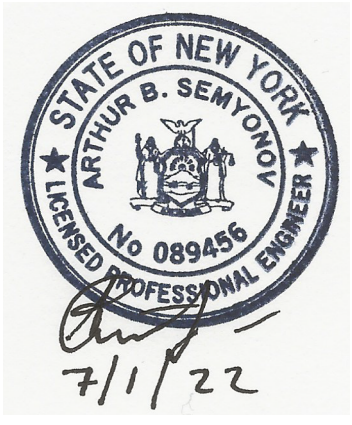
LEE CDC BLDG. 140 HVAC & DRAINAGE DESIGN

140 BUCKNERLOOP, WEST POINT, NY

USACE CONTRACT NO. W911SD21D0006

RTA SUBMISSION SPECIFICATIONS

JULY 1, 2022



ARCHITECTURAL & SITE
QPK DESIGN, LLP
ARCHITECTS/ENGINEERS

MEP
HDR

LAND SURVEYOR
SHUMAKER ENGINEERING

ESTIMATOR
CRAWFORD CONSULTING SERVICES

COMMISSIONING SERVICES
HORIZON-ENGINEERING

LEE – CDC

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SECTION 00 80 00

SPECIAL CONTRACT REQUIREMENTS (USMA)

Note: The information described herein is supplemental to those further described in other related sections of the specifications.

SC-01. WORKING CONDITIONS

The Contractor shall submit for approval by the Contracting Officer or Contracting Officer's Representative (COR) a construction plan indicating the type and extent of construction to be performed. The plan shall be submitted 14 calendar days prior to actual construction.

Parades, reviews and similar ceremonies are routinely conducted three or four times a week. Hours of such ceremonies are normally 5:00 p.m. on weekdays and 11:30 a.m. on Saturdays, although there are exceptions to these hours. In addition, the following requirements shall apply to all Contractor activities in connection with these ceremonies.

a. Right of way shall be given to cadets marching in formation to or from ceremonies.
b. During the actual ceremonies, the Contractor's activities that produce noise to an extent which would distract or interfere with the ceremony, such as the operation of loud and noisy machinery, shall be suspended until the ceremony is over.

Sallyports and other access ways shall be fully usable. The sallyports will be actively used by the Corps of Cadets throughout the duration of the project.

Funeral processions and other events at the cemetery may also occur on a frequent basis. These ceremonies including travel processions to and from the cemetery shall not be disrupted by the work.

All cost for conformance with the above stated requirements shall be included with contract amount and no claim for extra cost shall be considered.

SC-02. SCHEDULES FOR CONSTRUCTION CONTRACTS

a. At the project kick-off meeting, prior to commencing any work, the Contractor shall submit for approval three (3) copies of each of the following items:

    1. A practicable construction schedule showing the order in which the Contractor proposes to perform the work.
    2. The dates on which the Contractor contemplates starting and completing the salient features of the work (including acquiring materials, plant, and equipment).
    3. The proposed Schedule of Values for future pay applications.

b. The construction schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the full duration of construction.
c. The Schedule of Values shall clearly break-down the contract cost based at a minimum on major work scope as identified within individual specification sections. If the Contractor fails to submit a schedule within the time prescribed, the COR may withhold approval of progress payments until the Contractor submits the required schedule.

d. The Contractor shall enter the actual work progress on the chart as directed by the COR and shall deliver three (3) copies of the updated schedule to the COR on a month-by-month basis. If, in the opinion of the COR, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress, including those that may be required by the Contracting Officer or the COR, without additional cost to the Government. In this circumstance, the COR may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction work areas, and to submit for approval any supplementary schedule or schedules in chart form as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained.

e. Failure of the Contractor to comply with the requirements of the Contracting Officer or COR under this clause shall be grounds for determination by the Contracting Officer that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the COR may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of this contract.

SC-03. CONSTRUCTION LIGHTING: All areas shall be illuminated by means of temporary lights which shall provide intensity equal to or greater than 20-foot candles during construction. If the Contractor fails to provide and maintain the required illumination described above, the Contracting Officer may issue a stop order suspending all working the improperly illuminated area or areas. No part of the time lost due to any such stop order shall be the subject of a claim for extension of time or for excess costs or damages by the Contractor.

SC-04. ARTIFACTS, PRESERVATION & PROTECTION OF HISTORICAL, ARCHAEOLOGICAL AND CULTURAL RESOURCES: Any and all items of prehistoric, historic and military relics or memorabilia, which may be discovered in the course of the construction activities, shall remain the property of the Government. Examples of such items include but are not limited to: printed matter or other papers, buttons, buckles, or fragments of uniforms, buried weapons, bayonets, sabers, cannon balls, ammunition, fragments of structures or foundations, in short any item of historical or archaeological value. Federal legislation provides for the protection, preservation and collection of scientific, pre-historical, historical and archaeological data, including relics and specimens which might otherwise be lost due to alteration of terrain or building features as a result of any federal construction project. Any person who, without permission, injures, destroys, excavates, appropriates or removes any historical or pre-historical artifact, object of antiquity or archaeological resource from public lands of the United States is subject to arrest and penalty of law.

Cultural resources on Federal property are protected and managed by the Archaeological Resources Protection Act of 1979 and other applicable laws. The Contractor shall exercise care so as not to disturb or damage artifacts or fossils (should any be uncovered) during the excavation operations. Should the Contractor or any parties operating or associated with the performance of this contract discover evidence of possible scientific, prehistoric, historic or archaeological finds within the work limit lines or adjacent to work area shall immediately cease work at that location and notify the Contracting Officer, in accordance with USMA SOP 16-1. The Contractor shall provide the Contracting Officer with all information as to the specific location and nature of the findings. USMA SOP 16.1 will be furnished to the Contractor at the pre-construction meeting. The Contractor shall cooperate fully with the Contracting Officer in implementing the procedures of USMA SOP 16.1. Where appropriate by reason of discovery, the Contracting Officer may order delays in time of performance or changes in the work or both. If such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with the applicable clauses of the contract.

SC-05. SUBMITTAL DESCRIPTIONS: See Section 01 33 00 CONSTRUCTION SUBMITTAL PROCEDURES.

SC-06. SUBMITTAL PROCEDURES: See Section 01 33 00 CONSTRUCTION SUBMITTAL PROCEDURES.

SC-07. GOVERNMENT FURNISHED PROPERTY: The Government will not furnish the Contractor with any equipment or property for installation.

SC-08. SALVAGE: Items to be salvaged shall be removed carefully and reused in locations indicated on plans and specifications.

SC-09. FIELD OFFICE, SHOP OR STORAGE: The Contractor shall set up his trailer for use as an office, shop or storage area for supplies within the fenced in staging area as indicated on the Drawings. Space within the existing facility is not available for contractor use as a field office or storage facility except for the following. Storage of salvaged ceiling panels within the area of the current work phase when the phase is not scheduled for after hour construction.

The Contractor shall construct a temporary 6-foot-high chain link fence around trailers and materials. The fence shall include nylon fabric privacy screening on the inside, colored green or black so that visibility through the fence is obstructed. Fence post may be driven, in lieu of concrete bases, where soil conditions permit. Trailers, materials or equipment shall not be place or stored outside the fenced area unless such trailers, materials or equipment are assigned a separate and distant storage area by the Contracting Officer.

The Staging Area will be within the military boundaries. Trailer, equipment or materials shall not be open to public view with the exception of those items which are in support of ongoing work on any given day. Materials shall not be stockpiled outside the fence in preparation for the next day's work. At the end of each workday mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, backhoes and like equipment, shall be parked within the fenced area.

SC-10. PARKING FACILITIES: No parking is allowed within or adjacent to the project area. The Contracting Office will designate available off-site Parking Area(s).

SC-11. HOUSEKEEPING:

a. The Contractor shall take into full account the special Public, Military and Academic nature of the United States Military Academy and its prominence as a tourist attraction, all of which will be in operation during the course of this construction. Where materials or plants cannot be kept on the designated site area in neat, clean and orderly fashion, and thereby cause an unnecessary eyesore, they shall be moved to other locations, on or off Government property, as directed by the Contracting Officer. The Contractor shall, at all times furnish from his own organization a sufficient job force to carry out the housekeeping and cleanup requirements within and immediately surrounding areas affected by contract operations, on a day-to-day basis throughout the life of the contract. On Fridays before the home football game, the Contractor shall either temporarily backfill all excavations or plate them.
b. The Contractor shall provide and maintain a dumpster of sufficient size at the designated staging area. The dumpster shall be replaced at regular intervals to avoid overfilling or spillage. The area around the dumpster shall be kept clean at all times.
c. Remove excavated material by truck and legally dispose of off military property.
d. If, at any time during the progress of the work, the COR determines that the Contractor is failing to comply with the requirements of the subparagraph above, he may direct the Contractor to take such measures as he deems necessary to constitute corrective action. Such measures may include the requirement to increase the work force assigned to the housekeeping and cleanup operations or to work overtime during evenings or weekends until proper job conditions have been restored.

SC-12. DISPENSARY AND HOSPITAL FACILITIES: The facilities of the United States Military Academy Post Hospital are available for use by the Contractor only for the emergency treatment of his personnel injured at the job site. Charges to the Contractor for the use of said facilities will be at prevailing rates for the services provided and billing and payment will be made by separate transaction between the USMA Hospital and the Contractor.

SC-13. TOILET FACILITIES: Portable toilets shall be located as directed by the Contracting Officer's Representative (COR). Upon completion of contract, all temporary toilet facilities shall be removed and any damage to the areas rectified. Government toilet facilities shall not be used by contractor personnel at any time.

SC-14. IDENTIFICATION: The Contractor shall supply identification badges, which shall be worn by all the Contractor's personnel while working at the USMA. The badges shall be visible and contain the Contractor's name, employee's name and contract number and project description. This requirement is in addition to the requirement for West Point Visitor badges issued at the Visitor's Center.

SC-15. DISPOSAL AND BURNING: Construction debris and other rubbish shall be disposed of, off of the Military Reservation. Burning of rubbish or site removal items will not be permitted. Scrap, debris and surplus construction materials are not to be disposed of in the "Post Sanitary Disposal Containers" (Dumpsters), which are distributed throughout the area, but must be loaded in the Contractor's dumpsters for disposal at a location other than the United States Military Academy.

SC-16. RECORD DRAWINGS: (NOT USED).

SC-17. SCAFFOLDING: Contractor shall provide and install all necessary scaffolding and staging to accomplish all phases of the contract work. The Contractor shall be responsible for the strength and safety and be in full compliance with the laws governing safety standards of scaffolding.

SC-18. COORDINATION: It shall be the responsibility of the Contractor to be fully informed of the extent of the limits of work to be performed by his Subcontractors. The Contractor shall coordinate and review all coordination of various trades and work with the COR. The Contractor shall maintain ultimate responsibility and authority over coordination.

SC-19. ENVIRONMENTAL RESPONSIBILITY: West Point is committed to a safe environment and take seriously our steward role as defenders of the National treasure and Hudson Watershed (Constitution Area). Contractors and Subcontractors are expected to comply with all environmental requirements. Immediate actions shall be taken by the Contractor to minimize the effect of any environmental associated incidents (e.g. oil spillage, hazardous waste handling, lead abatement removal, and chemical spillage). Clean up shall be performed by the Contractor in accordance with all applicable Federal, State, and local laws and regulations.

a. CONTRACTOR REPORTING REQUIREMENTS: If an incident occurs on the installation pursuant to Contractor performance, whether or not caused by the Contractor, the Contractor shall immediately (no later than 15 minutes) notify USMA Environmental Management Office at 938-3224/5263, 4129, or 5175, and the Contracting Officer. If a project related incident occurs off the installation, the Contractor shall report it to the National Response Center (NRC), the Installation Coordinator and the Contracting Officer immediately following discovery and shall also comply with applicable State requirements including reporting to the New York State DEC Spill Hotline at 800-457-7362, and USTNRC at 800-424-8802.

When an incident is reported by phone to any of the above agencies, the Contractor shall provide the following information:

1. Description of Incident.
2. Time and Location of incident.
3. Any injuries incurred.
4. Estimated quantity of materials (tons, gallons, drums, etc.) involved in incident.
5. Whether the incident has reached any storm drains, sanitary sewers, ponds or waterways.
6. Containment procedures already initiated - brief description of containment (i.e. booms, pads, embankments sandbags).
7. The Contractor's point of contact.

A written follow-up report shall be submitted to the Contracting Officer no later than five (5) calendar days after the initial incident. The written report shall be in a narrative form and as a minimum include the following:

1. Description of the material involved (including identify, quantity, and manifest number).
2. What time the incident was reported, and to whom it was reported.
3. Exact Location of the incident, including description of the area involved.
4. Cause of incident and equipment and personnel involved.
5. Injuries or property damage of incident.
6. Containment procedures initiated.
7. Summary of any communication the Contractor has with press, agencies, or Government officials other than the COR.
8. Description of cleanup procedures employed or to be employed at the site, including disposal location of incident materials.

A follow-up meeting will be held within (5) calendar days after receipt of the written report to discuss after action procedures to eliminate or prevent this type of incident in the future. The Contractor will be required to attend the follow-up meeting.

The reporting requirement is in addition to any other environmental related actions, notices, reports, certifications or compliances required by other contract clauses or provisions or by federal, state or local law.

b. EPA OR DEC INSPECTION: The Contractor shall immediately inform the Environmental Management Division (EMD), Directorate of Public Works, USMA THROUGH the Contracting Officer or the Contracting Officer's Representative when the United States Environmental Protection Agency (EPA) and/or the New York State Department of Environmental Conservation (DEC) inspector visits the site for an official inspection.

SC-20. PROJECT SIGN: The Contractor shall furnish and erect a project sign at each work location as directed by the Contracting Officer and in compliance with Section 01 58 00 Project Identification. The specific Agency name and logo and specific project identification to be used on the sign will be Government furnished. The Contractor will be given this information and any associated layout adjustments at the time of the pre-construction conference. The decal shall receive a thin cost of clear spar varnish after application. The Contractor shall maintain the sign in good condition throughout the construction period. Upon completion of the project, the Contractor shall remove the sign from the worksite.

SC-21. QUALITY CONTROL SUPERVISOR
The Contractor shall employ a competent Quality Control Supervisor who shall be in attendance at the project site at all times, during performance of the work. The Quality Control Supervisor and the Construction Superintendent can be the same person.

SC-22. CONTRACTOR QUALITY CONTROL: The Contractor shall provide and maintain an effective quality control program that complies with the contract clause of the contract entitled "Inspection of Construction."

a. The Contractor shall establish a quality control system to perform sufficient inspection and tests of all items of work, including that of his Subcontractors, to ensure conformance to applicable specifications and drawings with respect to the materials, workmanship, construction, finish, functional performance and identification. This control will be established for all construction except where the Technical Provisions of the contract provide for specific Government control by inspections, tests or other means. The Contractor's control system will specifically include the surveillance and tests required in the Technical Provisions of the contract specifications. For purposes of the above description, shop manufacture of standard products is not defined as construction.

b. The Contractor's quality control system is the means by which he assures himself that his construction complies with the requirements to cover all construction operations, including both on-site and off-site fabrication and will be keyed to the proposed construction sequence and shall include as a minimum at least three phases of inspection for all definable items or segments of work, as follows:

1. Perform inspections in the presence of the Contracting Officer.
2. Preparatory Inspection: To be performed prior to beginning any work on any definable segment of work. To include a review of contract requirements; a check to assure that all new materials and/or equipment have been tested, submitted and approved; a check to assure that provisions have been made to provide required control testing; examination of the work area to ascertain that all preliminary work had been completed; and a physical examination of materials and equipment to assure that they conform to approved shop drawings or submittal data and that all materials and/or equipment are on hand. The Contractor shall submit to the Contracting Officer a memo for record of the preparatory inspection within two (2) days after the inspection is held.
3. Initial Inspection: To be performed as soon as a representative segment of the particular item of work has been accomplished and to include examination of the quality of workmanship and a review of control testing for compliance with contract requirements, use of defective or damaged materials, omissions and dimensional requirements.
4. Follow-Up Inspection: To be performed daily or as frequently as necessary to assure continuing compliance with contract requirements, including control testing, until completion of the particular segment of work.

d. The Contractor shall maintain current records and provide copies to Contracting Officer of all inspections and tests performed. These records should provide factual evidence that the required inspections or tests have been performed, including type and number of inspections or tests involved; results of inspections or tests; nature of defects, cause for rejection, etc.; proposed remedial action; and corrective actions taken. The Contractor shall not build upon or conceal any feature of the work containing uncorrected defects, and payment on deficient items will be withheld until they are satisfactorily corrected or other action has been taken as authorized, pursuant to the contract clause entitled "INSPECTION OF CONSTRUCTION".

These records must cover both conforming and defective items and must include signed statements verifying that the designated person in the Contractor's quality control organization has personally checked the materials, methods and workmanship installed on that day. Legible copies of these records must be furnished to the COR no later than 0800 hours the day after the work has been accomplished. This reporting is a daily requirement.

d. The Contractor shall furnish the COR within five (5) days of award, an original and two (2) copies of a quality control plan which shall include the personnel, procedures, instructions and records to be used. At a minimum, the plan shall include the following information:

1. The quality control organization.
2. Qualifications of personnel to be used for this purpose.
3. Authority and specific areas of responsibilities of each of the quality control personnel.
4. Methods of performing quality control inspections including that for his sub-contractors' work. Mechanical and electrical testing procedures shall be described in quality control plan in detail and approved prior to performing actual work. Where technical specifications require recording of test data, a proposed test log including planned duration of tests, readings to be taken, and instrumentation to be used, will be made a part of the Quality Control Program. Tests of air conditioning systems, boilers, chillers and the like would be covered as described above.
5. The Contractor's Quality Control Plan shall include a sub-plan titled "Testing Plan". The Testing Plan shall include the following:

   (a) Designate how testing will be performed either by technical employee, by the Contractor or an industry recognized testing laboratory.
   (b) Name and qualifications of each employee designated for the performance of specific types of tests.
   (c) A list of the control tests which he understands he is to perform, not only by name, but also by numerical designation; section of specifications, feature of work and frequency of testing. A statement to the effect that the laboratory has a copy of each such procedure and has facilities and serviceable testing equipment to perform tests conforming thereto.
   (d) His understanding of the procedure to be followed should his test results indicate lack of compliance with the specification requirement.

