION OF CORROSION

- a. Protect metallic materials against corrosion. Give equipment enclosures rust-inhibiting treatment, and provide standard finish.
- b. Do not use aluminum in contact with earth. Protect aluminum where connected to dissimilar metals by approved fittings, barrier material, or treatment.
- c. Ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps,

fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of stainless steel or nonferrous materials - Hot-dip galvanized in accordance with [ASTM A 123](#) for exterior locations, and cadmium-plated in accordance with [ASTM B 766](#) or [FS QQ-P-416](#) for interior locations.

1.8 MEASUREMENTS AND MEASUREMENT DATA

When measurements or surveys are required by a contract clause, the contractor shall furnish to the government the following information concerning the equipment used to make the specified measurements.

- a. Test Equipment - List of all test equipment used, including manufacturer, model number, serial number, calibration date, certificate of calibration, and special personnel qualifications required.
- b. Equivalency - If the contractor uses an equivalent test or procedure to meet the requirements of the contract specification, the contractor shall provide to the government proof of equivalency.

PART 2 PRODUCTS

2.1 ANCHORAGE

- a. Ensure that seismic anchorage of piping and equipment conforms to California Building Code, 2007 and [ASCE 7](#).
- b. Where anchorage details are not indicated, field installation is subject to approval by COTR.
- c. Proof load tests for expansion type or adhesive type anchor bolts loaded in pullout or shear.
 1. Ensure that bolts have ICBO approval.
 2. Test 50 percent of bolts (alternate bolts in any ground arrangement) in tension to twice allowable tensile load.

2.2 FINISHES

Provide factory-finished equipment. Methods and materials for any field retouching are subject to approval by the COTR.

PART 3 EXECUTION

3.1 INSTALLATION

- a. Install materials and equipment as indicated and in accordance with manufacturer's approved recommendations, International Conference of Building Officials (ICBO) Uniform Mechanical Code, Uniform Plumbing Code, and Uniform Building Code, whichever is more stringent. Perform installation so that there is no degradation of designated fire ratings of walls, partitions, ceilings, and floors. Except as otherwise indicated, install emergency switches and alarms in conspicuous locations.
- b. No installation shall be permitted which blocks or otherwise impedes access to any existing machine or system. All hinged doors shall swing

open a minimum of 120 degrees. The area in front of all access doors shall be clear a minimum of 3 feet. The area in front of all access doors to electrical circuits shall be clear the minimum distance to energized circuits as specified in OSHA Standards, part 1910.333 (Electrical-Safety Related work practices) and an additional 3 feet.

- c. Except as otherwise indicated, emergency switches and alarms shall be installed in conspicuous locations. All indicators to include gauges, meters, and alarms shall be mounted in order to be easily visible by people in the area.

3.2 EQUIPMENT PADS

Provide equipment pads where indicated and of sizes indicated or, if not indicated, of sizes conforming to shape of each piece of equipment served with a minimum 3 in. margin around equipment and supports.

3.3 CUTTING AND PATCHING

Install Work so as to require a minimum of cutting and patching of building structure. Holes in exposed locations, in or through existing floors and walls - Drill and smooth by sanding. Use a jackhammer only where specifically approved by COTR.

3.4 CLEANING

- a. Thoroughly clean exposed surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within building structure.
- b. Before final acceptance, ensure that mechanical equipment including piping, ducting, and fixtures, is clean and free from dirt, grease, and finger marks.

-- End of Section --

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DIVISION 15 -

SECTION 15 05 00

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SECTION 15 05 00

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.1 SUMMARY

This section specifies standard basic mechanical work in the domestic pump station.

1.2 REFERENCES

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC S328 Specification for Structural Steel Buildings - Load and Resistance Factor Design

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B40.1 Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.19.2M Vitreous China Plumbing Fixtures

ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings

ASME B16.25 Buttwelding Ends

ASME B31.3 (2008) Process Piping

ASME-17 Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A6M General Requirements for Rolled Structural Bars, Plates, Shapes, and Sheet Piling

ASTM A126 Gray Iron Castings for Valves, Flanges, and Pipe Fittings

ASTM A278M Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 662°F

ASTM A312M Seamless and Welded Austenitic Stainless Steel Pipes

ASTM A563M Carbon and Alloy Steel Nuts

ASTM B62 Composition Bronze or Ounce Metal Castings

ASTM B370	Copper Sheet and Strip for Building Construction
ASTM B749	Lead and Lead Alloy Strip, Sheet, and Plate Products
ASTM C67	Sampling and Testing Brick and Structural Clay Tile
ASTM C109	Compressive Strength of Hydraulic Cement Mortars (Using 2-inch Cube Specimens)
ASTM C190	Tensile Strength of Hydraulic Cement Mortars
ASTM C404	Aggregates for Masonry Grout
ASTM C476	Grout for Masonry
ASTM C920	Elastomeric Joint Sealants
ASTM E1	ASTM Thermometers
ASTM F104	Standard Classification System for Nonmetallic Gasket Materials
ASTM F568	Carbon and Alloy Steel Externally Threaded Metric Fasteners
AMERICAN WELDING SOCIETY (AWS)	
AWS WHB-2	Welding Handbook, Volume 2
FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)	
FM P7825	Approval Guide
FEDERAL SPECIFICATIONS (FS)	
FS FF-S-325	Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)
FS HH-I-558	Insulation, Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering, Thermal (Thermal Fiber, Industrial Type)
MILITARY SPECIFICATIONS (MS)	
MS MIL-C-18480	Coating Compound, Bituminous, Solvent, Coal-Tar Base
MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)	
MSS SP-58	Pipe Hangers and Supports - Materials, Design and Manufacture

MSS SP-67	Butterfly Valves
MSS SP-69	Pipe Hangers and Supports - Selection and Application
MSS SP-70	Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-72	Ball Valves with Flanged or Butt-Welding Ends for General Service

AMERICAN BEARING MANUFACTURERS ASSOCIATION (AFBMA)

AFBMA 9	Load Ratings and Fatigue Life for Ball Bearings
AFBMA 11	Load Ratings and Fatigue Life for Roller Bearings

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI	Designation of Stainless Steel Types
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HYDRAULIC INSTITUTE (HI)

HI 3.1-3.5	Rotodynamic (Centrifugal) Pump Nomenclature, Design, Installation, Operation and Maintenance
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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 5199	Technical Specificaitons for Centrifugal Pumps - Class 2
ISO 2858	End-Suction Centrifugal Pumps
ISO 1940-1	Mechanical Vibration

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG-1	Motors and Generators
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1.3 GENERAL REQUIREMENTS

Section 15 00 00, GENERAL MECHANICAL, applies to work specified in this section.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00, SUBMITTAL PROCEDURES:

SD-01 Schedules

Material, Equipment, and Fixture Lists shall be submitted for pipes, valves, and specialties including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information. A complete list of construction equipment to be used shall be

provided.

SD-02 Drawings

Coordination Drawings shall be submitted for pipes, valves, and specialties showing the physical layout of all components and coordination of work between different trades and with the structural and architectural elements of work. Drawings shall be in sufficient detail to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Drawings shall indicate where conflicts or clearance problems exist between various trades.

SD-02 Drawings

As-Built Drawings shall be submitted for pipes, valves, and accessories providing current factual information including deviations and amendments to the drawings, and concealed and visible changes in the work.

SD-03 Data

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

1. Pipe and fittings
2. Piping specialties
3. Valves
4. Miscellaneous materials
5. Supporting elements
6. Spare parts
7. Pumps
8. Compressors
9. Fans
10. Motors
11. Instrumentation and gauges

SD-05 Data

Equipment Foundation Data for Piping Systems shall include plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

SD-06 Test Reports

Test Reports on the following tests shall be submitted for pipes, valves, and specialties.

1. Hydrostatic tests
2. Valve-operating tests
3. Drainage tests
4. Non-destructive electric tests
5. System operation tests

SD-10 Operation and Maintenance Manuals

Operation and Maintenance Manuals shall be consistent with

manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions. Test data shall be legible and of good quality.

PART 2 PRODUCTS

2.1 PIPING SPECIALTIES

2.1.1 Flexible Metallic Pipe

- a. Flexible pipe shall be the bellows-type and shall be designed, constructed, and rated in accordance with [ASME B31.3](#).
- b. Working pressure minimum rating shall be [100 psi](#) at [300°F](#).
- c. Minimum burst pressure shall be four times working pressure at [300°F](#). Bellows material shall be [AISI 300](#) series corrosion-resistant steel. Braid shall be [AISI 300](#) series corrosion-resistant steel wire.
- d. Threaded end connections shall be hex-collared Schedule 40, [AISI 300](#) series corrosion-resistant steel conforming to [ASTM A312M](#).
- e. Flanged end connection rating and materials shall conform to specifications for system primary-pressure rating and if we use steel, it shall be 316 stainless steel.

2.1.2 Pressure Gages

- a. Pressure gages shall conform to [ANSI B40.1](#) and to requirements specified herein. Pressure gages shall be Type I, (for air, steam, and water) Class 1 (pressure). Pressure-gage size shall be [3½ inch](#) nominal diameter. Case shall be corrosion-resistant steel, conforming to any of the [AISI 300](#) series of [ASTM A6M](#), with an ASM No.4 standard commercial polish or better. Gages shall be equipped with adjustable red marking pointer and damper-screw adjustment in inlet connection. Service-pressure reading shall be at midpoint of gage range. Gages shall be equipped with gage isolators. Gages shall be in English units.

2.1.3 Sight-Flow Indicators

Sight-flow indicators for pressure service on [3 inches](#) and smaller shall be constructed of bronze with specially treated single- or double-glass sight windows and shall have a bronze, nylon, or tetrafluoroethylene rotating flow indicator mounted on an [AISI Type 304](#) corrosion-resistant steel shaft. Body may have screwed or flanged end. Assembly shall be pressure- and temperature-rated for the applied service. Flapper flow-type indicators are not acceptable.

2.1.4 Thermometers

Thermometers shall conform to [ASTM E1](#). Thermometers shall be industrial pattern Type I, except red organic-liquid-filled, Class 3 (well-threaded and seal-welded). Thermometers installed [6 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 indicated and shall be in English units. Thermometers shall be provided with nonferrous separable wells.

2.1.5 Line Strainers, Water Service

- a. Strainers shall be Y-type with removable basket. Strainers in sizes 2 inches and smaller shall have screwed ends. In sizes 2½ inches and larger, strainers shall have flanged ends. Body working-pressure rating shall exceed maximum service pressure of system in which installed by at least 50 percent. Body shall have cast-in arrows to indicate direction of flow. Strainer bodies fitted with screwed screen retainers shall have straight threads and shall be gasketed with nonferrous metal. Strainer bodies 2½ inches and larger fitted with bolted-on screen retainers shall have offset blowdown holes. Strainers larger than 2½ inches shall be fitted with manufacturer's standard ball-type blowdown valve. Body material shall be cast bronze conforming to ASTM B62. Where system material is nonferrous, metal strainer body material shall be nonferrous metal.
- b. Minimum free-hole area of strainer element shall be not less than 3.4 times the internal area of connecting piping. Strainer screens shall have perforations not exceeding 0.045 inch. Strainer screens shall have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material shall be AISI Type 304 corrosion-resistant steel.

2.2 VALVES

- a. Ball and Butterfly Valves
 1. Ball valves shall conform to MSS SP-72. Valves shall be rated for service at not less than 176 psi at 200°F. Valve bodies in sizes 2 inches and smaller shall be screwed-end connection type constructed of Class A copper alloy. Valve bodies in sizes 2½ inches and larger shall be flanged-end connection type. Balls and stems of valves 2 inches and smaller shall be manufacturer's standard with hard chrome plating finish. Balls and stems of valves 2½ inches and larger shall be manufacturer's standard Class C corrosion-resistant steel alloy with hard chrome plating. Balls of valves 6 inches and larger may be Class D with 900 Brinell hard chrome plating. Valves shall be suitable for flow from either direction, and shall seal equally tight in either direction. Valves with ball seals held in place by spring washers are not acceptable. Valves shall have adjustable packing glands. Seats and seals shall be tetrafluoroethylene.
 2. Butterfly valves shall conform to MSS SP-67. Valves shall be wafer type for mounting between specified flanges, and shall be rated for 150 psi shutoff and nonshock working pressure. Bodies shall be cast ferrous metal conforming to ASTM A126, Class B, and to ASME B16.1 for body wall thickness. Seats and seals shall be of the resilient elastomer type designed for field removal and replacement.
- b. Drain, Vent, and Gage Cocks
 1. Drain, vent, and gage cocks shall be lever handle, ground key type, with washer and screw, constructed of polished ASTM B62 bronze, and rated 125 psi wsp. End connections shall be rated for specified service.
 2. Pump vent cocks, and where spray control is required, shall be UL

umbrella-hood type, constructed of manufacturer's standard polished brass. Cocks shall be 0.590 inch male, end threaded, and rated at not less than 125 psi at 225°F.

c. Gate Valves (GAV)

1. Gate valves 2½ inches and larger shall be Type I, (wedge disk, tapered seats, steam rated); Class I (125 psi steam-working pressure at 352°F saturation); and Class 125, wog (nonshock), conforming to MSS SP-70 and to requirements specified herein. Valves shall be flanged, with bronze trim and outside screw and yoke (OS&Y) construction. Packing shall be made of non-asbestos type materials.

d. Standard Check Valves (SCV)

1. Standard check valves in sizes 2 inches and smaller shall be 200 psi swing check valves conforming to MSS SP-72, except as otherwise specified. Lift checks (lift check horizontal) and 200 psi, conforming to MSS SP-72, shall be provided where indicated. Swing-check pins shall be nonferrous and suitably hard for the service. Discs shall be composition type. Swing-check angle of closure shall be manufacturer's standard unless a specific angle is needed.
2. Check valves in sizes 2½ inches and larger shall be cast iron, bronze trim, swing type. Valve bodies shall be cast iron, conforming to ASTM A126, Class A. Valve ends shall be flanged in conformance with ASME B16.1. Swing-check pin shall be AISI Type 304 or approved equal corrosion-resistant steel. Angle of closure shall be manufacturer's standard unless a specific angle is needed. Valves shall have bolted and gasketed covers.

Horizontal swing check valves shall meet or exceed the requirements of AWWA Standard C508 and valve water working pressure rating is 200 psi.

e. Nonslam Check Valves (NSV)

1. 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.
2. Valve shall be rated for 200 psi maximum nonshock pressure at 151°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 A278M, Class 40 or equivalent strength ductile iron. Disks shall be corrosion-resistant steel. Pins, springs, and miscellaneous trim shall be manufacturer's standard corrosion-resistant steel. Disk and shaft seals shall be Buna-N elastomer tetrafluoroethylene.

2.3 PUMPS

- a. The contractor shall provide to the government the following information on all pumps supplied under the contract:

" Number of pump stages

- " Number of pump vanes per stage
 - " Number of gear teeth for each pump gear
 - " Type of impeller or gear(s)
 - " Rotating speed
 - " Number of volutes
 - " Number of diffuser vanes
- b. General Pump Requirements - This specification includes design, construction, installation, and performance features of centrifugal pumps. Pumps shall conform to **HI 3.1-3.5**, **ISO 5199** and **ISO 2858** standards for centrifugal pumps, and to requirements specified herein. Pumps shall conform to performance criteria as shown on the drawings and or the equipment schedule.
- c. Pump Balancing - Pump impeller assemblies shall be statically and dynamically balanced to **ISO 1940-1** G2.5. Correction planes needed for additional weight mass for balancing shall be determined by using a calibrated and certified balancing machine capable of identifying the magnitude and angular position of any unbalance of the impeller.
- d. Pump Bearings and Lubrication
1. Bearings shall be heavy-duty ball or roller type and shall have an L-10 rated life of not less than 20,000 hours in accordance with **AFBMA 9** or **AFBMA 11**.
- e. Pump Protection - Before any pump is operated, sumps and piping systems shall be cleaned and flushed to remove all particles larger than **0.04 inch** or larger than one-half of the smallest pump axial or radial clearance, whichever is smaller. Permanent and temporary pipeline strainers shall be in place and shall be cleaned frequently to prevent cavitation. Temporary strainers shall not be removed until after system acceptance, unless otherwise approved.
- f. Pump Alignment - Before attempting alignment, the contractor shall demonstrate that the load does not have any load/force imposed by the piping system. Minimum alignment values (below) are for pump and driver at normal running temperatures. Value must be compensated for thermal growth. Limited movement of the pump and driver (commonly known as bolt-bound) must be corrected to ensure alignment capabilities. Hold down bolts shall not be undercut in order to perform adjustments.
1. Shims shall be commercially die-cut, without seams or folds and be made of corrosion resistant stainless steel. No more than three shims shall be used at any single point.
 2. Units with drive motors over 15 hp shall have alignment jack bolts installed.

TABLE 1. Coupled Shaft Alignment Tolerance Values

Soft Foot:

<u>Motor Speed (RPM)</u>	<u>Maximum Movement</u>
All	<0.0508 mm at each foot

For short couplings:

Motor Speed (RPM)	Parallel Off set	Angularity (in./10 in.)
<1000	0.005 in.	0.015 in.
1200	0.004 in.	0.010 in.
1800	0.003 in.	0.005 in.
3600	0.002 in.	0.003 in.
7200	0.010 in.	0.002 in.

g. Vibration Analyzer

1. The contractor shall use an FFT analyzer to measure vibration levels. It shall have the following characteristics: dynamic range greater than 72db; a minimum of 400 line resolution; a frequency response range of 5Hz-10KHz (300 - 600000 cpm); the capacity to perform ensemble averaging; the capability to use Hanning window; auto-ranging frequency amplitude; a minimum amplitude accuracy over the selected frequency range of + or - 20% or = or - 1.5dB.
2. An accelerometer , either stud-mounted or mounted using a rare earth, low mass magnet and sound disk (or finished surface) shall be used with the FFT analyzer to collect data. The mass of the accelerometer and its mounting shall have minimal influence on the frequency response of the system over the selected measurement range.

h. Vibration Data

1. Vibration data shall be collected in the axial, vertical, and horizontal direction for each pump bearing.

TABLE ## MAXIMUM ALLOWABLE VIBRATION LEVELS FOR POSITIVE DISPLACEMENT AND CENTRIFUGAL PUMPS

BAND	LINE-AMPLITUDE BAND LIMITS	
	FREQUENCY RANGE (CPM)	VELOCITY (INCH/SEC - PEAK)
1	0.3 x RPM	0.04
	0.8 x RPM	
2	0.8 x RPM	0.075
	1.2 x RPM	
3	1.2 x RPM	0.04
	3.5 x RPM	
4	3.5 x RPM	0.03
	120,000 CPM	

2.4 MOTORS

- a. The contractor shall provide to the government the following information on all electric motors rated over 7.5 hp and those specified to meet a special vibration class in accordance with NEMA MG-1.

- " Motor type
- " Bearing information
- " Resistance

- " Winding Inductance
 - " Cooling fan blades
 - " Number of rotors
 - " Number of rotor bars
 - " Number of stator slots
 - " SCR firing sequence
- b. Factory Test - Electrical tests shall consist of winding resistance, insulation resistance, and high potential tests. Certified copies of Factory test results shall be submitted to the government for approval prior to shipment from factory. Previous test reports on identical motors are not acceptable for these tests.
- c. Equipment
1. Design, fabrication, testing and performance of motors shall be in accordance with NEMA MG-1 and ISO 1940-1.
 2. Motors shall conform to performance criteria as shown on the drawings and or the equipment schedule.
 3. Allowable balance limits shall be in accordance with ISO 1940/1.
 4. Motors shall have factory-sealed ball bearings with an L-10 rated life of not less than (80,000) hours in accordance with AFBMA 9 or AFBMA11. Motors with weatherproof/waterproof enclosures shall have permanent accelerometers installed in the horizontal, vertical and axial directions. The enclosure shall have a penetration installed to enable the accelerometer cables to be routed to outside the enclosure. A data collection box shall be mounted to the outside of the motor enclosure in a location that is easily accessible. Data collection box shall be rated NEMA 4R or NEMA 6X, non-metallic sealed NEMA Standard boxes.
- d. Installation - Motors shall be bolt mounted. Motor feet shall be coplanar within 0.001 inch. Base mounting points shall be accessible and adjustable to enable machine alignment. Motors over (15) hp shall have alignment jack bolts installed to enable alignment.
- e. Alignment - Before attempting alignment, the contractor shall demonstrate that the load does not have any load/force imposed by the piping system. Minimum alignment values (below) are for motor and load running at normal running temperatures. Value must be compensated for thermal growth. Limited movement of the motor or load (commonly known as bolt-bound) must be corrected to ensure alignment capabilities. Hold down bolts shall not be undercut in order to perform adjustments. Shims shall be commercially die-cut, without seams or folds and be made of corrosion resistant stainless steel. No more than three shims shall be used at any single point.

TABLE 1. Coupled Shaft Alignment Tolerance Values

Soft Foot:

<u>Motor Speed (RPM)</u>	<u>Maximum Movement</u>
All	<0.0508 mm at each foot

For short couplings:

Motor Speed (RPM)	Parallel Off set	Angularity (in./10 in.)
<1000	0.005 in.	0.015 in.
1200	0.004 in.	0.010 in.
1800	0.003 in.	0.005 in.
3600	0.0.002 in.	0.003 in.
7200	0.0.10 in.	0.002 in.

f. Electrical Tests

1. Perform continuity tests on all phases.
2. Perform insulation resistance and polarization index test on each phase of motor. Insulation tests on 480-volt motors shall be conducted using a 1000-volt insulation test set. Insulation tests on motors rated less than 480-volts shall be conducted using 500-volt insulation test set.
3. Test data shall include the location and identification of motors and megohm reading versus time. Test data shall be recorded at 15, 30, 45 seconds and 1 minute increments thereafter up to 10 minutes. Megohm readings shall not be less than 25 megohms for each phase and each phase reading shall be within 10 percent of the other two.
4. Calculate the polarization index of each phase by dividing the 10 minute reading by the 1 minute reading. The polarization index shall be greater than 1.25. Any values lower shall be rejected and the motor returned to the factory.

g. Vibration Analyzer

1. The contractor shall use an FFT analyzer to measure vibration levels. It shall have the following characteristics: dynamic range greater than 72db; a minimum of 400 line resolution; a frequency response range of 5Hz-10KHz (300 - 600000 cpm); the capacity to perform ensemble averaging; the capability to use Hanning window; auto-ranging frequency amplitude; a minimum amplitude accuracy over the selected frequency range of + or - 20% or = or - 1.5dB.
2. An accelerometer , either stud-mounted or mounted using a rare earth, low mass magnet and sound disk (or finished surface) shall be used with the FFT analyzer to collect data. The mass of the accelerometer and its mounting shall have minimal influence on the frequency response of the system over the selected measurement range.

h. Vibration Data

1. Vibration data shall be collected in the axial, vertical, and horizontal direction for each motor bearing.
2. Two narrowband spectra for each data collection point shall be obtained in the following manner: For all machines regardless of operating speed, a 5 to 500 Hz spectrum with a minimum of 400 lines of resolution shall be obtained. An additional spectrum of 5 to 2500 Hz or 5 to 5000 Hz shall be acquired for machines

operating at or below 1800 RPM or greater than 1800 RPM, respectively.

3. Vibration limits shall conform to the following:

TABLE 9.1A MAXIMUM ALLOWABLE VIBRATION LEVELS FOR ELECTRIC MOTORS
FRACTIONAL AND INTEGRAL HORSEPOWER AC/DC MOTORS
VELOCITY LINE-AMPLITUDE BAND LIMITS

BAND	FREQUENCY RANGE (CPM)	STANDARD (INCH/SEC - PEAK)
1	0.3 x RPM - 0.8 x RPM	0.04
2	0.8 x RPM - 1.2 x RPM	0.075
3	1.2 x RPM - 3.5 x RPM	0.04
4	3.5 x RPM - 8.5 x RPM	0.03
5	8.5 x RPM - 60,000 CPM	0.03
6	60,000 CPM - 120,000 CPM	0.03

- i. Leveling of Equipment Upon Installation - The contractor shall level all installed rotating electrical and mechanical machinery. After installation, the equipment shall not exceed a maximum slope of the base and the frame of 0.001 inch per foot. The contractor shall report to the government the type and accuracy of the instrument used for measuring the level; e.g., a 12-inch machinist's level graduated to 0.0002 inch per foot.

2.5 MISCELLANEOUS MATERIALS

a. Bituminous Coating

1. Bituminous coating shall be a solvent cutback, heavybodied material to produce not less than a 0.01 inch dry-film thickness in one coat, and shall be as recommended by the manufacturer to be compatible with factory-applied coating and rubber joints.
2. For previously coal-tar coated and uncoated ferrous surfaces underground, bituminous coating shall be solvent cutback coal-tar type conforming to MS MIL-C-18480.

- b. Bolting - Flange and general purpose bolting shall be hex-head and shall conform to ASTM F568, Class 4.8 or above (bolts, for flanged joints in piping systems where one or both flanges are cast iron). Heavy hex-nuts shall conform to ASTM A563M. Square-head bolts and nuts are not acceptable. Threads shall be coarse-thread series.

- c. Elastomer Calk - Polysulfide- or polyurethane-base elastomer calking material shall be two-component type conforming to ASTM C920.

d. Escutcheons

1. Escutcheons shall be manufactured from nonferrous metals and shall be chrome-plated except when AISI 300 series corrosion-resistant steel is provided. Metals and finish shall conform to ASME A112.19.2M.
2. Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing, and one-piece of split-pattern type elsewhere. Escutcheons shall have provisions consisting of setscrews for maintaining a fixed position against a surface.