6. Method of documenting quality control operation, inspection and testing. A copy of proposed daily record form shall be made a part of the submittal.
7. A copy of a letter of direction to the Contractor's representative responsible for quality control, outlining his duties and responsibilities, signed by a responsible officer of the firm.

   (a) Before Construction operations are commenced, the Contractor shall meet with the Contracting Officer or his representative and discuss his quality control plan. The meeting shall develop mutual understanding relative to details of the system, including the forms to be used for recording the quality control operations, inspections, administration of the system, and the interrelationship of Contractor and Government inspection.
   (b) Unless specifically authorized by the Contracting Officer, no construction and/or off-site fabrication shall be started until the Contractor's quality control plan is approved. Construction of any feature of work will only be permitted after approval of the quality control plan, or at least approval of that portion of the plan applicable under this contract until the quality control program has been approved by the Government. The Contractor shall notify the COR in writing of any proposed change to this inspection system; no such change shall be implemented prior to approval in writing by the Contracting Officer or his authorized representative.

(c) If recurring deficiencies in an Item or Items indicate that the quality control system is not adequate, such corrective actions will be taken as directed by the Contracting Officer.

(d) The Contractor agrees to insert the substance of this clause, including this paragraph (d), in all subcontracts hereunder.

8. A copy of these records and corrective tests, as well as the records of corrective action taken, shall be furnished to the Government as directed by the Contracting Officer.

SC-23. CERTIFICATES OF COMPLIANCE: Any certificates required for demonstrating proof of compliance of materials with specification requirements shall be executed in 4 copies. Each certificate shall be signed by an official authorized to certify in behalf of the manufacturing company, and shall contain the name and address of the Contractor, the project name and location, and the quantity and date or dates of shipment or delivery to which the certificates apply. Copies of laboratory test reports submitted with certificates shall contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification shall not be construed as relieving the Contractor from furnishing satisfactory material, if, after tests are performed on selected samples, the material is found not to meet the specific requirements. (ECI 7-670-3).

SC-24. IMPLEMENTING GUARANTEES: At any time subsequent to the acceptance by the Government of a completed installation under this contract, which installation is required to be covered by a specific guarantee under terms of the various sections in the TECHNICAL PROVISIONS, the Contracting Officer will be an authorized party for the purpose of implementing the provisions of such guarantees in behalf of the Government.

SC-25. SAFETY: In performing this contract, the Contractor shall provide for protecting the lives and health of employees and other persons; preventing damage to property, materials, supplies, and equipment; and avoiding work interruptions. For these purposes, the Contractor shall:

a. Provide appropriate safety barricades, signs, and signal lights. Plastic safety fencing is not considered adequate at USMA. The Contractor shall as a minimum provide a 6-foot-high chain link fence with privacy screening.

b. Ensure that any additional measures the Contracting Officer determines to be reasonably necessary for this purpose are taken. All work done on USMA reservation shall be performed in a safe manner, that is, in compliance with Corp of Engineer, Federal, State and local safety laws and regulations.

To ensure this is accomplished, prior to commencement of work at any job site an acceptable accident prevention plan written by the Contractor and submitted to the COR for the specific work and implementing in detail pertinent requirements of US Corp of Engineers Safety and Health Requirements Manual CEM 385 1-1 and other applicable regulations shall be forwarded to the Contracting Officer and USMA Safety Manager. The plan shall include but not limited to control measures the Contractor shall take to control hazards associated with materials, services, operations or equipment.

This plan shall provide for frequent and regularly scheduled safety/health inspections of the work site by contractor management who are knowledgeable of OSHA 1910 (Industrial), OSHA 1926 Construction and EM 385 1-1. The Safety/Health representative shall correct any unsafe/violated condition immediately.

Prior to bringing hazardous substances, as defined in 29 CFR 1910.1200, on to the job site, all employees involved shall be advised of Material Safety Data Sheet (MSDS) information and a copy of each hazardous substance's MSDS shall be provided to the CM. All materials requiring MSDS information shall be inventoried by the Contractor on a weekly basis. This inventory shall be put into a report named "Hazardous Substances Location Report" (HS). For all materials requiring MSDS information, the report shall include as a minimum the following:

1. Common Name for each material.
2. Location of each material.
3. Hazardous substance & Chemical Abstract Substance Registry Number (CAS).
4. Quantity of each substance.

The inventory shall be conducted every Friday by the Contractor and shall be submitted the following Monday morning at 0800 to the COR. This requirement is in accordance with the Emergency Planning and Community Right to Know Act (EPCRA) Inventory. Additional instruction on this act can be acquired from the West Point Environmental Management Office upon request through the Contracting Officer.

Any job performed in an unsafe or hazardous manner that creates an imminent danger to USMA or Contractor employees will be shut down by the USMA Safety Manager or his designate.

The following publications/standards are recommended for Contractor reference files. This is not intended as an all-encompassing list.

OSHA 1926 Construction

OSHA 1910 Industrial

EM 385 1-1 (Oct 87 or most recent version)

Applicable ANSI Standards

National Electric Code (NEC)

National Fire Protection Association Codes (NFPC)

New York State Vehicle Traffic Law (most recent edition)

New York State Building Construction Code

New York State Industrial Code Rule 23 (Dept of Labor)

FAR CLAUSES

SECTION L. SITE VISIT: It is suggested that the bidder visit the project site and inspect all of the affected areas to verify existing conditions prior to submission of bids. Arrange visit with the COR.

SECTION I. UTILITY OUTAGES: No utility outages are to be permitted without prior written approval from the Contracting Officer. Breaks, if occurring, are to be repaired immediately, day or night. Prior to performing any work on the Signal system, the Contractor shall notify the Contracting Officer at West Point. No work will be permitted unless approved by the Contracting Officer.

SECTION I. AVAILABILITY AND USE OF UTILITY SERVICES:

a. The Government shall make all reasonable amounts of utilities, except for electric for temporary heat, available during the course of the contract.

SECTION I. SUPERINTENDENT: The Contractor shall employ a competent construction superintendent and quality control supervisor. Both individuals shall be in attendance at the project site at all times during performance of the work. The construction superintendent and the Quality Control Supervisor can be the same person. The superintendent shall represent the Contractor and communications given to the superintendent shall be as binding as if given to the Contractor.

SECTION I. WARRANTY OF CONSTRUCTION:

a. In addition to any other warrants in this contract, the Contractor warrants, except as provided in paragraph (J) of this clause, that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, or design furnished, or workmanship performed by the Contractor or any subcontractor or supplier at any tier.
b. This warranty shall continue for a period of one (1) year from the date of final acceptance of the work. If the Government takes possession of any part of the work before final acceptance, this warranty shall continue for a period of one (1) year from the date the Government takes possession.
c. The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Government-owned or controlled real or personal property, when that damage is the result of:

    1. The Contractor's failure to conform to contract requirements; or
    2. Any defect of equipment, material, workmanship, or design furnished.

d. The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for one (1) year from the date of repair or replacement.
e. The COR shall notify the Contractor, in writing, within a reasonable time after the discovery of any failure, defect, or damage.
f. If the Contractor fails to remedy any failure, defect, or damage within a reasonable time after receipt of notice, the COR shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.
g. For all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall:

    1. Obtain all warranties that would be given in normal commercial practices.
    2. Require all warranties to be executed, in writing, for the benefit of the Government, if directed by the Contracting Officer; and
    3. Enforce all warranties to be executed, in writing for the benefit of the Government, if directed by the Contracting Officer; and

h. In the event the Contractor's warranty under paragraph (b) of this clause has expired, the Government may bring suit at its expense to enforce a Contractor's, manufacturer's or supplier's warranty.

i. Unless a defect is caused by the negligence of the Contractor or Subcontractor's supplier at any tier, the Contractor shall not be liable for the repair of any defects of material or design furnished by the Government.

j. This warranty shall not limit the Government's right under the Inspection and Acceptance clause of this contract with respect to latent defects, gross mistakes or fraud. (FAR 52.246-21)

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SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 REFERENCES

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

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification 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

Dig Safe Permit; G, RO

1.3 GENERAL

a. The Contractor must be required to (i) commence work under this Contract within five (5) calendar days after the date the Contractor receives the Notice to Proceed, (ii) prosecute the work diligently, and (iii) complete the entire work ready for use, not later than 730 calendar days after the date the Contractor receives the notice to proceed. The time stated for completion must include the final cleanup of the premises. (FAR 52.212-3)

b. The Contractor must furnish all labor, materials, equipment, and services for the following work as described in the construction documents.

c. All work must be in accordance with the drawings and specifications or instructions attached hereto and made a part thereof, or to be furnished hereafter by the Contracting Officer and subject, in every detail, to his supervision, direction, and instructions.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

1.4.1 Project Description

The work includes Site, architectural and mechanical systems replacements at the Lee Child Development Center, Building 140, on the West Point , NY campus.

Site work includes, but is not limited to, replacement of sections of underground drainage piping for the roof drainage system. These sections have collapsed or are plugged and are no longer functioning. Sections that are improperly pitched will also be replaced. The underground gutter drainage that has been daylighted to a nearby embankment will be rerouted into the rain garden as shown on the original construction documents. A new catchment structure is being added to the parking lot that will be connected to the rain garden to eliminate a steel bridged sidewalk design that is functioning poorly due to improper grade pitch.

Architectural work includes replacing gutters joints and adding a downspout near the entrance canopy which is a low point in the system. The new downspout will be connected to the underground drainage system. Inside the building, ceilings will be removed, salvaged and reinstalled as possible or replaced as necessary to install new fan coil units and ductwork systems above.

Fan coil units and ductwork serving the child care center will be replaced in their entirety throughout the building. A new louver to provide fresh makeup air and the related ductwork and accessories will be provided. A ground mounted boiler and a chiller unit that serve the fan coil units are being replaced as they are at the end of their useful lives. The piping from these two units will be replaced as needed. Ventilation fan units and their associated ductwork are also being replaced in full. The ventilation ductwork is entirely in the attic space.

Lighting and other ceiling devices are to be removed and reinstalled as required to install new ductwork.

Temporary enclosure and negative pressure for dust control will have to be provided for each piece of the work.

1.4.2 Location

The work is located at the United States Army Garrison, Building 140 Buckner Loop, West Point, New York, 10996. The exact location is indicated within the project construction drawings. The site of the work is on the property for a military reservation and all rules and regulations issued by the Commanding Officer covering general safety, security, and sanitary requirements, etc., must be observed by the Contractor.

1.5 DFARS 236.204, DISCLOSURE OF THE MAGNITUDE OF CONSTRUCTION PROJECTS

This project is estimated at $5,043,000.00.

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 must be in a condition equal to or better than that which existed before new work started.

c. At Contractor's own expense, Contractor must immediately restore to service and repair any damage caused by Contractor's workmen to the existing piping and conduits, wires, cables, etc., of utility services or of fire protection systems and communications systems (including telephone). Contractor must provide immediate notification of the Contracting Officer and verbal procedures to restore. The Contractor must immediately assemble personnel, equipment and material necessary to restore. Compliance with Contract Documents for quality installation must be included. The work must proceed at 24-hours per day until satisfactorily restored service is achieved. Fixing loose ends requires Contracting Officer approval to perform during normal working hours. The request to perform repairs during normal working hours requires Contractor's written approval. The write up of procedures to repair must be submitted ASAP.

d. The Contractor must repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this Contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

1.7 AUTHORIZED CONSTRUCTION AREA AND TRESPASSING

Do not inflict damage upon land and properties outside the authorized construction area by unwarranted entry upon, passage through, damage to, or disposal of, material on such land or property. The Contractor may make a separate agreement with any other party, regarding the use of, or right to, land or facilities outside the Contract area. If such an agreement is made, it must be in writing and a copy must be provided to the Contracting Officer. The Contractor must hold and save the Government, its officers, and agents free from liability arising from trespassing or damage occasioned by his operations.

Work on or near roadways must be flagged in accordance with the safety requirements in Safety and Health Requirements Manual EM 385-1-1, which forms a part of these specifications. Work located along the alert force route must not cause blockage, and the Contractor must maintain unobstructed access for alert force traffic at all times. Roadway construction must maintain two lanes of travel lanes when possible. Coordinated with the Contracting Officer any potential lane closures 15 days in advance of construction blockage.

1.8 PRIVATIZED UTILITIES

USAG WP has privatized water, wastewater and electrical service. All utility work on these systems must be coordinated with the Utility System Owners; Electric = City Light and Power; Water and Wastewater = American Water Federal Services. Coordinate with Contracting Officer or COR.

All work on privatized utilities to the point of demarcation indicated on the drawings must be completed by the utility system owner. The Contractor must closely coordinate the scope of utility work with the appropriate system owner to avoid conflicts and duplication. Project specified utility work by the System Owners must be paid directly by the government; costs associated with temporary utility services for Contractor use must be the Contractor’s responsibility.

1.9 LOCATION OF UNDERGROUND UTILITIES

Obtain digging permits prior to start of excavation, and comply with Installation requirements for locating and marking underground utilities. No excavation whether minor or major including trenching, sidewalk replacement, etc. will be permitted without an approved digging permit. Contractor must apply for renewal of work permits as required if the work continues beyond the original permit expiration date. Contact local utility locating service a minimum of 15 days prior to excavating, to mark utilities, and within sufficient time required if work occurs on a Monday or after a Holiday. Verify existing utility locations indicated on Contract drawings, within area of work.

Identify and mark all other utilities not managed and located by the local utility companies. Scan the construction site with Ground Penetrating Radar (GPR), electromagnetic, or sonic equipment, and mark the surface of the ground or paved surface where existing underground utilities are discovered. Verify the elevations of existing piping, utilities, and any type of underground obstruction not indicated, or specified to be removed, that is 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.

1.9.1 Notification Prior to Excavation

Notify the Contracting Officer Representative (COR) at least 30 days prior to starting excavation work. The Contractor must be responsible for obtaining a West Point "Dig-Safe Permit" and call 811 Dig Safely NY prior to commencing any excavation. The procedure for obtaining this "Dig-Safe Permit" is as follows:

a. The Contractor must notify the COR in writing 30 working days prior to commencing excavation. Notification letter and a completed Dig Safe Permit Request will be submitted to the COR and must include areas to be excavated, reason for excavation, depth of excavation, and supporting information such as drawings to allow the processing of permit. A copy of the Dig Safe Permit Request is attached below. The top portion of the request must be filled out by the Contractor. The Contractor cannot be compensated for delay caused by failure to notify government on timely basis to obtain the digging permit.

b. Once the permit is approved and signed by the Chief of the Utilities Division a Dig-Safe Permit will be issued to the Contractor. From the issuance of the Dig-Safe permit, the Contractor has two weeks to commence excavation, after that the permit will no longer be valid and will have to be re-submitted.

c. Once utilities have been identified and marked, it is the responsibility of the Contractor to maintain markings throughout the duration of the project.

d. In the event that utility line is damaged, all excavation will stop, and the COR and U&FD (845-938-2818) will be contacted immediately. The U&FD will take appropriate action to effect safe repair. If utility lines are uncovered which were not identified in the Dig-Safe, the U&FD will be contacted, and a determination will be made as to which utility is involved and whether the lines are active or

abandoned. When an unknown line is uncovered, it will be treated as "live" until determined otherwise.

e. The Dig-Safe permit may be received by the requestor with special instructions. These instructions must be complied with. These instructions will involve procedures that are determined safe by the Chief, Utilities and Facilities Division and will have to be followed.

f. Excavation may generate further actions depending upon each situation. Unknown utility locations must be recorded and drawings changed to show location.

g. There are no exceptions to the Dig-Safe Permit process.

h. See SOP 11-7 ANNEX V for additional requirements to obtain a Dig Safe Permit.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

-- End of Section --

(REQUEST SHOULD BE SUBMITTED NO MORE THAN 30 DAYS PRIOR TO BREAKING GROUND)

REQUESTOR WILL MARK EXCAVATION AREA WITH WHITE FLAGS PRIOR TO SUBMITTAL.
REQUESTOR IS RESPONSIBLE TO MAINTAIN MARKINGS FOR DURATION OF PROJECT.
UPON RECEIPT OF COMPLETED DIGSAFE PACKET (PERMIT, GIS MAP, AND APPROVED DA 4283) THE PROCESS, TO INCLUDE MARKOUTS, WILL TAKE 10 BUSINESS DAYS FOR COMPLETION.

SUSPENSE DATE:

DIG-SAFE REQUEST DATE:

PERMIT NUMBER:

REQUESTOR POC: (DPW PM)
PHONE: (DPW PM #)
DA 4283 (IJO NUMBER): (FROM BOID)
LOCATION OF DIG:
REASON FOR DIG:
MAP/SKETCH ATTACHED: YES: ☑ **NO:** ☐
DATE MARKED OUT:
ANTICIPATED DIGGING DEPTH:
ANTICIPATED DIGGING DATE:

= = = = = = = = = = == = = = = = = = == == =

(TO BE COMPLETED BY DIG SAFE COORDINATOR)

DIG-SAFE CLEARED THROUGH: (SHOP FOREMAN INITIAL AND DATE WHEN FINISHED)

ELECTRIC (RED): ☐
MAIN SEWERS (GREEN): ☐
STEAM (YELLOW): ☐
AGRONOMIST (PURPLE): ☐
MAIN STORM (LITE BLUE): ☐
ENVIRONMENTAL (PURPLE): ☐

GAS (YELLOW) ☐
SIGNAL (ORANGE) ☐
WATER (BLUE): ☐
CULTURAL RESOURCE: (PURPLE) ☐
CLP ☐

REQUESTOR OF DIG-SAFE PERMIT IS REMINDED THAT WHILE ALL KNOWN UTILITIES ARE MARKED, THESE MARKINGS ARE ONLY AS CLOSE AS REASONABLE. EXTREME CARE MUST BE EXERCISED WHEN EXCAVATING CLOSE TO EXISTING UTILITIES. REQUESTOR SHALL COMPLY WITH THE PROVISIONS OF 29 CFR 1926, SUBPART P-EXCAVATIONS, THE OSHA EXCAVATION STANDARDS.