- e. Flashing
 - 1. Sheet lead shall conform to [ASTM B749](#), Grade B (intended for use in laboratories and shops in general application).
 - 2. Sheet copper shall conform to [ASTM B370](#) and shall be of not less than 1 lbs/ft² mass.
- f. Flange Gaskets - Compressed non-asbestos sheet conforming to [ASTM F104](#), Type 7-P1161A, coated on both sides with graphite or similar lubricant, with nitrile composition, binder rated 750°F.
- g. Grout - Shrink-resistant grout shall be premixed and packaged metallic-aggregate, mortar-grouting compound conforming to [ASTM C404](#) and [ASTM C476](#), with the following properties:
 - 1. Tensile strength [ASTM C190](#) 1900 psi, minimum
 - 2. Compressive strength [ASTM C109](#) 14,000 psi, minimum
 - 3. Shrinkage, linear 0.3 percent, maximum
 - 4. Water absorption [ASTM C67](#) 0.1 percent, maximum
 - 5. Bond strength to steel in shear 1001, minimum
- h. Pipe Thread Compounds - Tetrafluoroethylene tape 0.002 inch to 0.003 inch thick shall be used in potable and process water and in chemical systems for pipe sizes to and including 1 inch. 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

- a. Necessary piping systems and equipment supporting elements shall be provided including, but not limited to, building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and spring-cushion, variable, or constant supports. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures and natural and other external forces normal to this facility without damage to supporting element system or to work being supported.
- b. Supporting elements shall be UL listed and conform to [ASME B31.3](#), [FM P7825](#), [FS FF-S-325](#), [MSS SP-58](#), and [MSS SP-69](#) except as noted.
- c. Attachments welded to pipe shall be made of materials identical to that of pipe or materials accepted as permissible raw materials by referenced code or standard specification.
- d. Supporting elements exposed to weather shall be hot-dip galvanized. Materials shall be of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process. Supporting elements in contact with copper tubing shall be electroplated with copper.

- e. Type designations specified herein are based on [MSS SP-58](#) and [MSS SP-69](#). Masonry anchor group-, type-, and style-combination designations shall be in accordance with [FS FF-S-325](#). Support elements, except for supplementary steel, shall be cataloged, load rated, commercially manufactured products.
- f. Building Structure Attachments
 - 1. Anchor Devices, Concrete and Masonry
 - a. (1) Group I - Shield, expansion (lead, bolt and stud anchors)
 - (2) Group II - Shield, expansion (bolt anchors)
 - Type 2 - Machine bolt expansion shield anchors
 - Class 2 - Open-end expansion shield anchors
 - Style 1 - Single-end expansion shield anchors
 - Style 2 - Double-end expansion shield anchors
 - (3) Group III - Shield, expansion (self-drilling tubular expansion shell bolt anchors)
 - (4) Group VIII - Anchors, expansion (non-drilling)
 - b. Cast-in, floor mounted, equipment anchor devices shall provide adjustable positions.
 - c. Masonry anchor devices shall be built-in.
 - d. Powder-actuated anchoring devices shall not be used to support any mechanical systems components.
- 2. Beam Clamps
 - a. Beam clamps shall be center-loading Type 21, 28, 29, 30, UL listed, cataloged and load-rated commercially manufactured product.
 - b. When it is not possible to use center-loading beam clamps, eccentric-loading beam clamps, Type 20 may be used for piping sizes [2 inches](#) and less. For pipe sizes over [2 inches](#), provide two counterbalancing clamps per point of pipe support. Where more than one rod is used per point of pipe support, rod diameter shall be determined in accordance with referenced standards.
- 3. C-Clamps - C-clamps shall not be used.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

- a. Piping systems shall be fabricated and installed in accordance with [ASME B31.3](#), [MSS SP-69](#), and [AWS WHB-2](#).
- b. Connections between steel piping and copper piping shall be electrically isolated from each other with dielectric unions or flanges with flange insulating kit rated for the service.
- c. Final connections to equipment shall be made with unions for sizes up to [2 inches](#) and flanges for sizes [2½ inches](#) and above, provided every [100 feet](#) of straight run. Unions shall be provided in the line

downstream of screwed- and welded-end valves.

- d. Pipe ends shall be reamed before joint connections are made.
- e. Screwed joints shall be made up with tetrafluoroethylene joint compound or tape, and not more than three threads shall show after joint is made up.
- f. Joint compounds shall be applied to the male thread only, and care shall be exercised to prevent compound from reaching the unthreaded interior of the pipe.
- g. Screwed unions, welded unions, or bolted flanges shall be provided wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system for maintenance.
- h. Piping systems shall be securely supported with due allowance for thrust forces, thermal expansion and contraction, and shall not be subjected to mechanical, chemical, vibrational or other damage as specified in [ASME B31.3](#).
- i. Field welded joints shall conform to [AWS WHB-2](#), [ASME B31.3](#), and [ASME-17](#).
- j. Piping systems butt weld joints shall be made without backing rings. Joint configuration shall conform to [ASME B16.25](#).
- k. Cutting of metallic piping shall be by wheel cutters or other machines designed specifically for that purpose. Electric-arc and oxyacetylene cutting is not permitted.
- l. Precautions shall be taken during installation of flexible pipe and hose including flushing/purging with water, steam, and compressed air to preclude bellows failure due to pipe line debris lodged in bellows. Installation shall conform to manufacturer's instructions.
- m. Assemble flanged joints with appropriate flanges, gaskets, and bolting. Make clearance between flange faces such that connections can be gasketed and bolted tightly without imposing undue strain on piping system. Make flange faces parallel and bores concentric; gasket centered on flange faces without projecting into bore. Lubricate bolting with oil and graphite before assembly to ensure uniform bolt stressing. Draw up flange bolts and tighten in staggered sequence so as to prevent unequal gasket compression and deformation of flanges. After piping system has been tested and is in service at its maximum temperature, retighten bolting to achieve minimum gasket seating stress recommended by gasket manufacturer. Use only [ASME B31.3](#) studs with nuts. Disassemble flange joints that fail pressure tests, correct the problem, then reassemble with new gaskets, studs, and nuts.
- n. Cut copper tubing or joints square and remove burrs with cutting and reaming tools. Clean inside surfaces of fittings and outside surfaces of tubes in joint area with steel wool before assembly of joint. Apply joint flux, solder, and heat source as recommended by manufacturer so as to provide proper capillary action to fill socket space and to achieve 100 percent shear-line strength. Valves in copper piping - screwed ends with end adapters to suit mechanical connections, unless solder jointing is specified or indicated for a given application. Remake copper joints that fail pressure tests with new materials, including pipe or tubing fittings and filler metal.

3.2 SUPPORTING ELEMENTS INSTALLATION

- a. Supporting elements shall be provided in accordance with the referenced codes and standards.
- b. Piping shall be supported from building structure. No piping shall be supported from roof deck or from other equipment such as pipe, duct, or cable tray.
- c. Anchorage of piping and equipment shall be in accordance with Section 15 00 00, GENERAL MECHANICAL.

3.3 PENETRATIONS

Seal exterior wall sleeves watertight, using mechanically expandable chloroprene inserts with mastic sealed metal components.

3.4 SLEEVES

- a. Sleeves shall be provided where piping passes through roofs, masonry, concrete walls and floors.
- b. Sleeves passing through steel decks shall be continuously welded or brazed to the deck.
- c. Sleeves that extend through floors, roofs, load bearing walls, and fire barriers shall be continuous and fabricated from Schedule 40 steel pipe, with welded anchor lugs. All other sleeves shall be formed by molded linear polyethylene liners or similar materials that are removable. Diameter of sleeves shall be sufficiently large to accommodate pipe, insulation, and jacketing without touching the sleeve, and shall provide a minimum 0.4 inch clearance. Sleeve size shall accommodate mechanical and thermal motion of pipe to preclude transmission of vibration to walls and the generation of noise.
- d. Space between a pipe, bare or insulated, and the inside of a pipe sleeve or a construction surface penetration shall be packed solid with a mineral fiber conforming to FS HH-I-558, Form B, Type 1 (flexible blanket), Class 8, (451°F to 1000°F). This packing shall be provided wherever the piping passes through firewalls, equipment room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction surface penetrations occur between conditioned and unconditioned spaces, the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction surface penetration shall be filled with an elastomer calk to a depth of ½ inch. Surfaces to be calked shall be oil- and grease-free.
- e. Exterior wall sleeves shall be calked watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed metal components.

3.5 ESCUTCHEONS

Escutcheons shall be provided at all penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping passes, escutcheons shall be provided on both sides of the

partition. Where suspended ceilings are installed, plates shall be provided at the underside only of such ceilings. For insulated pipes, the plates shall be sufficiently large to fit around the insulation. Escutcheons shall be chrome-plated in occupied spaces and of size sufficient to effectively conceal openings in building construction. Escutcheons shall be firmly attached with setscrews.

3.6 FLASHINGS

Flashings shall be provided at penetrations of building boundaries by mechanical systems and related work.

3.7 UNDERGROUND PIPING INSTALLATION

- a. Before being lowered into a trench, piping shall be cleaned, visually inspected for apparent defects, and tapped with a hammer to audibly detect hidden defects.
- b. Suspect cast-ferrous piping shall be further inspected by painting with kerosene on external surfaces to reveal cracks.
- c. Defective materials found shall be distinctly marked using a road-traffic quality yellow paint; defective material shall be promptly removed from the site.
- d. After conduit has been inspected, and not less than 48 hours before being lowered into a trench, external surfaces of cast ferrous conduit shall be coated with a compatible bituminous coating for protection against brackish ground water. Application shall be single coat, in accordance with the manufacturer's instructions, to result in a dry-film thickness of not less than 0.01 inch.
- e. Perform excavation and backfill operations as specified in Section 02 20 00, Site Preparation and Earthwork. Excavations shall be dry and clear of extraneous materials when pipe is being laid.
- f. Cutting of piping shall be by wheel cutters or other machines designed specifically for that purpose. Electric-arc and oxyacetylene cutting are not permitted.
- g. Laying of pipe shall begin at the low point of a system. When in final acceptance position, pipe shall be true to the grades and alignment indicated, with unbroken continuity of invert. Blocking and wedging are not permitted.
- h. Bell or grooved ends of piping shall point upstream.
- i. Changes in direction of drainage piping shall be made with long sweep fittings.
- j. Necessary socket clamping, piers, bases, anchors, and thrust blocking shall be provided. Rods, clamps, and bolting shall be protected with a coating of bitumen.
- k. 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.
- l. On excavations that occur near and below building footings, the

backfilling material shall consist of 2176 psi cured compressive-strength concrete poured or pressure-grouted up to the level of the footing.

- m. 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.
- n. Non-metallic underground piping shall have a copper tracer wire attached to the pipe.
- o. Valves - Install where indicated, set plumb, and centered on valves. Where feasible, locate valves outside traffic areas. Carefully tamp soil around each valve box to a distance of 4 feet on all sides of the box, or to undisturbed trench face if less than 4 feet. Protect valve boxes located in roads or sidewalks by a concrete slab as indicated.

3.8 DISINFECTION

Water piping, including valves, fittings, and other devices, shall be disinfected with a solution of chlorine and water. Solution shall contain not less than 50 parts per million (ppm) of available chlorine. Solution shall be held for not less than 8 hours, after which the solution shall contain not less than 10 ppm of available chlorine or the piping shall be re-disinfected. After successful sterilization, the piping shall be thoroughly flushed before placing into service. Flushing shall be complete when the flush water contains less than 0.5 ppm of available chlorine. Water for disinfection will be furnished by the Government. Contractor shall be responsible for approved disposal of contaminated flush water.

-- End of Section --

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DIVISION 15 -

SECTION 15 40 00

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SECTION 15 40 00

PLUMBING

PART 1 GENERAL

1.1 SUMMARY

This section specifies requirements for plumbing.

1.2 REFERENCES

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A112.18.1M Plumbing Fixture Fittings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.7 Hose Coupling Screw Threads

ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A126 Gray Iron Castings for Valves, Flanges,
and Pipe Fittings

AMERICAN WATERWORKS ASSOCIATION, INC. (AWWA)

AWWA C104 Cement-Mortar Lining for Ductile-Iron Pipe
and Fittings for Water

AWWA C500 Gate Valves for Water and Sewerage Systems

AWWA C506 Backflow Prevention Devices - Reduced
Pressure Principle and Double Check Valve
Types

AWWA C700 Cold Water Meters - Displacement Type,
Bronze Main Case

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH
(FCCHR)

FCCHR-01 Manual of Cross-Connection Control

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-80 Bronze Gate, Globe, Angle and Check Valves

CALIFORNIA BUILDING STANDARDS COMMISSION

CPC California Plumbing Code

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO

LRFD Bridge Design Specifications

1.3 DESIGN REQUIREMENTS

- a. Section 15 00 00, GENERAL MECHANICAL, applies to work specified in this section.
- b. Plumbing systems shall be provided and shall include the water supply system, the waste and vent system, and all required plumbing fixtures and fittings.

1.4 SUBMITTALS

The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material, equipment, and fixture lists shall be submitted for plumbing systems.

SD-02 Drawings

Installation Drawings shall be submitted for piping systems in accordance with paragraph entitled, "Pipe Installation", of this section.

Provide "as-built" exact routing of lines, pipe material and sizes, and location of valves and equipment.

SD-06 Test Reports and Records

Test Reports shall be submitted for hydrostatic pressure tests in accordance with paragraph 3.2, Tests.

SD-10 Operation and Maintenance Data

Provide four copies for all appliances.

PART 2 PRODUCTS

2.1 WATER SUPPLY SYSTEM COMPONENTS

- a. Pipe and Fittings - As specified in Section 15 05 00, BASIC MECHANICAL MATERIALS AND METHODS.
- b. Valves and Specialties
 1. Gate Valves - Valves shall be designed for a minimum of 150 psi. Valves smaller than 3 inches shall be all brass and shall conform to MSS SP-80, Type I. Valves 3 inches and larger shall be iron-body, brass-mounted, conforming to AWWA C500.
 2. Vacuum and Relief Valves - Vacuum and relief valves shall be of 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.

3. Hose Faucets
 - a. Hose faucets shall be constructed with $\frac{1}{2}$ inch male inlet threads, hexagon shoulder, and $\frac{3}{4}$ inch hose connection, conforming to ANSI A112.18.1M. Hose-coupling screw threads shall conform to ASME B1.20.7.
 - b. Vandalproof, atmospheric-type vacuum breaker shall be provided on discharge.
4. Globe Valves - Valves shall be 125 psi, bronze body, conforming to MSS SP-80. Disk shall be free to swivel on the stem. Composition seating surface disk construction may be substituted for all-metal disk construction. Packing shall be a woven non-asbestos material, impregnated with not less than 25 percent, by weight, tetrafluoroethylene resin.
5. Check Valves
 - a. Standard check valves in sizes 2 inches and smaller shall be 125 psi swing check conforming to MSS SP-80. Lift checks (lift check horizontal) and 125 psi valves conforming to MSS SP-80 shall be provided.
 - b. Check valves in sizes $2\frac{1}{2}$ inches and larger shall be cast iron, bronze trim, swing type. Valve bodies shall be cast iron, conforming to ASTM A126, Class A. Valve ends shall be flanged in conformance with ASME B16.1. Swing-check pin shall be AISI Type 304 corrosion-resistant steel. Valves shall have bolted and gasketed covers. Horizontal swing check valves shall meet or exceed the requirements of AWWA Standard C508 and the valve water working pressure rating is 200 psi.
 - c. Check valves in the discharge pipe of domestic pump must be a wafer check valve with 316 SS Body and Spring.
6. Backflow Prevention Devices
 - a. Backflow prevention devices shall conform to AWWA C506.
 - b. Devices 2 inches ips and smaller with moving components defined in AWWA C506 shall be constructed of nonferrous metals. Nonmetal components of such devices shall be rated for the applicable service temperature.
 - c. External surfaces of devices may be rough castings where these devices are used outside the building or in equipment rooms. Devices shall be protected from freezing and shall be installed, tested, and used in conformance with the manufacturer's instructions.
 - d. 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.

e. Reduced pressure principle devices shall conform to **AWWA C506** and **FCCHR-01**. This unit shall be installed a minimum of **12 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 that should be installed in accessible locations.

7. Water Meters - Positive displacement disk meters shall conform to **AWWA C700**, except as otherwise noted. Parts wetted by water shall be bronze. Casing shall be flanged in sizes **2½ inches** and larger. Registers shall be magnetic drive, straight reading. Maximum pressure drop at maximum capacity shall not exceed **10 psi** for inches sized **1½ inches** and smaller, and **15 psi** for inches sized **2 inches** and larger.

8. Valve Boxes

a. Valve boxes shall be cast iron, complete with covers. Cast-iron boxes shall be extension type with slide adjustments and with flared bases. The word "WATER" shall be cast in the cover. Boxes shall be installed over each underground 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.

b. Provide boxes sufficiently long to have covers flush with finished surface, and allow an additional 3 inches of upward adjustment. Provide guide rings where operating rods are longer than **6 feet**.

c. Minimum **0.2 inch** thick construction; extension type with screw or slide adjustments and flared bases. Valves **3 inches** diameter and under - Fitted with **4¼ inches** diameter shaft. Valves **4 inches** diameter and larger - Fitted with **5 inches** diameter shaft. Bases - Fitted to valve. Internal and external surfaces - Coated with bituminous sealer conforming to **AWWA C104**.

9. Valve Manholes - Valve manholes shall be constructed in accordance with the designed details.

2.2 DRAIN, WASTE, AND VENT SYSTEM (DWV)

a. Sanitary Drain Waste and Vent Fixtures

1. Floor Sinks (FS)

a. Floor sinks shall be complete with traps and bottom outlets.

b. Floor sinks located in slabs on earth shall have hub outlets. Drains in slabs not on earth shall have threaded outlets or hub outlets, as required to match piping used.

c. Floor sinks shall have integral seepage pans and weepholes.

2. Cleanouts (CO)

a. Cleanouts shall be per **CPC**, Chapter 10, and shall be effectively gastight and watertight, sized to provide quick and easy access for plug removal and rodding tools in their specific location.

b. Cleanouts set outside the building shall have adjustable housings.

c. Cast-iron bodies shall be coated with manufacturer's standard material.

(1) Type CO-1 for yard cleanouts set in paved driveways or concrete floors in heavy vehicular traffic areas. Cast-iron body and set screw-adjustable housing with deep-set tractor-type cast-iron scoriated cover. Construction shall be heavy duty, suitable for **AASHTO** H-10 vehicle loading.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

Excavation and backfill operations shall be performed as specified in Section **02 20 00**, SITE PREPARATION AND EARTHWORK.

3.2 WATER SYSTEMS TESTING

- a. Before acceptance of the work, systems shall be tested in the presence of the COTR.
- b. Tests shall be performed before 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 COTR.
- c. Tests shall be hydrostatic, unless otherwise specified. Water used for testing shall be potable.
- d. Government will supply testing water, but the Contractor shall provide for approved disposal of contaminated water.
- e. Contractor may conduct tests for its own purposes, but the acceptance test shall be conducted as specified herein.
- f. If the test demonstrates that leakage rate exceeds specified limits, the sources of leakage shall be determined, defective materials and workmanship shall be repaired or replaced, and the system shall be retested until specified requirements are met.
- g. 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. Safe test-pressure rating of any plug used shall be not less than two times the actual test pressure being applied.
- h. Precautions shall be taken to vent the expansive force of compressed air trapped during high-pressure hydrostatic testing to preclude injury and damage.

- i. COTR may require the removal of system components, such as plugs or caps, to ascertain that the water has reached all parts of the system if purging or vent valves are not provided.
- j. Piping system components such as valves shall be checked for functional operation under system test pressure. Components that could sustain damage due to test pressure shall be removed from piping systems before hydrostatic testing.
- k. Leaking gasket joints shall be remade with new gaskets. Leaking copper joints shall be remade with new fittings and new tube ends.
- l. Temperature of water used for testing shall not cause condensation on system surfaces.
- m. Test media shall not be added to a system during a test for a period specified or to be determined by the COTR.
- n. Duration of a test will be determined by the COTR and shall be for a minimum of 2 hours, with a maximum of 24 hours. Test may be terminated by direction of the COTR at any time during this period after it has been determined that the permissible leakage rate has not been exceeded.
- o. Test records of piping systems tests shall be prepared and maintained. Records shall show test personnel responsibilities, dates, test gage identification number, ambient and test water temperatures, pressure ranges, rate of pressure drop, leakage rates, and other system characteristics.
- p. Test Gages - Test gages shall have a 4½ in. or larger dial, be accurate to +/- 0.5 percent of full-scale range, and have dial graduations and pointer width compatible with readability and one-half the accuracy extremes. 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 before use, test gage number, and project number.
- q. Test and Acceptance Criteria
 1. Aboveground water systems shall be hydrostatically tested at 1.5 times design pressure or 125 psi, whichever is higher, and the applied test pressure shall be maintained without further addition of test media for not less than 2 hours. Maximum allowable pressure drop shall be 2 psi, or as approved.
 2. Maximum allowable leakage for the piping installation shall be indicated by not more than a 1 percent drop of total system pressure.
 3. Hydrostatic tests shall be applied only to piping with concrete anchorage that has cured for a minimum of 7 days.
 4. Backflow prevention devices in water systems and other water system devices shall be tested for proper functioning under conditions normal to their application.
- r. Plumbing systems shall be tested to prove tightness of piping and

connections and proper operation of equipment and fixtures.

- s. 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. Pressure shall be maintained until pipe under test has been examined, but in no case for less than 1 hour.
- t. 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.
- u. Drainage and venting piping shall be tested before the fixtures are installed. Underground soil and waste piping shall be tested before backfilling. Testing shall be applied to the system in its entirety or in sections.
- v. 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.
- w. 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 4 psi water pressure. In testing successive sections, at least the upper 10 feet of the next preceding section shall be tested so that each joint or pipe except the uppermost 10 feet of the system has been submitted to a test of at least 4 psi water pressure. 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.

3.3 PLUMBING FIXTURES

- a. Materials, equipment, and fixtures shall be installed in accordance with the manufacturer's recommendations. Fixtures and equipment shall be installed to comply with water conservation policy.
- b. 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.

3.4 ADJUSTING

Automatic control devices shall be adjusted for proper operation.

3.5 UNDERGROUND PIPING

Non-metallic underground piping shall have a copper tracer wire attached to the pipe.

3.6 INSTALLATION

Unless otherwise specified in the drawings, final connections to equipment shall have a straight run of 5 times the pipe diameter.

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SECTION 23 65 00

COOLING TOWERS

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.

ACOUSTICAL SOCIETY OF AMERICA (ASA)

ASA S1.13 (2005) Methods for the Measurement of Sound Pressure Levels in Air (ASA 118)

AMERICAN WELDING SOCIETY (AWS)

AWS Z49.1 Safety in Welding and Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM A 123/A 123M (2009) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 153/A 153M (2009) Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 48/A 48M (2003; R 2008) Standard Specification for Gray Iron Castings

ASTM A 653/A 653M (2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM B 117 (2009) Standing Practice for Operating Salt Spray (Fog) Apparatus

ASTM D 1784 (2008) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

ASTM D 2996 (2001; R 2007e1) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe

ASTM D 520 (2000; R 2005) Zinc Dust Pigment

ASTM E 84 (2009c) Standard Test Method for Surface

Burning Characteristics of Building
Materials

COOLING TECHNOLOGY INSTITUTE (CTI)

CTI Std-137 (2007) Fiberglass Pultruded Structural
Products for Use in Cooling Towers

CTI Std-201 (2009) Standard for Certification of Water
Cooling Tower Thermal Performance

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2007; Errata 2008) Standard for Motors
and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 214 (2005) Standard on Water-Cooling Towers

NFPA 255 (2005; Errata 06-1) Standard Method of
Test of Surface Burning Characteristics of
Building Materials

NFPA 70 (2008; AMD 1 2008) National Electrical Code

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J534 (2008) Lubrication Fittings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data**Cooling Towers; G**

Manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show material, size, options, performance charts and curves, etc. in adequate detail to demonstrate compliance with contract requirements. Data shall include manufacturer's recommended installation instructions and procedures.

Demonstrations; G

A schedule, at least 2 weeks prior to the date of the proposed training course, which identifies the date, time, and location for the training.

Verification of Dimensions

A letter, at least 2 weeks prior to beginning construction, including the date the site was visited, confirmation of existing conditions, and any discrepancies found.

SD-06 Test Reports and Records

Packaged cooling tower - installation instructions; G

Packaged cooling tower - field acceptance test plan; G

Packaged cooling tower - field acceptance test report; G

SD-07 Certificates

Service Organization

Cooling Tower

SD-08 Manufacturer's Instructions

Packaged cooling tower - installation instructions

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

1.3 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements shall be in accordance with AWS Z49.1. Ladder, cage, and guardrail shall be provided.

1.4 DELIVERY, STORAGE, AND HANDLING

Stored items shall be protected from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Proper protection and care of all material both before and during installation shall be the Contractor's responsibility. Any materials found to be damaged shall be replaced at the Contractor's expense. During installation, piping and similar openings shall be capped to keep out dirt and other foreign matter.

1.5 PROJECT/SITE CONDITIONS

1.5.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.5.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.5.3 Spare Parts

Submit spare parts data for each different item of equipment, after approval of detail drawings and not later than start of performance testing. Data shall include a complete list of parts and supplies, with current prices and source of supply, a recommended spare parts list for one year of operation, and a list of the parts recommended by the manufacturer to be replaced on a routine basis.

1.6 Warranty

In addition to the warranty requirements specification in Division 00, Contract Requirements, the following major components of the cooling tower shall be covered by a warranty of a duration period of five years: fans, fan drives, electric motors, cold water basin.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment shall be standard commercial catalogued products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship.

The standard products shall have been in satisfactory commercial or industrial use in field service for 2 years prior to bid opening. The 2 year use shall include applications of equipment and materials under similar circumstances and of similar size.

Products having less than a 2 year field service record shall be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. This 6000 hour record shall not include any manufacturer's prototype or factory testing.

Records of satisfactory field use shall be completed by a product that had been, and presently is, sold, or offered for sale on a commercial market through the following copyrighted means: advertisements, manufacturer's catalogs, or brochures. Products shall be supported by a [service organization](#). System components shall be environmentally suitable for the indicated locations.

2.2 MANUFACTURER'S STANDARD NAMEPLATES

Major equipment including cooling towers, cooling tower gear drive assemblies, fans, and motors 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. Plates shall be durable and legible throughout equipment life. Plates shall be fixed in prominent locations.