CLEARED BY: DATE:

BOID, WORK MANAGEMENT BRANCH CHIEF

NOTIFY DIG SAFE COORDINATOR @ 3107 WHEN DIG IS COMPLETE.

SPECIAL INSTRUCTIONS: ____
____
____
____
____
____

EFFECTIVE 30 Sep 2019 (All other dig-safe forms are obsolete)

SECTION 01 14 00

WORK RESTRICTIONS

PART 1 GENERAL

1.01 SUBMITTALS

A. Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01 33 00 Construction Submittal Procedures:

1. SD-01 Preconstruction Submittals.

a. List of Contact Personnel; G.

1.02 SPECIAL SCHEDULING REQUIREMENTS

A. Have materials, equipment, and personnel required to perform the work at the site prior to the commencement of the work.

B. All facilities will remain in operation during the entire construction period. The Contractor shall conduct his operations to cause the least possible interference with normal operations of activity within the building and throughout the West Point property site.

C. Permission to interrupt any Activity roads, railroads, and/or utility service shall be requested in writing a minimum of seven (7) calendar days prior to the desired date of interruption.

D. Refer to project Drawings for work phasing.

1.03 CONTRACTOR ACCESS AND USE OF PREMISES

A. Activity Regulations

1. Ensure that Contractor personnel employed on the Activity become familiar with and obey Activity regulations including safety, fire, traffic and security regulations. Keep within the limits of the work and avenues of ingress and egress. Ingress and egress of Contractor vehicles at the Activity is limited to the designated gate. To minimize traffic congestion, delivery of materials shall be outside of peak traffic hours (6:30 to 8:00 a.m. and 3:30 to 5:00 p.m.) unless otherwise specifically approved by the Contracting Officer or Contracting Officer’s Representative (COR). Wear hard hats and protective clothing to meet OSHA requirements in designated construction areas. Do not enter any restricted areas unless required to do so and until cleared for such entry. The Contractor's equipment shall be conspicuously marked for identification.

B. Covid-19 Requirements

1. The United States Army Garrison West Point (USAG WP) signed a Memorandum of Agreement (MOA) to facilitate installation access to Contractors. This MOA will be provided to the Contractor. After receiving the MOA from the Contracting Officer, proceed as described below:

a. Contractors and Contractor personnel entering West Point must report to the Visitor's Control Center (VCC) and present their credentials to include employment verification with the contracted company, a completed West Point COVID-19 screening survey and a copy of the MOA.
b. After Visitor Pass issuance, present the pass and MOA and additional COVID mitigation paperwork to the security guard or military police (MP) at the gate to gain access. Once on the installation, Contractors must adhere to West Point guidance pertaining to COVID-19 and must not interact with the Cadets or general public to the greatest extent possible, including limited use of the on-post facilities.

c. The MOA may be terminated at any time by USAG WP in the event of a health emergency on the West Point Installation. The MOA may also be terminated at any time upon the mutual written consent of USAG WP and USAGE NY.
d. Safety requirements; including masking, vaccination, and testing; may be revised at any time based upon the current or projected environment. Contractor and Contractor personnel shall comply with all updated requirements as directed by the Contracting Officer.

1.04 EMPLOYEE LIST

A. The Contractor shall provide to the COR, with a written List of Contact Personnel as follows:

1. The name of two Contractor representatives authorized to request personnel and vehicle passes for visitors and employees prior to commencement of work under this contract.
2. A complete list of Contractor and subcontractor information, including addresses and telephone numbers for use in the event of an emergency. Update list and resubmit to COR as information changes.

B. All on-site contractor personnel shall be approved for entry to the site and display Visitor badges as issued through the West Point Visitor's Center. Personnel shall not be admitted to the site without the proper identification.

1.05 NO SMOKING POLICY

A. Smoking is prohibited within and outside of all buildings on the installation, except in designated smoking areas. This applies to existing buildings and buildings under renovation including all the adjacent grounds. Discarding tobacco materials other than into designated tobacco receptacles is considered littering and is subject to fines. The Contracting Officer will identify designated smoking areas if one is available.

1.06 WORKING HOURS

A. Regular working hours shall be between 7 a.m. and 5:00 p.m., Monday through Friday, excluding Government holidays.

1.07 WORK OUTSIDE REGULAR HOURS

A. Work to be performed "after hours" shall be scheduled outside the regular working hours as indicated above. Specific times shall be coordinated with the Government and shall be clearly identified within the project schedule submission.

B. Weekend Working Hours: For work scope as indicated in Phasing documents and as follows:

1. Work outside regular working hours requires Contracting Officer and COR approval. Make application to Contracting Officer or COR fifteen (15) calendar days prior to such work to allow arrangements to be made by the Government for inspecting the work in progress, giving the specific dates, hours, location, type of work to be performed, contract number and project title. Based on the justification provided, the Contracting Officer may approve work outside regular hours. During periods of darkness, the different parts of the work shall be lighted in a manner approved by the Contracting Officer. Make utility cutovers after normal working hours or on Saturdays, Sundays, and Government holidays unless directed otherwise.

1.08 PERFORMANCE PERIOD RESTRICTIONS

A. No work shall be performed during the following designated periods, without prior written approval of the Contracting Officer.

1. 48 hours prior to and during any home Army football game.
2. Government Holidays - Ten (10) days per calendar year.
3. FINAL EXAM WEEK(s) – Fall and Spring Semesters: No loud work from 0700 to 1100 and from 1500 to 1900 hours at Central Post. No restrictions between 1100 and 1500 hours.

4. THE WEEK PRIOR TO GRADUATION: Central Post will be busy. Work during this period is to be restricted and isolated.
5. Any day that a funeral is being held on post. Work will be restricted and isolated, and any processes that produce disruptive sound/noise will be prohibited.
6. Reception-Day (R-Day): A single day in late June or early July. No work will be permitted
7. Parents week: 3 days in middle August. No work will be permitted.

B. Adverse Weather:

1. Contractor is to adhere to the Installation Adverse Weather Policy. On-site construction is not allowed during Code Red and these times/days are to be considered adverse whether days as described by the Contract. Contractor may work during Code White. Refer to USMA Adverse Weather Policy (copy attached at end of this section).

1.09 OCCUPIED AND EXISTING BUILDINGS

A. The Contractor shall be working around existing buildings which are occupied. Do not enter the buildings without prior approval of the Contracting Officer or COR.

B. Provide temporary closures as required to maintain safety and security as directed by the Contracting Officer.

C. Provide dust covers or protective enclosures to protect existing work that remains.

D. The Contractor shall relocate all Government property unassociated with the work including fixtures, furniture and equipment to a safe location within the work area/room and cover as necessary to protect from damage. Upon completion of the work move all material back to original locations.

1. Inspect all existing fixtures, furniture and equipment within the phased work area and document conditions prior to commencing demolition work within the area.
2. Documentation to identify each item individually and clearly note any existing damage.
3. Submit documentation to the COR prior to commencing work within the work phase.

1.10 UTILITY CUTOVERS AND INTERRUPTIONS

A. Operation of Station Utilities: The Contractor shall not operate nor disturb the setting of control devices in the station utilities system, including water, sewer, electrical, and steam services. The Government will operate the control devices as required for normal conduct of the work. The Contractor shall notify the Contracting Officer giving reasonable advance notice when such operation is required.

1.11 TRANSPORTATION OF PERSONNEL, MATERIALS AND EQUIPMENT

A. Coordinate arrangements for transporting materials, equipment and personnel with the Contracting Officer. The Contractor may use commercial or privately-owned transportation.

1.12 AT/FP-IDENTIFICATION FOR CONTRACTOR PERSONNEL

A. For contractors that do not require CAC but require access to a DoD facility or the installation, the contractor and all associated sub-contractors' employees must comply with adjudication standards and procedures using the National Crime Information Center Interstate Identification Index (NCIC-III) and Terrorist Screening Database (TSDB) (Army Directive 2014-05/AR 190-13). This is also for all employees who will be entering Army-controlled installations or facilities (Central Area/Restricted area). Applicable installation, facility and area commander installation/facility access and local security policies and procedures (provided by government representative) must be adhered to. Documentation of these checks will be made available to the COR and security personnel upon request.

1. The company will have a law enforcement background and NCIC check completed for all employees who will be entering Army-controlled installations or facilities (central area/Restricted area). Documentation of these checks will be made available to the Contracting Officer upon request.

2. The company will ensure that its employees entering Army-controlled installations or facilities have obtained access badges and passes (if required) in accordance with facility regulations and that these badges and passes are obtained in advance so as not to delay the accomplishment of contracted services.
3. The company will return all issued U.S. Government Common Access Cards, installation badges, and/or access passes to the COR when the contract is completed or when a contractor employee no longer requires access to the installation or facility.

1.13 DOD Level 1 Antiterrorism - AT Standards Clause (as of 1 July 14)

A. When annotated on the AT/OPSEC cover sheet Contractors are required to complete this training.

1. Pursuant to Department of Defense Instruction Number 2000.16, "DoD Antiterrorism (AT) Standards," dated October 2, 2006, each contractor employee requiring access to a Federally controlled installation, facility and/or federally controlled information system(s) must complete Level I AT Awareness Training on an annual basis and receive a certificate of completion. The training is accessible from any computer and is available at http://jko.jten.mil/ follow the below instructions:

   a. Click - DOD CAC or No DOD CAC.
   b. Next click - I am a U.S. mil, government civil servant, or contract employee.
   c. Next click - I've been directed to take required training on JKO.
   d. Next click – Courses.
   e. I do not have a .MIL, .GOV, or .NDU.EDU address or I am a Multi-National Student.
   f. Fill out the contact sheet and email to sponsor (COR).
   g. Sponsor (COR) will email to the JKO help desk.

   The COR and contractor are responsible for ensuring that all applicable employees have completed antiterrorism awareness training and must certify that their workforce has completed the training through the submission of completion certificate(s) to the Contracting Officer and the Contracting Officer's Representative (if appointed) within five working days after contract award or prior to access to a Federally- controlled installation or information system.
2. In the event that the automated system is not available (e.g., server problems), Level I AT Awareness Training can be provided by a qualified instructor. However, if the training is not completed online, the Level I AT Awareness Instructor qualification must be coordinated with the Installation Antiterrorism Officer (or Installation Security equivalent) and the resultant name(s) of approved instructors must be provided the contracting officer or designee along with all associated cost or schedule impacts to the contract.
3. Antiterrorism performance (Level I AT Awareness Training attendance and compliance) may be documented as a performance metric under the resultant contract and be part of past performance information in support of future source selections.
4. Documentation of this training will be made available to the Installation Antiterrorism Officer upon request.

1.14 Contracting Officer Representative (COR)

A. Will ensure that all contractors/subcontractors are processed for a background check or National Agency Check with Inquiry (NACI) as needed. The background check is the minimal investigation to be adjudicated for a USMA Identification Card (yellow badge) versus the NACI, which requires fingerprinting and submission of EQIP. NACIs are required for contractors/subcontractors that require a CAC and/or government computer accounts.

B. Will ensure that the USMA Form 13-16, Personnel Background Check, dated Apr 06, is correctly completed and signed by the COR who is a properly cleared Federal Employee.

C. Will ensure that the USMA Form 13-16, Personnel Background Check, dated Apr 06, is submitted within 10 days prior to personnel starting projects on West Point, depending on when contract is awarded and work is scheduled to start. Waivers are made for the 10 day suspense on a case by case basis, in emergency situations as needed only.

D. Will ensure that all identified contractors requiring a CAC and/or government computer access, submit fingerprints and complete a NACI investigation submission via EQIP, prior to being issued a CAC and/or given access to the government computer network.

E. Will ensure that all government issued identification and vehicle stickers are confiscated from contractors/subcontractors upon termination of employment or end of project. These items will be returned to MPD and DES.

F. Will ensure that all contractors requiring access to the Installation have completed antiterrorism awareness training and must certify that their workforce has completed the training through the submission of completion certificate(s) to the Contracting Officer.

1.15 Force Protection Conditions (FPCON's) Clause

A. During higher Force Protection Conditions (FPCON's) Contract personnel are required to comply with all Antiterrorism policies and procedures while on the installation. Contract personnel may be directed to enter the installation through certain access control points where they can best be identified and searched. Contractor personnel may be prohibited from certain portions of the installation during exercises and actual emergencies.

B. Contractors will comply with parking restrictions and will not park in unauthorized parking areas or within 82 feet of an inhabited building when directed.

C. Access control roster (personnel and vehicles) must be provided. Names / vehicles verified by the company and received background screening. Substitutes receive same vetting process prior to work.

D. All contractor personnel and vehicles are subject to search while on the installation.

E. In the event of an identified restricted/exclusion area, the contractor personnel will not be authorized without specific permission or an escort.

F. Access may be denied during increased readiness or Force Protection Conditions (FPCON's).

G. Alien Employment: The contractor must not employ any alien who does not have a valid US Immigration I-551 or I-94. The contractor must provide valid social security numbers and citizenship status of all employees to the Government, upon request.

1.16 E-Verify

A. E-Verify is an Internet based system operated by the Department of Homeland Security (DHS) in partnership with the Social Security Administration (SSA) that allows participating employers to electronically verify the employment eligibility of their newly hired employees. E-Verify is currently free to employers and is available in all 50 states. E-Verify provides an automated link to federal databases to help employers determine employment eligibility of new hires and the validity of their Social Security numbers. E-Verify are the best means for determining employment eligibility of new hires and the validity of their Social Security numbers.

B. Contractors must use E-Verify on all employees that will be working on this installation, under this contract. This must be done prior to the employee starting work on the installation.

C. For E-Verify information: https://www.e-verify.gov/ or call 1-888-464-4218.

D. The United States Government has adopted a zero tolerance policy regarding trafficking in persons. Additional information about trafficking in persons may be found at the website for the Department of State's Office to Monitor and Combat Trafficking in Persons' at https://www.state.gov/bureaus-offices/under-secretary-for-civilian-security-democracy-and-human-rights/office-to-monitor-and-combat-trafficking-in-persons/.

E. Government contracts must:

1. Prohibit contractors, contractor employees, subcontractors and subcontractor employees from the following activities:

   a. Engaging in severe forms of trafficking in persons during the period of the contract.
   b. Procuring commercial sex acts during the period of performance of the contract.
   c. Using forced labor in the performance of the contract.

2. Require contractors and subcontractors to notify employees of the prohibited activities described in paragraph (1) of this section and the actions that may be taken against them for violations.
3. Impose suitable remedies, including termination, on contractors that fail to comply with the requirements of paragraphs (1) and (2) of this section. Remedies can be applied to employees and suppliers, or delivery service and similar type of personnel connected to the project and contract.

1.17 CONTRACTOR VEHICLES

A. Ensure the Contractor, including contractor personnel and subcontractors understand the West Point Parking Policy dated 12 July 2018. Parking will only be permitted in dedicated parking locations as specifically authorized by the Contracting Officer.

B. All contractor on-site vehicles shall be registered with West Point authorities prior to entry. All vehicles are subject to search and seizure of contraband and/or unauthorized government property upon entering or leaving the facility.

C. Parking will not be permitted at the 683K lot (in front of Subway, Starbucks and Fitness Center) and will be limited to (4) spaces outside the fenced in lay down area at the CDC site

D. See additional parking restrictions as indicated in Section 01 50 00 Temporary Construction Facilities and Controls.

PART 2 PRODUCTS – Not Used.

PART 3 EXECUTION – Not Used.

END OF SECTION 00 14 00

CIVILIAN PERSONNEL BULLETIN

UNITED STATES MILITARY ACADEMY
WEST POINT,
NEW YORK 10996

28 October 2016 Number 17-03

DUTY STATUS AND LEAVE DURING ADVERSE WEATHER SITUATIONS

1. USMA Policy 40-03, Leave During Adverse Weather

It is the policy of the United States Military Academy to remain open during adverse weather conditions and to continue full operations in support of the mission. When roads are closed or treacherous because of adverse weather, the Garrison Commander or his designee may decide to implement, USMA Policy 40-03, Leave During Adverse Weather.

2. Accurate and up to date official Status information

You are encouraged to utilize 938-7000, the Garrison homepage (www.westpoint.army.mil), and the Garrison Facebook page (https://www.facebook.com/USAGWestPoint/?fref=ts) for accurate and up to date official information. As a convenience, the following radio stations will provide unofficial information at regular intervals starting on or about 6:00 a.m. when adverse weather conditions develop during non- working hours.

RADIO STATIONS					
WFAN-AM	660	KHz	WRRV-FM	92.7	MHz
WABC-AM	770	KHz	WQXR-FM	96.3	MHz
WCBS-AM	880	KHz	WHUD-FM	100.7	MHz
WRKL-AM	910	KHz	WNEW-FM	102.7	MHz
WTBQ-AM	1110	KHz	WGNY-FM	103.1	MHz
WGNY-AM	1220	KHz	WFAS-FM	103.9	MHz
WFAS-AM	1230	KHz	WAXB-FM	105.5	MHz
WRCR-AM	1300	KHz	WWXY-FM	107.1	MHz
WALL-AM	1340	KHz	WLNA-AM	1420	KHz
TV STATIONS					
WCBS-TV Ch 2			WNYW-TV Ch 5		
WNBC-TV Ch 4			WABC-TV Ch 7		
TV CH 8 AND 23 COMMAND INFORMATION CHANNEL					

3. NON-EMERGENCY POSITIONS

The following policy applies to: Appropriated Fund (AF) Employees in non-emergency positions only.

ANNOUNCEMENTS

During adverse weather conditions, announcements will be made as follows:

CODE WHITE

"West Point is CODE WHITE (All Day, Delayed Arrival, or Early Departure)." This announcement means employees have the option for UNSCHEDULED LEAVE or UNSCHEDULED TELEWORK. Employees must notify their supervisor of their intent to take unscheduled leave, or to perform unscheduled telework as defined in the employee's individual telework agreement. Employees scheduled to telework on the day of the announcement are expected to begin telework on time or request unscheduled leave.

or

CODE RED Until XX

"West Point is CODE RED until XX (Delayed Arrival)." This announcement means employees will be granted excused absence (administrative leave) for up to the designated number of hours past their normal arrival time. Employees on pre-approved leave for the entire workday or employees who were granted unscheduled leave for the entire workday should be granted excused absence for the duration of the Code Red. Employees scheduled to telework on the day of the announcement are expected to begin telework on time or request unscheduled leave.

or

CODE RED at XX HOUR

"West Point is CODE RED at XX HOUR (Early Dismissal)." This announcement means that non- emergency employees should depart earlier than their normal departure time from work and may request UNSCHEDULED LEAVE or UNSCHEDULED TELEWORK to leave prior to the early departure time.

Or

CODE RED ALL DAY

"West Point is CODE RED ALL DAY." This means that emergency employees are expected to report for work on time. Non-emergency employees (including Appropriate Fund employees on pre- approved paid leave) will be granted excused absence (administrative leave) for the number of hours they were scheduled to leave, unless:

- The employee is required to telework
- The employee works or is on official travel outside of the West Point area
- The employee is on leave without pay
- The employee is on an alternative work schedule

Employees on pre-approved leave for the entire workday or employees who were granted unscheduled leave for the entire workday should be granted excused absence for the entire day. With supervisory approval, a telework-ready employee may telework, as defined in the employee's telework agreement.

4. When adverse weather conditions develop

The Garrison Commander or his designee may decide to institute the Leave During Adverse Weather Policy for Employees who are on duty at the time of the dismissal. Such decisions will be conveyed to all Activity Directors who are responsible for notifying all activities under their control.

5. EMERGENCY POSITIONS

The procedures in paragraph three above do not apply to employees in positions designated as emergency. These employees will always make a valid attempt to reach the Work site on time during emergency weather situations. Employees who make a valid attempt, but do not reach the work site on time, will be given consideration for any tardiness due to road conditions and will, generally, not be penalized for conditions beyond their control. Employees in emergency positions who are at work during a snow emergency will normally be required to remain for their entire tour of duty and may be needed to remain for overtime or to cover additional shifts. Employees in emergency positions are so notified in writing.

6. Supervisors

Supervisors are encouraged to discuss this policy with each employee. Any questions concerning the designation of your position as weather essential, or non-weather essential, should be discussed with your supervisor.

7. CIVILIAN ON-SITE TRAINING CLASSES

Civilian on-site training classes will be postponed when Code Red is in effect. Participants will be notified of the rescheduled date as soon as arrangements are made. Classes may be postponed in other cases. The proponent of the class will communicate the status of the class to the registered attendees.

8. For further guidance, please see below.

Appropriated Fund Employees CPAC…….....	938-3943
Non Appropriated Fund Employees NAF Personnel Branch, CPAC…	938-2822
On-site training classes CPAC……...	938-3943
Time and attendance reporting Civilian Pay Service Center Directorate of Resource Management……	938-6508
Weather and road conditions…….	938-7000
USMA homepage……..	http://www.usma.edu

-Signed-
CAROL L. MCQUINN
Human Resources Officer

DISTRIBUTION:
1 – each AF employee
1 – each NAF employee

SECTION 01 20 00

PRICE AND PAYMENT PROCEDURES
11/20, CHG 2: 08/21

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Schedule of Values; G

1.2 CONTRACT COST BREAKDOWN (SCHEDULE OF VALUES)

The Contractor must furnish within 30 days after the date of Notice to Proceed, but no later than at the time of the Kick-off Meeting and prior to the submission of its first partial payment estimate, a breakdown of its single job pay item or items which will be reviewed by the Contracting Officer as to propriety of distribution of the total cost to the various accounts. Any unbalanced items as between early and late payment items or other discrepancies will be revised by the Contracting Officer to agree with a reasonable cost of the work included in the various items. This Contract cost breakdown will then be utilized as the basis for progress payments to the Contractor.

1.3 CONTRACTOR'S INVOICE AND CONTRACT PERFORMANCE STATEMENT

1.3.1 Submission of Invoices

If DFARS Clause 252.232-7006 Wide Area WorkFlow Payment Instructions is included in the Contract, provide the documents listed in above paragraph CONTENT OF INVOICE in their entirety as attachments in Wide Area Work Flow (WAWF) for each invoice submitted. The maximum size of each WAWF attachment is two megabytes, but there are no limits on the number of attachments. If a document cannot be attached in WAWF due to system or size restriction, provide it as instructed by the Contracting Officer.

1.3.2 Final Invoice

a. A final invoice must be accompanied by the certification required by DFARS 252.247.7023 Transportation of Supplies by Sea, and the Contractor's Final Release. If the Contractor is incorporated, the Final Release must contain the corporate seal. An officer of the corporation must sign and the corporate secretary must certify the Final Release.

b. For final invoices being submitted via WAWF, the original Contractor's Final Release Form and required certification of Transportation of Supplies by Sea must be provided directly to the respective Contracting Officer prior to submission of the final invoice. Once receipt of the original Final Release Form and required certification of Transportation of Supplies by Sea has been confirmed by the

Contracting Officer, the Contractor must then submit final invoice and attach a copy of the Final Release Form and required certification of Transportation of Supplies by Sea in WAWF.

c. Final invoices not accompanied by the Contractor's Final Release and required certification of Transportation of Supplies by Sea will be considered incomplete and will be returned to the Contractor.

1.4 SINGLE JOB PAYMENT ITEMS

Payment items for the work of this Contract for which Contract job payments will be made are listed in the BIDDING or PRICING SCHEDULE as applicable and as described below. All costs for items of work, which are not specifically mentioned to be included in a particular job or unit price payment item, are included in the listed job item most closely associated with the work involved. The job price and payment made for each item listed constitutes full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for which separate payment is not otherwise provided.

1.4.1 Mobilization and Demobilization

1.4.1.1 MOBILIZATION

Mobilization must include all costs for preparatory work and operations necessary for the movement of personnel, equipment, supplies, and incidentals to the project site, and other work performed prior to actual commencement of work. The Contractor must furnish and set up necessary general facilities, as are required by local, county, state or Federal laws, regulations or codes. The cost of required insurance and bonds and/or any other similar significant initial expense required for the initiation of the Contract work must be included in this item. The determination of the adequacy of the Contractor's facilities, except as required by local, county, state or Federal laws or regulations, must be made by the Contractor.

1.4.1.2 DEMOBILIZATION

Demobilization must consist of all activities and costs for movement of personnel, equipment, and supplies/materials not used in this Contract, including the disassembly, removal and site cleanup of any temporary offices, buildings, or other facilities assembled on the site for this Contract. Upon completion of work, the Contractor must restore all access areas to the same conditions as prior to the start of work. The Contractor must mark the positions of each grade stake, and remove them after completion of the project. Contractor must be held responsible for accounting for 100 percent removal of all grade stakes, as they pose a serious public safety hazard as the fill erodes and any remaining stakes become exposed in the surf. All stakes should be metal pipes, so that they can be pulled out intact, and located with a metal detector, if necessary.

1.5 UNIT PRICE PAYMENT ITEMS

Payment items for the work of this Contract on which the Contract unit price payments will be made are listed in the BIDDING or PRICING SCHEDULE as applicable and as described below. The unit price and payment made for

each item listed constitutes full compensation for furnishing all plant, labor, materials, and equipment, and performing any associated Contractor quality control, environmental protection, meeting safety requirements, tests and reports, and for performing all work required for each of the unit price items.

1.5.1 Ceiling Panel Replacement

1.5.1.1 Payment

Payment will be made for costs associated with replaceing ceiling panels damaged prior to commencing the work. Document work scope at start of project and notify Owner of suspected quantity. Include all costs associated with disposal of existing damaged panels and installation of new.

1.5.1.2 Measurement

The total quantity of ceiling panel material for which payment will be based on full carton amount. Include any extra panels from the carton in addition to the specified extra material.

1.5.1.3 Unit of Measure

Unit of measure: Carton (box) - (10) Panels 40 square feet.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 30 00

ADMINISTRATIVE REQUIREMENTS
08/15

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.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual
EP 1110-1-8	(2016) Construction Equipment Ownership and Operating Expense Schedule

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. Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance with Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

View Location Map; G, RO

Progress and Completion Pictures; G, RO

Preconstruction Video Recording

Preconstruction Digital Photographs

Work To Be Performed By The Contractor; G, RO

Eng Form 93; G, RO

SD-04 Samples

Construction Color Boards; G, RO

SD-05 Design Data

Periodic Construction Video Recordings

Periodic Construction Digital Photographs

Final Completion Construction Video Recordings

SD-07 Certificates

Eng Form 93; G, RO

SD-11 Closeout Submittals

Final Completion Construction Digital Photographs

1.3 COLOR BOARDS

The Contractor must submit two sets of color boards depicting samples of all finish materials and one digital pdf copy for record. The color board (finishes sample submittal package) must include all visible exterior and interior materials and finishes that are a part of the building (and/or structure) or built-in items provided under this contract. The color boards must be delivered to each of the addresses listed below in this section. The Contractor must furnish color board submittal to each of the addresses within 90 days after receipt of the notice to proceed, but more than 30 days prior to ordering finishing materials. The Contractor should obtain approval of his entire color board submission before beginning work involving final finishes. The Contractor must use the following format when assembling the color boards:

a. Provide the samples on 8-1/2 by 11 inches board modules with a maximum spread of 25-1/2 by 33 inches for foldouts. Label the modules with the project titles and design them to fit in a standard loose-leaf, three- post binder. The modules should support and anchor all samples. Anchor large or heavy samples with mechanical fasteners.

b. Organize the submittals in a logical manner to allow a fast review. Write descriptions and explanations clearly. Drawings and photographs must be clear and concise.

c. Indicate true pattern color and texture for interior material and finish samples.

d. Include color/finish pattern and texture for exterior materials and finishes.

e. Provide at least a 6 by 6 inches square sample for ceiling panels or exterior special finishes. The Contracting Officer or his representative will obtain concurrence from USAG DPW prior to approving exterior finishes submitted by the Contractor.

f. Contractor to deliver above to address:

US Army Garrison, West Point Directorate of Public Works (USAG DPW)

Building 667B Ruger Road

West Point, NY 10996

917.790.8477

1.4 VIEW LOCATION MAP

Submit, prior to or with the first digital photograph submittals, a sketch or drawing indicating the required photographic locations. Update as required if the locations are moved.

1.5 PROGRESS AND COMPLETION PICTURES

Photographically document site conditions prior to start of construction operations. Provide monthly, and within one month of the completion of work, digital photographs, 1600x1200x24 bit true color 12 mega pixels minimum resolution in JPEG file format showing the sequence and progress of work. Take a minimum of 20 digital photographs each week throughout the entire project from a minimum of ten views from points located by the Contracting Officer. Submit with the monthly invoice two sets of digital photographs, each set on a separate compact disc (CD) or data versatile disc (DVD), cumulative of all photos to date. Indicate photographs demonstrating environmental procedures. Provide photographs for each month in a separate monthly directory and name each file to indicate its location on the view location sketch. Also provide the view location sketch on the CD or DVD as a digital file. Include a date designator in file names. Cross reference submittals in the appropriate daily report. Photographs provided are for unrestricted use by the Government.

1.5.1 Digital Photographs

Identification: Provide the following information with each image description in file metadata tag or in web-based project software site:

a. Name of Project.
b. Name of Architect.
c. Name of Contractor.
d. Date photograph was taken.
e. Description of location, vantage point, and direction.
f. Unique sequential identifier keyed to accompanying view location map.

1.5.2 Video Recording

Video Recordings: Submit video recordings within seven days of recording.

1. Submit video recordings on CD-ROM, or by uploading to web-based project software site. Include copy of view location map indicating each video's location and direction.

2. Identification: With each submittal, provide the following information in file metadata tag or on web-based project software site:

    a. Name of Project.
    b. Name of Architect.
    c. Name of Contractor.
    d. Date photograph was taken.
    e. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

1.5.3 Formats And Media

1.5.3.1 Digital Photographs

As indicated above.

1.5.3.2 Digital Video Recordings

Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of 12 megapixels and capable of recording in full high-definition mode with vibration-reduction

technology. Provide supplemental lighting in low light levels or backlit conditions.

1.5.3.3 Digital Images

Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software

1.5.3.4 Metadata

Record accurate date and time from camera

1.5.3.5 File Names

Name media files with date and Project name and sequential numbering suffix

1.5.4 Construction Photographs

1.5.4.1 General

Take photographs with maximum depth of field and in focus.

1. Maintain view location map with each set of construction photographs that identifies each photographic location.

1.5.4.2 Preconstruction Digital Photographs

Before commencement of preservation and construction activities, take photographs of Project site and surrounding areas, including existing items to remain during construction and any Government property to be used as contractor or Government office space, from different vantage points, as directed by Architect and Historic Preservation Consultant.

1.5.4.3 Periodic Construction Digital Photographs

Take representative progress photographs once work commences. Select vantage points to show status of construction and progress since last photographs were taken.

1.5.4.4 Final Completion Construction Digital Photographs

Take photographs after date of Substantial Completion for submission as Project Record Documents. Architect and Historic Preservation Consultant will inform photographer of desired vantage points

1.5.5 Construction Video Recordings

1.5.5.1 Narration

Describe scenes on video recording by audio narration by microphone while, or dubbing audio narration off-site after video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.

1. Confirm date and time at beginning and end of recording.
2. Begin each video recording with name of Project, Contractor's name, and Project location.

1.5.5.2 Preconstruction Video Recording

Before starting construction, record video recording of Project site and surrounding areas, including existing items to remain during construction and any Government property to be used as contractor or Government office space, from different vantage points, as directed by Architect.

1. Show existing conditions adjacent to Project site before starting the Work.
2. Show protection efforts by Contractor.

1.5.5.3 Periodic Construction Video Recordings

Record video recordings at vantage points to show status of construction and progress since last video recordings were recorded.

1.5.5.4 Final Completion Construction Video Recordings

Record video recordings at vantage points to show the final construction and completion.

1.6 MINIMUM INSURANCE REQUIREMENTS

Provide the minimum insurance coverage required by FAR 28.307-2 Liability, during the entire period of performance under this contract. Provide other insurance coverage as required by State law.

a. Procure and maintain during the entire period of project performance under this contract the following insurance policies:

(1) Commercial General Liability Insurance as required by FAR 28.307-2

(2) The policies described above must be endorsed (i) to include National Park Service (NPS) and New York State Department of Environmental Conservation (NYSDEC) as additional insured and (ii) to provide that notice of an occurrence to the insurance company from any insured will serve as notice from all insured.

(3) Comprehensive Automobile Liability Insurance as required by FAR 28.307-2

(4) Certificates of Insurance evidencing the issuance of all insurance required hereby, and guaranteeing at least thirty (30) days prior notice to the Government of cancellation or non-renewal, must be delivered to the Contracting Officer, NPS and NYSDEC prior to entry of the Government's Contractors upon the project area, or, in the case of new or renewal policies replacing any policies expiring during the period, no later than thirty (30) days before the expiration dates of such expiring policies.

b. Prior to the commencement of work hereunder, provide to the Contracting Officer a certificate or statement of the above required insurance. The policies evidencing required insurance must contain an endorsement to the effect that cancellation or any material change in the policies adversely affecting the interests of the Government in such insurance must not be effective for such a period as may be prescribed by the laws of the State in which this contract is to be performed and in no event less than thirty (30) days after written

notice thereof to the Contracting Officer.

c. The Contractor must insert the substance of this clause, including this paragraph (c), in subcontracts under this contract that require work on a Government installation and must require subcontractors to provide and maintain the insurance required in the Schedule or elsewhere in the contract. The Contractor must maintain a copy of all subcontractors' proofs of required insurance, and must make copies available to the Contracting Officer upon request.

d. This insurance will be included at no additional cost to the government.

1.7 CONTRACTOR'S KEY MANAGEMENT PERSONNEL

The following Key Management Personnel, must be employed for the full duration of the contract and meet the minimum requirements described herein. All Key Management Personnel Qualifications are to be submitted at the Preconstruction Conference and are subject to Contracting Officer Approval.

a. Contractor's Project Manager:

(1) Performs all project management duties of the project.

(2) Serves as the Governments' sole point of contact in all matters relating to work including, but not limited to, contract compliance, progress of work, overall project scheduling, financial matters, and change orders.

(3) Attends all job meetings.

(4) On site a minimum of five (5) days per week.

(5) Minimum of fifteen (15) years of construction experience in similar size project as a project superintendent and/or project manager.

(6) Authorized to negotiate changes.

b. Contractor's Superintendent: (Overall Field Manager Responsible for Construction)

(1) Performs all superintendent duties require of the Contractor, except any duties required under "Superintendence of Subcontractors" below.

(2) Serves as the Governments' sole on site point of contact in all matters relating to the work including, but not limited to, scheduling of work, utility interruptions, and testing.

(3) Attends all job meetings.

(4) On site at all time during all construction activities.

(5) Serves under, and reports directly to, the Contractor's Project Manager.

(6) Minimum of fifteen (15) years of construction experience in

similar size project as a project superintendent and/or project manager.

c. Two (2) Assistant Superintendents: (Field Manager Responsible for Construction - Assistant)

(1) Same duties as Superintendent above but acts as assistant (not the lead).

(2) Minimum of ten (10) years of construction experience in similar size project.

(3) Performs all subcontract management/superintendent duties required of the Contractor, and any duties required under contract clause titled SUPERINTENDENCE OF SUBCONTRACTORS.

(4) Serves as the alternate in the event the Superintendent is absent.

d. Contractor's Quality Control System Manager: (Manager of Field Quality Control Personnel)

(1) Performs all quality control management duties required of the Contractor (reference Section 01 45 00.00 10).

(2) Serves as the Governments' sole point of contact in all matters relating to the quality of the work including, but not limited to, contract compliance and testing procedures.

(3) Has no other duties except Quality Control.

(4) Attends all job meetings.

(5) On site at all times during construction activities.

(6) Reports all deficiencies to the Government and the Contractor's Project Manager for correction.

(7) Works directly under, and is responsible to, an officer of the Contractor at least one level higher than the Contractor's Project Manager.

(8) Minimum of fifteen (15) years of construction experience in similar size project.

(9) Manager of Field Quality Control Personnel indicated in sections e., f., and all additional staff required under the CQC Personnel experience matrix per Section 01 45 00.00 10.