2.3 ELECTRICAL WORK

- a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers equipment, including motors and wiring, as specified in Division 26. Manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers including the

required monitors and timed restart.

- b. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system, and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1.
- c. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure. Motor bearings shall conform to bearing life and vibration criteria listed on drawings.
- d. Inverter duty premium efficiency motors shall be provided for variable frequency drive applications. Motors shall have efficiency labeling in accordance with NEMA MG 1. Provide variable frequency drives for motors as specified in Section 26 29 23 VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS.

2.4 COOLING TOWER MATERIALS

2.4.1 Fiberglass Reinforced Plastic (FRP)

FRP components shall be inert, corrosion resistant, and fire-retardant with a thickness of 12 ounces per square foot. FRP components shall contain an ultraviolet (UV) ray inhibitor as per CTI Std-137, Grade 1 or 3. Components manufactured of polystyrene will not be permitted.

2.4.2 Zinc-Coated Steel

Components fabricated of zinc-coated steel shall be not lighter than 16 gauge steel, protected against corrosion by a zinc coating. The zinc coating shall conform to ASTM A 153/A 153M and ASTM A 123/A 123M, as applicable and have an extra heavy coating of not less than 2.5 ounces per square foot of surface. Galvanized surfaces damaged due to welding shall be coated with zinc rich coating conforming to ASTM D 520, Type 1.

2.4.3 Polyvinyl Chloride (PVC) Formed Sheets

ASTM D 1784, Type I, Grade 1 with a flame spread rating of 25 or less per ASTM E 84.

2.4.4 Stainless Steel Sheets

Type 304.

2.4.5 Hardware

Bolts shall be Type 304 stainless steel. Each bolt shall be provided with neoprene and cadmium-plated steel washers under the heads. Angle brackets and similar parts shall be cast iron or zinc-coated steel. Zinc coatings

shall conform to ASTM A 153/A 153M, ASTM A 123/A 123M, and ASTM A 653/A 653M, as applicable, and shall have an extra heavy coating of not less than 2.5 ounces per square foot of surface. Subject hardware to a salt-spray fog test in accordance with ASTM B 117. No signs of corrosion shall be evident after 1,000 hours continuous exposure to a 5 percent salt spray.

2.5 COOLING TOWERS

2.5.1 Factory Assembled Towers

2.5.1.1 Description

The cooling tower shall be of the induced mechanical draft type. The cooling tower shall include frames and casings, louvers, drift eliminators, partitions, windbreak baffles, drift-check walls, cold water basin equipment, hot water basins, fans and fan walls, blowers, drives, electric motors, access doors, working platforms, inspection plates, and panels.

2.5.1.2 Construction

Tower shall be constructed to withstand a wind pressure of not less than 30 psf on any external surface. Fan deck shall be constructed to withstand a live load of not less than 60 psf in addition to the concentrated or distributed loads of equipment mounted on the fan deck.

The hot water distribution system shall be of the open basin gravity feed type or the pressurized spray header type design.

2.5.1.3 Tower Frame and Louvers

Provide frame, louvers, and casing constructed from galvanized steel. Intermediate structural members shall be provided for rigidity and support of casings, louvers, fill, distribution systems, fan decks, and other equipment. Inlet air louvers shall permit free air passage but no splashout, and shall be designed to prevent debris and sunlight from entering the cold water basin.

2.5.1.4 Fill

The fill shall support expected loads without sag or failure and arranged to effectively break up the water. The fill shall be manufactured and performance tested by the cooling tower manufacturer. The fill shall be of the materials as specified. Chlorinated polyvinyl chloride (CPVC) fill shall be used for applications where inlet temperatures are greater than 130 degrees F. Tower fill shall be rated for continuous operation at 130 degrees F, and operation for minimum of two hours at 150 degrees F.

2.5.1.5 Drift Eliminators

Provide drift eliminator sections designed and arranged to effectively trap water droplets entrained in the discharge airstream. Sections shall be assembled in easily removable sections.

2.5.1.6 Cold Water Basin Equipment.

Include sump with removable screen and vortex breaker, float valves, and necessary pipe connections and fittings within the tower. Provide float valves with adjustable arms. Valve sizes shall be the balanced piston type. Valve seats and disks shall be replaceable.

Provide cold water basins and casings suitably sealed and flashed at joints and connections to ensure watertight construction.

2.5.1.7 Fans, Blowers, and Drives.

The towers shall have propeller-type fans having not less than four metal blades. Fans and blowers shall be designed and constructed to withstand 50 percent overspeed above normal maximum operating speeds.

If belt drives are utilized, multi-grooved solid back single belt design shall be used to avoid uneven belt stretch. Adjustment shall be provided for belt tension and drive centers. Belt drives shall be designed and constructed for 150 percent overload.

Sheaves located in the airstream shall be corrosion-resistant material. Shafting for gear drives shall have flexible-type couplings requiring no lubrication.

The gear assemblies shall be enclosed in an oil filled housing provided with fill and drain plugs.

2.5.1.8 Tower Piping

Plastic piping shall be not less than schedule 40 and conform to [ASTM D 2996](#). Fittings for other piping materials shall be of the same material or equal and of the same class and grade as the pipe.

2.5.1.9 Electric Motors

Requirements are specified in paragraph ELECTRICAL WORK.

2.5.1.10 Vibration Cutout Switch.

Provide electronic vibration cutout switch with auxiliary contacts in a protected position and most effective location, interlocked with the fan wiring to electrically open the motor circuit under excessive fan vibration.

2.5.1.11 Performance

The factory assembled tower shall have [Cooling Tower Institute](#) certification that, in accordance with [CTI Std-201](#), the cooling tower will perform thermally at the rating published by the tower manufacturer in his copyrighted literature.

2.5.1.12 Sound Power Level

Sound power levels, in decibels (dB) with a reference pressure of 0.0002 microbars, of the cooling tower shall be not greater than the maximum permitted dB levels for the designated octave band as set forth in Table I. The sound power level data for the cooling tower shall have been verified in tests conducted in accordance with [ASA S1.13](#).

Table I. Sound Power Level For Induced Mechanical Draft Type

Octave Band (Hz)	63	125	250	500	1000	2000	4000	8000
Sound Power								

Level (dB)	108	106	107	102	97	90	85	82
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2.5.1.13 Drift Loss

Drift loss shall be not greater than 0.005 percent of the water circulated.

2.5.2 Lubrication

The lubricating points shall be extended to the outside of the unit for easy accessibility. Hydraulic lubrication fittings shall be in accordance with [SAE J534](#). Where use of high pressure lubricating equipment, [1000 psi](#) or higher, will damage grease seals or other parts, a suitable warning shall be affixed to the equipment in a conspicuous location.

2.5.3 Factory Finish System

Manufacturer's standard factory finish system shall be provided.

Galvanized metal shall have been proven to withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with [ASTM B 117](#).

For that salt-spray fog test, the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond [0.125 inch](#) on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above [120 degrees F](#), the factory painting system be designed for the temperature service and shall have been proven to pass the specified salt-spray test.

2.5.4 Fire Safety

Towers shall conform to [NFPA 214](#). Fire hazard rating for plastic impregnated materials shall not exceed 25. Plastics shall not drip or run during combustion. Fire hazard ratings shall be in accordance with [ASTM E 84](#) or [NFPA 255](#).

Tower shall be constructed to the requirements of Factory Mutual Approval Standards for Cooling Towers (Class Number 4930).

2.6 SUPPLEMENTAL COMPONENTS/SERVICES

2.6.1 Cooling Tower Water Treatment Systems

Cooling tower water treatment systems shall be provided and installed in as noted on plans.

PART 3 EXECUTION

3.1 DEMONSTRATIONS

Contractor shall conduct a training course for the operating staff as

designated by the Contracting Officer. The training period shall consist of a total 4 hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. Training demonstrations shall cover all of the items contained in the approved [Operation and Maintenance Manuals](#) as well as demonstrations of routine maintenance operations.

3.2 INSTALLATION

Installation of cooling tower systems including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with [NFPA 70](#), and in compliance with the manufacturer's written installation instructions, including the following:

- a. [Packaged cooling tower - installation instructions](#)

3.3 RELATED FIELD TESTING

3.3.1 Test Plans

- a. Manufacturer's Test Plans: Within 120 calendar days after contract award, submit the following plans:

1. [Packaged cooling tower - field acceptance test plan](#)

Field acceptance test plans shall developed by the cooling tower manufacturer detailing recommended field test procedures for that particular type and size of equipment. Field acceptance test plans developed by the installing Contractor, or the equipment sales agency furnishing the equipment, will not be acceptable.

Contracting Officer will review and approve the field acceptance test plan for each of the listed equipment prior to commencement of field testing of the equipment. The approved field acceptance test plans shall be the plan and procedures followed for the field acceptance tests of the cooling towers and subsequent test reporting.

- b. Coordinated testing: Indicate in each field acceptance test plan when work required by this section requires coordination with test work required by other specification sections. Furnish test procedures for the simultaneous or integrated testing of tower system controls which interlock and interface with controls factory prewired or external controls for the equipment as required by Sequence of Operation.
 - c. Test procedure: Indicate in each field acceptance test plan each equipment manufacturer's published installation, start-up, and field acceptance test procedures. Include in each test plan a detailed step-by-step procedure for testing automatic controls provided by the manufacturer.

Each test plan shall include the required test reporting forms to be completed by the Contractor's testing representatives. Procedures shall be structured to test the controls through all modes of control to confirm that the controls are performing with the intended sequence of control.

Controllers shall be verified to be properly calibrated and have the proper set point to provide stable control of their respective

equipment.

- d. Performance variables: Each test plan shall list performance variables that are required to be measured or tested as part of the field test.

Include in the listed variables performance requirements indicated on the equipment schedules on the design drawings. Tower manufacturer shall furnish with each test procedure a description of acceptable results that have been verified.

Tower manufacturer shall identify the acceptable limits or tolerances within which each tested performance variable shall acceptably operate.

- e. Job specific: Each test plan shall be job specific and shall address the particular cooling towers and particular conditions which exist with this contract. Generic or general preprinted test procedures are not acceptable.

3.4 Testing

- a. Each cooling tower system shall be field acceptance tested in compliance with its approved field acceptance test plan and the resulting following field acceptance test report submitted for approval:

- 1. **Packaged cooling tower - field acceptance test report**

- b. Manufacturer's recommended testing: Conduct the manufacturer's recommend field testing in compliance with the approved test plan. Furnish a factory trained field representative authorized by and to represent the equipment manufacturer at the complete execution of the field acceptance testing.
- c. Operational test: Conduct a continuous 24 hour operational test for each item of equipment. Equipment shutdown before the test period is completed shall result in the test period being started again and run for the required duration. For the duration of the test period, compile an operational log of each item of equipment. Log required entries every two hours. Use the test report forms for logging the operational variables.
- d. Notice of tests: Conduct the manufacturer's recommended tests and the operational tests; record the required data using the approved reporting forms. Notify the Contracting Officer in writing at least 15 calendar days prior to the testing. Within 30 calendar days after acceptable completion of testing, submit each test report for review and approval.
- e. Report forms: Type data entries and writing on the test report forms. Completed test report forms for each item of equipment shall be reviewed, approved, and signed by the Contractor's test director. The manufacturer's field test representative shall review, approve, and sign the report of the manufacturer's recommended test. Signatures shall be accompanied by the person's name typed.

-- End of Section --

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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING

SECTION 23 81 48

PLATE HEAT EXCHANGER

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SECTION 23 81 48

PLATE HEAT EXCHANGER

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 B 117 (2009) Standing Practice for Operating Salt Spray (Fog) Apparatus

1.2 RELATED REQUIREMENTS

Requirements for cooling towers are specified in Section 23 65 00 COOLING TOWER.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; G

SD-03 Product Data

Plate heat exchangers; G

SD-06 Test Reports

Plate Heat Exchangers - field acceptance test plan; G

Plate Heat Exchangers - field acceptance test report; G

SD-08 Manufacturer's Instructions

Plate Heat Exchangers - installation instructions

ON-SITE TRAINING; G

SD-10 Operation and Maintenance Data

Plate Heat Exchangers, Data Package 2; G

1.4 QUALITY ASSURANCE

1.4.1 Material and Equipment Qualifications

Provide materials and equipment that are standard products of manufacturers regularly engaged in the manufacture of such products, which are of a similar material, design and workmanship. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.4.2 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.4.3 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.4.3.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.4.3.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.5 DELIVERY, STORAGE, AND HANDLING

Materials delivered and placed in storage shall be stored with protection from the weather, excessive humidity variation, excessive temperature variation, dirt, dust and/or other contaminants. Proper protection and care of material before, during and after installation is the Contractor's responsibility. Any material found to be damaged shall be replaced at the Contractor's expense. During installation, piping shall be capped to keep out dirt and other foreign matter. Materials shall be stored with

protection from puncture, dirt, grease, moisture, mechanical abrasions, excessive heat, ultraviolet (UV) radiation damage, or other damage. Upon delivery of equipment to the site, inspect items for damage and verify items meet project requirements.

1.6 SAFETY REQUIREMENTS

Exposed moving parts, parts that produce high operating temperature, parts which may be electrically energized, and parts that may be a hazard to operating personnel shall be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices shall be installed so that proper operation of equipment is not impaired.

1.7 PROJECT/SITE CONDITIONS

1.7.1 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions indicated in the field, and advise the Contracting Officer of any discrepancy before performing any work.

1.7.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and shall arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.7.3 Accessibility

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible.

PART 2 PRODUCTS

2.1 EQUIPMENT

2.1.1 Plate Heat Exchangers

Plates, frames, and gaskets shall be designed for a working pressure of 75 psi and factory tested at 98 psi. Connections larger than 3 inches shall be ASME 150 pound flanged. Plates shall be corrugated Type 304 stainless steel. Provide ASME "U" stamp and register with National Board of Boiler and Pressure Vessel Inspectors.

2.2 PAINTING OF NEW EQUIPMENT

New equipment painting shall be factory applied or shop applied, and shall be as specified herein. New equipment surfaces constructed of non-ferrous surfaces and materials do not have to be factory or shop painted.

2.2.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied shall withstand 3000 hours in a salt-spray fog test. Field applied coatings are not acceptable. Salt-spray fog test shall be in accordance with ASTM B 117, and for that

test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 120 degrees F, the factory painting system shall be designed for the temperature service.

PART 3 EXECUTION

3.1 INSTRUCTING OPERATING PERSONNEL

Upon completion of work and at time designated by Contracting Officer, provide services of manufacturer's technical representative for period of not less than one 2-hour working day for instruction of Government operating personnel in proper operation and maintenance of equipment.

3.2 FIELD QUALITY CONTROL

Upon completion and before final acceptance of work, test each system in service to demonstrate compliance with the contract requirements. Adjust controls and balance systems prior to final acceptance of completed systems. Test controls through every cycle of operation. Test safety controls to demonstrate performance of required function. Correct defects in work provided by Contractor and repeat tests. Furnish water, electricity, instruments, connecting devices, and personnel for tests. Flush and clean piping before placing in operation. Clean equipment, piping, and strainers.

3.2.1 Equipment Tests

3.2.1.1 Field Testing

Test each item of equipment in operation, for continuous period of not more than 24 hours under every condition of operation in accordance with each equipment manufacturer's recommendation. Verify that each item of equipment operating parameters are within limits recommended by the manufacturer.

3.2.1.2 Field Test Plans

Furnish field test plans developed by each equipment manufacturer detailing recommended field test procedures for each item of equipment. Field test plans developed by the installing Contractor, or the equipment sales agency furnishing the equipment will not be acceptable. The Contracting Officer will review and approve the field test plan for each item of equipment listed below prior to commencement of field testing of the equipment.

a. Equipment Items to Test:

Plate Heat Exchangers - field acceptance test plan

b. Coordinated Testing: Indicate in each field test plan when work required by this section requires coordination with test work required

by other specification sections. Furnish test procedures for the simultaneous or integrated testing of equipment controls which interlock and interface with controls factory prewired or external controls for the equipment provided.

- c. Prerequisite Testing: Equipment for which performance testing is dependent upon the completion of the testing, adjusting, and balancing work shall have that work completed as a prerequisite to testing work under this section. Indicate in each field test plan when such prerequisite work is required.
- d. Test Procedure: Indicate in each field test plan each equipment manufacturer's published installation, start-up, and field acceptance test procedures. Each test plan shall include the required test reporting forms to be completed by the Contractor's testing representatives.
- e. Performance Variables: Each test plan shall list performance variables that are required to be measured or tested as part of the field test. Include in the listed variables performance requirements indicated on the equipment schedules on the design drawings. Furnish with each test procedure a description of acceptable results that have been verified. Identify the acceptable limits or tolerances within which each tested performance variable shall acceptably operate.
- f. Job Specific: Each test plan shall be job specific and shall address the particular item of equipment and particular conditions which exist with this contract. Generic or general preprinted test procedures are not acceptable.

3.2.1.3 Field Test Reports

- a. Equipment Items to Test:
 - Plate Heat Exchangers - field acceptance test report
- b. Manufacturer's Recommended Test: Conduct the manufacturer's recommended field testing in compliance with the approved test plan specified above.
- c. Operational Test: Conduct a standard continuous 24 hour operational test for each item of equipment. Equipment shutdown before the test period is completed shall result in the test period being started again and run for the required duration. For the duration of the test period, compile an operational log of each item of equipment. Log required entries every 2 hours. Use the test report forms for logging the operational variables.
- d. Notice of Tests: Conduct the manufacturer's recommended tests and the operational tests; record the required data using the approved reporting forms. Notify the Contracting Officer in writing at least 15 calendar days prior to the testing. Within 30 calendar days after acceptable completion of testing, submit each test report for review and approval.
- e. Report Forms: Type data entries and writing on the test report forms. Completed test report forms for each item of equipment shall be reviewed, approved, and signed by the Contractor's test director and the QC Manager. The manufacturer's field test representative shall

review, approve, and sign the report of the manufacturer's recommended test. Signatures shall be accompanied by the person's name typed.

- f. Deficiency Resolution: The test requirements acceptably met; deficiencies identified during the tests shall be corrected in compliance with the manufacturer's recommendations and corrections retested to verify compliance.

3.2.2 Additional Field Testing

Requirements for testing, adjusting, and balancing (TAB) is specified on the drawings. Testing, adjusting, and balancing shall begin only when the entire system, including controls, has been completed with the exception of performance tests.

3.2.3 ON-SITE TRAINING

The shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 2 hours of normal working time and shall start after the system is functionally complete but prior to the performance tests. The on-site training shall cover all of the items contained in the approved Operation and Maintenance Data packages.

-- End of Section --

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DIVISION 26 - ELECTRICAL

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BASIC ELECTRICAL MATERIALS AND METHODS

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.

ASTM INTERNATIONAL (ASTM)

ASTM D 709 (2001; R 2007) Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2007) National Electrical Safety Code

IEEE C57.12.28 (2005) Standard for Pad-Mounted Equipment - Enclosure Integrity

IEEE C57.12.29 (2005) Pad-Mounted Equipment - Enclosure Integrity for Coastal Environments

IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC (2007) California Electrical Code

1.2 RELATED REQUIREMENTS

This section applies to certain sections of Division 13, SPECIAL CONSTRUCTION. This section applies to all sections of Division 26 ELECTRICAL, of this project specification unless specified otherwise in the individual sections.

1.3 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE Std 100.
- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

- c. The technical paragraphs referred to herein are those paragraphs in PART 2 - PRODUCTS and PART 3 - EXECUTION of the technical sections that describe products, systems, installation procedures, equipment, and test methods.

1.4 ELECTRICAL CHARACTERISTICS

Electrical characteristics for this project shall be 480Y/277V and 208Y/120V, three phase, four wire. Final connections to the power distribution system shall be made by the Contractor as directed by the Contracting Officer.

1.5 ADDITIONAL SUBMITTALS INFORMATION

Submittals required in other sections that refer to this section must conform to the following additional requirements as applicable.

1.5.1 Shop Drawings (SD-02)

Include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices.

1.5.2 Product Data (SD-03)

Submittal shall include performance and characteristic curves.

1.6 QUALITY ASSURANCE

1.6.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Equipment, materials, installation, and workmanship shall be in accordance with the mandatory and advisory provisions of CEC unless more stringent requirements are specified or indicated.

1.6.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year period shall include applications of equipment and materials under similar circumstances and of similar size. The product shall have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items shall be products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in the technical section.

1.6.2.1 Alternative Qualifications

Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished.

1.6.2.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site shall not be used, unless specified otherwise.

1.7 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.8 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal or peeling.

1.9 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.10 FIELD FABRICATED NAMEPLATES

ASTM D 709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified in the technical sections or as indicated on the drawings. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall

be melamine plastic, 0.125 inch thick, white with black center core. Surface shall be matte finish. Corners shall be square. Accurately align lettering and engrave into the core. Minimum size of nameplates shall be one by 2.5 inches. Lettering shall be a minimum of 0.25 inch high normal block style.

1.11 WARNING SIGNS

Provide warning signs for the enclosures of electrical equipment including substations, pad-mounted transformers, pad-mounted switches, generators, and switchgear having a nominal rating exceeding 600 volts.

- a. When the enclosure integrity of such equipment is specified to be in accordance with IEEE C57.12.28 or IEEE C57.12.29, such as for pad-mounted transformers, provide self-adhesive warning signs on the outside of the high voltage compartment door(s). Sign shall be a decal and shall have nominal dimensions of 7 by 10 inches with the legend "DANGER HIGH VOLTAGE" printed in two lines of nominal 2 inch high letters. The word "DANGER" shall be in white letters on a red background and the words "HIGH VOLTAGE" shall be in black letters on a white background. Decal shall be Panduit No. PPS0710D72 or approved equal.
- b. When such equipment is guarded by a fence, mount signs on the fence. Provide metal signs having nominal dimensions of 14 by 10 inches with the legend "DANGER HIGH VOLTAGE KEEP OUT" printed in three lines of nominal 3 inch high white letters on a red and black field.

1.12 ELECTRICAL REQUIREMENTS

Electrical installations shall conform to IEEE C2, CEC, and requirements specified herein.

1.13 INSTRUCTION TO GOVERNMENT PERSONNEL

Where specified in the technical sections, furnish the services of competent instructors to give full instruction to designated Government personnel in the adjustment, operation, and maintenance of the specified systems and equipment, including pertinent safety requirements as required. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work. Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section.

PART 2 PRODUCTS

2.1 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces

or to meet the indicated or specified safety criteria.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side, but space the signs a maximum of 30 feet apart.

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COMMON WORK RESULTS FOR ELECTRICAL

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COMMON WORK RESULTS FOR ELECTRICAL

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.

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA 480 (1981) Toggle Switches

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE Std 100 (2000) The Authoritative Dictionary of IEEE Standards Terms

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 (2003; R 2004) Standard for Accessible and Usable Buildings and Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA FB 1 (2007) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

NEMA KS 1 (2001; R 2006) Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

NEMA OS 1 (2008) Standard for Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports

NEMA RN 1 (2005) Standard for Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit

NEMA TC 2 (2003) Standard for Electrical Polyvinyl Chloride (PVC) Tubing and Conduit

NEMA TC 3 (2004) Standard for Polyvinyl Chloride PVC Fittings for Use With Rigid PVC Conduit and Tubing

NEMA WD 6 (2002; R 2008) Standard for Wiring Devices - Dimensional Requirements

NEMA Z535.1 (2006) Standard for Safety Colors

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC	(2007) California Electrical Code
UNDERWRITERS LABORATORIES (UL)	
UL 1	(2005; Rev thru Jul 2007) Standard for Flexible Metal Conduit
UL 489	(2009) Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 6	(2007) Standard for Electrical Rigid Metal Conduit-Steel
UL 797	(2007) Standard for Electrical Metallic Tubing -- Steel
UL 870	(1995; Rev thru Jul 2003) Standard for Wireways, Auxiliary Gutters, and Associated Fittings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Submit Material, Equipment, and Fixture Lists for the following:

- Conduits, Raceways and Fittings
- Wire and Cable
- Splices and Connectors
- Switches
- Receptacles
- Outlets, Outlet Boxes, and Pull Boxes
- Circuit Breakers
- Lamps and Lighting Fixtures

SD-03 Product Data

Submit manufacturer's catalog data for the following items:

- Conduits, Raceway sand Fittings
- Wire and Cable
- Splices and Connectors
- Switches
- Receptacles
- Outlets, Outlet Boxes, and Pull Boxes
- Circuit Breakers
- Lamps and Lighting Fixtures
- Spare Parts

Certification

Submittal for vertical assemblies will be reviewed by a licensed Mechanical, Civil or Structural Engineer to determine that the entire assembly will withstand 135 mph wind loading.

SD-06 Test Reports and Records

Continuity Test
Phase-Rotation Tests
Insulation Resistance Test

SD-08 Manufacturer's Instructions

Submit **Manufacturer's Instructions**.

1.3 PREVENTION OF CORROSION

Protect metallic materials against corrosion. Provide equipment enclosures with the standard finish by the manufacturer when used for most indoor installations. Do not use aluminum when in contact with earth or concrete and, where connected to dissimilar metal, protect by approved fittings and treatment. Ferrous metals such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous **spare parts** not of corrosion-resistant steel shall be hot-dip galvanized except where other equivalent protective treatment is specifically approved in writing.

1.4 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in **IEEE Std 100**.
- b. The technical sections referred to herein are those specification sections that describe products, installation procedures, and equipment operations and that refer to this section for detailed description of submittal types.

1.5 GENERAL REQUIREMENTS

Submit **Material, Equipment, and Fixture Lists** for the following items showing manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Submit **Manufacturer's Instructions** including special provisions required to install equipment components and system packages. Special notices shall detail impedances, hazards and safety precautions.

Submit **Certification** required to install equipment components and system packages.

1.6 POSTED OPERATING INSTRUCTIONS

Provide for each system and principal item of equipment as specified in the technical sections for use by operation and maintenance personnel. The operating instructions shall include the following:

- a. Wiring diagrams, control diagrams, and control sequence for each

principal system and item of equipment.

- b. Start up, proper adjustment, operating, lubrication, and shutdown procedures.
- c. Safety precautions.
- d. The procedure in the event of equipment failure.
- e. Other items of instruction as recommended by the manufacturer of each system or item of equipment.

Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to the weather, provide weather-resistant materials or weatherproof enclosures. Operating instructions shall not fade when exposed to sunlight and be secured to prevent easy removal or peeling.

1.7 MANUFACTURER'S NAMEPLATE

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

PART 2 PRODUCTS

2.1 MATERIALS

Materials and equipment to be provided shall be the standard cataloged products of manufacturers regularly engaged in the manufacture of the products.

2.1.1 Rigid Steel Conduit

Rigid steel conduit shall comply with [UL 6](#) and be galvanized by the hot-dip process. Rigid steel conduit shall be polyvinylchloride (PVC) coated in accordance with [NEMA RN 1](#), where underground and in corrosive areas, or must be painted with bitumastic.

Fittings for rigid steel conduit shall be threaded.

Gaskets shall be solid. Conduit fittings with blank covers shall have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Covers shall have captive screws and be accessible after the work has been completed.

2.1.2 Electrical Metallic Tubing (EMT)

EMT shall be in accordance with [UL 797](#) and be zinc coated steel. Couplings and connectors shall be zinc-coated, raintight, gland compression with insulation throat. Crimp, spring, or setscrew type fittings are not acceptable.

2.1.3 Flexible Metallic Conduit

Flexible metallic conduit shall comply with **UL 1** and be galvanized steel.

Fittings for flexible metallic conduit shall be specifically designed for such conduit.

Provide liquidtight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

Specifically design fittings for liquidtight flexible metallic conduit for such conduit.

2.1.4 Rigid Nonmetallic Conduit

Rigid nonmetallic conduit shall comply with **NEMA TC 2** and **NEMA TC 3** with wall thickness not less than Schedule 40.

2.1.5 Wireways and Auxiliary Gutters

Wireway and auxiliary gutters shall be a minimum 4- by 4 inch trade size conforming to **UL 870**.

2.2 WIRE AND CABLE

Conductors installed in conduit shall be copper 600-volt type THHN or THWN. All conductors **AWG No. 8** and larger, shall be stranded. All conductors smaller than **AWG No. 8** shall be stranded.

Flexible cable shall be Type SO and contain a grounding conductor with green insulation.

Conductors installed in plenums shall be marked plenum rated.

2.3 SPLICES AND CONNECTORS

Make all splices in **AWG No. 8** and smaller with approved insulated electrical type.

Make all splices in **AWG No. 6** and larger with bolted clamp-type connectors. Joints shall be wrapped with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

2.4 SWITCHES

2.4.1 Safety Switches

Safety switches shall comply with **NEMA KS 1**, and be the heavy-duty type with enclosure, voltage, current rating, number of poles, and fusing as indicated. Switch construction shall be such that, when the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device shall be coinproof and be so constructed that an external tool shall be used to open the cover. Make provisions to lock the handle in the "OFF" position, but the switch shall not be capable of being locked in the "ON" position.

Provide switches of the quick-make, quick-break type. Approve terminal lugs for use with copper conductors.

Safety color coding for identification of safety switches shall conform to [NEMA Z535.1](#).

2.4.2 Toggle Switches

Toggle switches shall comply with [EIA 480](#), control fluorescent lighting fixtures and be of the heavy duty, general purpose, noninterchangeable flush-type.

Toggle switches shall be commercial grade toggle type, single-pole, three-way two-position devices rated 20 amperes at 277 volts, 60 hertz alternating current (ac) only.

All toggle switches shall be products of the same manufacturer.

2.5 RECEPTACLES

[Receptacles](#) shall be commercial grade, 20A, 125 VAC, 2-pole, 3-wire duplex conforming to [NEMA WD 6](#), NEMA 5-20R.

2.6 OUTLETS, OUTLET BOXES, AND PULL BOXES

Outlet boxes for use with conduit systems shall be in accordance with [NEMA FB 1](#) and [NEMA OS 1](#) and be not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

2.7 CIRCUIT BREAKERS

Circuit-breaker interrupting rating shall be not less than those indicated and in no event less than 22,000 amperes root-mean-square (rms) symmetrical at 208 volts, respectively. Multipole circuit breakers shall be the common-trip type with a single handle. Molded case circuit breakers shall be bolt-on type conforming to [UL 489](#).

2.8 LAMPS AND LIGHTING FIXTURES

Manufacturers and catalog numbers shown are indicative of the general type desired and are not intended to restrict the selection to fixtures of any particular manufacturer. Fixtures with the same salient features and equivalent light distribution and brightness characteristics, of equal finish and quality, are acceptable. Provide lamps of the proper type and wattage for each fixture.

Ballasts shall be high power factor and be energy efficient. Ballasts shall have a Class P terminal protective device for 120-volt operation as indicated and be rapid-start fluorescent. Ballasts shall be "A" sound rated. Fluorescent lamps shall be standard reduced wattage type.

PART 3 EXECUTION

3.1 CONDUITS, RACEWAYS AND FITTINGS

Conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of three 90-degree bends, including those bends located immediately at the outlet or fitting.

Do not install crushed or deformed conduit. Avoid trapped conduit runs

where possible. Take care to prevent the lodgment of foreign material in the conduit, boxes, fittings, and equipment during the course of construction. Clear any clogged conduit of obstructions or be replaced.

Conduit and raceway runs concealed in or behind walls, above ceilings, or exposed on walls and ceilings 5 feet or more above finished floors and not subject to mechanical damage may be electrical metallic tubing (EMT).

3.1.1 Rigid Steel Conduit

Make field-made bends and offsets with approved hickey or conduit bending machine. Conduit elbows larger than 2-1/2 inches shall be long radius.

Provide all conduit stubbed-up through concrete floors for connections to free-standing equipment with the exception of motor-control centers, cubicles, and other such items of equipment, with a flush coupling when the floor slab is of sufficient thickness. Otherwise, provide a floor box set flush with the finished floor. Conduits installed for future use shall be terminated with a coupling and plug set flush with the floor.

3.1.2 Electrical Metallic Tubing (EMT)

EMT shall be grounded in accordance with CEC, using pressure grounding connectors especially designed for EMT.

3.1.3 Flexible Metallic Conduit

Use flexible metallic conduit to connect recessed fixtures from outlet boxes in ceilings, transformers, and other approved assemblies.

Bonding wires shall be used in flexible conduit as specified in CEC, for all circuits. Flexible conduit shall not be considered a ground conductor.

Electrical connections to vibration-isolated equipment shall be made with flexible metallic conduit.

Liquidtight flexible metallic conduit shall be used in wet and oily locations and to complete the connection to motor-driven equipment.

3.1.4 Rigid Nonmetallic Conduit

Rigid PVC conduit shall be direct buried.

A green insulated copper grounding conductor shall be in conduit with conductors and be solidly connected to ground at each end. Grounding wires shall be sized in accordance with CEC.

3.1.5 Wireway and Auxiliary Gutter

Straight sections and fittings shall be bolted together to provide a rigid, mechanical connection and electrical continuity. Dead ends of wireways and auxiliary gutters shall be closed. Plug all unused conduit openings.

Wireways for overhead distribution and control circuits shall be supported at maximum 5-foot intervals.

Auxiliary gutters used to supplement wiring spaces for equipment not contained in a single enclosure shall contain no switches, overcurrent devices, appliances, or apparatus and be not more than 30 feet long.

3.2 WIRING

Feeder and branch circuit conductors shall be color coded as follows:

<u>CONDUCTOR</u>	<u>COLOR 480Y/277VAC</u>	<u>COLOR 208Y/120VAC</u>
Phase A	Brown	Black
Phase B	Orange	Red
Phase C	Yellow	Blue
Neutral	White	White
Equipment Grounds	Green	Green

Conductors up to and including **AWG No. 2** shall be manufactured with colored insulating materials. Conductors larger than **AWG No. 2** shall have ends identified with color plastic tape in outlet, pull, or junction boxes.

Splice in accordance with the **CEC**. Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Terminal and conductor identification shall match as indicated.

Where several feeders pass through a common pullbox, the feeders shall be tagged to clearly indicate the electrical characteristics, circuit number, and panel designation.

3.3 SAFETY SWITCHES

Securely fasten switches to the supporting structure or wall, utilizing a minimum of four **1/4 inch** bolts. Do not use sheet metal screws and small machine screws for mounting. Do not mount switches in an inaccessible location or where the passageway to the switch may become obstructed. Mounting height shall be **5 feet** above floor level, when possible.

3.4 WIRING DEVICES

3.4.1 Wall Switches and Receptacles

Install wall switches and receptacles so that when device plates are applied, the plates will be aligned vertically to within **1/16 inch**.

Ground terminal of each flush-mounted receptacle shall be bonded to the outlet box with an approved green bonding jumper when used with dry wall type construction.

3.4.2 Device Plates

Device plates for switches that are not within sight of the loads controlled shall be suitably engraved with a description of the loads.

Device plates and receptacle cover plates for receptacles other than 125-volt, single-phase, duplex, convenience outlets shall be suitably marked, showing the circuit number, voltage, frequency, phasing, and amperage available at the receptacle. Required marking shall consist of a self-adhesive label having **1/4 inch** embossed letters.

Device plates for convenience outlets shall be similarly marked indicating the supply panel and circuit number.

3.5 BOXES AND FITTINGS

Furnish and install pullboxes where necessary in the conduit system to facilitate conductor installation. Conduit runs longer than 100 feet or with more than three right-angle bends shall have a pullbox installed at a convenient intermediate location.

Securely mount boxes and enclosures to the building structure with supporting facilities independent of the conduit entering or leaving the boxes.

Mounting height of wall-mounted outlet and switch boxes, measured between the bottom of the box and the finished floor, shall be in accordance with ICC A117.1 and as follows:

<u>LOCATION</u>	<u>MOUNTING HEIGHT</u>
Receptacles in offices	18 inches
Receptacles in corridors	18 inches
Receptacles in shops & laboratories	48 inches
Receptacles in rest rooms	48 inches
Switches for light control	48 inches

3.6 LAMPS AND LIGHTING FIXTURES

Install new lamps of the proper type and wattage in each fixture. Securely fasten fixtures and support to structural members and install parallel and perpendicular to major axes of structures.

3.7 IDENTIFICATION PLATES AND WARNINGS

Furnish and install identification plates for lighting and power panelboards, motor control centers, all line voltage heating and ventilating control panels, fire detector and sprinkler alarms, door bells, pilot lights, disconnect switches, manual starting switches, and magnetic starters. Process control devices and pilot lights shall have identification plates.

Furnish identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. Circuits 480 volts and above shall have conspicuously located warning signs in accordance with OSHA requirements.

3.8 FIELD TESTING

Submit Test Reports in accordance with referenced standards in this section.

After completion of the installation and splicing, and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified before the conductors are energized.

Contractor shall provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices shall be used to isolate the circuits under test.

Perform [Insulation-Resistance Test](#) on each field-installed conductor with respect to ground and adjacent conductors. Applied potential shall be 500 volts dc for 300 volt rated cable and 1000 volts dc for 600 volt rated cable. Take readings after 1 minute and until the reading is constant for 15 seconds. Minimum insulation-resistance values shall not be less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable. For circuits with conductor sizes 8AWG and smaller insulation resistance testing is not required.

Perform [Continuity Test](#) to insure correct cable connection (i.e correct phase conductor, grounded conductor, and grounding conductor wiring) end-to-end. Any damages to existing or new electrical equipment resulting from contractor mis-wiring will be repaired and re-verified at contractor's expense. All repairs shall be approved by the CO prior to acceptance of the repair.

Conduct [Phase-Rotation Tests](#) on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment clockwise, facing the source.

Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved by the CO.

-- End of Section --

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SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT

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- 3.2 LIGHTING FIXTURES ON BUILDINGS
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-- End of Section Table of Contents --

SECTION 26 05 48.00 10

SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT

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.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC 325-05 (2006) Steel Construction Manual,
Thirteenth Edition

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-310-04 (2007; R 1/27/10) Seismic Design for
Buildings

UNDERWRITERS LABORATORIES (UL)

UL 1598 (2008) Standard for Luminaires

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the electrical equipment and systems listed below.

1.2.2 Electrical Equipment

Electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

- Control Panels
- Pumps with Motors
- Light Fixtures
- Air Handling Units
- Storage Racks

1.2.3 Electrical Systems

The following electrical systems shall be installed as required on the drawings and other sections of these specifications and shall be seismically protected in accordance with this specification:

1.2.4 Contractor Designed Bracing

The Contractor shall design the bracing in accordance with **UFC 3-310-04** and additional data furnished by the Contracting Officer. Resistance to lateral forces induced by earthquakes shall be accomplished without

consideration of friction resulting from gravity loads. UFC 3-310-04 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using UFC 3-310-04 are based on strength design; therefore, AISC 325-05 shall be used for the design. The bracing for the following electrical equipment and systems shall be developed by the Contractor.

1.2.5 Conduits Requiring No Special Seismic Restraints

Seismic restraints may be omitted from electrical conduit less than 2-1/2 inches trade size. All other interior conduit, shall be seismically protected as specified.

1.3 EQUIPMENT REQUIREMENTS

1.3.1 Rigidly Mounted Equipment

The electrical equipment to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in UFC 3-310-04. Each item of rigid electrical equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

1.3.2 Nonrigid or Flexibly-Mounted Equipment

Electrical equipment to be furnished shall be constructed and assembled to resist a horizontal lateral force of the operating weight of the equipment at the vertical center of gravity of the equipment.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Drawings

Lighting Fixtures Equipment Requirements

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Lighting Fixtures; G Equipment Requirements; G

Copies of the design calculations with the detail drawings.

Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

Contractor Designed Bracing; G

Copies of the Design Calculations with the Drawings. Calculations shall be approved, certified, stamped and signed by a Registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

PART 2 PRODUCTS

2.1 LIGHTING FIXTURE SUPPORTS

Lighting fixtures and supports shall conform to [UL 1598](#).

2.2 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be specified per SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

PART 3 EXECUTION

3.1 SWAY BRACES FOR CONDUIT

Conduit shall be braced as for an equivalent weight pipe in accordance with SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

3.2 LIGHTING FIXTURES ON BUILDINGS

Lighting fixtures and supports shall conform to the following:

3.2.1 Surface-Mounted Fixtures

Seismic protection for the fixtures shall conform to the requirements of [UFC 3-310-04](#).

3.2.2 Assembly Mounted on Outlet Box

A supporting assembly, that is intended to be mounted on an outlet box, shall be designed to accommodate mounting features on [4 inch](#) boxes, plaster rings, and fixture studs.

-- End of Section --

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SECTION 26 05 71.00 40

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-- End of Section Table of Contents --

SECTION 26 05 71.00 40

LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES

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 A 48/A 48M (2003; R 2008) Standard Specification for Gray Iron Castings

IPC - ASSOCIATION CONNECTING ELECTRONICS INDUSTRIES (IPC)

IPC D330 (1992) Switches

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA AB 1 (2002) Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures

NEMA AB 3 (2001) Molded Case Circuit Breakers and Their Application

NEMA C78.23 (1995; R 2003) Standard for Incandescent Lamps - Miscellaneous Types

NEMA ICS 1 (2000; R 2008) Industrial Control and Systems: General Requirements

NEMA ICS 2 (2000; R 2005; Errata 2006) Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts

NEMA ICS 6 (1993; R 2006) Industrial Controls and Systems Enclosures

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC (2007) California Electrical Code

UNDERWRITERS LABORATORIES (UL)

UL 489 (2009) Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures

UL 508

(1999; Rev thru Sep 2008) Standard for
Industrial Control Equipment

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that reviews the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Prior to the beginning of construction, submit manufactures equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details.

SD-02 Drawings

Submit [Connection Diagrams](#) and [Fabrication Drawings](#) for the following items in accordance with paragraph entitled, "General Requirements," of this section.

Submit Installation drawings for the following items in accordance with the paragraph entitled, "Installation," of this section.

[Control Devices](#)
[Protective Devices](#)

SD-03 Product Data

Submit manufacturer's equipment and performance data for the following items including use life, system functional flows, safety features, and mechanical automated details.

[Motor Control](#)
[Enclosures](#)
[Circuit Breakers](#)
[Control Devices](#)
[Indicating Lights](#)

SD-07 Certificates

Submit certificates for [Circuit Tests](#) on similar motor-control or submit motor-circuit protector (MCP) units under actual conditions in lieu of factory tests on the actual units provided. Also include [dielectric tests](#).

SD-08 Manufacturer's Instructions

Submit manufacturer's instructions for the following items, including special provisions required to install equipment components and system packages. Provide detail on resistance impedances, hazards and safety precautions within the special notices.

[Control Devices](#)

Protective Devices

SD-10 Operation and Maintenance Data

Submit Operation and Maintenance Manuals for the following equipment:

Magnetic Motor Controllers
Combination Motor Controllers
Circuit Breakers

1.3 GENERAL REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS applies to work specified in this section.

Submit [Connection Diagrams](#) showing the relations and connections of control devices and protective devices by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit [Fabrication Drawings](#) for control devices and protective devices consisting of fabrication and assembly details to be performed in the factory.

PART 2 PRODUCTS

2.1 MOTOR CONTROL

Conform to [NEMA ICS 1](#), [NEMA ICS 2](#), and [UL 508](#) for motor controllers. Provide controllers that have thermal overload protection in each phase.

2.1.1 Magnetic Motor Controllers

2.1.1.1 Full-Voltage Controllers

Provide full-voltage, full magnetic devices in accordance with [NEMA ICS 1](#), [NEMA ICS 2](#), and [UL 508](#) for magnetic motor controllers for the control and protection of three-phase, 60-hertz, squirrel-cage induction motors.

Provide operating coil assembly that operates satisfactorily between 85 and 110 percent of rated coil voltage. Provide 120 volts, 60 hertz motor control circuits.

Provide controller with two normally open and two normally closed auxiliary contacts rated per [NEMA ICS 1](#) and [NEMA ICS 2](#) in addition to the sealing-in contact for control circuits.

Provide solderless pressure wire terminal connectors for line-and load-connections to controllers.

Include three manual reset thermal overload devices for overcurrent protection, one in each pole of the controller. Provide thermal overload relays of bimetallic nonadjustable type with continuous current ratings and service-limit current ratings, and with a plus or minus 15 percent adjustment to compensate for ambient operating conditions.

Provide an externally operable manual-reset button to re-establish control power to the holding coil of the electromagnet. After the controller has

tripped from overload, ensure that resetting the motor-overload device does not restart the motor.

Provide enclosure in accordance with NEMA 250, Type 4.

2.1.1.2 Combination Motor Controllers

Following requirements are in addition to the requirements specified for magnetic motor controller:

Provide combination motor controllers for the control and protection of three-phase 60-hertz alternating-current squirrel-cage induction motors with branch-circuit disconnecting and protective devices in accordance with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6.

For combination motor controllers include magnetic motor controllers and molded-case circuit breakers or MCP in metal enclosures in accordance with NEMA 250 or motor-control center draw-out assemblies with control-power transformers, selector switches, pushbuttons, and indicating lights as follows:

Provide full-voltage, full-magnetic devices as specified in this section under paragraph entitled, "Remote-Control Station Enclosures." for magnetic motor controllers and enclosures.

Provide thermal-magnetic breakers as specified in paragraph entitled, "Manual Motor Controllers." for molded-case circuit breakers. Manufacturer's standard MCP may be used in lieu of molded-case circuit breakers.

Provide control-power transformers 120-volt ac maximum, selector switches, pushbuttons, and pilot lights as required.

Identify combination motor controllers with identification plates affixed to front cover of the controller.

2.1.2.1 Nonreversing Combination Motor Controllers

Following requirements are in addition to the requirements for magnetic motor controllers:

For nonreversing combination motor controllers for the control and protection of single-speed squirrel-cage induction motors, include a magnetic controller with molded-case circuit breaker or MCP with selector switch or start/stop pushbutton and indicating light in the cover of the enclosure.

Provide rating of three-phase single-speed full-voltage magnetic controllers for nonplugging and nonjogging duty in accordance with NEMA ICS 1 and NEMA ICS 2.

Provide wiring and connections for full-voltage single-speed magnetic controllers in accordance with NEMA ICS 1 and NEMA ICS 2.

2.2 ENCLOSURES

2.2.1 Equipment Enclosures

Provide enclosures for equipment in accordance with NEMA 250.

Contain equipment installed inside, clean, dry locations in a NEMA Type 1, general-purpose sheet-steel enclosure.

Contain equipment installed in wet locations in a NEMA Type 4 watertight, corrosion-resistant sheet-steel enclosure, constructed to prevent entrance of water when tested in accordance with NEMA ICS 6 for Type 4 enclosures.

Provide cast-iron enclosures from gray-iron castings conforming to ASTM A 48/A 48M with tensile-strength classification recognized as suitable for the application. Provide cast metal enclosures that are not less than 1/8-inch thick at every point, of greater thickness at reinforcing ribs and door edges, and not less than 1/4-inch thick at tapped holes for conduits.

2.3 CIRCUIT BREAKERS

Provide circuit breakers that conform to UL 489, NEMA AB 1, and NEMA AB 3.

2.3.1 Molded-Case Circuit Breakers

Provide molded case, manually operated, trip-free, circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection as required. Completely enclose circuit breakers in a molded case, with the calibrated sensing element factory-sealed to prevent tampering.

Locate thermal-magnetic tripping elements in each pole of the circuit breaker, and provide inverse-time-delay thermal overload protection and instantaneous magnetic short-circuit protection. Provide instantaneous magnetic tripping element, that is adjustable and accessible from the front of the breaker on frame sizes larger than 100 amperes.

Size breaker as required for the continuous current rating of the circuit. Provide breaker class as required.

Provide sufficient interrupting capacity of the panel and lighting branch circuit breakers, to successfully interrupt the maximum short-circuit current imposed on the circuit at the breaker terminals. Provide circuit breaker interrupting capacities with a minimum of 22,000 amperes at 208Y/120V and 42,000 at 480Y/277V.

Provide the common-trip type multipole circuit breakers having a single operating handle and a two-position on/off indication. Provide circuit breakers with temperature compensation for operation in an ambient temperature of 104 degrees F. Provide circuit breakers that have root mean square (rms) symmetrical interrupting ratings sufficient to protect the circuit being supplied. Interrupting ratings may have selective type tripping (time delay, magnetic, thermal, or ground fault).

Provide phenolic composition breaker body capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required.

Provide circuit breakers used for meter circuit disconnects that meet the applicable requirements of CEC and that are of the motor-circuit protector type.

For circuit breakers used for service disconnection, provide an enclosed circuit-breaker type with external handle for manual operation. Provide

sheet metal enclosures with a hinged cover suitable for surface mounting.

2.3.2 Enclosed Molded-Case Circuit Breakers

For enclosed circuit breakers, provide thermal-magnetic molded-case circuit breakers in surface-mounted, nonventilated enclosures conforming to the appropriate articles of [NEMA 250](#) and [NEMA AB 1](#).

Provide enclosed circuit breakers in nonhazardous locations as follows:

Contain circuit breakers installed inside clean, dry locations in NEMA Type 1, general purpose sheet steel enclosures.

Contain circuit breakers installed in unprotected outdoor locations, in NEMA Type 3R, weather-resistant sheet steel enclosures that are splashproof, weatherproof, sleetproof, and moisture resistant.

Contain circuit breakers installed in wet locations, in NEMA Type 4, watertight corrosion-resistant sheet steel enclosures constructed to prevent entrance of water.

Contain circuit breakers installed in wet locations 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.

Provide cast-iron enclosures of gray-iron castings conforming to [ASTM A 48/A 48M](#) with tensile strength classification suitable for this application. Provide cast metal enclosures that are not less than 1/8-inch thick at every point, of greater thickness at reinforcing ribs and door edges, and not less than 1/4-inch thick at tapped holes for conduits.

2.4 CONTROL DEVICES

2.4.1 Magnetic Contactors

Provide magnetic contactors in accordance with [NEMA ICS 1](#) and [NEMA ICS 2](#) as required for the control of low-voltage, 60-hertz, tungsten-lamp loads, fluorescent-lamp loads, resistance-heating loads, and the primary windings of low-voltage transformers.

Provide core-and-coil assembly that operates satisfactorily with coil voltage between 85 and 110 percent of its voltage rating.

Provide contactor that is designed with a normally open holding circuit auxiliary contact for control circuits, with a rating in accordance with [NEMA ICS 1](#) and [NEMA ICS 2](#).

Furnish solderless pressure wire terminal connectors, or make available for line-and-load connections to contactors in accordance with [NEMA ICS 1](#) and [NEMA ICS 2](#).

Provide magnetic contactors with a rating in accordance with [NEMA ICS 1](#) and [NEMA ICS 2](#).

2.4.2 Control-Circuit Transformers

Provide control-circuit transformers within the enclosure of magnetic contactors and motor controllers when the line voltage is in excess of 120

volts. Provide encapsulated dry type, single-phase, 60-hertz transformer, with a 120-volt (or 24-volt) isolated secondary winding.

Do not provide a transformer with a rated primary voltage less than the rated voltage of the controller, or a rated secondary current less than the continuous-duty current of the control circuit.

Provide voltage regulation of the transformer such that, with rated primary voltage and frequency, the secondary voltage is not less than 95 percent nor more than 105 percent of rated secondary voltage.

Provide source of supply for control-circuit transformers at the load side of the main disconnecting device. Protect secondary winding of the transformer and control-circuit wiring against overloads and short circuits, with fuses selected in accordance with NEMA ICS 6. Ground secondary winding of the control-circuit transformer in accordance with NEMA ICS 6.

2.4.3 Magnetic Control Relays

Provide magnetic control relays for energizing and de-energizing the coils of magnetic contactors or other magnetically operated devices, in response to variations in the conditions of electric control devices in accordance with NEMA ICS 1, and NEMA ICS 2.

Provide core-and-coil assembly that operates satisfactorily with coil voltages between 85 and 110 percent of their voltage rating.

Provide relays that are designed to accommodate normally open and normally closed contacts.

Provide 120-volt, 60-hertz, Class AIB magnetic control relays with a continuous contact rating of 10 amperes, and with current-making and -breaking ability in accordance with NEMA ICS 1 and NEMA ICS 2, two normally open and two normally closed.