(10) The CQC Manager and CQC organization is solely responsible for certifying that all submittals and deliverables are in compliance with the contract requirements.

e. Contractor's Quality Control System Manager (Mechanical and Electrical Quality Control Personnel)

(1) Performs all quality control management duties required of the Contractor (reference Section 01 45 00.00 10).

(2) Serves as the Governments' sole point of contact in all matters

relating to the quality of the work including, but not limited to, contract compliance and testing procedures for MEP.

(3) Has no other duties except Quality Control. Acts as assistant to the overall quality control manager.

(4) Attends all job meetings.

(5) On site at all times during construction activities.

(6) Reports all deficiencies to the Government and the Contractor's Project Manager for correction.

(7) Works directly under, and is responsible to, an officer of the Contractor at least one level higher than the Contractor's Project Manager.

(8) Minimum of ten (10) years of construction experience in similar size project.

f. Contractor's Assistant Quality Control System Manager: (Manager of Field Quality Control Personnel)

(1) Performs all quality control management duties required of the Contractor (reference Section 01 45 00.00 10).

(2) Serves as the Governments' sole point of contact in all matters relating to the quality of the work including, but not limited to, contract compliance and testing procedures.

(3) Has no other duties except Quality Control. Acts as assistant to the overall quality control manager.

(4) Attends all job meetings.

(5) On site at all times during construction activities.

(6) Reports all deficiencies to the Government and the Contractor's Project Manager for correction.

(7) Works directly under, and is responsible to, an officer of the Contractor at least one level higher than the Contractor's Project Manager.

(8) Minimum of seven (7) years of construction experience.

g. Site Safety and Health Officer: (Principal in Charge of Enforcing Safety Codes)

(1) Performs all safety management duties required of the Contractor including duties of the Site Safety and Health Officer (SSHO)(reference Specification Section 01 35 29 SAFETY AND OCCUPATIONAL HEALTH REQUIREMENTS).

(2) Serves as the Governments' sole point of contact for all matters relating to safety.

(3) Continually enforces and implements the safety requirements of the contract including the Accident Prevention Plan.

(4) On site at all times during construction activities.

(5) Has no other duties other than safety. Performs all duties as per EM 385-1-1.

(6) Works under and reports to the Contractor's Project Manager.

(7) Minimum of ten (10) years construction experience on similar projects in a similar role.

h. Assistant Site Safety and Health Officer: (Principal in Charge of Enforcing Safety Codes)

(1) Performs all safety management duties required of the Contractor including duties of the Site Safety and Health Officer (SSHO)(reference Specification Section 01 35 29 SAFETY AND OCCUPATIONAL HEALTH REQUIREMENTS).

(2) Serves as the Governments' sole point of contact for all matters relating to safety.

(3) Continually enforces and implements the safety requirements of the contract including the Accident Prevention Plan.

(4) On site at all times during construction activities.

(5) Has no other duties other than safety. Performs all duties as per EM 385-1-1.

(6) Works under and reports to the Site Safety Health Officer.

(7) Minimum of seven (7) years construction experience on similar projects in a similar role.

1.8 SUPERVISION

1.8.1 Minimum Communication Requirements

Have at least one qualified superintendent, or competent alternate, capable of reading, writing, and conversing fluently in the English language, on the job-site at all times during the performance of contract work. In addition, if a Quality Control (QC) representative is required on the contract, then that individual must also have fluent English communication skills.

1.8.2 Superintendent Qualifications

The project superintendent must have a minimum of 20 years experience in construction with at least 15 of those years as a superintendent on projects similar in size and complexity. The individual must be familiar with the requirements of EM 385-1-1 and have experience in the areas of hazard identification and safety compliance. The individual must be capable of interpreting a critical path schedule and construction drawings. The qualification requirements for the alternate superintendent are the same as for the project superintendent. The Contracting Officer may request proof of the superintendent's qualifications at any point in the project if the performance of the superintendent is in question.

1.8.2.1 Duties

The project superintendent is primarily responsible for managing and coordinating day-to-day production and schedule adherence on the project. The superintendent is required to attend partnering meetings, and quality control meetings. The superintendent or qualified alternative must be on-site at all times during the performance of this contract until the work is completed and accepted.

1.8.3 Assistant Superintendent Qualification

Refer to the CONTRACTOR'S KEY MANAGEMENT PERSONNEL article.

1.8.4 Non-Compliance Actions

The Project Superintendent is subject to removal by the Contracting Officer for non-compliance with requirements specified in the contract and for failure to manage the project to insure timely completion. Furthermore, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders is acceptable as the subject of claim for extension of time for excess costs or damages by the Contractor.

1.9 PHYSICAL CONDITIONS

The information and data provided or referred to below are not intended as representations or warranties but are provided for information only. It is expressly understood that the Government will not be responsible for the accuracy thereof or for deductions, interpretation or conclusion drawn there from by the Contractor.

a. Weather Conditions: Climatological data determined from records of the U.S. Weather Bureau Station: Newburgh/Stewart, NY

Mean Annual Temperature: 51.9 degrees Fahrenheit
Mean Annual Precipitation: 46.1 inches

b. TRANSPORTATION.

1. Transportation Facilities:

Highways and Roads: All deliveries must proceed through the Stony Lonesome Gate Entrance to the United States Military Academy. The Contractor will be responsible for coordinating all deliveries with the installation. Roads within the military reservation proposed to be used by the Contractor, must be subject to prior approval of the post authorities and such roads, if used, must be maintained throughout construction and must be restored to as good condition as existed prior to their use. All costs for the use of existing transportation facilities, for the construction of temporary facilities, and for maintenance, repair, removal and restoration must be borne by the Contractor. The roads system on the installation is inclusive of vehicular bridges. The Contractor is responsible for following all applicable weight restrictions for the vehicular bridges on post. Loading of a vehicular bridge in excess of its rated load requires an oversized load from the asset Owner.

Transportation for or rock removal only, construction vehicles loaded with rock to be removed from West Point are permitted to exit the Thayer Gate. All municipal, County, and State road rules and regulations must be adhered to. These vehicles must enter the Stony Lonesome gate similar to all other construction vehicles. Refer to the drawings for construction travel routes.

2. Railroads: Conrail serves the locality of the proposed work. Railhead is located approximately 15 miles from the project site. The Contractor must make all arrangements at his expense for the use of sidings necessary for the delivery of materials, equipment, supplies, and other facilities required for completion of the work. The Contractor's use of sidings must be arranged so as not to interrupt or delay the operation of the Military reservation.

1.10 SUBMITTAL OF WORK TO BE PERFORMED BY THE CONTRACTOR

Provide the Contracting Officer, within five days after award, items of work to be performed by Contractor's employees and the estimated cost of those items. For the purposes of this contract, the percentage of work that must be performed by the Contractor is stated in FAR Clause 52.236-01.

1.11 VETERANS EMPLOYMENT EMPHASIS FOR U.S. ARMY CORPS OF ENGINEERS CONTRACTS

In addition to complying with the requirements outlined in FAR Part 22.13, FAR Provision 52.222-38, FAR Clause 52.222-35, FAR Clause 52.222-37, DFARS 222.13 and Department of Labor regulations, U.S. Army Corps of Engineers (USACE) Contractors and subcontractors at all tiers are encouraged to promote the training and employment of U.S. veterans while performing under a USACE contract. While no set-aside, evaluation preference, or incentive applies to the solicitation or performance under the resultant contract, USACE Contractors are encouraged to seek out highly qualified veterans to perform services under this contract.

The following resources are available to assist USACE Contractors in their outreach efforts:

Federal Veteran employment information at
http://www.fedshirevets.gov/index.aspx
Department of Labor Veterans Employment Assistance
https://www.dol.gov/vets/
Department of Veterans Affairs-VOW to Hire Heroes Act
http://benefits.va.gov/vow/
Army Wounded Warrior Program-
http://wtc.army.mil/modules/employers/index.html
U.S. Chamber of Commerce Foundation-Hiring Our Heroes
http://www.hiringourheroes.org/

1.12 EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE (52.231-5000)

a. This special contract requirement does not apply to terminations. See USACE Acquisition Instructions (UAI) 52.249-5000, Basis for Settlement of Proposals, and FAR Part 49.

b. Allowable cost for construction and marine plant and equipment in sound workable condition owned or controlled and provided by a Contractor or subcontractor at any tier must be based on actual cost data for each piece of equipment or groups of similar serial and

series for which the Government can determine both ownership and operating costs from the Contractor's accounting records. When both ownership and operating costs cannot be determined for any piece of equipment or groups of similar serial or series equipment from the Contractor's accounting records, costs for that equipment must be based upon the applicable provisions of EP 1110-1-8, Region I. Working conditions must be considered to be average for determining equipment rates using the schedule unless specified otherwise by the contracting officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiations must apply. For retroactive pricing, the schedule in effect at the time the work was performed must apply.

c. Equipment rental costs are allowable, subject to the provisions of FAR 31.105(d)(ii) and FAR 31.205-36, Rental Costs. Rates for equipment rented from an organization under common control, lease purchase arrangements, and sale-leaseback arrangements, will be determined using the schedule, except that actual rates will be used for equipment leased from an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees.

d. When actual equipment costs are proposed and the total amount of the pricing action exceeds the SAT, the contracting officer must request the Contractor to submit either certified cost or pricing data, or partial/limited data, as appropriate. The data must be submitted on Standard Form 1411, Contract Pricing Proposal Cover Sheet.

1.13 SUPERINTENDENCE OF SUBCONTRACTORS

a. Provide the following, in addition to the superintendence required by FAR Clause 52.236-6 - Superintendence by the Contractor.

(1) If more than 50 percent and less than 70 percent of the value of the contract work is subcontracted, One superintendent must be provided at the site and on the Contractor’s payroll to be responsible for coordinating, directing, inspecting and expediting the subcontract work.
(2) If 70 percent or more of the value of the work is subcontracted, the Contractor must be required To provide two such superintendents to be responsible for coordinating, directing, inspecting and expediting the subcontract work.

b. If the Contracting Officer, at any time after 50 percent of the subcontracted work has been completed, finds that satisfactory progress is being made, he may waive all or part of the above requirement for additional superintendence subject to the right of the Contracting Officer to reinstate such requirement if at any time during the progress of the remaining work he finds that satisfactory progress is not being made.

1.14 PRECONSTRUCTION CONFERENCE

After award of the contract but prior to commencement of any work at the site, meet with the Contracting Officer to discuss and develop a mutual understanding relative to the administration of the value engineering and safety program, preparation of the schedule of prices or earned value

report, shop drawings, and other submittals, scheduling programming and prosecution of the work. Major subcontractors who will engage in the work must also attend.

The Contractor must provide at this conference the following items as indicated:

a. Initial Project Schedule; Section 01 32 01.00 10 Project Schedule

b. Accident Prevention Plan (APP); Section 01 35 29 Safety and Occupational Health Requirements

c. Contractor Quality Control (CQC) Plan; Section 01 45 00.00 10 Quality Control

d. List of Contact Personnel; Section 01 14 00 Work Restrictions

e. Letter appointing Superintendent

f. Detailed Concept of Operations Plan

1.15 COORDINATION PERIOD

In addition to contract clause titled PRECONSTRUCTION CONFERENCE, the Contractor must reserve a 2 workday period of time no later than one month following the contract preconstruction conference for coordination. The Contractor's project management team responsible for this project must participate. During the 2-day coordination period the Contractor and the Government will exchange information related to the government regulations and procedures, points of contact, relevant design information and general discussion about the execution and coordination of the project. The Contractor must dedicate his management team for this 2-day coordination period.

1.16 CONNECTION WITH WORK OF OTHER CONTRACTS

During the period of this contract, other contracts may be in force for the construction of other features of work on or adjacent to the site of work being accomplished under this contract. The Contractor must arrange his plant and must schedule and perform the work as to effectively cooperate with all other Contractors and Government agencies. It is the Contractor's responsibility to know the extent of the limits of his contract. No direct or extra compensation will be allowed on account of the cooperation required.

a. At all points of connection with work of other contracts, the Contractor must have weekly coordination meetings until all connections have been completed with the adjoining Contractor(s) to insure proper and timely connections.

b. Where the work under this contract is completed before that of the adjoining Contractor, the Contractor must terminate his work in an approved manner ready for future connection by the adjoining Contractor. Pipes and conduits must be closed with suitable caps or plugs that will prevent entry of dirt or debris, but that are readily removable when final connections are made. For underground lines that are back-filled, approved type markers that extend above the ground surface must be provided to facilitate future location of the lines by the adjoining contract.

c. Where the work of the adjoining Contractor is already in place, the Contractor must perform all work required to effect the necessary connection, including locations of underground lines, removing of caps, providing necessary adapters or joining pieces, and all related incidental work for necessary for a proper, secure connection.

d. As USAG DPW continues to utilize and award utility privatization contracts, the Contractor is expected to coordinate with the utility system owners and their standard operating procedures. The Contractor must coordinate at the time of award and continuously over the course of the project to ensure the construction schedule properly encompasses Primary Utility Contractor's schedule. The Contractor is to designate an authorized representative to be responsible for the coordination with the utility system owner, preparation of the schedule and all required updating. The project schedule is to demonstrate the proposed sequence to perform the work and dates contemplated for starting and completing all schedule activities of the privatized utility provider. Activities associated with the procurement, fabrication, and delivery of long lead materials, equipment, fabricated assemblies, and supplies are to be included in the schedule.

Contractor must assume that the project construction schedule will shift and must be able to adjust the schedule's relationship with the utility provider's schedule accordingly. Ongoing coordination with the Privatized Utility Owner, to include working interactive exchange of idea and periodic schedule update meetings are expected.

1.17 COORDINATION OF TRADES

a. The contract drawings are in part diagrammatic and show the general arrangement of duct, piping and other mechanical and electrical trades. The Contractor must have a competent engineer on the project site to coordinate all fieldwork and shop drawings of the various trades prior to installation and/or submission of field or shop drawings for approval. The Contractor must allot spaces to the various trades prior to installation of the work. In spaces where all the various installations cannot be accommodated, the Contractor must notify the Contracting Officer and must submit alternate solutions as to its solution at no cost to the Government. The decision of the Contracting Officer must be final.

b. The Contractor must be responsible for the coordinated drawings of the various trades showing locations and sizes of all sleeves, electric outlets, inserts, piping, shafts, hangers, lights, ducts, catwalks, pads, chases, sprinklers, smoke detectors, soffits, fascias, steel trusses, blocking, high-density storage components/rails, etc. Composite signed-off coordinated shop drawings must be developed at 3/8" equals 1'-0 scale showing all mechanical electrical work in hung ceilings and chases.

1.18 CERTIFICATES OF COMPLIANCE

Any certificates required for demonstrating proof of compliance of materials with specification requirements must be executed in 4 copies. Each certificates must be signed by an official authorized to certify in behalf of the manufacturing company and must contain the name and address of the Contractor, the project name and location, and the quantity and

date or dates of shipment or delivery to which the certification apply. Copies of laboratory tests reports submitted with certificates must contain the name and address of the testing laboratory and the date or dates of the tests to which the report applies. Certification must not be construed as relieving the Contractor from furnishing satisfying material, if, after tests are performed on selected samples, the material is found not to meet the specific requirements

1.19 NO WAIVER BY GOVERNMENT

The failure of the Government, in any one or more instances, to insist upon the strict performance of any of the terms of this Contract or to exercise any option herein conferred must not be construed as a waiver or relinquishment to any extent of the right to assert or rely upon such terms or option on any future occasion.

1.20 PROGRESS PAYMENTS

See FAR Clause 52.232-16 PROGRESS PAYMENTS for any item of work in the bid schedule.

1.21 PROCEDURES FOR SUBMISSION AND PAYMENT OF ALL CONTRACT PAYMENTS

In addition to the requirements contained in the Contract Clause entitled "PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS" and to implement the requirements of the Prompt Payment Act Amendments of 1988, P.L. 100-496, the following must apply to all payments made under this contract:

a. At the time of submission of the progress chart, the Contractor must submit for approval by the Contracting Officer or his authorized representative a breakdown of the contract work which must be to the degree of detail required by the Contracting Officer or his representative to effect reasonable progress payments. The Contracting Officer or his representative must review this breakdown within 30 calendar days after receipt and either advise the Contractor that it is approved or disapproved, and if disapproved the reasons for disapproval. Only after the breakdown is approved must any payment invoice be accepted from the Contractor and any payment made to him. The Contracting Officer can determine if it is in the best interest of the Government to make payment without an approved breakdown, however, in no case could be more than 10 percent of the contract amount be paid unless the breakdown is approved.

b. The Contractor must submit his request for payment by submission of a proper invoice to the office or Person(s) designated in subparagraph (c). For purposes of payment a "proper invoice" is defined as the following:

(1) An estimate of the work completed in accordance with the approved breakdown indicating the percentage of work of each item and the associated costs.

(2) A properly completed Eng Form 93 and 93a (where required).

(3) All contractual submissions indicated elsewhere in this contract to be submitted with payment, such as updated progress schedules, updated submittal registers, etc.

(4) The following certification executed by a responsible official of

the organization authorized to bind the firm. A "responsible official" would be either a corporate officer, partner, or owner, in the case of a sole proprietorship I hereby certify, to the best of my knowledge and belief, that --

(a) The amounts requested are only for performance in accordance with the specifications, terms and conditions of the contract;

(b) Payments to subcontractors and suppliers have been made from previous payments received under the contract and timely payments will be made from the proceeds of the payment covered by this certification, in accordance with subcontract requirements and the requirements of chapter 39 of Title 31, United States Code; and

(c) This request for progress payments does not include any amounts, which the prime Contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of the subcontract.

(d) All required prime and subcontractor payrolls have been submitted.

(Name)_____

(Title)_____

(Date)_____

c. The Government will designate the office or person(s) who will first receive the invoice submissions and the Contractor will be so notified at the preconstruction conference. In addition to the designated Project Engineer, the Contractor must at the same time submit one copy of the detailed breakdown and the Eng Form 93 and 93a Form to the Area Engineer.

d. The Government representative will return any request for payment which is deemed defective within 7 days of receipt and will specify the defects. If the defect concerns a disagreement as to the amount of work performed and/or the amount of the payment being submitted, the Government and the Contractor's representative should meet to resolve the differences and reach agreement. Upon agreement, the Contractor must submit a new breakdown and Eng Form 93 (and 93a) and any other submissions requiring correction. These will be incorporated with the previous submittal and will then constitute a proper invoice.

e. If agreement cannot be reached, the Government must determine the proper amount per Contract Clause, PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS and process the payment accordingly. In this event, a "proper invoice" for Prompt Payment Act purposes will not have been submitted to the Government.

1.22 SUBMISSION OF CLAIMS

The following must be submitted to the Contracting Officer at the following address: U.S. Army Corps of Engineers, Room 1843, New York District, 26 Federal Plaza, New York, New York 10278-0090:

a. claims referencing or mentioning the Contracting Disputes Act of 1978

b. requests for a written decision by the Contracting Officer

c. claims certified in accordance with the Contract Disputes Act of 1978

No other Government representative is authorized to accept such requests. A copy must also be provided to the Authorized Representative of the Contracting Officer.

Provide the Contracting Officer with a copy of any requests for additional time, money or interpretation of contract requirements which were provided to the Authorized Representative of the Contracting Officer and which have not been resolved after 90 days.

1.23 PRICING OF ADJUSTMENT

When costs are a factor in any determination of a contract price adjustment pursuant to the Changes clause or any other clause of this contract, such costs must be in accordance with Part 31 of the Federal Acquisition Regulation and DFARS 252.215-7000 (Dec. 1991) as follows:

PRICE ADJUSTMENTS (DEC 2012)

The term “pricing adjustments”, as used in paragraph (a) of the clauses entitled “Price Reduction for Defective Certified Cost or Pricing Data-Modifications”, “Subcontractor Certified Cost or Pricing Data,” and “Subcontractor Certified Cost or Pricing Data- Modifications,” means the aggregate increases and/or decreases in cost plus applicable profits.

1.24 PAYMENTS FOR MATERIALS DELIVERED OFF-SITE (52.232-5000)

(a) Pursuant to FAR 52.232-5, Payments Under Fixed Price Construction Contracts, materials delivered to the Contractor at locations other than the site of the work may be taken into consideration in making payments if included in payment estimates and if all the conditions of the General Provisions are fulfilled. Payment for items delivered to locations other than the work site must be limited to:

(1) Materials required by the technical provisions; or

(2) Materials that have been fabricated to the point where they are identifiable to an item of work required under this contract; or

(3) Items specifically listed below.

(b) Payment for materials delivered off-site must be made only after receipt of paid invoices listing the value of material and labor incorporated in the items along with a canceled check showing the prime Contractor’s title to the items delivered off site.

1.25 LABOR-ADDITIONAL REQUIREMENTS

Fringe benefits statement: The method of payment of applicable fringe benefits will be indicated on DD Form 879, Statement of Compliance, and attached to each weekly payroll.

1.26 (S-102) CONTRACTOR SUPPLY and USE OF ELECTRONIC SOFTWARE FOR PROCESSING DAVIS-BACON ACT CERTIFIED LABOR PAYROLLS (April 2011)

The Contractor is encouraged to use a commercially-available electronic system to process and submit certified payrolls electronically to the Government. The requirements for preparing, processing and providing certified labor payrolls are established by the Davis-Bacon Act as stated in FAR 52.222-8, PAYROLLS AND BASIC RECORDS and FAR 52.222-13, COMPLIANCE WITH DAVIS-BACON AND RELATED ACT REGULATIONS.

If the Contractor elects to use an electronic Davis-Bacon payroll processing system, then the Contractor must be responsible for obtaining and providing for all access, licenses, and other services required to provide for receipt, processing, certifying, electronically transmitting to the Government, and storing weekly payrolls and other data required for the Contractor to comply with Davis-Bacon and related Act regulations. When the Contractor uses an electronic Davis-Bacon payroll system, the electronic payroll service must be used by the Contractor to prepare, process, and maintain the relevant payrolls and basic records during all work under this construction contract and the electronic payroll service must be capable of preserving these payrolls and related basic records for the required three years after contract completion. If the Contractor chooses to use an electronic Davis-Bacon payroll system, then the Contractor must obtain and provide electronic system access to the Government, as required to comply with the Davis-Bacon and related Act regulations over the duration of this construction contract. The access must include electronic review access by the Government contract administration office to the electronic payroll processing system used by the Contractor.

The Contractor's provision and use of an electronic payroll processing system must meet the following basic functional criteria: commercially available; compliant with appropriate Davis Bacon Act payroll provisions in the FAR; able to accommodate the required numbers of employees and subcontractors planned to be employed under the contract; capable of producing an Excel spreadsheet-compatible electronic output of weekly payroll records (format at http://www.rmssupport.com/guides.aspx) for export in an Excel spreadsheet to be imported into the Contractor's Quality Control System (QCS) demonstrated security of data and data entry rights; ability to produce Contractor-certified electronic versions of weekly payroll data; ability to identify erroneous entries and track the data/time of all versions of the certified Davis Bacon payrolls submitted to the government over the life of the contract; capable of generating a durable record copy, that is, a CD or DVD and PDF file record of data from the system database at end of the contract closeout. This durable record copy of data from the electronic Davis-Bacon payroll processing system must be provided to the Government during contract closeout.

All Contractor-incurred costs related to the Contractor's provision and use of an electronic payroll processing service must be included in the Contractor's price for the overall work under the contract. The costs for Davis-Bacon Act compliance using electronic payroll processing services must not be a separately bid/proposed or reimbursed item under this contract.

1.27 BID GUARANTEE

See contract clause entitled BID GUARANTEE in Specifications section 00 72 00 CONTRACT CLAUSES.

1.28 DESIGNATION OF PROPERTY ADMINISTRATOR

The Chief, Property and Accounting Section, U.S. Army Engineer District, New York, Federal Building, 26 Federal Plaza, New York, N.Y. 10278-0090 is designated as Property Administrator, in connection with this contract.

1.29 EQUAL OPPORTUNITY PREAWARD CLEARANCE OF SUBCONTRACTORS

Notwithstanding the clause of this contract entitled “Subcontracts”, the Contractor must not enter into a first-tier subcontract for an estimated or actual amount of $1 million or more without obtaining in writing from the Contracting Officer a clearance that the proposed subcontractor is in compliance with the equal opportunity requirements and therefore is eligible for award.

1.30 DAMAGE TO WORK

The responsibility for damage to any part of the permanent work must be as set forth in the article of the contract clause entitled "PERMITS AND RESPONSIBILITIES". However, if in the judgment of the Contracting Officer, any part of the permanent work performed by the Contractor is damaged by flood, earthquake, hurricane, severe coastal storm or tornado, which damage is not due to the failure of the Contractor to take reasonable precautions or to exercise sound engineering and construction practices in the conduct of the work, the Contractor will make the repairs as ordered by the Contracting Officer and full compensation for such repairs will be made at the applicable Contract unit or lump-sum prices as fixed and established in the Contract. If, in the opinion of the Contracting Officer, there are no Contract unit or lump sum prices applicable to any part of such work, an equitable adjustment, pursuant to Contract Clause entitled CHANGES, will be made as full compensation for the repairs of that part of the permanent work for which there are not applicable Contract unit or lump-sum prices. Except as herein provided, damage to all work, utilities, materials, equipment, and plant, including temporary construction and utilities, pavements, and other property along the routes used by the Contractor's pipelines and/or land vehicles, must be repaired to the satisfaction of the Contracting Officer, the State of New York, and the utilities companies, at the Contractor's expense regardless of the cause of such damage.

1.31 VERIFICATION OF SMALL BUSINESS UTILIZATION

a. This clause is applicable to small business concerns whose contracts exceed $1,000,000.

b. In accordance with the clause at FAR 52.219-8, entitled UTILIZATION OF SMALL BUSINESS CONCERNS AND SMALL DISADVANTAGED BUSINESS CONCERNS, in effect on the date of this contract, the Contracting Officer may survey the extent of small and small disadvantaged business utilization under this contract. The Contractor may be required to report to the Contracting Officer statistical data on the number and dollars amounts of subcontracting awards with small businesses and small disadvantaged businesses.

c. As appropriate, the Contracting Officer may require one or more follow-up reports to the initial report.

d. The Contractor agrees to insert this clause in any subcontract that

may exceed $1,000,000, including this subparagraph (d).

1.32 FAR 52.211-12, LIQUIDATED DAMAGES--CONSTRUCTION

For liquidated damages amount see FAR Clause 52.211-12 in the Solicitation.

1.33 PERFORMANCE EVALUATION OF CONTRACTOR

(a) As a minimum, the Contractor's performance will be evaluated upon final acceptance of the work. However, interim evaluation may be prepared at any time during contract performance when determined to be in the best interest of the Government.

(b) The format for the evaluation will be SF Form 2626, and the Contractor will be rated, either, outstanding, satisfactory, or unsatisfactory in the areas of Contractor Quality Control, Timely Performance, Effectiveness of Management, Compliance with Labor Standards, and Compliance with Safety Standards. The Contractor will be advised of any unsatisfactory rating, either in an individual element or in the overall rating, prior to completing the evaluation, and all Contractor comments will be made a part of the official record. Performance Evaluation Reports will be available to all DOD Contracting Offices for their future use in determining Contractor responsibility, in compliance with DFARS 236.201.

(c) A similar evaluation for subcontractors will be prepared if the Government deems it to be appropriate.

1.34 RED ZONE MEETINGS

Towards the end of the construction contract, conduct red zone meetings to discuss known construction issues before beneficial occupancy. Coordinate with the Contracting Officer to schedule these meetings. Attendees must include the Contractor representatives, Contracting Officer, customer, and others as appropriate. The meeting will be scheduled at least 60 days from the scheduled Beneficial Occupancy Date (BOD) or at 80 percent construction completion.

The meeting agenda should include, but not be limited to the following:

(1) Status of progress vs. schedule of the project.

(2) Pending modifications, time extensions, etc.

(3) Submittals -O&M Manuals and as-built drawings.

(4) Warranty information and periods, transfer procedures and responsibilities, and security requirements and key transfer.

(5) Posting equipment instructions, training requirements for maintenance personnel, and pre-final and final inspection procedures.

(6) HVAC Commissioning, Building Commissioning, and Enhanced Commissioning.

(7) Correction of deficiencies (timely).

(8) Status of payroll requirements.

(9) Withholding of payments for outstanding deficiencies.

(10) Liquidated damages.

(11) Fiscal Items - Modifications required for BOD, post BOD modifications, mods funded by MIPRS.

(12) On Military Contracts - DD Form 1354 coding requirements discussed with the Real Property Accountable Officer.

(13) Joint occupancy requirements / fit-out / follow-on Contractor coordination issues.

(14) LEED notebook.

Refer to attachment A - INITIAL RED ZONE MEETING CHECKLIST

1.35 PARTNERING

To most effectively accomplish this contract, the Government requires the formation of a cohesive partnership within the Project Team whose members are from the Government, the Contractor and their Subcontractors. Key personnel from the Supported Command, the End User (who will occupy the facility), the Government Design and Construction team and Subject Matter Experts, the Installation, the Contractor and Subcontractors, and the Designer of Record will be invited to participate in the Partnering process. The Partnership will draw on the strength of each organization in an effort to achieve a project that is without any safety mishaps, conforms to the Contract, and stays within budget and on schedule.

The Contracting Officer will provide Information on the Partnering Process and a list of key and optional personnel who should attend the Partnering meeting.

1.35.1 Formal Partnering

Provide and host the Partnering sessions with key personnel of the Project Team, including Contractor personnel and Government personnel. The Contractor should plan for the attendance of approximately 15 to 20 individuals from the Government, local community representatives, NYSDEC in addition to the Contractor's and subcontractor's personnel. Pay all costs associated with the Partnering effort including the third-party independent Formal PartneringFacilitator, the meeting room, and other incidental items. In exception, each participant bears their own costs for meals, lodging, and transportation associated with the Partnering sessions.

Before a Partnering session, coordinate with the Facilitator all requirements for incidental items (such as audio-visual equipment, easels, flipchart paper, colored markers, note paper, pens/pencils, colored flash cards), and have these items available at the Partnering session. Provide copies of documents for distribution to all attendees. Provide a Facilitator experienced in conducting Partnering Workshops, and who is acceptable to both the Government and the Contractor. The Facilitator is responsible for leading the team in a timely manner and making sure that issues are identified and resolved. A list of Partnering Facilitators is available from the Contracting Officer.

a. Schedule the Initial Partnering Session for a duration of one day minimum. Locate this session at a place off the construction site, as

agreed to by the Contracting Officer and the Contractor. It may take place concurrently with the Pre-Construction conference.

b. Schedule follow-on Partnering Session(s) for a maximum of 4 hours. Schedule them at no more than 3 to six month intervals. Participants are encouraged to utilize electronic means to expedite meetings. Meetings may be held at a location off-Base, at the project site, or in a Government Facility on Base. Follow-on meetings may be held concurrently with other scheduled meetings. Attendees need only be those required to resolve current issues. Recommend using the same Facilitator from the Initial Partnering session to achieve best results and for continuity.

c. Provide a completed partnering agreement to all participants within 30 days of partnering session.

1.36 GENERAL MEETING REQUIREMENTS

1.36.1 Preparatory and Initial Phase meeting checklists

See Section 01 45 00.00 10 QUALITY CONTROL for Preparatory and Initial Phase meeting checklists. The Contractor is responsible for phase and progress meetings to include:

a. Meeting notification to participants

b. Prepare agenda for meetings

c. Use phase checklists for Preparatory and Initial Phase meetings

d. Physical arrangements for meetings

e. Preside at meetings

f. Record minutes recording proceedings and decisions

g. Copy and send minutes to:

(1) Meeting participants

(2) Project parties affected by decisions

(3) Contracting Officer (No later than 3 working days)

1.36.2 Weekly Progress Meetings Agenda

See section 01 32 01.00 10 PROJECT SCHEDULE for the weekly progress meeting. Modify the agenda as needed for on-going work.

a. Review minutes from previous progress meetings

b. Review RMS CM Contractor Action Item Report

c. Review work progress since previous meeting

d. Review current definable features of work:

-- Identify phases of current features of work

-- Identify pending phase changes

-- Identify features for discussion in next scheduled meeting

e. Discuss problem prevention:

(1) Field observations

(2) Deficiencies and tracking

(3) Procedures working well

(4) Problems, conflicts

(5) Methods to improve

f. Review construction schedule:

(1) Identify delays

(2) Discuss proposed corrective actions to regain schedule

g. Submittals and Requests for Information (design interpretation):

(1) Review submittal register

(2) Identify submittals to expedite as required

h. Review off-site activities:

(1) Fabrications

(2) Material and equipment delivery schedule

i. Review Testing:

(1) Type, Schedule

(2) Received Results

j. Review changes to construction schedule:

(1) Planned progress during succeeding work period

(2) Coordination of various schedules

(3) Effect of changes on construction and completion date

k. Review site safety

l. Discuss maintaining contract quality for materials and workmanship

m. Discuss pending modifications, changes, and substitutions

n. Discuss other business, as appropriate

1.37 ELECTRONIC MAIL (E-MAIL) ADDRESS

Establish and maintain electronic mail (e-mail) capability along with the

capability to open various electronic attachments as text files, pdf files, and other similar formats. Within 10 days after contract award, provide the Contracting Officer the email addresses required for electronic communications from the Contracting Officer related to this contract including, but not limited to contract documents, invoice information, request for proposals, and other correspondence. The Contracting Officer may also use email to notify the Contractor of base access conditions when emergency conditions warrant, such as hurricanes or terrorist threats. Multiple email addresses are not allowed.

It is the Contractor's responsibility to make timely distribution of all Contracting Officer initiated e-mail with its own organization including field office(s). Promptly notify the Contracting Officer, in writing, of any changes to this email address.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 32 01.00 10

PROJECT SCHEDULE
02/15

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.

AACE INTERNATIONAL (AACE)

AACE 29R-03	(2011) Forensic Schedule Analysis
AACE 52R-06	(2006) Time Impact Analysis - As Applied in Construction

U.S. ARMY CORPS OF ENGINEERS (USACE)

ER 1-1-11	(1995) Administration -- Progress, Schedules, and Network Analysis Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification 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

Project Scheduler Qualifications; G, RO

Preliminary Project Schedule; G, RO

Initial Baseline Project Schedule; G, RO

Periodic Schedule Update; G, RO

Narrative Report; G, RO

1.3 PROJECT SCHEDULER QUALIFICATIONS

Designate an authorized representative to be responsible for the preparation of the schedule and all required updating and production of reports. Include a copy of the candidate's resume with qualifications. The Contracting Officer may remove the Designated Project Scheduler, and require replacement, if the scheduler does not effectively fulfill their duties in accordance with this Contract requirements.

1.3.1 Project Scheduler Qualifications and Requirements

The authorized project scheduler must have a minimum of three years of experience scheduling construction projects similar in size and nature to this project with scheduling software that meets the requirements of this Contract specifications. The scheduler must have a comprehensive knowledge of CPM scheduling, principles application and obtain the skill/knowledge on following and adhering to this Contract, specification and drawing. The Designated Project Scheduler must have prepared and maintained at least five previous construction schedules of similar size and complexity to this Contract, utilizing the most recent version of Oracle Primavera P6.

During the entire Contract duration, the Government will require the Project Scheduler to be present at the project site office/trailers as often as needed to maintain and provide the Government with a fully completed status-to-date schedule.

PART 2 PRODUCTS

2.1 SOFTWARE

The scheduling software utilized to produce and update the schedules required herein must be capable of meeting all requirements of this specification.

2.1.1 Government Default Software

The Government intends to use Primavera P6.

2.1.2 Contractor Software

Scheduling software used by the Contractor must be commercially available from the software vendor for purchase with vendor software support agreements available. The software routine used to create the required sdef file must be created and supported by the software manufacturer.

2.1.2.1 Primavera

Utilize the most recent version of Oracle Primavera P6. Provide the "xer" export file in a version of P6 importable by the Government systems.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

The Contractor is prohibited from beginning work on-site prior to Government approval the Project Baseline Schedule. Prepare for approval a Project Schedule, as specified herein, pursuant to FAR Clause 52.236-15 Schedules for Construction Contracts. Show in the schedule the detailed proposed sequence to perform the work and dates with for starting and completing all schedule activities. A detailed schedule of the entire project is required. The schedule development, details, maintenance and to-date status of the entire schedule is the responsibility of the Contractor and will required Government approval on a monthly basis. Failure in receiving the Government approval may result in rejection of payment in full or for partial amount.