2.4.4 Pushbuttons and Switches

2.4.4.1 Pushbuttons

For pushbuttons for low-voltage ac full-voltage magnetic controllers, provide heavy-duty oiltight NEMA 250, Type 12, momentary-contact devices rated 600 volts, with pilot light, and with the number of buttons and the marking of identification plates as shown. Furnish pushbutton color code in accordance with NEMA ICS 6.

Provide pushbuttons that are designed with normally open, circuit-closing contacts; normally closed circuit-opening contacts; and two-circuit normally open and normally closed circuit-closing and -opening contacts. Provide pushbutton-contact ratings in accordance with NEMA ICS 1 and NEMA ICS 2 with contact designation A600.

Identify pushbuttons in remote control stations with identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the identification plate.

2.4.4.2 Selector Switches

Provide heavy-duty oiltight maintained-contact selector switches for

low-voltage control circuits, with the number of positions and the marking of identification plates in accordance with [NEMA ICS 1](#) and [NEMA ICS 2](#).

Identify selector switches in remote control stations with engraved identification plates affixed to front cover in a prominent location. Carry the identification of the system being controlled on the identification plate.

2.4.4.3 Miscellaneous Switches

Provide float, limit, door, pressure, proximity, and other types of switches in accordance with [IPC D330](#) and of the types and classes indicated.

2.5 FACTORY TESTING

Perform factory tests on control and low voltage protective devices in accordance with the manufacturer's recommendations.

Conduct short-circuit tests in accordance with Section 2 of [NEMA ICS 1](#).

2.6 INDICATING LIGHTS

2.6.1 General-Purpose Type

For indicating lights, provide oiltight instrument devices with threaded base and collar for flush-mounting, translucent convex lens, candelabra screw-base lampholder, and 120-volt, 6-watt, Type S-6 incandescent lamp in accordance with [NEMA C78.23](#). Provide indicating lights color coded in accordance with [NEMA ICS 6](#).

Provide indicating lights in remote-control stations when pushbuttons and selector switches are out of sight of the controller.

2.6.2 Switchboard Indicating Lights

For switchboard indicating lights, provide the manufacturer's standard transformer type units 120-volt input utilizing low-voltage lamps and convex lenses of the colors indicated. Provide indicating lights that are capable of being relamped from the switchboard front. Indicating lights utilizing resistors in series with the lamps are not permitted except in direct-current control circuits. Provide lights that have a press-to-test feature.

2.7 FINISH

Protect metallic materials against corrosion. Provide equipment with the standard finish by the manufacturer when used for most indoor installations.

PART 3 EXECUTION

3.1 INSTALLATION

Install [Control devices](#) and [protective devices](#) that are not factory installed in equipment, in accordance with the manufacturer's recommendations and field adjusted and operation tested. Conform to [CEC](#), [NEMA ICS 1](#) and [NEMA ICS 2](#) requirements for installation of control and protective devices.

3.2 FIELD TESTING

Demonstrate to operate as indicated control and protective devices not factory installed in equipment.

Ratio and verify tap settings of instrumentation, potential, and current transformers.

Do not energize control and protective devices until recorded test data has been approved. Provide final test reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Reports - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

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SECTION 26 29 23

VARIABLE FREQUENCY DRIVE SYSTEMS UNDER 600 VOLTS

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.

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

- IEEE 519 (1992; R 1993; Errata 2004) Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems
- IEEE C62.41.1 (2002; R 2008) Guide on the Surges Environment in Low-Voltage (1000 V and Less) AC Power Circuits
- IEEE C62.41.2 (2002) Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)
- NEMA ICS 1 (2000; R 2008) Industrial Control and Systems: General Requirements
- NEMA ICS 3.1 (2009) Guide for the Application, Handling, Storage, Installation and Maintenance of Medium-Voltage AC Contactors, Controllers and Control Centers
- NEMA ICS 6 (1993; R 2006) Industrial Controls and Systems Enclosures
- NEMA ICS 7 (2006) Adjustable-Speed Drives

CALIFORNIA CODE OF REGULATIONS (CCR)

- CEC (2007) California Electrical Code

U.S. DEPARTMENT OF DEFENSE (DOD)

- MIL-STD-461 (2007; Rev F) Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

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

47 CFR 15

Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 489

(2009) Molded-Case Circuit Breakers,
Molded-Case Switches and Circuit-Breaker
Enclosures

UL 508C

(2002; R thru 2010) Power Conversion
Equipment

1.2 RELATED REQUIREMENTS

Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS.

1.3 SYSTEM DESCRIPTION

1.3.1 Performance Requirements

1.3.1.1 Electromagnetic Interference Suppression

Computing devices, as defined by 47 CFR 15, MIL-STD-461 rules and regulations, shall be certified to comply with the requirements for class A computing devices and labeled as set forth in part 15.

1.3.1.2 Electromechanical and Electrical Components

Electrical and electromechanical components of the Variable Frequency Drive (VFD) shall not cause electromagnetic interference to adjacent electrical or electromechanical equipment while in operation.

1.3.2 Electrical Requirements

1.3.2.1 Power Line Surge Protection

IEEE C62.41.1 and IEEE C62.41.2, IEEE 519 Control panel shall have surge protection, included within the panel to protect the unit from damaging transient voltage surges. Surge arrestor shall be mounted near the incoming power source and properly wired to all three phases and ground. Fuses shall not be used for surge protection.

1.3.2.2 Sensor and Control Wiring Surge Protection

I/O functions as specified shall be protected against surges induced on control and sensor wiring installed outdoors and as shown. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

- a. A 10 microsecond by 1000 microsecond waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An 8 microsecond by 20 microsecond waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation. The

following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Drawings

Schematic diagrams; G

Interconnecting diagrams; G

Installation drawings; G

Submit drawings for government approval prior to equipment construction or integration. Modifications to original drawings made during installation shall be immediately recorded for inclusion into the as-built drawings.

SD-03 Product Data

Variable frequency drives; G

Wires and cables

Equipment schedule

Include data indicating compatibility with motors being driven.

SD-06 Test Reports and Records

VFD Test

Performance Verification Tests

Endurance Test

SD-08 Manufacturer's Instructions

Installation instructions

SD-09 Manufacturer's Field Reports

VFD Factory Test Plan; G

Factory test results

SD-10 Operation and Maintenance Data

Variable frequency drives

- a. Safety precautions
- b. Operator prestart
- c. Startup, shutdown, and post-shutdown procedures
- d. Normal operations
- e. Emergency operations
- f. Operator service requirements
- g. Environmental conditions
- h. Lubrication data
- i. Preventive maintenance plan and schedule
- j. Cleaning recommendations
- k. Troubleshooting guides and diagnostic techniques

- l. Wiring diagrams and control diagrams
- m. Maintenance and repair procedures
- n. Removal and replacement instructions
- o. Spare parts and supply list
- p. Corrective maintenance man-hours
- q. Product submittal data
- r. O&M submittal data
- s. Parts identification
- t. Warranty information
- u. Personnel training requirements
- v. Testing equipment and special tool information
- w. Testing and performance data
- x. Contractor information

Provide service and maintenance information including preventive maintenance, assembly, and disassembly procedures. Include electrical drawings from electrical general sections. Submit additional information necessary to provide complete operation, repair, and maintenance information, detailed to the smallest replaceable unit. Include copies of as-built submittals. Provide routine preventative maintenance instructions, and equipment required. Provide instructions on how to modify program settings, and modify the control program. Provide instructions on drive adjustment, trouble-shooting, and configuration. Provide instructions on process tuning and system calibration.

1.5 QUALITY ASSURANCE

1.5.1 Schematic Diagrams

Show circuits and device elements for each replaceable module. Schematic diagrams of printed circuit boards are permitted to group functional assemblies as devices, provided that sufficient information is provided for government maintenance personnel to verify proper operation of the functional assemblies.

1.5.2 Interconnecting Diagrams

Show interconnections between equipment assemblies, and external interfaces, including power and signal conductors. Include for enclosures and external devices.

1.5.3 Installation Drawings

Show floor plan of each site, with V.F.D.'s and motors indicated. Indicate ventilation requirements, adequate clearances, and cable routes.

1.5.4 Equipment Schedule

Provide schedule of equipment supplied. Schedule shall provide a cross reference between manufacturer data and identifiers indicated in shop drawings. Schedule shall include the total quantity of each item of equipment supplied. For complete assemblies, such as VFD's, provide the serial numbers of each assembly, and a sub-schedule of components within the assembly. Provide recommended spare parts listing for each assembly or component.

1.5.5 Installation instructions

Provide installation instructions issued by the manufacturer of the equipment, including notes and recommendations, prior to shipment to the site. Provide operation instructions prior to acceptance testing.

1.5.6 Factory Test Results

Document test results and submit to government within 7 working days after completion of test.

1.6 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.

1.7 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.

1.8 MAINTENANCE

1.8.1 Spare Parts

Manufacturers provide spare parts in accordance with recommended spare parts list.

1.8.2 Maintenance Support

During the warranty period, the Contractor shall provide on-site, on-call maintenance services by Contractor's personnel on the following basis: The service shall be on a per-call basis with 36 hour response. Contractor shall support the maintenance of all hardware and software of the system. Various personnel of different expertise shall be sent on-site depending on the nature of the maintenance service required. Costs shall include travel, local transportation, living expenses, and labor rates of the service personnel while responding to the service request. The provisions of this Section are not in lieu of, nor relieve the Contractor of, warranty responsibilities covered in this specification. Should the result of the service request be the uncovering of a system defect covered under the warranty provisions, all costs for the call, including the labor necessary to identify the defect, shall be borne by the Contractor.

PART 2 PRODUCTS

2.1 VARIABLE FREQUENCY DRIVES (VFD)

Provide frequency drive to control the speed of induction motor(s). The VFD shall include the following minimum functions, features and ratings.

- a. Input circuit breaker per [UL 489](#) with a minimum of 42,000 amps

symmetrical interrupting capacity and door interlocked external operator.

- b. A converter stage per **UL 508C** shall change fixed voltage, fixed frequency, ac line power to a fixed dc voltage. The converter shall utilize a full wave bridge design incorporating diode rectifiers. Silicon Controlled Rectifiers (SCR) are not acceptable. The converter shall be insensitive to three phase rotation of the ac line and shall not cause displacement power factor of less than 0.98 lagging under any speed and load condition.
- c. An inverter stage shall change fixed dc voltage to variable frequency, variable voltage, ac for application to a standard NEMA design B squirrel cage motor. The inverter shall be switched in a manner to produce a sine coded pulse width modulated (PWM) output waveform.
- d. The VFD shall be capable of supplying 120 percent of rated full load current for one minute at maximum ambient temperature.
- e. The VFD shall be designed to operate from a 480 volt, + or - 10 percent, three phase, 60 Hz supply, and control motors with a corresponding voltage rating.
- f. Acceleration and deceleration time shall be independently adjustable from one second to 60 seconds.
- g. Adjustable full-time current limiting shall limit the current to a preset value which shall not exceed 120 percent of the controller rated current. The current limiting action shall maintain the V/Hz ratio constant so that variable torque can be maintained. Short time starting override shall allow starting current to reach 175 percent of controller rated current to maximum starting torque.
- h. The controllers shall be capable of producing an output frequency over the range of 3 Hz to 60 Hz (20 to one speed range), without low speed cogging. Over frequency protection shall be included such that a failure in the controller electronic circuitry shall not cause frequency to exceed 110 percent of the maximum controller output frequency selected.
- i. Minimum and maximum output frequency shall be adjustable over the following ranges: 1) Minimum frequency 3 Hz to 50 percent of maximum selected frequency; 2) Maximum frequency 40 Hz to 60 Hz.
- j. The controller efficiency at any speed shall not be less than 97 percent.
- k. The controllers shall be capable of being restarted into a motor coasting in the forward direction without tripping.
- l. Protection of power semiconductor components shall be accomplished without the use of fast acting semiconductor output fuses. Subjecting the controllers to any of the following conditions shall not result in component failure or the need for fuse replacement:
 1. Short circuit at controller output
 2. Ground fault at controller output

3. Open circuit at controller output
 4. Input undervoltage
 5. Input overvoltage
 6. Loss of input phase
 7. AC line switching transients
 8. Instantaneous overload
 9. Sustained overload exceeding 115 percent of controller rated current
 10. Over temperature
 11. Phase reversal
- m. Solid state motor overload protection shall be included such that current exceeding an adjustable threshold shall activate a 60 second timing circuit. Should current remain above the threshold continuously for the timing period, the controller will automatically shut down.
- n. A slip compensation circuit shall be included which will sense changing motor load conditions and adjust output frequency to provide speed regulation of NEMA B motors to within + / - 0.5 percent of maximum speed without the necessity of a tachometer generator.
- o. The VFD shall be factory set for manual restart after the first protective circuit trip for malfunction (overcurrent, undervoltage, overvoltage or overtemperature) or an interruption of power. The VFD shall be capable of being set for automatic restart after a selected time delay. If the drive faults again within a specified time period (adjustable 0-60 seconds), a manual restart will be required.
- p. The VFD shall include external fault reset capability. All the necessary logic to accept an external fault reset contact shall be included.
- q. Provide critical speed lockout circuitry to prevent operating at frequencies with critical harmonics that cause resonant vibrations. The VFD shall have a minimum of three user selectable bandwidths.
- r. Provide the following operator control and monitoring devices mounted on the front panel of the VFD:
1. Manual speed potentiometer.
 2. Hand-Off-Auto (HOA) switch.
 3. Power on light.
 4. Drive run power light.
 5. Local display.
- s. Provide properly sized NEMA rated by-pass and isolation contactors to enable operation of motor in the event of VFD failure. Mechanical and

electrical interlocks shall be installed between the by-pass and isolation contactors. Provide a selector switch and transfer delay timer.

2.2 ENCLOSURES

Provide equipment enclosures conforming to NEMA 250, NEMA ICS 7, NEMA ICS 6.

2.3 WIRES AND CABLES

All wires and cables shall conform to NEMA 250, NEMA ICS 7, CEC.

2.4 NAMEPLATES

Nameplates external to NEMA enclosures shall conform with the requirements of Section 26 00 00.00 20 BASIC ELECTRICAL MATERIALS AND METHODS.

Nameplates internal to enclosures shall be manufacturer's standard, with the exception that they must be permanent.

2.5 SOURCE QUALITY CONTROL

2.5.1 VFD Factory Test Plan

To ensure quality, each VFD shall be subject to a series of in-plant quality control inspections before approval for shipment from the manufacturer's facilities. Provide test plans and test reports.

PART 3 EXECUTION

3.1 INSTALLATION

Per NEMA ICS 3.1, install equipment in accordance with the approved manufacturer's printed installation drawings, instructions, wiring diagrams, and as indicated on project drawings and the approved shop drawings. A field representative of the drive manufacturer shall supervise the installation of all equipment, and wiring.

3.2 FIELD QUALITY CONTROL

Specified products shall be tested as a system for conformance to specification requirements prior to scheduling the acceptance tests. Contractor shall conduct performance verification tests in the presence of Government representative, observing and documenting complete compliance of the system to the specifications. Contractor shall submit a signed copy of the test results, certifying proper system operation before scheduling tests.

3.2.1 VFD Test

A proposed test plan shall be submitted to the contracting officer at least 28 calendar days prior to proposed testing for approval. The tests shall conform to NEMA ICS 1, NEMA ICS 7, and all manufacturer's safety regulations. The Government reserves the right to witness all tests and review any documentation. The contractor shall inform the Government at least 14 working days prior to the dates of testing. Contractor shall provide video tapes, if available, of all training provided to the Government for subsequent use in training new personnel. All training aids, texts, and expendable support material for a self-sufficient presentation shall be provided, the amount of which to be determined by the

contracting officer.

3.2.2 Performance Verification Tests

"Performance Verification Test" plan shall provide the step by step procedure required to establish formal verification of the performance of the VFD. Compliance with the specification requirements shall be verified by inspections, review of critical data, demonstrations, and tests. The Government reserves the right to witness all tests, review data, and request other such additional inspections and repeat tests as necessary to ensure that the system and provided services conform to the stated requirements. The contractor shall inform the Government 14 calendar days prior to the date the test is to be conducted.

3.2.3 Endurance Test

Immediately upon completion of the performance verification test, the endurance test shall commence. The system shall be operated at varying rates for not less than 192 consecutive hours, at an average effectiveness level of 0.9998, to demonstrate proper functioning of the complete PCS. Continue the test on a day-to-day basis until performance standard is met. During the endurance test, the contractor shall not be allowed in the building. The system shall respond as designed.

3.3 DEMONSTRATION

3.3.1 Training

Coordinate training requirements with the Contracting Officer.

3.3.1.1 Instructions to Government Personnel

Provide the services of competent instructors who will give full instruction to designated personnel in operation, maintenance, calibration, configuration, and programming of the complete control system. Orient the training specifically to the system installed. Instructors shall be thoroughly familiar with the subject matter they are to teach. The Government personnel designated to attend the training will have a high school education or equivalent. The number of training days of instruction furnished shall be as specified. A training day is defined as eight hours of instruction, including two 15-minute breaks and excluding lunch time; Monday through Friday. Provide a training manual for each student at each training phase which describes in detail the material included in each training program. Provide one additional copy for archiving. Provide equipment and materials required for classroom training. Provide a list of additional related courses, and offers, noting any courses recommended. List each training course individually by name, including duration, approximate cost per person, and location of course. Unused copies of training manuals shall be turned over to the Government at the end of last training session.

3.3.1.2 Operating Personnel Training Program

Provide one 2 hour training session at the site at a time and place mutually agreeable between the Contractor and the Government. Provide session to train 4 operation personnel in the functional operations of the system and the procedures that personnel will follow in system operation. This training shall include:

- a. System overview
- b. General theory of operation
- c. System operation
- d. Alarm formats
- e. Failure recovery procedures
- f. Troubleshooting

3.3.1.3 Engineering/Maintenance Personnel Training

Accomplish the training program as specified. Training shall be conducted on site at a location designated by the Government. Provide a one day training session to train 4 engineering personnel in the functional operations of the system. This training shall include:

- a. System overview
- b. General theory of operation
- c. System operation
- d. System configuration
- e. Alarm formats
- f. Failure recovery procedures
- g. Troubleshooting and repair
- h. Maintenance and calibration
- i. System programming and configuration

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SECTION 26 56 00

EXTERIOR LIGHTING

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.

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA HB-9 (2000; Errata 2004; Errata 2005; Errata 2006) IES Lighting Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 100 (2000; Archived) The Authoritative Dictionary of IEEE Standards Terms

IEEE C2 (2007) National Electrical Safety Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C136.3 (2005) American National Standard for Roadway and Area Lighting Equipment Luminaire Attachments

NEMA 250 (2008) Enclosures for Electrical Equipment (1000 Volts Maximum)

NEMA ICS 2 (2000; R 2005; Errata 2006) Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts

NEMA ICS 6 (1993; R 2006) Industrial Controls and Systems Enclosures

CALIFORNIA CODE OF REGULATIONS (CCR)

CEC (2007) California Electrical Code

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

Energy Star (1992; R 2006) Energy Star Energy Efficiency Labeling System

UNDERWRITERS LABORATORIES (UL)

UL 1598 (2008) Standard for Luminaires

UL 773 (1995; R 1994 thru 2002) Standard for Plug-In Locking Type Photocontrols for Use

with Area Lighting

UL 773A

(2006) Standard for Nonindustrial
Photoelectric Switches for Lighting Control

1.2 DEFINITIONS

- a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, shall be as defined in IEEE 100.
- b. Average life is the time after which 50 percent will have failed and 50 percent will have survived under normal conditions.
- c. Groundline section is that portion between one foot above and 2 feet below the groundline.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Drawings

Luminaire drawings; G

SD-03 Product Data

Local/Regional Materials

Submit documentation indicating distance between manufacturing facility and the project site. Indicate distance of raw material origin from the project site. Indicate relative dollar value of local/regional materials to total dollar value of products included in project.

Energy Efficiency

Luminaires; G

Lamps;

Ballasts; G

Lighting contactor; G

Time switch; G

Photocell switch; G

Brackets

SD-05 Design Data

Design Data for luminaires; G

SD-06 Test Reports and Records

Operating test

Submit operating test results as stated in paragraph entitled "Field Quality Control."

SD-10 Operation and Maintenance Data

Operational Service

Submit documentation that includes contact information, summary of procedures, and the limitations and conditions applicable to the project. Indicate manufacturer's commitment to reclaim materials for recycling and/or reuse.

1.4 QUALITY ASSURANCE

1.4.1 Drawing Requirements

1.4.1.1 Luminaire Drawings

Include dimensions, effective projected area (EPA), accessories, and installation and construction details. Photometric data, including zonal lumen data, average and minimum ratio, aiming diagram, and computerized candlepower distribution data shall accompany shop drawings.

1.4.2 Design Data for Luminaires

- a. Distribution data according to IESNA classification type as defined in IESNA HB-9.
- b. Computerized horizontal illumination levels in footcandles at ground level, taken every 10 feet. Include average maintained footcandle level and maximum and minimum ratio.
- c. Amount of shielding on luminaires.

1.5 SUSTAINABLE DESIGN REQUIREMENTS

1.5.1 Local/Regional Materials

Use materials or products extracted, harvested, or recovered, as well as manufactured, within a 500 mile radius from the project site, if available from a minimum of three sources.

1.5.2 Energy Efficiency

Comply with National Energy Policy Act and Energy Star requirements for lighting products. Submit documentation for Energy Star qualifications for equipment provided under this section. Submit data indicating lumens per watt efficiency and color rendition index of light source.

1.6 WARRANTY

The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis

during the warranty period of the contract.

1.7 POWER SOURCE

Use existing electrical night panel "300" located in Bldg. N231.

1.8 OPERATIONAL SERVICE

Coordinate with manufacturer for maintenance agreement and take-back program. Collect information from the manufacturer about maintenance agreement options, and submit to Contracting Officer. Services shall reclaim materials for recycling and/or reuse. Services shall not landfill or burn reclaimed materials. Indicate procedures for compliance with regulations governing disposal of mercury. When such a service is not available, local recyclers shall be sought after to reclaim the materials.

PART 2 PRODUCTS

2.1 PRODUCT COORDINATION

Products and materials not considered to be lighting equipment or lighting fixture accessories are specified in Section 26 05 71.00 40 LOW VOLTAGE OVERCURRENT PROTECTIVE DEVICES, and Section 26 05 48.00 10 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

2.2 LUMINAIRES

UL 1598. Provide luminaires as indicated. Provide luminaires complete with lamps of number, type, and wattage indicated, electronic HPF ballast, photocell. Details, shapes, and dimensions are indicative of the general type desired, but are not intended to restrict selection to luminaires of a particular manufacturer. Luminaires of similar designs, light distribution and brightness characteristics, and of equal finish and quality will be acceptable as approved.

2.2.1 Lamps

2.2.1.1 Fluorescent Lamps

- a. Compact fluorescent lamps shall be: CRI 80, minimum, 3500 K, 10,000 hours average rated life, and as follows:

1. Triple-tube 4-pin 42 watts, 5200 initial lumens.

Average rated life is based on 3 hours operating per start.

2.3 LIGHTING CONTACTOR

NEMA ICS 2, electrically held contactor. Contacts shall be rated 120 Volts, 100 Amperes, and single pole. Coils shall be rated 120 volts. Rate contactor as indicated. Provide in NEMA 4 enclosure conforming to NEMA ICS 6. Contactor shall have silver alloy double-break contacts and shall require no arcing contacts. Provide contactor with hand-off-automatic selector switch. Contactor shall be hermetically sealed.

2.4 TIME SWITCH

Astronomic dial type or electronic type, arranged to turn "ON" at sunset, and turn "OFF" at predetermined time between 8:30 p.m. and 2:30 a.m. or

sunrise, automatically changing the settings each day in accordance with seasonal changes of sunset and sunrise. Provide switch rated 120 volts, having automatically wound spring mechanism or capacitor, to maintain accurate time for a minimum of 7 hours following power failure. Provide time switch with a manual on-off bypass switch. Housing for the time switch shall be surface mounted, NEMA 3R enclosure conforming to NEMA ICS 6.

2.5 PHOTOCCELL SWITCH

UL 773 or UL 773A, hermetically sealed cadmium-sulfide or silicon diode type cell rated 120 Volts ac, 60 Hz with single-throw contacts designed to fail to the ON position. Switch shall turn on at or below 3 footcandles and off at 4 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Provide a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Provide switch integral to the luminaire, rated 1000 VA, minimum.

2.6 BRACKETS AND SUPPORTS

ANSI C136.3 as applicable. Brackets shall be not less than 1 1/4 inch galvanized steel pipe secured to building structure. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to luminaires provided, and brackets for use with one type of luminaire shall be identical. Brackets for pole-mounted lights shall correctly position luminaire. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with luminaire head.

2.7 EQUIPMENT IDENTIFICATION

2.7.1 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

2.7.2 Labels

Provide labeled luminaires in accordance with UL 1598 requirements. Luminaires shall be clearly marked for operation of specific lamps and ballasts according to proper lamp type.

- a. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated).
- b. Correlated color temperature (CCT) and color rendering index (CRI) for all luminaires.

Markings related to lamp type shall be clear and located to be readily visible to service personnel, but unseen from normal viewing angles when lamps are in place. Ballasts shall have clear markings indicating multi-level outputs and indicate proper terminals for the various outputs.

2.8 FACTORY APPLIED FINISH

Electrical equipment shall have factory-applied painting systems which shall, as a minimum, meet the requirements of NEMA 250 corrosion-resistance test.

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations shall conform to [IEEE C2](#), [CEC](#), and to the requirements specified herein.

3.1.1 GROUNDING

Ground noncurrent-carrying parts of equipment including luminaires, mounting arms, brackets, and metallic enclosures as specified in this section. Where copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

3.1.2 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.2 FIELD QUALITY CONTROL

Upon completion of installation, verify that equipment is properly installed, connected, and adjusted. Conduct an [operating test](#) to show that the equipment operates in accordance with the requirements of this section.

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TRENCHING AND BACKFILL

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.