Contractor management personnel must actively participate in its

development. SubContractors and suppliers working on the project must also contribute in developing and maintaining an accurate and detailed Project Schedule. Provide a schedule that is a forward planning, a project monitoring tool and a schedule the Contractor and Sub Contractors are to follow on a daily basis and be held responsible and accountable. Use the Critical Path Method (CPM) of network calculation to generate all Project Schedules. Prepare each Project Schedule using the Precedence Diagram Method (PDM).

3.1.1 Project Schedules

Submit Preliminary, Initial, Baseline and Monthly Project Schedules for Government review.

3.1.2 Approved Project Schedule

Use the approved Project Schedule to measure the progress of the work and to aid in evaluating time extensions, and to provide the basis of all progress payments. Make the schedule cost loaded and activity coded. The schedule will provide the basis for all progress payments.

When Contractor fails to submit schedules within the time prescribed, the Contracting Officer may withhold approval of progress payments until the Contractor submits the required schedule.

3.1.3 Schedule Status Reports

Provide a Schedule Status Report(s) on at least a weekly and monthly basis. If, in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, the Contractor must take steps necessary to improve its progress including those that may be required by the Contracting Officer, without additional cost to the Government. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction planned, resources and to submit for approval a supplementary schedule or schedules as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained.

3.1.4 Default Terms

Failure of the Contractor to comply with the requirements of this Contract will be grounds for a determination by the Contracting Officer that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the Contract. Upon making this determination, the Contracting Officer will terminate the Contractor's right to proceed with the work, or separable parts of it, in accordance with the default terms of the Contract.

3.2 BASIS FOR PAYMENT AND COST LOADING

The schedule is the basis for determining Contract earnings during each update period and therefore the amount of each progress payment. The aggregate value of all activities coded to a Contract CLIN must equal the value of the CLIN.

3.2.1 Activity Cost Loading

Activity cost loading must be reasonable and without front-end loading.

Provide cost documentation within 48 hours to demonstrate reasonableness, when directed by the Contracting Officer. Commissioning and Close-Out activities will be paid at 100 percent complete, and not partially paid.

Do not include field overhead positions as individual pay items. Evenly disperse overhead costs and profit to each activity over the duration of the project.

It is the discretion of the Government of which activities are to be cost loaded. Cost of activities will be approved by the Government. When directed by the Government, Contractor must reallocate activity cost appropriately with or without Contractor Documentation.

3.2.2 Layout Activity Cost Loading

"Layout" activities will have zero cost. ("Layouts" have been captured on project drawings and paid by the Government at the completion of Design.)

3.2.3 Schematic Diagram/Drawing Activity Cost Loading

"Schematic Diagram/Drawing" activities will have zero cost. ("Schematic Diagram/Drawing" are supplied by the manufacturer and paid at the Government verification of material delivery and or install.)

3.2.4 Cost Loading of Submittal

"Submittal" Activities will zero cost. Government does not allow cost loading of submittals. Cost loading of submittals is prohibited.

3.2.5 Mobilization and Demobilization Cost

Under a separate WBS for each Mobilization and Demobilization include detail activities with reasonable cost. Front-end loading is prohibited. Provide the Government with detail documentation and cost of Mobilization and Demobilization, prior to submitting a Preliminary Schedule.

3.2.5.1 Cost Loading of Commissioning Activities

The value of all "Government Approval Received of Test Reports" activities of commissioning systems are not be less than 10 percent of the total costs for procurement and construction activities of each commissioned system (Total Commissioned System Cost). Work performed on Testing, Checklist, Reports, Plans, Procedures, Manual's type activities are paid once "Government Approval Received" of the final document, only if cost are applicable and cost loading is approved by the Contracting Officer.

The activity(ies) for "Government Approval Received Final Commissioning Report" must be valued at no less than 5 percent of the total commissioned system cost. The balance of the 10 percent must be spread across other "Government Approval Received" activities for preliminary Commissioning testing reports (TAB, DALT, Start Up Testing, etc).

3.2.6 Payment Rejection

Failure to meet the requirements of this specification may result in the disapproval of the preliminary, initial or periodic schedule updates and rejection of payment request until compliance is met.

In the event that the Contracting Officer directs schedule revisions and

those revisions have not been included in subsequent Project Schedule revisions or updates, the Contracting Officer may withhold 10 percent of pay request amount from each payment period until such revisions to the project schedule have been made.

3.3 PROJECT SCHEDULE DETAILED REQUIREMENTS

3.3.1 Level of Detail Required

Develop the Project Schedule to the appropriate level of detail to address Project Contract, Specifications, Drawings with major milestones, and to allow for satisfactory project planning and execution. Include quantity and unit of measure on the Activity Name, ex: 50CY, 100Tons, 1000LF and others. Failure to develop the Project Schedule to an appropriate level of detail will result in its disapproval. The Contracting Officer will consider, but is not limited to, the following characteristics and requirements to determine appropriate level of detail:

3.3.2 Activity Durations

Reasonable activity durations are those that allow the progress of ongoing activities to be accurately determined between update periods. Activities are to have Duration 20 Workdays or less. Up to 1 percent of all non-procurement activities may have Original Durations (OD) greater than 20 workdays or 30 calendar days. Activities with Durations less than 20 Workdays must be reasonable and Achievable. Default, unreasonable and excessive durations are prohibited and will not be approved or accepted.

3.3.3 Procurement Activities

Include activities associated with the critical submittals and their approvals, procurement, fabrication, and delivery of long lead materials, equipment, fabricated assemblies, and supplies. Long lead procurement activities are those with an anticipated procurement sequence of over 90 calendar days.

3.3.4 Baseline Schedule Activity Updates

Baseline activities neglected, overlooked, left-out of the Initial baseline schedule will be added, and the baselines schedule will be re-submitted, reviewed, and approved. Logic, Relationships, Durations, and schedule data of the initial baseline schedule is not to change. The Contractor must discuss and receive Government approval of added activities prior to the resubmission. No time extension and cost will be issued for neglected, overlooked, left-out activities.

3.3.5 Modification Obligatory Activities

Add Obligatory Activities leading to Modification(s) within 10 days of discovering the modification. The Contractor must meet, discuss and receive Government approval prior to schedule incorporation. Separate modification and activities by a dedicated WBS. Activities must be detailed. Capture and include all activity-associated data.

3.3.6 Mandatory Tasks

Include the following activities/tasks in the initial project schedule and all updates.

a. Submission, review and acceptance of SD-01 Preconstruction Submittals (individual activity for each).

b. Submission, review and acceptance of features require design completion

c. Submission and approval of mechanical/electrical/information systems layout drawings.

d. Long procurement activities

e. Submissions, Reviews and approval of O & M manuals.

f. Submissions, Reviews and approval of as-built drawings.

g. Submission and approval of DD1354 data and installed equipment lists, draft and final.

h. Submissions, Reviews and approval of testing and air balance (TAB).

i. Submissions, Reviews and Approvalsof TAB specialist design review report.

j. Submissions, Reviews and approval of fire protection specialist.

k. Submissions, Reviews and approval of Building Commissioning Plan, test data, and reports: Develop the schedule logic associated with testing and commissioning of mechanical systems as defined in Section 01 91 00.15 10 TOTAL BUILDING COMMISSIONING. All tasks associated with all building testing and commissioning will be completed prior to submission of building commissioning report and subsequent Contract completion.

l. Air and water balancing.

m. Building commissioning - Functional Performance Testing.

n. Controls testing plan submission.

o. Controls testing.

p. Performance Verification testing.

q. Other systems testing, if required.

r. Contractor's pre-final inspection.

s. Correction of punch list from Contractor's pre-final inspection.

t. Government's pre-final inspection.

u. Correction of punch list from Government's pre-final inspection.

v. Final inspection.

w. Coordination With DPW Utility Privatization Contractors.

x. Detail Activities of all Sub Contractor Buyouts.

y. Submissions, Reviews and Approvals of all Mobilization and Demobilization.

z. Submission, Review-Approval of Preliminary Schedule

aa. Submission, Review-Approval of Initial Baseline Schedule

3.3.7 Government Activities

Show Government and other agency activities that could impact progress. These activities include, but are not limited to: approvals, environmental permit approvals by State regulators, inspections, utility tie-in, Government Furnished Equipment (GFE) and Direction to Proceed for phasing requirements.

3.3.8 Standard Activity Coding Dictionary

Use the activity coding structure defined in the Standard Data Exchange Format (SDEF) in ER 1-1-11. This exact structure is mandatory. Develop and assign all Activity Codes to activities as detailed herein.

The SDEF format is as follows:

Field	Activity Code	Length	Description
1	WRKP	3	Workers per day
2	RESP	4	Responsible party
3	AREA	4	Area of work
4	MODF	6	Modification Number
5	BIDI	6	Bid Item (CLIN)
6	PHAS	2	Phase of work
7	CATW	1	Category of work
8	FOW	20	Feature of work*
9	CX	2	Commissioning & Commissioning Dependent Activities
10	BLDG	4	Barracks Name or Building Number

*Some systems require that FEATURE OF WORK values be placed in several activity code fields. The notation shown is for Primavera P6. Refer to the specific software guidelines with respect to the FEATURE OF WORK field requirements.

3.3.8.1 Workers Per Day (WRKP)

Assign Workers per Day for all field construction or direct work activities. Workers per day is based on the average number of workers expected each

day to perform a task for the duration of that activity.

3.3.8.2 Responsible Party Coding (RESP)

Assign a unique responsibility code for all activities to the Prime Contractor, SubContractor(s) or Government agency(ies) responsible for performing the activity. Activities cannot have more than one Responsibility Code.

a. Activities coded with a Government Responsibility code include, but are not limited to: Government approvals, Government design reviews, environmental permit approvals by State regulators, Government Furnished Property/Equipment (GFP) and Notice to Proceed (NTP) for phasing requirements. Apply DOR (for the designer of record); and GOVT (for USACE); PRIM (for Prime Contractor) as RESP coding.

c. Utilize four unique characters in length where the first character identifies the trade (ex: "E" for Electrical, "M" for Mechanical, others as-required) and where the next three characters Identify the Sub-Contractor. Examples of unique acceptable activity code values are: EACM ("ACME Electrical Company"); EXYZ ("XYZ Electrical Company"); MACM "ACME Mechanical Company," MAIR ("Air Mechanical Company").

3.3.8.3 Area of Work Coding (AREA)

Assign Work Area code to activities based upon the work area in which the activity occurs. Define work areas based on resource constraints or space constraints that would preclude a resource, such as a particular trade or craft work crew from working in more than one work area at a time due to restraints on resources or space. Examples of Work Area Coding include different areas within a floor of a building, different floors within a building, and different buildings within a complex of buildings. Activities cannot have more than one Work Area Code.

Work Area Codes are to be applied on the following Work Breakdown Structure (WBS) and Activities: Mobilization/Demobilization, Deliveries, Laydown, Storage, Construction, Commissioning, and Closeout.

3.3.8.4 Modification Number (MODF)

Assign a Modification Number Code to activities or sequence of activities added to the schedule as a result of a Contract Modification, when approved by Contracting Officer. Key all Code values to the Government's modification numbering system. An activity can have only one Modification Number Code.

3.3.8.5 Bid Item Coding (BIDI)

Assign a Bid Item Code to all activities using the Contract Line Item Schedule (CLIN) to which the activity belongs, even when an activity is not cost loaded. An activity can have only one BIDI Code.

3.3.8.6 Phase of Work Coding (PHAS)

Assign Phase of Work Code to all activities. Examples of phase of work are preconstruction, procurement, construction, commissioning and closeout. Each activity can have only one Phase of Work code.

a. Code proposed fast track design and construction phases proposed to allow filtering and organizing the schedule by fast track design and construction packages.

b. If the Contract specifies phasing with separately defined performance periods, identify a Phase Code to allow filtering and organizing the schedule accordingly.

3.3.8.7 Category of Work Coding (CATW)

Assign a Category of Work Code to all activities. Category of Work Codes include, but are not limited to construction submittal, procurement, fabrication, weather sensitive installation, non-weather sensitive installation, start-up, and testing activities. Each activity can have no more than one Category of Work Code.

3.3.8.8 Feature of Work Coding (FOW)

Assign a Feature of Work Code to appropriate activities based on the Definable Feature of Work to which the activity belongs based on the approved QC plan.

Definable Feature of Work is defined in Section 01 45 00.00 10 QUALITY CONTROL. An activity can have only one Feature of Work Code.

3.3.8.9 Commissioning Activities (CX)

Assign Activity Code "CX" to Commissioning and Commissioning Dependent Activities. Capture Submittals, Reviews, Approvals, Approvals Received, Meetings, Plans, Reports, Start-Ups, TABs, Procedures, Test, Re-Test, O and M Manuals, Checklist, Certificates, Logs, Seasonal, Packages, Training, and others. Include commissioning activities specified by the Government, Commissioning Agent(s), GC, and Sub Constrictors.

3.3.9 Contract Milestones and Constraints

Milestone activities are to be used for significant project events including, but not limited to, project phasing, project start and end activities, or interim completion dates. The use of artificial float constraints such as "zero free float" or "zero total float" are prohibited.

Mandatory constraints that ignore or effect network logic are prohibited. No constrained dates are allowed in the schedule other than those specified herein. Submit additional constraints to the Contracting Officer for approval on a case by case basis.

3.3.9.1 Project Start Date Milestone and Constraint

The first activity in the project schedule must be a start milestone titled "NTP Acknowledged," which must have a "Start On" constraint date equal to the date that the NTP is acknowledged by the Contractor.

3.3.9.2 End Project Finish Milestone and Constraint

The last activity in the schedule must be a finish milestone, with a hard constraint, titled "End Project."

Constrain the project schedule to the Contract Completion Date in such a

way that if the schedule calculates an early finish, then the float calculation for "End Project" milestone reflects positive float on the longest path. If the project schedule calculates a late finish, then the "End Project" milestone float calculation reflects negative float on the longest path. The Government is under no obligation to accelerate Government activities to support a Contractor's early completion.

3.3.9.3 Interim Completion Dates and Constraints

Constrain Contractually specified interim completion dates to show negative float when the calculated late finish date of the last activity in that phase is later than the specified interim completion date.

3.3.9.3.1 Start Phase

Use a start milestone as the first activity for a project phase. Call the start milestone "Start Phase X" where "X" refers to the phase of work.

3.3.9.3.2 End Phase

Use a finish milestone as the last activity for a project phase. Call the finish milestone "End Phase X" where "X" refers to the phase of work.

3.3.10 Calendars

Schedule activities on a Calendar to which the activity logically belongs. Develop calendars to accommodate Contract defined work periods such as a 7-day calendar for Government Acceptance activities, concrete cure times, others as required. Develop the default Calendar to match the physical work plan with non-work periods identified including weekends and holidays. Develop Seasonal Calendar(s) and assign to seasonally affected activities as applicable.

If an activity is weather sensitive it should be assigned to a calendar showing non-workdays on a monthly basis, with the non-workdays selected at random across the weeks of the calendar, using the anticipated adverse weather delay workdays provided in the Time Extension paragraph. Assign non-work days over a seven-day week as weather records are compiled on seven-day weeks, which may cause some of the weather related non-work days to fall on weekends.

Minimum Calendars Required: 5-day work with applicable days off, five-day workweek with Weather days and applicable days off, seven-day workweek, six-day workweek with applicable days off, and six-day work week with weather days and an applicable day off.

3.3.11 Open Ended Logic

Only two open ended activities are allowed: the first activity "NTP Acknowledged" may have no predecessor logic, and the last activity -"End Project" may have no successor logic.

Predecessor open ended logic may be allowed in a time impact analyses upon the Contracting Officer's approval.

3.3.12 Default Progress Data Disallowed

Actual Start and Finish dates must not automatically update with default mechanisms included in the scheduling software. Updating of the percent

complete and the remaining duration of activities must be independent functions. Disable program features that calculate one of these parameters from the other. Activity Actual Start (AS) and Actual Finish (AF) dates assigned during the updating process must match those dates provided in the Contractor Quality Control Reports. Failure to document the AS and AF dates in the Daily Quality Control report will result in disapproval of the Contractor's schedule.

3.3.13 Out-of-Sequence Progress

Activities that have progressed before all preceding logic has been satisfied (Out-of-Sequence Progress) will be allowed only on a case-by-case basis subject to approval by the Contracting Officer. Propose logic corrections to eliminate out of sequence progress or justify not changing the sequencing for approval prior to submitting an updated project schedule. Address out of sequence progress or logic changes in the Narrative Report and in the periodic schedule update meetings.

3.3.14 Added and Deleted Activities

Do not delete activities from the project schedule or add new activities to the schedule without approval from the Contracting Officer. Activity ID and description changes are considered new activities and cannot be changed without Contracting Officer approval.

3.3.15 Original Durations

Activity Original Durations (OD) must be reasonable to perform the work item. OD changes are prohibited unless justification is provided and approved by the Contracting Officer.

3.3.16 Leads, Lags, and Start to Finish Relationships

Lags are not to be used unless approved by the Government on a case-by-case basis prior to incorporating the schedules. Lags must be reasonable as determined by the Government and not used in place of realistic original durations, must not be in place to artificially absorb float, or to replace proper schedule logic.

a. Leads (negative lags) are prohibited.

b. Start to Finish (SF) relationships are prohibited.

3.3.17 Retained Logic

Schedule calculations must retain the logic between predecessors and successors ("retained logic" mode) even when the successor activity(ies) starts and the predecessor activity(ies) has not finished (out-of-sequence progress). Software features that in effect sever the tie between predecessor and successor activities when the successor has started and the predecessor logic is not satisfied ("progress override") are not be allowed.

3.3.18 Percent Complete

Update the percent complete for each activity started, based on the realistic assessment of earned value. Activities which are complete but for remaining minor punch list work and which do not restrain the initiation of successor activities may be declared 100 percent complete to

allow for proper schedule management.

3.3.19 Remaining Duration

Update the remaining duration for each activity based on the number of estimated workdays it will take to complete the activity. Remaining duration may not mathematically correlate with percentage found under paragraph entitled Percent Complete.