1.2 SCOPE

This work shall consist of trench excavation, backfill and resurfacing, all as required for the installation of underground utilities and shall be in accordance with these Standard Provisions and the Standard Details.

ASTM INTERNATIONAL (ASTM)

ASTM C 150/C 150M	(2009) Standard Specification for Portland Cement
ASTM C 260	(2006) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C 618	(2008a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for use in Concrete

1.3 MATERIALS

1.3.1 Select Backfill Material

Select backfill material shall be sand or granular material of the quality herein specified. Select backfill material shall have a size and gradation falling within the following limits:

<u>Sieve Size</u>	<u>Percentage Passing Sieve</u>
1/2"	100
No. 4	50 - 100
No. 200	15 Maximum

The minus two hundred (200) portion of the material expressed as a percentage multiplied by the Plasticity Index shall not exceed one hundred (100). The material shall be compacted to a relative compaction of ninety percent (90%) as determined by Test Method No. California 216.

1.3.2 Aggregate Base (AB)

Aggregate base shall be Class 2 as specified in Section 16, "Aggregate Base", of these Standard Provisions.

1.3.3 Asphalt Concrete (AC)

Asphalt concrete shall be Type B of the one-half inch (1/2") maximum (medium) grading as specified in Section 17, "Asphalt Concrete Pavement", of these Standard Provisions.

1.3.4 Controlled Density Fill (CDF)

Controlled density fill (CDF) shall consist of a fluid, workable mixture of aggregate, cement and water. CDF may be accepted in lieu of sand or granular fill as a nonstructural backfill material only upon written approval by the Engineer, unless otherwise specified in these Standard Provisions. In no case shall CDF be used for structural backfill.

Cement shall meet the standards as set forth in [ASTM C-150](#) for Type II Cement.

Fly ash shall meet the standards as set forth in [ASTM C-618](#) for Class F Pozzalans. The fly ash shall not inhibit the entrainment of air.

Air entrainment agent shall meet the standards as set forth in [ASTM C-260](#).

Coarse aggregate shall be no larger than three-eighths inch (3/8") (pea gravel) top size, not shall the three-eighths inch (3/8") aggregate comprise more than forty percent (40%) of the total aggregate content. Fine aggregate shall be commercial quality concrete sand and not comprise more than seventy percent (70%) of the total aggregate content.

Water shall be free from oil, slats and other impurities which would have an adverse effect on the quality of the backfill material.

The aggregate, cement and water shall be proportioned either by weight or by volume. Not less than ninety (90) pounds (1-sack) nor more than one hundred eighty (180) pounds (2-sacks) of cement shall be used for each cubic yard of material produced. The water contact shall be sufficient to produce a fluid, workable mix that will flow and can be pumped without segregation of the aggregate while being placed. Entrained air content shall be a minimum of 8.0 percent. The material produced shall reach unconfined compressive strengths from 50 psi to a maximum of 150 psi at 28 days.

Materials for CDF shall be thoroughly machine mixed at a batch plant and delivered to the job site by means of transit mixing trucks. Material tags from the CDF supplier shall be provided to the Public Works Inspector by the end of each working day. CDF shall be placed in the work within one hour after mixing.

1.4 TRENCH EXCAVATION

1.4.1 Existing Paving

Prior to excavation, the existing pavement shall be neatly sawcut along the limits of the proposed excavation. Existing pavement over the trench shall be removed and hauled away from the job site. If a longitudinal pavement joint or edge of pavement is located within three feet (3') of the limit of the excavation, the Contractor shall remove and replace all intervening pavement after completing the trench backfill and prior to the installing of permanent trench surfacing. All utilities shall be laid in open trench and/or tunnels as indicated on the Plans or as directed by the Engineer.

1.4.2 Trench Width

The allowable trench width at the top of the pipe shall conform to the following:

<u>Pipe Type (Abbreviation)</u>	<u>Trench Width (Maximum)</u>
Vitrified Clay Pipe (VCP)	Outside Diameter of Barrel + 18"
Polyvinylchloride Pipe (PVC)	
Concrete Cylinder Pipe (CCP)	
Ductile Iron Pipe (DIP)	
Welded Steel Pipe (WSP)	
Corrugated Metal Pipe (CMP)	Outside Diameter of Barrel + 24"
Reinforced Concrete Pipe (RCP)	

The maximum trench width shall be inclusive of all shoring.

Whenever the maximum allowable trench width is exceeded for any reason, the Contractor shall, at his expense, embed or cradle the pipe in concrete in a manner satisfactory to the Engineer. In no case shall the free working space on each side of the barrel be less than six inches (6").

1.4.3 Pipe Bedding

The trench shall be excavated below the grade of the pipe bottom to the following minimum depths:

<u>Pipe Type (Abbreviation)</u>	<u>Depth</u>
Vitrified Clay Pipe (VCP)	6"
Polyvinylchloride Pipe (PVC)	6"
Concrete Cylinder Pipe (CCP)	6"
Ductile Iron Pipe (DIP)	6"
Welded Steel Pipe (WSP)	6"
Corrugated Metal Pipe (CMP)	6"
Reinforced Concrete Pipe (RCP)	6"

Sufficient "Select Backfill Material" as specified above shall be placed in the trench and tamped to bring the trench bottom up to the grade of the bottom of the pipe. The relative compaction of the tamped material shall not be less than ninety percent (90%) as determined by Test Method No. California 26. The "Select Material" shall be shaped by hand. Holes for bells and fittings shall be excavated by hand. It is the intention of these requirements to provide uniform bearing under the full length of the pipe to a width of at least sixty percent (60%) of the external diameter.

When the trench bottom is unstable due to a wet or spongy foundation, the trench bottom must be stabilized with gravel or crushed rock. If the unstable condition was caused by the operations of the Contractor, such gravel or crushed rock shall be furnished at the Contractor's expense. The Engineer shall be

1.4.4 Excavated Material

Material excavated in streets and roadways shall be laid alongside the trench and kept trimmed so as to cause as little inconvenience as possible to public traffic. All material excavated in streets or roadways and not

required for backfill shall be immediately removed and disposed of by the Contractor in accordance with Section 13, "Excess Material", of these Standard Provisions. No surplus material shall be placed on private property unless written permission, signed by the owner of the property, is furnished to and approved by the Engineer.

1.4.5 Open Trench

No more than **three hundred feet (300')** of trench shall be open at any one time. Not more than **thirty feet (30')** of trench shall be left open at the end of the day, or as the Engineer may direct.

- a. At all street crossings, existing driveways, water gate valves and fire hydrants, the Contractor shall make provisions for trench crossings and for free access either by backfill or temporary bridges, as the Engineer may direct.
- b. Provisions shall be made whereby all surface runoff water can flow uninterrupted in gutters or drainage channels.

1.4.6 Bracing and Shoring

Excavation and trenches shall be supported and excavation operations conducted in accordance with Article 6, "Excavations, Trenches and Earthwork", of the State Division of Industrial Safety Construction Safety Orders, as amended. Attention is directed to the requirements in Paragraph 5-03, "Trench Excavation Safety Plants", of these Standard Provisions.

During backfilling, the bottom of the shoring shall be kept above the level of the backfill at all times.

1.4.7 Grade Control

All storm drains, water mains and sanitary sewers shall be accurately laid to grade. An offset string line (or other acceptable method) should be stretched between accurately surveyed grade stakes set at intervals not to exceed twenty-five feet (25'). The Contractor shall make available to the inspector adequate equipment to check both the grade of the string line prior to excavation and the grade of the pipe prior to backfilling. Any deviation from the proposed grade shall be approved by the Engineer. The Contractor shall make the necessary corrections before any pipe is laid.

1.5 TRENCH BACKFILL

Prior to pipe laying and trench backfill, the Engineer shall inspect and approve the condition of the trench.

1.5.1 Initial Backfill

"Select Backfill Material" as specified in Paragraph 24-02.091, "Select Backfill Material", of these Standard Provisions shall be used for initial backfill unless CDF has been approved by the Engineer as a backfill material or as otherwise specified in these Standard Provisions. When CDF has been approved as a backfill material, steel dowel stakes (rebar), or other material approved by the Engineer, may be used to secure the pipes to the bottom of the trench to prevent the pipes from floating in the CDF. After the pipe has been properly laid and inspected, select backfill material shall be placed on both sides of the pipe to such a depth that after thorough consolidation by jetting or hand-tamping, the final depth of

select backfill material shall be as follows:

<u>Pipe Type (Abbreviation)</u>	<u>Depth</u>
Vitrified Clay Pipe (VCP)	
Polyvinylchloride Pipe (PVC)	
Ductile Iron Pipe (DIP)	12" Above
Welded Steel Pipe (WSP)	Top of Pipe
Concrete Cylinder Pipe (CCP)	
Corrugated Metal Pipe (CMP)	1/2 Outside
Reinforced Concrete Pipe (RCP)	Diameter of Pipe (Pipe Springline)

1.5.2 Initial Backfill Compaction

- a. Jetting may be allowed for compacting sand backfill when approved by the Engineer. When jetting, it is important that proper precautions be taken to prevent floating of the pipe. The Contractor shall be wholly responsible for damage resulting from neglect of these precautions. After consolidation by jetting, the relative compaction of the initial backfill material shall be not less than ninety percent (90%) as determined by Test Method No. California 216.
- b. At the Contractor's option, the initial backfill may be compacted by hand-tamping in lieu of jetting. The use of machine tampers will not be permitted. The initial backfill material shall be hand-tamped in layers not exceeding four inches (4") in uncompacted depth. The final depth of compacted initial backfill shall be as noted above. After hand-tamping, the relative compaction of the initial backfill material shall be not less than ninety percent (90%) as determined by Test Method No. California 216.

1.5.3 Subsequent Backfill

- a. Above the level of initial backfill, the trench shall be backfilled with select imported material. Subsequent imported backfill within **two and one-half feet (2-1/2')** of the finished surface grade or **one and one-half (1-1/2')** of the finished subgrade, whichever is lowest in elevation, shall be mechanically compacted by tamping or rolling. Subsequent imported backfill, below **two and one-half feet (2-1/2')** of the finished grade or **one and one-half (1-1/2')** of the finished subgrade, whichever is lowest in elevation, shall be compacted by jetting or mechanical compaction.
 1. If the Contractor elects to compact by jetting, the backfill material shall be place in layers not exceeding **four feet (4')** in loose depth, each layer being thoroughly and uniformly wetted by means of a jet pipe of sufficient length to reach the bottom of the layer being compacted.
 2. If the Contractor elects to compact by tamping or rolling, the backfill material shall be placed in layers not exceeding **eight inches (8")** in loose depth, each layer being thoroughly compacted before succeeding layers are placed. The use, setup and operation of free-fall hammers, vibratory plates and mini-sheep's foot mechanical compactors is subject to the Engineer's approval. The use of double acting mechanical compactors will NOT be permitted.

- b. Subsequent backfill placed by jetting or by tamping or rolling shall be free from stones or lumps exceeding **three inches (3")** in greatest dimension, vegetable matter or other unsatisfactory material, and shall be compacted to a relative compaction of not less than ninety percent (90%) as determined by Test Method No. California 216, except that the relative compaction shall not be less than ninety-five percent (95%) within **two and one-half feet (2-1/2')** of finished permanent surfacing grade or **one and one-half feet (1-1/2')** below the finished subgrade, whichever is greater.
- c. Where CDF has been approved by the Engineer as a backfill material, it shall be placed in a uniform manner that will prevent voids in, or segregation of, the backfill. Foreign material which falls into the trench prior to or during placing of the CDF shall be immediately removed. Backfilling over or placing any material over the CDF shall not commence until it has sufficiently self-consolidated and the surface water is gone so that the surface will withstand the process of subsequent backfilling without displacement or disruption.

1.5.4 Reexcavation

If the compaction requirements as previously specified are not met within sixty (60) calendar days after jetting the backfill, the trench shall be reexcavated. Backfill material shall then be compacted by mechanical methods as previously specified until the compaction requirements are satisfied.

1.6 TRENCH SURFACING

1.6.1 General

In unimproved areas not in a traveled way, the trench shall be restored to its original surface.

Where a gravel surface is encountered, surfacing shall be replaced over the width of the trench with Class 2 aggregate base as specified in Section 16, "Aggregate Base", of these Standard Provisions to a minimum depth of **six inches (6")**.

Where the existing surface is some type of paving, surfacing shall be restored with a temporary surface followed by a permanent surface specified herein.

1.6.2 Temporary Surfacing

The temporary surfacing shall consist of **two and one-half inches (2-1/2")** of asphalt concrete (Type B, **3/4"** maximum aggregate) on **twelve inches (12")** of Class 2 aggregate base. As noted in Paragraph 24-05.03, "Permanent Surfacing", of these Standard Provisions, asphalt concrete (Type B) in excess of **two and one-half inches (2-1/2")** and aggregate base in excess of **twelve inches (12")** may be required in order to use the temporary surfacing as part of the permanent surfacing.

All temporary surfacing shall be laid within one (1) day after backfilling or as specified. Before the trenching area is opened for traffic, all excess dirt, rock and debris shall be removed and the street surface shall be swept clean. Temporary surfacing shall be constantly maintained so that at no time will there be any mudholes, nor shall the surface settle below **one inch (1")** or be raised more than **one inch (1")** from the existing

pavement grade.

1.6.3 Permanent Surfacing

Permanent surfacing shall not be constructed until the compaction requirements for backfill and subgrade of these Standard Provisions are satisfied.

All trenches shall be permanently surfaced within thirty (30) calendar days after compacting backfill.

Prior to installing permanent surfacing, any irregularities in the original wheelcut along the limits of the excavation shall be corrected by wheelcutting and removing the jagged pavement. Also, adjacent pavement noted to be removed per Paragraph 1.3.1, "Existing Paving", of these Standard Provisions shall be remove.

The base rock for permanent surfacing shall be Class 2 aggregate base as specified in Paragraph 1.9, "Aggregate Base", of these Standard Provisions. The aggregate base shall be equal in depth to the existing pavement structural section but not less than twelve inches (12") in depth.

The wearing surface for permanent surfacing on improved streets shall be asphalt concrete equal in thickness to the existing pavement but not less than two and one-half inches (2-1/2") in depth. The asphalt concrete shall be Type B asphalt concrete conforming to the requirements of Section 1.10, "Asphalt Concrete Pavement", of these Standard Provisions. Asphalt concrete shall be placed by a paving machine unless approved by the Engineer.

At the option of the Contractor, the temporary surfacing may be used as an integral part of the permanent pavement section provided that the following requirements are satisfied:

- a. The compaction requirements for backfill and subgrade are met, as determined by testing. The Contractor shall bear the cost of exposing the aggregate base, subgrade or backfill as necessary for the Engineer to conduct tests.
- b. The existing pavement along the limits of the excavation is neatly sawcut.
- c. The base rock is installed as part of the temporary surfacing and is equal in depth to the existing pavement structural section, but is not less than twelve inches (12") in depth.
- d. Cut-back asphalt shall not be used in the temporary surfacing.
- e. A one-inch (1") minimum asphalt concrete overly (Type B, medium, 3/8" maximum aggregate) shall be installed over the existing temporary surfacing in no less than thirty (30) days and no more than sixty (60) days.
- f. The combined depth of the asphalt concrete installed as part of the temporary surfacing and the one-inch (1") minimum overlay for permanent surfacing shall be equal to or greater in depth than the existing asphalt concrete pavement.

If any of the above requirements are not met, the Contractor shall remove

the temporary surfacing to limits specified by the Engineer and replace it with permanent surfacing as necessary to fulfill the above-stated permanent surfacing specifications.

Permanent surfacing shall extend twelve inches (12") beyond neatly cut lines in the existing pavement as shown in the Standard Details.

1.7 UTILITY EASEMENTS

Whenever the trench lies within property controlled by agencies such as the Southern Pacific Railroad, State of California, Santa Clara County, San Francisco Water Department, Pacific Bell, or Pacific Gas and Electric Company, the trench backfill and resurfacing shall comply with the requirements of these agencies as well as with the requirements of these Standard Provisions. If permits must be obtained or bonds posted before entering these right-of-ways, the Contractor shall obtain and pay for such permits and bonds.

1.8 MEASUREMENT AND PAYMENT

Wheelcutting, sawcutting, trench excavation, shoring, dust control, backfill and resurfacing shall not be measured for payment but shall be considered as paid for in the contract price for pipe installation. Excess material disposal shall be paid for under Paragraph 1.8, "Surplus Material", of these Standard Provisions. When there is a separate bid item for shoring, all sheeting, shoring and other trench protection shall be paid for under that item.

1.9 SURPLUS MATERIAL

1.9.1 Scope

Surplus material and construction debris remaining upon completion of the work shall become the property of the Contractor unless otherwise specified herein or noted on the plans, and shall be removed from the work site by the Contractor and disposed of off-site in a lawful manner.

1.9.2 Measurement

The disposal of surplus material shall be measured on the lump sum basis.

1.9.3 Payment

The lump sum price paid for hauling and depositing surplus material shall be full compensation for furnishing all labor, material, tools, equipment and incidentals and for doing all work involved in hauling and depositing the surplus material as required in the Special Provisions, shown on the plans and specified herein.

Where no bid item is provided for surplus material, the cost paid for hauling and depositing surplus material shall be considered as paid in other items of work and no further compensation shall be allowed.

1.10 AGGREGATE BASE

1.10.1 Scope

Aggregate base shall conform to the requirements of Paragraph 1.9, "Aggregate Bases", of the Standard Specification except as modified herein.

1.10.2 Materials

The aggregate base shall be three-quarters of an inch (3/4") maximum and Class 2 (R-value 78 minimum) and shall be of the thickness as shown on the plans. No waiver of R-value will be allowed. The aggregate base shall be untreated material.

1.10.3 Construction

The aggregate base may be spread by the use of motor graders as long as segregation of large or fine particles of aggregate is avoided and the material as spread is free from pockets of large or fine materials. Subgrade preparation for roadway is specified in Section 14, "Subgrade Preparation", of City of Mountain View Standard Provisions is required when placing aggregate base on native material. Aggregate base shall have a relative compaction of not less than ninety-five percent (95%) as determined by Test Method No. California 216.

The Contractor shall be responsible for protecting the aggregate base after it has been placed and compacted. The Contractor will not be allowed any additional compensation for the recompaction or retesting of the aggregate base due to the Contractor's failure to place the successive asphalt concrete pavement or other materials within a reasonable time period as determined by the Engineer. The Contractor shall pay for all costs to retest the aggregate base, at no cost to the City.

1.10.4 Measurement

Aggregate base under asphalt concrete paving shall be measured by the square foot in place and shall include that portion which may be required under Paragraph 23-01, "Asphalt Concrete Conforms", of City of Mountain View Standard Provisions.

1.10.5 Payment

The contract unit price paid per square foot of aggregate base shall include full compensation for furnishing all labor, materials, tools, aggregate base protection, equipment and incidentals and for doing all work involved in constructing base as required in the Special Provisions, shown on the plans and specified herein.

1.11 ASPHALT CONCRETE PAVEMENT

1.11.1 Scope

Asphalt concrete shall conform to the requirements of Section 39, "Asphalt Concrete", of City of Mountain View Standard Specifications except as modified herein.

1.11.2 Material and Construction

Asphalt concrete shall be Type B (medium) and shall be of the thickness as shown on the plans or as specified in the Special Provisions. Maximum aggregate size shall be as follows:

<u>Thickness AC</u>	<u>Max. Agg.</u>
1" and 1-1/2" Surface Course	1/2"

2" and 2-1/2" Surface Course	3/4"
Base Course	3/4"

Surface course layer of asphalt concrete shall not exceed two and one-half inches (2-1/2") nor be less than one and one-half (1-1/2") in compacted thickness.

Compaction shall be a minimum of ninety-five percent (95%) of the laboratory maximum density of the asphalt concrete. Laboratory maximum density shall be determined by field samples submitted to a testing laboratory by the Engineer. Cost for testing shall be paid by the City.

Asphalt binder to be mixed with aggregate shall be paving asphalt, having a viscosity grade of AR-4000 and shall conform to the requirements of Section 92, "Asphalts", of the Standard Specifications.

The prime coat shall be liquid asphalt (SC-70) conforming to the requirements of Section 93, "Liquid Asphalts", of City of Mountain View Standard Specifications. As much liquid asphalt shall be applied to the prepared base as will soak in during a twenty-four (24) hour period without puddling. Sand cover shall be applied at driveways, intersections and to the roadbed surface where continuous traffic access must be maintained.

Paint binder (asphaltic tack coat) shall be asphaltic emulsion Grade SS-1h, and shall conform to the requirements of Section 94, "Asphaltic Emulsions", of the Standard Specifications. The rate of application shall be approximately 0.05 to 0.15 gallon per square yard. The exact rate of application will be determined by the Engineer. A one-to-one (1:1) dilution of SS-1h in water shall be used. It is important that the water be added to the emulsion, NOT the emulsion to the water, to prevent premature breaking.

Newly installed asphalt concrete shall be fog sealed in accordance with Section 19, "Fog Seal", of City of Mountain View Standard Provisions.

The Contractor is required to provide adequate protection of the subgrade, aggregate subbase, aggregate base and other materials if the asphalt concrete pavement is not placed within a specified time as determined by the Engineer. Retesting of the subgrade, aggregate subbase, aggregate base or other material will be required and will be paid for by the Contractor, if the asphalt concrete pavement is not placed within a specified time as determined by the Engineer.

1.11.3 Measurement

Asphalt concrete shall be measured by the square foot in place or by the ton as determined from certified weight tickets furnished at the time of delivery to the Engineer in the field. At the end of each workday, total weight tags shall be delivered to the Engineer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

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SECTION 40 05 13.96

WELDING PROCESS PIPING

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.

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

- ASNT SNT-TC-1A (2006) Recommended Practice No. SNT-TC-1A: Personnel Qualification and Certification in Nondestructive Testing and ANSI/ASNT CP-105: Training Outlines for Qualification of Nondestructive Testing Personnel
- ASNT SNT-TC-1A Q&A Bk A (2006) Supplement to Recommended Practice No. SNT-TC-1A (Q&A Book): Radiographic Testing Method
- ASNT SNT-TC-1A Q&A Bk B (2007) Supplement to Recommended Practice SNT-TC-1A (Q&A Book): Magnetic Particle Method
- ASNT SNT-TC-1A Q&A Bk C (1994) Supplement to Recommended Practice No. SNT-TC-1A (Q&A Book): Ultrasonic Testing Method
- ASNT SNT-TC-1A Q&A Bk D (2003; R 2009) Supplement to Recommended Practice No. SNT-TC-1A (Q&A Book): Liquid Penetrant Testing Method

AMERICAN WELDING SOCIETY (AWS)

- AWS A2.4 (2007) Standard Symbols for Welding, Brazing and Nondestructive Examination
- AWS A3.0M/A3.0 (2010) Standard Welding Terms and Definitions
- AWS B2.1/B2.1M (2009) Specification for Welding Procedure and Performance Qualification
- AWS QC1 (2007) Standard for AWS Certification of Welding Inspectors
- AWS Z49.1 Safety in Welding and Cutting and Allied Processes

ASME INTERNATIONAL (ASME)

ASME B31.3	(2008) Process Piping
ASME BPVC SEC I	(2010) BPVC Section I-Rules for Construction of Power Boilers
ASME BPVC SEC II-C	(2010) BPVC Section II-Materials Part C-Specifications for Welding Rods Electrodes and Filler Metals
ASME BPVC SEC IX	BPVC; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC V	BPVC; Section V; Nondestructive Examination

1.2 DEFINITIONS AND SYMBOLS

Definitions shall be in accordance with AWS A3.0M/A3.0. Symbols shall be in accordance with AWS A2.4.

1.3 PERFORMANCE REQUIREMENTS

Quality of all joint preparation, welding, and examination is the Contractor's responsibility for. Clearly identify and record all materials used in the welding operations. The inspection and testing defined in this specification are minimum requirements. Additional inspection and testing shall be the responsibility of the Contractor when it is deemed necessary to achieve the quality required.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings**Pressure Piping; G**

Detail drawings showing location, length, and type of welds; and indicating postweld heat treatment and NDE as required.

SD-03 Product Data**Qualifications**

Welding procedure qualification.

Welding Operations

Detailed procedures which define methods of compliance to contract drawings and specifications. Inspection and material procurement records. System and material testing and certification records. Written records and drawings indicating location of welds made by each welder or welding operator.

SD-06 Test Reports

Test Reports shall be submitted for radiographs.

SD-07 Certificates

Qualifications

Welder and welding operator performance qualification certificates. Welding inspectors and NDE personnel certificates. Qualifications of testing laboratory or the Contractor's quality assurance organization.

1.5 QUALIFICATIONS

See Piping General Notes on Sheet M1.

1.6 REGULATORY REQUIREMENTS

This section covers the welding of **pressure piping** systems. Deviations from applicable codes, approved procedures, and approved detail drawings will not be permitted without prior written approval. Materials or components with welds made offsite will not be accepted if the welding does not conform to the requirements of this specification, unless otherwise specified. Procedures shall be developed by the Contractor for welding all metals included in the work. Welding shall not be started until welding procedures, welders, and welding operators have been qualified. Qualification testing shall be performed by an approved testing laboratory, or by the Contractor if approved by the Contracting Officer. Costs of such testing shall be borne by the Contractor. The Contracting Officer shall be notified at least 24 hours in advance of the time and place of the tests. When practicable, the qualification tests shall be performed at or near the worksite. Maintain current records of the test results obtained in the welding procedure, welding operator, welder performance qualifications, and nondestructive examination (NDE) procedures readily available at the site for examination by the Contracting Officer. The procedures for making transition welds between different materials or between plates or pipes of different wall thicknesses shall be qualified. **ASME B31.3** requirements for branch connections may be used in lieu of detailed designs. Unless otherwise specified, the choice of welding process shall be the responsibility of the Contractor. Safety precautions shall conform to **AWS Z49.1**.

1.7 DELIVERY, STORAGE, AND HANDLING

All filler metals, electrodes, fluxes, and other welding materials shall be delivered to the site in manufacturers' original packages and stored in a dry space until used. Packages shall be properly labeled and designed to give maximum protection from moisture and to insure safe handling.

1.7.1 Material Control

Materials shall be stored in a controlled access and clean, dry area that is weathertight and is maintained at a temperature recommended by the manufacturer. The materials shall not be in contact with the floor and shall be stored on wooden pallets or cribbing.

1.7.1.1 Damaged Containers

Low-hydrogen steel electrodes shall be stored in their sealed shipping

container. If the seal is damaged during shipment or storage, and the damage is not immediately detected, the covered electrodes in that container shall be rebaked in accordance with the manufacturer's instructions prior to issuance or shall be discarded. If a container is damaged in storage and the damage is witnessed, the electrodes from that container shall be immediately placed in a storage oven. The storage oven temperature shall be as recommended by the manufacturer or the welding material specification.

1.7.1.2 Partial Issues

When a container of covered electrodes is opened and only a portion of the content is issued, the remaining portion shall, within 1/2 hour, be placed in a storage oven.

1.7.2 Damaged Materials

Materials which are damaged shall be discarded. Covered electrodes which are oil or water-soaked, dirty, or on which the flux has separated from the wire shall be discarded.

PART 2 PRODUCTS

2.1 MATERIALS

Provide welding materials which comply with ASME BPVC SEC II-C. Welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator using qualified welding procedures.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

Perform welding in accordance with qualified procedures using qualified welders and welding operators. Welding shall not be done when the quality of the completed weld could be impaired by the prevailing working or weather conditions. The Contracting Officer will determine when weather or working conditions are unsuitable for welding. Welding of hangers, supports, and plates to structural members shall conform to Section 05 12 00 STRUCTURAL STEEL.

3.1.1 Base Metal Preparation

Oxy-fuel cutting shall not be used on austenitic stainless steel or nonferrous materials.

3.1.2 Weld Joint Fit-Up

Parts that are to be joined by welding shall be fitted, aligned, and retained in position during the welding operation by the use of bars, jacks, clamps, or other mechanical fixtures. Welded temporary attachments shall not be used except when it is impractical to use mechanical fixtures. When temporary attachments are used, they shall be the same material as the base metal, and shall be completely removed by grinding or thermal cutting after the welding operation is completed. If thermal cutting is used, the attachment shall be cut to not less than 1/4 inch from the member and the balance removed by grinding. After the temporary attachment has been removed, the area shall be visually examined.

3.1.3 Preheat and Interpass Temperatures

Preheat temperatures shall meet the requirements specified by ASME B31.3. However, in no case shall the preheat be below 50 degrees F for ferritic steel or austenitic stainless steel, or 32 degrees F for nonferrous alloys. The maximum interpass temperatures shall not exceed 300 degrees F for austenitic stainless steels, nickel alloys, and copper alloys; and 500 degrees F for carbon steels. Preheat techniques shall be such as to ensure that the full thickness of the weld joint preparation and/or adjacent base material, at least 3 inches in all directions, is at the specified temperature. Preheating by induction or resistance methods is preferred. When flame heating is used, only a neutral flame shall be employed. Oxy-fuel heating shall not be used on austenitic stainless steel or nickel-alloy materials; however, air-fuel heating is acceptable if controlled to insure that the surface temperature does not exceed 150 degrees F. Interpass temperatures shall be checked on the surface of the component within 1 inch of the weld groove and at the starting location of the next weld pass, and for a distance of about 6 inches ahead of the weld, but not on the area to be welded.

3.1.4 Production Welding Instructions

- a. Welding shall not be done when the ambient temperature is lower than 0 degree F.
- b. Welding is not permitted on surfaces that are wet or covered with ice, when snow or rain is falling on the surfaces to be welded, or during periods of high winds, unless the welders and the work are properly protected.
- c. Gases for purging and shielding shall be welding grade and shall have a dew point of minus 40 degrees F or lower.
- d. Back purges are required for austenitic stainless steels and nonferrous alloys welded from one side and shall be set up such that the flow of gas from the inlet to the outlet orifice passes across the area to be welded. The oxygen content of the gas exiting from the purge vent shall be less than 2 percent prior to welding.
- e. The purge on groove welds shall be maintained for at least three layers or 3/16 inch.
- f. Removable purge dam materials shall be made of expandable or flexible plugs, such as plexiglass, plywood (which shall be dry when used), etc. Wood dams shall be kiln-dried quality. Nonremovable purge dams and purge dam adhesives shall be made of water soluble materials. Purge dams shall not be made of polyvinyl alcohol.
- g. Any welding process which requires the use of external gas shielding shall not be done in a draft or wind unless the weld area is protected by a shelter. This shelter shall be of material and shape appropriate to reduce wind velocity in the vicinity of the weld to a maximum of 5 mph or 440 fpm.
- h. Welding of low-alloy and hardenable high-alloy steels may be interrupted provided a minimum of at least 3/8 inch thickness of weld deposit or 25 percent of the weld groove is filled, whichever is greater, and the preheat temperature is maintained during the time that

welding is interrupted. If the temperature falls below the minimum preheat temperature before all welding has been completed on a joint, or, where required, before post weld heat treatment, a liquid penetrant or magnetic particle examination shall be performed to insure sound deposited metal before reheating. Welding of other materials may be interrupted without restriction provided a visual inspection is performed before welding is resumed.

- i. Tack welds to be incorporated in the final welds shall have their ends tapered by grinding or welding technique. Tack welds that are cracked or defective shall be removed and the groove shall be retacked prior to welding. Temporary tack welds shall be removed, the surface ground smooth, and visually inspected. For low-alloy and hardenable high-alloy steels, the area shall be magnetic particle examination inspected.
 - j. When joining ferritic steel pressure piping components to austenitic stainless steel pressure piping components and postweld heat treatment is required, the following requirements apply:
 1. The weld-end preps of ferritic steel components, which are to be welded to austenitic stainless steel, shall be buttered with one of the following weld filler metals and shall conform to the specified requirements: [ASME BPVC SEC II-C](#), SFA 5.14, Classification ERNiCr-3; or [ASME BPVC SEC II-C](#), SFA 5.11, Classification ENiCrFe-2.
 2. The ferritic steel weld-end prep shall be buttered, receive a postweld heat treatment as required by [ASME B31.3](#) and then be machined with the applicable weld-end preparation. After machining, the buttered layer shall be a minimum of 1/4 inch thick.
 3. Pressure piping transition joints shall be completed using ERNiCr-3 or ENiCrFe-2 weld filler metals. No further postweld heat treatment shall be performed.
 - k. When joining ferritic steel pressure piping components to austenitic stainless steel pressure piping components and postweld heat treatment is not required, prepare and weld the joint using either ERNiCr-3 or ENiCrFe-2 filler metals. For service temperatures of 200 degrees F or less, stainless filler metal 309 [ASME BPVC SEC II-C](#), SFA 5.4 or 5.9 is permissible in lieu of the nickel-based alloys.
 1. Grinding of completed welds is to be performed only to the extent required for NDE, including any inservice examination, and to provide weld reinforcement within the requirements of [ASME B31.3](#). If the surface of the weld requires grinding, reducing the weld or base material below the minimum required thickness shall be avoided. Minimum weld external reinforcement shall be flush between external surfaces.
- 3.1.5 Postweld Heat Treatment
- a. Postweld heat treatment shall be performed in accordance with [ASME B31.3](#). Temperatures for local postweld heat treatment shall be measured continuously by thermocouples in contact with the weldment.
 - b. Postweld heat treatment of low-alloy steels, when required, shall be performed immediately upon completion of welding and prior to the

temperature of the weld falling below the preheat temperature. However, postweld heat treatment may be postponed after the completion of the weld, if, immediately after the weld is completed, it is maintained at a minimum temperature of 300 degrees F or the preheat temperature, whichever is greater, for 2 hours per 1 inch of weld thickness.

c. For low-alloy steels, the cooling rates shall be such that temper embrittlement is avoided.

3.2 EXAMINATIONS, INSPECTIONS, AND TESTS

Visual and NDE shall be performed qualified Level II inspectors to detect surface and internal discontinuities in completed welds. The services of a qualified commercial inspection or testing laboratory or technical consultant, approved by the Contracting Officer, shall be employed by the Contractor. All tack welds, weld passes, and completed welds shall be visually inspected. In addition, magnetic particle (carbon steel) or liquid penetrant (stainless steel) examination shall be performed on root passes. Examination shall be required as indicated in Piping General Notes on Sheet M1. When inspection and testing indicates defects in a weld joint, the weld shall be repaired by a qualified welder in accordance with paragraph CORRECTIONS AND REPAIRS.

3.2.1 Random NDE Testing

See Piping General Notes on Sheet M1 for scope of NDE testing. The selection of welds for inspection shall include an examination of welds made by each welding operator or welder. If the random testing reveals that any welds fail to meet minimum quality requirements, an additional 20 percent of the welds in that same group shall be inspected. If all of the additional welds inspected meet the quality requirements, the entire group of welds represented shall be accepted and the defective welds shall be repaired. If any of the additional welds inspected also fail to meet the quality requirements, that entire group of welds shall be rejected. The rejected welds shall be removed and rewelded, or the rejected welds shall be 100 percent inspected and all defective weld areas removed and rewelded.

3.2.2 Visual Inspection

Weld joints shall be inspected visually as follows:

- a. Before welding - for compliance with requirements for joint preparation, placement of backing rings or consumable inserts, alignment and fit-up, and cleanliness.
- b. During welding - for cracks and conformance to the qualified welding procedure.
- c. After welding - for cracks, contour and finish, bead reinforcement, undercutting, overlap, and size of fillet welds.

3.2.3 NDE Testing

NDE shall be in accordance with written procedures. Procedures for tests and methods shall conform to ASME BPVC SEC V. The approved procedure shall be demonstrated to the satisfaction of the Contracting Officer. In addition to the information required in ASME BPVC SEC V, the written procedures shall include the timing of the NDE in relation to the welding operations and safety precautions.

3.2.4 Inspection and Tests by the Government

The Government will perform inspection and supplemental nondestructive or destructive tests as deemed necessary. The cost of supplemental NDE will be borne by the Government. The correction and repair of defects and the reexamination of weld repairs shall be performed by the Contractor at no additional cost to the Government. Inspection and tests will be performed as required for visual inspection and NDE, except that destructive tests may be required also. When destructive tests are ordered by the Contracting Officer and performed by the Contractor, and the specimens or other supplemental examinations indicate that the materials and workmanship do not conform to the contract requirements, the cost of the tests, corrections, and repairs shall be borne by the Contractor. When the specimens or other supplemental examinations of destructive tests indicate that materials or workmanship do conform to the specification requirements, the cost of the tests and repairs will be borne by the Government. When destructive tests are made, repairs shall be made by qualified welders or welding operators using welding procedures which will develop the full strength of the members cut. Welding shall be subject to inspection and tests in the mill, shop, and field. When materials or workmanship do not conform to the specification requirements, the work may be rejected at any time before final acceptance of the system containing the weldment.

3.3 ACCEPTANCE STANDARDS

NDE acceptance standards are in accordance with [ASME B31.3](#).

3.4 CORRECTIONS AND REPAIRS

Defects shall be removed and repaired as specified in [ASME B31.3](#) unless otherwise specified. Disqualifying defects discovered between weld passes shall be repaired before additional weld material is deposited. Wherever a defect is removed, and repair by welding is not required, the affected area shall be blended into the surrounding surface eliminating sharp notches, crevices, or corners. After defect removal is complete and before rewelding, the area shall be examined by the same test method which first revealed the defect to ensure that the defect has been eliminated. After rewelding, the repaired area shall be reexamined by the same test method originally used for that area. Any indication of a defect shall be regarded as a defect unless reevaluation by NDE or by surface conditioning shows that no disqualifying defects are present. The use of any foreign material to mask, fill in, seal, or disguise welding defects will not be permitted.

-- End of Section --

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SECTION 44 10 00

AIR POLLUTION CONTROL

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.

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL (AMCA)

AMCA 801 (2001) Industrial Process/Power Generation Fans: Specification Guidelines

AMERICAN NATIONAL STANDARD INSTITUTE (ANSI)

ANSI 2358.1 (2009) American National Standard for Emergency Eyewash and Shower Equipment

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C700 Cold Water Meters - Displacement Type, Bronze Main Case

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 Structural Welding Code

ASME INTERNATIONAL (ASME)

ASME B1.20.1 (1983; R 2006) Pipe Threads, General Purpose (Inch)

ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings

ASME B16.11 (2009) Forged Fittings, Socket-Welding and Threaded

ASME B16.15 (2006) Cast Bronze Alloy Threaded Fittings Classes 125 and 250

ASME B16.24 (2006) Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500

ASME B16.3 Malleable Iron Threaded Fittings, Classes 150 and 300

ASME B16.39 Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300

ASME B16.5 Pipe Flanges and Flanged Fittings

ASME B16.9	Factory-Made Wrought Steel Butt Welding Fittings
ASME B31.3	(2008) Process Piping
ASME B40.100	(2005) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	BPVC Section IX - Welding and Brazing Qualifications
ASME PTC 19.3	(1974; R 2004) Temperature Measurement

ASTM INTERNATIONAL (ASTM)

ASTM A 167	(1999; R 2009) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 653/A 653M	(2009a) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 733	(2003; R 2009e1) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 924/A 924M	(2009a) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 280	(2008) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 42	(2002e1) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B 68	(2002) Standard Specification for Seamless Copper Tube, Bright Annealed
ASTM B 88	(2009) Standard Specification for Seamless Copper Water Tube
ASTM D 1248	(2005) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D-3299	Filament Wound Glass Fiber Reinforced Thermoset Resin Chemical Resistant Tanks
ASTM D-4097	Contact Molded Glass Fiber Reinforced

Thermoset Resin Chemical Resistant Tanks

HYDRAULIC INSTITUTE (HI)

HI 3.1-3.5 (2000) Rotary Pumps for Nomenclature, Definitions, Applications and Operations

INSTITUTE OF CLEAN AIR COMPANIES (ICAC)

ICAC WS-3 (1976; R 1980) Basic Types of Wet Scrubbers

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25 (2008) Standard Marking System for Valves, Fittings, Flanges and Unions

MSS SP-70 Cast Iron Gate Valves, Flanged and Threaded Ends

MSS SP-80 Bronze Gate, Globe, Angle and Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1 (2000; R 2005; R 2008) Standard for Industrial Control and Systems: General Requirements

NEMA ICS 6 (1993; R 2001; R 2006) Enclosures

NEMA MG 1 (2007; Errata 2008) Standard for Motors and Generators

NATIONAL BUREAU OF STANDARDS

PS-15 Voluntary Product Standard

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

29 CFR 1910 Occupational Safety and Health Standards for General Industry

40 CFR 50 National Primary and Secondary Ambient Air Quality Standards

40 CFR 60 Standards of Performance for New Stationary Sources

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG-1 Motors and Generators

1.2 SYSTEM DESCRIPTION

Equipment to be furnished shall include, but is not limited to: condenser column (packed bed), packed-bed scrubbers, oxidizers, recycle tanks, recycle pumps, chemical metering pumps, chemical storage tanks, instrumentation, control panel, motor control center, piping, and ductwork. All equipment shall be designed to be specially adapted for the intended

service.

All equipment shall be designed, constructed, and installed in accordance with the best industry standards, methods, and practices. Scrubbers, oxidation columns, recycle tanks, and pumps shall be mounted on a coated steel frame. The frame shall include platforms and ladders which allow access to components of the scrubber system for inspection and maintenance.

The P&ID number shall identify all valves and instruments.

All materials of construction as well as miscellaneous hardware shall be resistant to attack by the compounds being absorbed and by the scrubbing solutions.

The scrubber system shall be designed to treat the gaseous effluent from a test facility. The effluent is a continuous air stream that is saturated with water vapor and intermittently contaminated with high concentrations of NO when tests are in progress. The air stream is 195 °F and 1.005 bar, but highly variable with respect to gas flow, water vapor flow, and NO concentration.

The equipment shall be designed to operate on a standby load of air/water vapor, then for continuous operation in the environment described herein. The standby load is air with 0.2Kg/sec of steam. The frequency and duration of tests for maximum, typical, and minimum operating scenarios is shown in table in paragraph SCHEDULES.

An outlet NOx concentration is not defined, rather the daily NOx emission is limited to 4.54 kg (10 lbs). The NOx removal performance required in each operating scenario is shown in the table in paragraph SCHEDULES. The worst case operating scenario for design is Maximum Current, although consideration shall be given to future additions for Max. Future.

A portion of the scrubbing solution shall be purged from each recycle tank in order to prevent excessive accumulation of compounds, which could reduce efficiency of the scrubber or cause fouling.

Make-up of evaporation and other water losses shall be accomplished by continuous or controlled water make-up. Fresh water shall be added to the last recycle tank to create a purge stream, which shall flow through the scrubber system countercurrent to the direction of air flow. Equipment shall be designed for seismic load in accordance with ASCE 7 Chapter 15 (Non-building Structures), Importance Factor = 1, site class "D", occupancy category II, and seismic design category "D", and with a maximum 85 MPH wind load according to requirements of ASCE 7-05, Chapter 6.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G

Detail drawings containing complete wiring and schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

Drawings and other information describing the equipment shall be submitted for evaluation and approval. Equipment will not be purchased, fabricated, or installed without review and written approval by the Purchaser.

Three (3) complete sets of drawings and other information shall be submitted to the Purchaser for review.

General arrangement drawings for each major assembly shall be submitted. The drawings shall include Overall plan and elevation space requirements; clearance required for operation, maintenance, removal, or repair of components.

SD-03 Product Data

Emission Monitoring System

Reports for emissions permit compliance

Air Pollution Control Equipment

- a. A complete list of equipment and material, including manufacturer's descriptive data and technical literature, performance charts and curves, catalog cuts, and installation instructions. Spare parts data for each different item of material and equipment specified, after approval of detail drawings. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.
- b. Proposed diagrams, instructions, and other sheets, prior to posting. Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, including equipment, piping, valves, and control sequence, shall be posted where directed. Condensed operating instructions explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams, and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the system.

The information which is furnished for equipment shall include name of manufacturer, model number, quantity, dimensions, materials of construction, total shipping and operating weights, anchoring requirements, power requirements, performance curves, sequence of operation, and installation instructions.

Instrumentation and Controls

Detailed manufacturer's data on the overall controls, sensors, process controllers, control operators, ladder diagrams, timers,

sequence of controls, valves, alarms, signals, interlocks and cut off systems. Data describing in detail the equipment used to monitor emissions, including the sampling probe, filters, sampling pump, moisture separator/drier, tubing, analyzer, analyzer calibration system, data recorder, and alarms. Process and instrumentation diagrams (P&IDs).

A functional description of the control system covering operation, start-up, alarms, and emergency shutdown shall be submitted.

Training

Training course curriculum and training instructions 10 days prior to the start of training.

Testing and Inspections; G

A proposed performance test procedure, 30 days prior to the proposed test date, containing a complete description of the proposed tests and sample locations, with calibration curves or test results by an independent testing laboratory of each instrument, meter, and gauge to be used in the tests. The test shall not commence until the procedure has been approved.

SD-06 Test Reports and Records

Factory Tests

Printout of factory test results.

Testing and Inspections;

Test procedures, prior to starting test. Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to provide compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-07 Certificates

Manufacturer's Field Representative

Names and qualifications of each manufacturer's field representative and training engineer with written certification from the manufacturer that each representative and trainer is technically qualified.

SD-10 Operation and Maintenance Data

Air Pollution Control Equipment; G Accessories; G

Six (6) complete copies of operation manual outlining the step-by-step procedures required for system startup, operation, and shutdown. The manuals shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and its basic operating features. Six (6) complete copies of maintenance manual listing routine maintenance

procedures, possible breakdowns and repair, and troubleshooting guides. The manuals shall include piping layout, equipment layout, and simplified wiring and control diagrams of the system as installed. Operation and maintenance manuals shall be approved prior to training course.

Three (3) copies of operation and maintenance instructions for the entire system shall be furnished. The information shall be sufficient to instruct someone who is not familiar with the equipment in the operation and maintenance of the system. It shall include:

- a. System description and principle of operation
- b. Complete parts list with model and part numbers
- c. Diagrams, illustrations, and cut sheets
- d. Performance and nameplate data
- e. Installation instructions
- f. Procedures for starting, testing, and operating the system
- g. Operating parameters and methods for proper adjustment
- h. Steps required to correct or avoid deviations from operating limits, and consequences of such deviations
- i. Procedure for start-up following a turnaround, or after emergency shutdown
- j. Shutdown instructions; short, long term, and emergency
- k. Diagnostic procedures and troubleshooting guide to be used in the event of system shutdown or malfunction
- l. Instructions and drawings to facilitate maintenance, lubrication and overhaul of the equipment and ordering of spare or replacement parts
- m. List of recommended spare parts
- n. List of electrical relay, control and alarm contact settings
- o. Electrical wiring diagram
- p. Safety precautions
- q. Address and phone for factory and local representatives

1.4 QUALIFICATIONS

All equipment, materials, and workmanship shall conform to good engineering practices and to the latest edition of the codes or standards published by the following organizations:

- a. American National Standards Institute (ANSI)
- b. National Electrical Code (NEC)
- c. Underwriters Laboratories (UL)

If there is a conflict between the codes or standards and these specifications, the standards will prevail and an exception to the specifications should be noted.

1.4.1 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 BPVC SEC IX](#). Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by [ASME B31.3](#). The Contracting Officer shall be notified 24 hours in advance of tests and the

tests shall be furnished at the work site if practicable. The Contracting Officer shall be furnished a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators. The welder or welding operator shall apply his assigned symbol near his welds using a rubber stamp or felt-tipped marker with permanent weatherproof ink or other methods approved by the Contracting Officer that do not deform the metal. Structural members shall be welded in accordance with AWS D1.1. Welding and nondestructive testing procedures are specified in Section 40 05 13.96 WELDING PROCESS PIPING.

1.4.2 Contractor

Contractor shall have had a minimum of 3 years of experience in the construction and maintenance of industrial air pollution control systems.

1.4.3 Manufacturer's Field Representative

Services of a manufacturer's field representative, who is experienced in the installation, adjustment, and operation of the equipment furnished, and who has complete knowledge of the proper operation and maintenance of the system, shall be provided. Field representative shall be onsite to supervise the installation, adjustment and compliance testing of the equipment. Field representative shall provide supervision of the system for 3 days after startup of the system.

1.5 CONSTRUCTION REQUIREMENTS

System shall be suitable for outdoor installation. System shall be designed for a wind load of 85 mph according to requirements of ASCE 7-05 Chapter 6, and an internal negative static pressure. Max negative pressure at the fan estimated -20 inch water, gauge, but ultimately depending on manufacturers design. Seismic protection of equipment shall be according to criteria on the drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

Store all equipment delivered and placed in storage as recommended by the manufacturer, with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

1.7 EXTRA MATERIALS

Auxiliaries for maintenance shall be provided with the equipment and shall include all special tools, rigs, jigs, fixtures, equipment, or other devices required for normal operation and service. Any special equipment required for routine maintenance shall be provided. Tests or measurement instruments or gauges shall be included.

1.8 OVERALL SYSTEM REQUIREMENTS NOx EMISSION REDUCTION

1.8.1 Overall System Requirements

- a. The effluent from the NOx scrubber system shall comply with the guidelines for atmospheric air quality discharge that are defined by the NASA Ames Health and Safety Office.
- b. The NOx scrubber shall be designed so as not to expose personnel in the vicinity to hazardous levels (greater than permissible exposure level, PEL) of NOx gas, (e.g. consider the exhaust stack height and location).

- c. The new NOx scrubber system shall be designed to interface with all relevant operational and safety systems and processes in the existing Steam Vacuum System.
- d. The location shall not block the yard north of building N231 that is the proposed site for new SVS boiler equipment.
- e. The location and configuration of the new NOx scrubber system shall be subject to final NASA review and approval.
- f. Any piping and equipment insulation shall be sealed and weather proofed, as necessary, to protect against all weather conditions that may reasonably occur in the region and possible animal infestation.
- g. All equipment shall be designed, constructed, and installed in accordance with the best industry standards, methods, and practices.
- h. The scrubber system and any resultant structures shall include platforms, catwalks, stairways, and ladders that allow personnel access to serviceable components for inspection and maintenance (bid additive 1).
- i. All platforms, catwalks, stairways, and ladders shall conform to OSHA standards.
- j. All scrubber equipment, (pumps motors, valves, etc.) should be shielded from the elements for ease of maintenance in inclement weather conditions.
- k. Any serviceable vessels shall have man-ways for easy access to internal components for inspection and repair.
- l. All equipment located at elevated positions whose weight exceeds 50 pounds shall be provided with convenient lift-assist equipment (e.g. chain hoist, jib crane, etc.) or hard-points for the attachment of such equipment.
- m. All waste products generated as a result of the NOx scrubbing process shall be non-hazardous and within the limits for discharge to the atmosphere (gaseous) or sanitary sewer (liquid).
- n. All installed equipment and instruments shall be identified (e.g. stamped placard, tag, etc.) with their unique, standardized P&ID number.
- o. All construction materials and equipment exposed to the flow being processed shall be resistant to corrosion and damage by the chemicals being abated and by the scrubber chemicals and processes.
- p. A complete set of final design, operations, and maintenance documentation shall be delivered to NASA after the new system has completed acceptance tests.
- q. The system shall be designed to have an estimated working life of at least 25 years.
- r. All equipment and vessels (or vessel coatings) with a service life that is less than 25 years shall be designed for ease of removal, inspection, or refurbishment, and shall be identified in the system

maintenance documentation.

- s. All equipment, materials, and workmanship shall conform to good engineering practices and, at the least, to the latest edition of the codes or standards published by the following organizations:
 - 1. American National Standards Institute (ANSI)
 - 2. National Electrical Code (NEC)
 - 3. Underwriters Laboratories (UL)
 - 4. American Society of Mechanical Engineers (ASME)
- t. All eyewashes and emergency safety equipment as prescribed by ANSI 2358.1.
- u. All new components including piping, vessels, and pressure systems shall meet current NASA Ames Research Center directives or requirements for design and construction, including NASA Seismic standards.
- v. If there is a conflict between any of the above and these specifications, the codes, standards, and NASA directives or requirements will prevail, and an exception to the specifications shall be noted.
- w. All new chemical storage tanks and interconnecting piping that contains hazardous chemicals shall conform to current Santa Clara County Ordinance Code Division B11, Section B11-286 New Storage Facilities Secondary Containment Requirements.
- x. Contractor shall submit construction drawings showing tank and piping information and obtain hazardous materials construction permit and approval from the County of Santa Clara, Department of Environmental Health, Hazardous Materials Compliance Division prior to construction.

1.9 CONTROL SYSTEM FUNCTIONS

- a. Automated system start-up, operation, and shutdown sequences shall be provided for all NOx scrubber system functions.
- b. Control equipment for the scrubber system shall be located adjacent to the scrubber.
- c. Control equipment shall be provided with sufficient protection and climate control as required for year-round all-weather use (NEMA 4 or better).
- d. The control equipment may be co-located with the emission analyzer.
- e. A remote control panel with full functional capability, control and monitoring, shall be located in the Boiler House Control Room, N234A.
- f. Control and monitoring of the scrubber system shall be independently performed from either the N234A remote panel or the panel located adjacent to the scrubber (local), but only one panel at any one time as determined by "local-remote" selector switch in local control panel.
- g. The remote control panel in N234A should be easily movable in the event the boiler control room is relocated in the future.
- h. A functional description document of the control system covering

start-up, operation, logic, alarms, and emergency shutdown shall be submitted.

- i. If a programmable controller is used, a backup copy of the programming, including all system logic, recipes, etc., shall be provided.
- j. Faults detected by the control system shall be integrated with, and displayed on, the SVS Boiler House Control Room annunciator.

1.10 EMISSIONS MONITORING

- a. A continuous emissions analyzer/monitor shall be furnished in order to measure (or calculate) and record concentration of NO, NO₂, and total NO_x. The system shall be capable of monitoring NO_x at two locations: the inlet and exhaust of the scrubber system. Analyzer/monitor shall be approved by BAAQMD.
- b. The emissions analyzer shall be housed in a weatherproof and lockable shed or other small structure next to the scrubber.
- c. A sensor shall be installed on the output of the scrubber to continuously measure exhaust gas flow rate. Flow rate sensor shall be approved by BAAQMD. If an analyzer, calibrator, or other related system is needed to support the flow rate sensor, it may be co-located with the emissions analyzer.
- d. Chemical Treatment Controls (if applicable) consisting of chemical sensors, analyzers, controllers, and chemical metering pump shall have their data integrated with the emissions monitoring system.
- e. All analyzers, monitors, sensors, and controls shall be monitored at the control board in N234A.
- f. All sensors, controls and measurements shall be recorded at the Boiler Control Room, N234A.
- g. All instrumentation shall be accessible, capable of being calibrated, and protected from the elements.
- h. All unique sensors and analyzers shall be provided with spares in case of failure and for ease of calibration and maintenance. All spare components shall be identified and delivered prior to facility acceptance.
- i. Submit documentation of proposed emissions monitoring system for review and approval prior to procurement.
- j. Warning indication and alarms shall be integrated with the SVS Boiler House Control Room annunciator to indicate failure of the NO_x scrubber to abate NO_x below the required levels or of the failure of sensors and analyzers critical to monitor NO_x emissions-as part of the Facilities Permit to Operate.

1.11 START UP AND TRAINING

- a. All labor, equipment, and utilities necessary for system start-up shall be provided.
- b. The equipment supplier shall furnish the services of a factory

representative, who has complete knowledge of the system and its components, to inspect the final installation, supervise initial operation, and train operating personnel in the proper operation and maintenance of the system.

- c. Training sessions shall cover the following topics: system overview, safety procedures, operation, maintenance, and troubleshooting.
- d. Three (3) copies of operation and maintenance instructions for the entire system shall be furnished. The information shall be sufficient to instruct someone who is not familiar with the equipment in the operation and maintenance of the system. It shall include:
 1. System description and principle of operation.
 2. Complete parts list with model and part numbers.
 3. Diagrams, illustrations, and cut sheets.
 4. Performance and nameplate data.
 5. Installation instructions.
 6. Procedures for starting, testing, and operating the system.
 7. Operating parameters and methods for proper adjustment.
 8. Steps required to correct, or avoid, deviations from operating limits, and consequences of such deviations.
 9. Procedure for start-up following a turnaround, or after emergency shutdown.
 10. Shutdown instructions; short, long term, and emergency.
 11. Diagnostic procedures and troubleshooting guide to be used in the event of system shutdown or malfunction.
 12. Instructions and drawings to facilitate maintenance, lubrication, and overhaul of the equipment and ordering of spare or replacement parts.
 13. List of recommended spare parts.
 14. List of electrical relay, control, and alarm contact settings.
 15. Electrical wiring diagram.
 16. Safety precautions.
 17. Address and phone for factory and local representatives.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening. Equipment shall be supported by in-service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. In-service organization shall respond to a service call within one day.

Glass-reinforced plastic equipment shall meet the requirements of [ASTM D-3299](#) for filament wound tanks, and [ASTM D-4097](#) and National Bureau of Standards Voluntary Product Standard [PS-15](#) for custom contact molded equipment.

Vessels shall have a nameplate installed and resin coated. The following information shall be printed on the nameplate:

- a. Name of Manufacturer

- b. Manufacturer Serial Number
- c. Year Fabricated
- d. Capacity in Gallons
- e. Empty Weight of Vessel
- f. Chemical Environment
- g. Maximum Specific Gravity
- h. Design Pressure & Temperature
- i. Resin Used

2.1.2 General Requirements

Equipment and appurtenances shall be as specified and as shown on the [approved detail drawings](#), and shall be suitable for the service intended. Materials and equipment shall be new and unused, to include testing equipment furnished under the contract. Components that serve the same function and are the same size shall be identical products of the same manufacturer. Design and fabricate vessels in accordance with ASME Section VIII, Div. 1, if design pressure exceeds [15 psig](#), or vacuum/pressure vessel volume is greater than [100 cubic feet](#).

2.1.3 Nameplates

Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment. Each piece of equipment shall bear the approval designation and the markings required for that designation. Valves shall be marked in accordance with [MSS SP-25](#) and shall bear a securely attached tag with the manufacturer's name, catalog number and valve identification permanently displayed.

2.1.4 Equipment Guards and Access

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts so located that any person may come in close proximity thereto, shall be enclosed or guarded to prevent accidental personal injury, in accordance with [29 CFR 1910](#), Subpart O, Machinery and Machine Guarding. Guards shall be removable and arranged to allow access to the equipment for maintenance. High-temperature equipment and piping so located as to endanger personnel or to create a fire hazard shall be guarded or covered with insulation of type specified for service. Items such as catwalk, stair, ladder, and guardrail shall be provided where required for access.

2.2 GAUGE

Gauge shall conform to the following:

2.2.1 Draft Gauge

[ASME B40.100](#). Tubing for gauges for service above [150 degrees F](#) shall conform to [ASTM B 68](#); for service below [150 degrees F](#), plastic tubing

conforming to [ASTM D 1248](#) may be used.

2.2.2 Gauges, Pressure and Vacuum

[ASME B40.100](#), range suitable for the related conditions.

2.3 LOW-WATER CUTOFF

Low-water cutoff shall be provided for all scrubber liquid sumps, holding tanks, reservoirs, and mixing tanks. Cut-off shall cause a safety shutdown of the scrubber and shall be provided with auxiliary contacts to be used to sound an alarm. Low-water shutdown shall require a manual reset before any equipment can recycle or operate.

2.4 PIPE, FITTINGS, AND TUBING

See Piping General Notes on Sheet M1.

2.5 STEEL SHEET

Steel sheets shall conform to the following:

2.5.1 Zinc Coated (Galvanized)

[ASTM A 653/A 653M](#); [ASTM A 924/A 924M](#) for dust collector casings, housing, and components. Gauges specified are manufacturers' standard gauge.

2.5.2 Low-Carbon

Gauges specified, for dust collector casings, housings, and components, refer to manufacturers' standard gauge.

2.5.3 Corrosion Resistant

[ASTM A 167](#), Class 304 or 316. Gauges specified refer to U.S. Standard Gauge.

2.6 THERMOMETERS

Thermometers shall conform to [ASME PTC 19.3](#) with wells and temperature range suitable for the use encountered.

2.7 VALVES

Valves shall conform to the following:

2.7.1 Angle Valves

[MSS SP-80](#), Types 1, 2, or 3, Class 125, except that valves over 3 inch shall have iron bodies and brass or bronze standard trim with glands or followers in the stuffing boxes. Valves shall have nonmetallic renewable composition discs and raised flat seats designed for 125 psi steam. Wheels shall be secured with hexagonal nuts.

2.7.2 Check Valves

[MSS SP-80](#), Types 1, 2, 3, or 4, Class 125, as required. Valves over 3 inch shall have iron bodies and shall be the swing type designed for 125 psi steam. Check valves shall have renewable composition discs or shall have

metallic discs of the regrinding type to permit regrinding without removing valve from the line.

2.7.3 Gate Valves

Sizes of 1-1/2 inch or less, MSS SP-80, Class 125, Type 1 and 2; 2 inch size and over, MSS SP-70, Class 125 or 250, as specified; outside screw and yoke with threaded end (design OT), or flanged end (design OF), as required.

2.7.4 Globe Valves

MSS SP-80, Type 1. Valves over 3 inch shall have iron bodies and brass or bronze standard trim and shall have glands or followers in the stuffing boxes. Valves shall have nonmetallic renewable composition discs and raised flat seats designed for 150 psi steam. Wheels shall be secured to the stems with hexagonal nuts.

2.8 WATER METERS

Water meters shall be the disc type with reinforced disc for hot water above 150 degrees F, and rubber or carbon disc for cold water, and shall be constructed of bronze composition or cast iron protected by noncorrosive coating. Moving parts subject to wear shall be easily replaceable. Meters shall conform to the requirements of AWWA C700.

2.9 ELECTRICAL WORK

Electrical motor-driven equipment specified shall be provided complete with motors, motor starters, and controls. Electrical equipment and wiring shall be in accordance with Division 26. Electrical characteristics shall be as indicated or specified. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary for the motor control specified. Each motor shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified but not shown, shall be provided. Motors shall conform to NEMA MG 1, with enclosures as indicated. Controls, interlocks, instruments, status indication lights, and other devices required for operation and observation of equipment status shall be assembled on an open face panel. Panel shall be factory-assembled, connected to equipment, and mounted on unit or factory assembled and boxed for field installation. Instrumentation and control system shall include local control panels and a central control panel located in the facility control room. The control system shall integrate local controls provided with equipment, as specified, so that complete system operation can be monitored and controlled from the control room. The air pollution control system shall be integrated with the emission generating equipment. The control system shall provide integrated control of all system processes and equipment, and shall contain all necessary instrumentation required for monitoring and operation of the air pollution control system. Control system panels shall graphically display the system. Local control panels shall be provided with selector switches so that equipment can be operated manually for test and maintenance purposes. Suitable safety interlocks shall be incorporated to assure that proper permissive conditions have been met prior to changing the operating status of major system components. Shutdown of the air pollution control equipment system, or portion thereof, shall be automatically initiated, with alarms should unsafe conditions arise during operation of the system.

Visible and audible alarms shall be provided on critical functions locally and at N234A boiler control room. Controls shall conform to NEMA ICS 1. Enclosures for power and control panels shall conform to NEMA ICS 6.

2.10 DRAFT FANS

Centrifugal fans conforming to AMCA 801 Type I or Type II induced draft shall be furnished as an integral part of air pollution control equipment design. Fans shall be centrifugal with backward curved blades or radial blades or axial flow type. Each fan shall be sized for an output volume and static pressure rating sufficient for pressure losses, leakages, temperature, and elevation corrections for worst ambient conditions. In addition, fan sizing shall include margins of 10 percent volume and 21 percent static pressure, plus margins of 40 degrees F for induced draft fans. Induced draft fans shall be provided with outlet dampers. Noise levels for fans shall not exceed 85 decibels in any octave band at a 3 foot station. Fan bearings shall be air cooled and backward curved fan blade type with bearings not requiring water cooling may be of the self-aligning antifriction type.

2.10.1 Draft Fan Control

Induced draft centrifugal fans shall have variable speed control.

2.10.2 Draft Fan Drives

Fan shall be driven by an electric motor. Electric motor shall be totally enclosed fan-cooled. Motor starter shall be magnetic type with weather-resistant enclosure and shall be furnished with four auxiliary interlock contacts. Provide motors with electrical and mechanical premium performance in accordance with NEMA MG-1.

2.11 AIR POLLUTION CONTROL EQUIPMENT

Performance of equipment shall be as indicated in Paragraph SCHEDULES. Water piping shall comply with ASME B31.3. Equipment shall be provided with steel walkways, safety rails and stairs, or ladders. Access shall be by means of step stairs with handrails.

2.11.1 Wet Scrubber

Scrubber shall be one of the types identified by ICAC WS-3 as a fixed packed bed type. Unit shall employ a small quantity of water or chemical neutralizing water solution to provide for maximum scouring and pollutant removal of the gas stream. Water demand rates of less than one gpm per 1000 cfm of processed gases shall use cooling tower blowdown plant water with waste to drain. Water demand in excess of the above flow rate shall provide for recirculation of the washing liquor. Unit shall be provided with an automatic water supply control valve, and a totalizing water meter, strainer, and water pressure gauge.

2.11.1.1 Chemical System

Each unit requiring neutralizing chemical additives shall be provided with a complete automatic chemical monitoring, control, mixing, feeding, and reserve storage system.

2.11.1.2 Chemical Storage Tanks

Tanks for the storage of treatment chemicals that are necessary for the proper operation of the system can be optioned.

Chemical storage tanks shall have flat-bottom, cylindrical or rectangular construction with dome or conical top. They shall be fabricated from filament wound glass-reinforced plastic. The resin shall be vinyl ester type.

Capacity of the tank shall be sufficient for 30 days of operation at typical conditions without need for re-filling.

Each tank shall have flanged connections for filling, overflow, pump, sight gauge, vent, drain, and level switches.

Chemical storage tanks and interconnecting piping shall have secondary containment and conform to Santa Clara County Secondary Containment requirements.

2.11.1.3 Chemical Metering Pumps

Chemical metering pumps shall be the positive displacement diaphragm type. They shall deliver one of the following chemical solutions:

- a. Sodium sulfide or sodium hydrogen sulfide
- b. Sodium hydroxide
- c. Sodium chlorite
- d. Sulfuric acid

2.11.1.4 Packed Bed Scrubbers and Oxidation Columns

Scrubber shall be fluid-tight construction of glass fibre reinforced polyester. Unit shall be provided with leak-tight viewing windows and access doors to permit appraisal of entire operation as well as full access for all service operations or parts replacement. Vanes, baffles, deflectors, or diffuser plates shall provide for uniform gas flow through the processing area. Scrubber shall be factory assembled, piped, and wired on floor mounted welded steel bases as indicated.

PACKED BED Columns

Each scrubber shall be a vertical, cylindrical vessel with domed ends. Air shall enter near the bottom of the scrubber and shall be discharged near the top. Scrubbing liquid shall be applied to the top of the pack and shall flow by gravity toward the bottom of the column.

Scrubbers shall be complete, including all internals, packing, packing supports, mist eliminator, liquid distributors, air inlet and outlet, access doors, couplings or flanges for connection of instruments or plumbing, lifting lugs, anchoring lugs, and other appurtenances shown on the Drawings, or necessary for safe and efficient operation of the system.

The vessels shall be of filament wound glass-reinforced plastic construction. The resin shall be vinyl ester type.

Packing shall be a random-dumped, high-efficiency type. It shall be fabricated from polypropylene and have a nominal diameter that is commensurate with the tower diameter.

The mist eliminator shall be integral to the scrubber and shall consist of several layers of mesh pad material constructed from polypropylene monofilament. The demister shall be six layers of Kimre Style 37/97 material or equivalent.

Scrubbing liquid shall be evenly distributed over the top of the packing by an arrangement of spray nozzles on one or more headers.

Spray nozzles shall be a non-clogging, open-orifice type. They shall be easily removable for cleaning and shall be attached to the header with tees.

Access doors shall be provided at the top and bottom of the packing section to facilitate removal and replacement of the packing.

An access door shall be provided for inspection of and access to the mist eliminator.

At least one (1) access door shall be provided in order to facilitate observation and maintenance of the spray headers.

All access doors shall be a flanged opening with diameters as appropriate for safe access. They shall be located away from obstructions such as ladders, piping, and ductwork. Manufacturer shall provide clear flange covers, gaskets, and hardware.

Gaskets for all flanged fittings or access doors shall be 1/8 inch thick full face type made from ethylene propylene rubber (EPR).

Lifting lugs shall be provided. A minimum of three are required.

Pipe supports for the recycle line shall be attached to the vessel.

OXIDATION Columns

Each oxidation tower shall be a vertical, cylindrical vessel with domed ends. Air shall enter near the top of the tower and shall be discharged near the bottom.

Oxidation towers shall be complete, including all internals, mist eliminators, liquid distributors, air inlet and outlet, access doors, couplings or flanges for connection of instruments or plumbing, lifting lugs, anchoring lugs, and other appurtenances shown on the Drawings, or necessary for safe and efficient operation of the system.

The vessels shall be of filament wound glass-reinforced plastic construction. The resin shall be vinyl ester type.

Oxidizer suspension pads shall be provided at two locations in each tower to retain chemicals sprayed into the gas stream to oxidize nitric oxide. The pads consist of several layers of material that is constructed from polypropylene or PVDF monofilament. The pads shall be made from six layers of Kimre Style 37/97 material or equivalent.

The mist eliminator shall be integral to the scrubber and shall consist of several layers of mesh pad material constructed from polypropylene

monofilament.

Oxidizing chemicals shall be evenly distributed over the top of the suspension pads by an arrangement of spray nozzles on one or more headers. The entire liquid distributor shall be made from PVC.

Spray nozzles shall be a non-clogging, open-orifice type.

An access door shall be provided for inspection of and access to the mist eliminator and each oxidizer suspension pad.

An access door shall be provided in order to facilitate observation and maintenance of the spray headers.

Access doors shall be a flanged openings with dimensions as shown on the Drawings. They shall be located away from obstructions such as ladders, piping, and ductwork. Clear flange covers, gaskets, and hardware shall be furnished.

2.11.1.5 Recirculation Pumps

Unit requiring recirculation of the scrubbing liquor shall be provided with electric motor centrifugal pumps to conform to HI 3.1-3.5. Pumps shall develop the system pressure head required by the scrubber. Materials, construction, ratings, application, and testing shall conform to the standards and recommendations of HI 3.1-3.5 for corrosion resistant operation of pumping the scrubber liquor. Each pump shall have a discharge pressure gauge appropriate for the pump head and a low pressure limit switch to close a circuit for an alarm. Pumps shall be provided with corrosion-resistant strainers, valves, and piping suitable for the system and the gas to be processed. Pumps for metering the feed rate of scrubber chemical additives shall be provided with automatic means for varying the feed rate.

Centrifugal pumps shall be used to deliver scrubbing solution from the recycle tank to the spray nozzles in the scrubber, and to discharge effluent from the overflow tank.

Pumps, drivers, and auxiliaries shall be suitable for start-up and continuous operation in an outdoor, totally unprotected environment, and at any temperature within the design range.

Pumps shall be top-discharge, self-venting design with fully confined gaskets. Suction and discharge connections shall be 150# standard ANSI flanges.

An arrow to indicate direction of rotation shall be permanently attached to the pump housing by the Manufacturer.

Mechanical seals, as manufactured by Durametallic, John Crane, or Borg Warner, shall be furnished.

Pumps shall be GRP type as manufactured by Ingersoll Dresser, or approved equal.

Electric Motors

Motors shall conform to the latest revision of NEMA standard publications MG1 and MG13.

Motors shall be NEMA design B (normal torque).

Motors shall be for continuous duty and shall have TEFC enclosures.

Motors shall be manufactured by Lincoln Electric Company, U.S. Motors, Baldor, or approved equal.

Pipe and Fittings

Recycle lines shall be Schedule 80 PVC or CPVC. They shall be valved so that the pump can be removed for maintenance without first draining tanks and sump.

Provide basket strainers to prevent objects from entering the pump suction. The strainer shall have flanged inlet and outlet couplings. The basket shall have 3/16-inch diameter holes. The top of the strainer shall be flanged to allow access to the basket for cleaning.

2.11.1.6 Piping Materials

Piping materials shall be compatible with the scrubber fluids.

2.11.1.7 Scrubber Collector System (Pretreatment Tank)

Each scrubber requiring the use of chemical additives shall be provided with a system for removing and dewatering the collected material and chemical residues of the scrubber process. Related equipment and controls shall be provided. Pressure test connections shall be provided at the inlet and outlet pipes connecting to the tank.

2.11.1.8 Pretreatment Tank

General: Horizontal double-wall above ground tank to retain waste recycled water. Manufacture tank with ASME RTP-1 stamp. Design tank for ambient outdoor temperature, and atmospheric pressure.

Tank: Glass fiber reinforced plastic tank with isophthalic resin body and vinyl ester resin inner barrier reinforced with 20 mil c-glass surface veil. Finish exterior surface with white gel coat. Use 2 ply c-glass veil on all inside bonds. Resin coat all cut edges.

Nozzle flanges: ASME B16.5, Class 150. Provide nozzles as required by piping design, including full drain fitting.

Accessories: Hinged manway on top, saddle supports, tie-down lugs, and lifting lugs for tank.

Access: Fiberglass work platforms, catwalks, handrails, and ladders to allow personnel access to serviceable components and inside of tank for inspection and maintenance.

2.12 EMISSION MONITORING SYSTEM

Emission monitoring system complete with all components, accessories, analyzers, analyzer calibration system, and recorders, alarms, and free-standing factory assembled panel shall be provided to monitor nitric oxide, nitrogen dioxide. System shall continuously monitor. Emissions shall be indicated and recorded in ppm and percent of sample.

2.12.1 Gas Sampling System

Sampling locations for air pollution control equipment performance shall be in accordance with 40 CFR 60, Appendix A. A vacuum pump shall draw a gas sample through a filter probe mounted inside the stack, a prefilter, and a moisture separator/drier. It shall discharge the sample through a flow meter on each analyzer to atmosphere as indicated. Equipment and necessary tubing shall be provided for automatically purging pollutants from sampling tubing, stack probe, and drier tubing, and for automatic regeneration of the drier. Cleaning and drying operation shall be time programmed.

2.12.2 Analyzing System

System shall provide simultaneous measuring and analyzing of sample gas by each analyzer with independent flow meters, valves, piping, and accessories. Each analyzer shall indicate ppm of the measured pollutant. A recorder shall be provided for each analyzer with 30-day, 5 inch strip chart with pressure sensitive stylus. Each analyzer shall be provided with a visual color coded, panel mounted, high limit alarm with a single audible alarm with silencing button for all alarms. A relay on each analyzer shall be provided for connection to remote alarms.

Exhaust Gas Analyzer

A continuous emissions monitor shall be furnished in order to measure concentration of nitric oxide (NO) and total NOx, and to calculate nitrogen dioxide (NO2).

The emissions monitoring system shall be Horiba Instruments Inc. Model VA-3000 (CEMS), or approved equal.

2.12.3 System Mounting

Gas sampling, analyzing, and recording systems shall be piped, wired, and mounted within a factory fabricated 12 gauge cold rolled black steel enclosure with angle frame support and key-locked doors for wall or floor mounting. Entire system shall be suitable for 120 Vac, 60 Hz, single-phase electric service.

2.12.4 Calibration

Calibration gas tanks of capacities indicated complete with regulators, valving, and tubing shall be provided for the specified emissions.

2.13 PAINTING AND FINISHING

Equipment and component items shall be factory primed and finish coated with the manufacturer's standard finish. Items located outside the building shall have weather resistant finish. Damaged finish surfaces shall be refinished with an identical type of finish used at the factory.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 INSTALLATION

Work shall be installed as indicated and in accordance with manufacturer's diagrams and written instructions. A factory installation specialist shall be at the site for erection of scrubber.

3.3 OPERATION AND PERFORMANCE REQUIREMENTS

Air pollution control equipment shall process and remove pollutants from exhaust gas streams to produce an effluent that will conform to 40 CFR 50 and other federal, state, and local regulations, without degrading the performance of related system components. The air pollution control equipment installed shall perform the cleaning operation as indicated in paragraph SCHEDULES.

3.4 FRAMED INSTRUCTIONS

Framed instructions containing wiring and control diagrams under glass or in laminated plastic shall be posted in enclosure for analyzer. The instructions shall show wiring and control diagrams and complete layout of the entire system. The instructions shall include, in typed form, condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation and procedures for safely starting and stopping the system. The framed instructions shall be posted before acceptance testing of the system.

3.5 TESTING AND INSPECTIONS

3.5.1 System Performance Test

Upon completion, and prior to acceptance of the project, the air pollution control equipment and monitoring system shall be tested in accordance with 40 CFR 60, Appendix A and state and local codes by the Contractor to demonstrate indicated performance. A factory startup specialist shall be at the site to direct and monitor startup for testing of scrubber. Notify the Contracting Officer 10 days in advance of the test date. The Contractor shall furnish all instruments and personnel required for the tests. Submit the applicable test procedures and sampling locations to the Government for approval. Electricity and water will be furnished by the Government.

3.5.2 Retesting

If any deficiencies are revealed during test, such deficiencies shall be corrected and the tests reconducted.

3.6 MANUFACTURER'S FIELD SERVICE

3.6.1 Installation

Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the specified equipment shall be provided. The representative shall supervise the installing, adjusting, and testing of the equipment.

3.6.2 Training

Conduct training course for operating staff as designated by the

Contracting Officer. The training period, of a total of 8 hours of normal working time, shall start after the system is functionally completed, but prior to final acceptance tests. The field instructions shall cover all of the items contained in the operating and maintenance instructions, as well as demonstrations of routine maintenance operations. The Contracting Officer shall be notified at least 14 days prior to date of proposed conduction of training course.

3.7 SCHEDULES

See Attachment 1.

-- End of Section --