3.3.20 Cost Loading of Closeout Activities

Cost load the "Correction of punch list from Government pre-final inspection" activity(ies) (numerous CO activities may exist) not less than 1 percent of the present Contract value. Activity(ies) may be declared 100 percent complete upon the Government's verification of completion and correction of all punch list work identified during Government pre-final inspection(s).

3.3.20.1 As-Built Drawings

If there is no separate Contract line item (CLIN) for as-built drawings, cost load the "Government Approval Received of as-built drawings" activity not less than $35,000 or 1 percent of the present Contract value, whichever is greater, up to $200,000. Activity will be paid when declared 100 percent complete upon the Government's approval.

3.3.20.2 O & M Manuals

Cost load the "final "Government Approval Received of O & M manuals" activity not less than $50,000. Activity will be declared 100 percent complete upon the Government's approval of all O & M manuals.

3.3.21 Early Completion Schedule and the Right to Finish Early

An Early Completion Schedule is an Initial baseline Project Schedule (IPS) that indicates all scope and activities of the required Contract work will be completed before the Contractually required completion date.

a. No IPS indicating an Early Completion will be accepted without being fully resource-loaded (including crew sizes and manhours) and the Government reviewing, agreeing and approving the schedule is reasonable and achievable.

b. The Government is under no obligation to accelerate work items it is responsible for to ensure that the early completion is met nor is it responsible to modify incremental funding (if applicable) for the project to meet the Contractor's accelerated work.

3.3.22 Activity Grouping, Lumping, Combining, Nesting

Activities are prohibited from Grouping, Lumping, Combining, and Nesting. Refrain from listing a single high-level activity in place of two or more activities.

3.3.23 Activity IDs

1. Beginning with the Preliminary Schedule, Activity IDs are prohibited from changes.

2. The first character for Activities IDs of 740 (Lee) will begin with the letter “L,” and Sherman Barracks activities IDs cannot begin with the letter “L.”

3. The first character for Activities IDs of Sherman Barracks will begin with the letter “S,” and 740 (Lee) activities IDs cannot begin with the letter “S.”

3.3.24 Activity Usage and Separation

Activities cannot be interchangeable and or multi-purpose use between 740 (Lee) and Sherman Barracks.

All 740 (Lee) activities will be separated from Sherman Barracks activities and all Sherman Barracks activities will be separated from 740 (Lee) activities.

3.3.25 WBS and Activities

WBS (Work Breakdown Structure) is to be detailed. Ten activities are to lie under a single WBS. Greater than ten activities will require Contracting Officer Approval and are not to exceed fifteen activities.

3.3.26 Activity Original Durations

Activities Original Durations from the Approved Baseline schedule are to be achieved.

3.3.27 Activity Excessive Actual Durations

Activity Actual Duration greater than Original Duration from the Approved baseline schedule must be divided into separate activities. Divide activity cost and, when applicable associated activity data. Newly separated activities are to be added to the Approved Baseline schedule. Resubmit Baseline schedule for Contracting Officer approval.

3.3.28 Activity Actual Start - Material Cost

Refrain from the Actual Start of activities for the sole purpose of collecting the cost of the material. Material is paid once the Government verifies and approves delivery or installation.

3.3.29 Activity Early Start and Late Start

Notify the Government of Early Start(s). Prior to an early start, the activity must have all resources readily available. Activity early start does not extend the original duration and must maintain the baseline schedule original durations.

Regardless of Free Float, notify the Government of Late Start(s). Prior to a late start, the activity must have all resources readily available. Activity late start does not extend the finish calculated by the original duration. The activity must maintain the baseline schedule's original duration.

3.4 PROJECT SCHEDULE SUBMISSIONS

Provide the submissions as described below. The data CD/DVD, reports, and network diagrams required for each submission are contained in paragraph

SUBMISSION REQUIREMENTS. If the Contractor fails or refuses to furnish the information and schedule updates as set forth herein, then the Contractor will be deemed not to have provided an estimate upon which a progress payment can be made.

Review comments made by the Government on the schedule(s) do not relieve the Contractor from compliance with requirements of the Contract Documents.

3.4.1 Preliminary Project Schedule Submission

Within 15 calendar days after the NTP is acknowledged submit the Preliminary Project Schedule defining the planned operations detailed for the first 90 calendar days for approval. During the 15 days of developing the Preliminary Project Schedule, the Contractor, Contractor's scheduler, and the Government are to conduct a one-hour meeting once a week for adherence to project Contract, specification, and drawings. The approved Preliminary Project Schedule will be used for payment purposes not to exceed 90 calendar days after NTP. Completely cost load the Preliminary Project Schedule to balance the Contract award CLINS shown on the Price Schedule. The Preliminary Project Schedule may be summary in nature or detailed for the remaining performance period. It must be early start and late finish constrained and logically tied as specified. The Preliminary Project Schedule forms the basis for the Initial Baseline Project Schedule specified herein and must include all of the required plan and program preparations, submissions and approvals identified in the Contract (for example, Quality Control Plan, Safety Plan, and Environmental Protection Plan) as well as design activities, planned submissions of all early design packages, permitting activities, design review conference activities, and other non-construction activities intended to occur within the first 90 calendar days. Government acceptance of the associated design package(s) and all other specified Program and Plan approvals must occur prior to planned construction activities. Activity code, activities that are summary in nature after the first 90 calendar days with Bid Item (CLIN) code (BIDI), Responsibility Code (RESP) and Feature of Work code (FOW). No payment will be made until the Government approves a fully detailed 90-day Preliminary Project Schedule, with exception of Payment of Bond and insurance.

3.4.2 Initial Baseline Project Schedule Submission

Submit the Initial Baseline Project Schedule for approval within 42 calendar days after notice to proceed is issued. During the 42 days of developing the Initial Baseline Project Schedule, the Contractor, Contractor's scheduler, and the Government conduct a one-hour meeting once a week to adhere to the project Contract, specification, and drawings. Include all activity coding and cost loading. The entire project schedule must be submitted fully completed in detail.

The schedule details must demonstrate a reasonable and realistic sequence of activities representing all work through the entire Contract performance period. Onsite work, not included in the Preliminary Project Schedule, will not start, and no payment will be made until the Government Approves a fully detailed Initial Baseline Project Schedule.

3.4.3 Periodic Schedule Updates

Update the Project Schedule every week on the last workday of each week. Provide a draft Periodic Schedule Update for review weekly and at the scheduled update meetings as prescribed in the paragraph PERIODIC SCHEDULE

UPDATE MEETINGS. These updates will enable the Government to assess the Contractor's progress.

a. Update all activities statuses, including Actual Start Dates (AS), Actual Finish Dates (AF), Remaining Durations (RD), and Percent Complete is subject to the approval of the Government at the meeting.

b. AS and AF dates must match the date(s) reported on the Contractor's Quality Control Report for an activity start or finish.

3.5 SUBMISSION REQUIREMENTS

Submit the following items for the Preliminary Schedule, Initial Schedule, and every Periodic Schedule Update throughout the life of the project:

3.5.1 Data CD/DVDs

Provide two sets of data CD/DVDs containing the current project schedule and all previously submitted schedules in the .xer and sdef format of the scheduling software. In addition to the scheduling software format, submit data in Excel and pdf format. Also include on the data CD/DVDs the Narrative Report and all required Schedule Reports. Label each CD/DVD indicating the type of schedule (Preliminary, Initial, Update), full Contract number, Data Date and file name. Each schedule must have a unique file name and use project specific settings.

3.5.2 Narrative Report

Provide a Narrative Report with each schedule submission. Four copies of the schedules showing codes, values, categories, numbers, and other items, etc., as required. The Narrative Report is expected to communicate to the Government the thorough analysis of the schedule output and the plans to compensate for problems, either current or potential, which are revealed through that analysis. Include the following information as minimum in the Narrative Report:

a. Identify and discuss the work scheduled to start in the next update period.

b. A description of activities along the two most critical paths where the total float is less than or equal to 20 work days.

c. List and provide all activity details and description of Negative Total Float: Causes and effects.

d. Description of current and anticipated problem areas or delaying factors and their impact and an explanation of corrective actions taken or required to be taken.

e. Identify and explain why activities based on their calculated late dates should have either started or finished during the update period but did not.

f. Identify and discuss all schedule changes by activity ID and activity name including what specifically was changed and why the change was needed. Include at a minimum new and deleted activities, logic changes, duration changes, calendar changes, lag changes, resource changes, and actual start and finish date changes.

g. Identify and discuss out-of-sequence work.

3.5.3 Schedule Reports

The format, layout(s), filtering, organizing and sorting for each schedule report will be as directed by the Contracting Officer. Typically, reports contain Activity Numbers, Activity Description, Original Duration, Remaining Duration, Actual Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Free Float, Total Float, Actual Start Date, Actual Finish Date, and Percent Complete. Provide the reports electronically in .pdf format. Provide five set(s) of hardcopy reports. The following lists typical reports that must be delivered:

3.5.3.1 Activity Report

List of all activities sorted according to activity number.

3.5.3.2 Logic Report

List of detailed predecessor and successor activities for every activity in ascending order by activity number.

3.5.3.3 Total Float Report

A list of all incomplete activities sorted in ascending order of total float. List activities which have the same amount of total float in ascending order of Early Start Dates. Do not show completed activities on this report.

3.5.3.4 Earnings Report by CLIN

A compilation of the Total Earnings on the project from the NTP to the data date, which reflects the earnings of activities based on the agreements made in the schedule update meeting defined herein. Provided a complete schedule update has been furnished, this report serves as the basis of determining progress payments. Group activities by CLIN number and sort by activity number. Provide a total CLIN percent earned value, CLIN percent complete, and project percent complete. The printed report must contain the following for each activity: the Activity Number, Activity Description, Original Budgeted Amount, Earnings to Date, Earnings this period, Total Quantity, Quantity to Date, and Percent Complete (based on cost).

3.5.3.5 Schedule Log

Provide a Scheduling/Leveling Report generated from the current project schedule being submitted.

3.5.4 Network Diagram

The Network Diagram is required for the Preliminary, Initial and Periodic Updates. Depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.4.1 Continuous Flow

Show a continuous flow from left to right with no arrows from right to left. Show the activity number, description, duration, and estimated earned value on the diagram.

3.5.4.2 Project Milestone Dates

Show dates on the diagram for start of project, Contract required interim completion dates, and Contract completion dates.

3.5.4.3 Critical Path

Show all activities on the critical path. The critical path is defined as the longest path.

3.5.4.3.1 Work Breakdown Structure (WBS)

Group all activities and milestones within appropriate detail WBS categories, including the following and additional WBS categories are to be added as required:

a. Project Milestones:

1. Management Milestones

2. Project Administrative Meetings

3. Permits

b. Pre-Construction Phase:

1. Submittals and Reviews

2. Procurement

3. Mobilization

c. Construction Phase: Create multiple sub-sections in accordance with project-specific categories of work, including in WBS descending order as follows:

1. General Area

(a) Type of Work Item

2. Location

d. Commissioning & Testing:

1. Specific area/locations of commissioning

2. Commissioning System

3. Final Testing

4. Training

e. Project Closeout: Include activity items such as Punchlist,

Demobilization, and As-built Drawings.

f. Modifications: Create a sub-category of Conformed and Non-Conformed under Modification WBS. Create multiple sub-sections as the project progresses identified by issue, and Fragnet placed in Conformed for modifications issued prior data date, or non-Conformed for issues not modified to Contract prior data date.

g. Add a WBS Removed Activities: Place all removed activities remaining within the logic sequence and changing to Finish Milestone. Actualize finish date to date activity removed from the schedule and provide reason(s) for removal explained in Activity Notebook.

3.5.4.4 Banding / Work Breakdown Structure (WBS)

Organize activities using the WBS or as otherwise directed to assist in the understanding of the activity sequence. Typically, this flow will group activities by major elements of work, category of work, work area and/or responsibility. Activities listed under a WBS will be limited to ten.

3.5.4.5 Cash Flow / Schedule Variance Control (SVC) Diagram

With each schedule submission, provide a SVC diagram showing 1) Cash Flow S-Curves indicating planned project cost based on projected early and late activity finish dates, and 2) Earned Value to-date.

3.6 PERIODIC SCHEDULE UPDATE

3.6.1 Periodic Schedule Update Meetings

Throughout the entire project duration, the Contractor must submit a complete status Monthly Project Schedule on the First of each month.

Conduct periodic schedule update meetings to address Government analysis, questions, comments, issues, reviewing the proposed Periodic Schedule Update, Narrative Report, Schedule Reports, and progress payment. Conduct meetings at least monthly within five days of the proposed schedule data date. Provide a computer with the scheduling software loaded and a projector that allows all meeting participants to view the proposed schedule during the meeting. The Contractor's authorized scheduler must organize, group, sort, filter, perform schedule revisions as needed and review functions as requested by the Contractor and/or Government.

The meeting is a working interactive exchange which allows the Government and Contractor the opportunity to review the updated schedule on a real time and interactive basis. The meeting will last up to 8 hours per day, with adjacent days as required. Provide a draft of the proposed narrative report and schedule data file to the Government a minimum of five workdays in advance of the meeting. The Contractor's Project Manager, Superintendents/Foreman, Quality Control Manager and Scheduler must attend the meeting with the authorized representative of the Contracting Officer. Superintendents, foremen and major subContractors must attend in-person and remain in the meeting, for its entirety as required, addressing subContract project schedule, activities and work. Authorized representatives of the Government will be in attendance.

Following the periodic schedule update meeting, make corrections to the draft submission. Include only those changes approved by the Government

in the submission and invoice for payment.

3.6.2 Update Submission Following Progress Meeting

Submit the complete Periodic Schedule Update of the Project Schedule containing all approved progress, revisions, and adjustments, pursuant to paragraph SUBMISSION REQUIREMENTS not later than three workdays after the periodic schedule update meeting.

3.7 WEEKLY PROGRESS MEETINGS

Conduct a weekly meeting with the Government (or as otherwise mutually to) between the meetings described in paragraph entitled PERIODIC SCHEDULE UPDATE MEETINGS for the purpose of jointly reviewing the status of weekly activities of the project as compared to the as planned progress and to review planned activities for the previous weeks, current week, and upcoming two weeks. Use the current approved schedule update for the purposes of this meeting and for the production and review of reports. At the weekly progress meeting, address the status of RFIs, project schedule, RFPs and Submittals.

Require physical attendees: Government, Contractor Project Manager, QC Manager, and Superintendents/Foreman. Additional required attendees, as directed by the Government.

The Contractor must include the following:

a. Use the current Approved Baseline, Last Approved, and Current Status Schedules.

b. Forward an electronic file (PDF) of updated activity statuses on previous, current, and upcoming Two-Weeks Look Ahead Schedule to the Contracting Officer no later than 11 a.m. each Monday.

c. P6 Layout must include (in order of) Activity ID, Activity Name, Activity Type, Physical % Complete, Calendar, Original Duration, BL Project Start, Start, BL Project Finish, Finish, Free Float, Total Float, and Gantt chart. The Layout is at the discretion of the Government. As required, the Government will direct the Contractor to provide layout editing and resubmissions. Use the Project Baseline Schedule for "BL" column data and Gantt chart bar display.

d. Include upcoming outages, closures, preparatory meetings, and initial meetings, testing, and inspections.

e. Identify longest path activities on the Two-Week Look Ahead Schedule. Include a key or legend that distinguishes longest path activities. Include all Longest Path activity start/finish dates exceeded and occurring during this period.

f. The detailed work plans are derived from but maintained separately from the Project on an electronic spreadsheet program and printed on 11 by 17-inch landscape sheet(s) or as directed by the Government.

g. Activities must not exceed five working days in duration unless authorized by the Government, sized and have sufficient detail to assign crews, tools, and equipment required to complete the work.

3.8 Weekly Activity Status and Data

Project activities are to be status (d) on a weekly basis at end of the last workday of each week. On each Monday, by 11 a.m., extract the following data from P6 and forward to the Government field team (P6 layout with headers/columns in order of left to right): Activity ID, Activity Name, Activity Type, Physical Percent Complete, Calendar, Original Duration, Remaining Duration, Start, Finish, Free Float and Total Float.

3.9 REQUESTS FOR TIME EXTENSIONS

Provide a justification of delay to the Contracting Officer in accordance with the Contract provisions and clauses for approval within 10 days of a delay occurring. Also prepare a time impact analysis for each Government request for proposal (RFP) to justify time extensions.

3.9.1 Justification of Delay

Within 10 calendar days of a delay and or impact occurring provide a description of the event(s) that caused the delay and/or impact to the work. As part of the description, identify all schedule activities impacted. Show that the event that caused the delay/impact was the responsibility of the Government. Provide a time impact analysis that demonstrates the effects of the delay or impact on the project completion date or interim completion date(s). Evaluate multiple impacts chronologically; each with its own justification of delay. With multiple impacts consider concurrences of delay. A schedule time extension fragnet becomes part of the project schedule and all future schedule updates upon approval by the Contracting Officer. Additional project schedule fragnet/activities becomes part of the project schedule and all future schedule updates upon approval by the Contracting Officer. Failure to provide Justification of delay/impact will deem the delay and or impact invalid and will be dismissed/omitted by the Government.

3.9.2 Time Impact Analysis (Prospective Analysis)

Within 10 calendar days of a delay/impact occurring, preparea time impact analysis for approval by the Contracting Officer based on industry standard AACE 52R-06. Utilize a copy of the last approved schedule prior to the first day of the impact or delay for the time impact analysis. If Contracting Officer determines the time frame between the last approved schedule and the first day of impact is too great, prepare an interim updated schedule to perform the time impact analysis. Unless approved by the Contracting Officer, no other changes will be incorporated into the schedule being used to justify the time impact.

3.9.3 Forensic Schedule Analysis (Retrospective Analysis)

Prepare an analysis for approval by the Contracting Officer based on industry standard AACE 29R-03.

3.9.4 Fragmentary Network (Fragnet)

Prepare a proposed fragnet for time impact analysis consisting of a sequence of new activities that are proposed to be added to the project schedule to demonstrate the influence of the delay or impact to the project's Contractual dates. Clearly show how the proposed fragnet is to be tied into the project schedule including all predecessors and successors to the fragnet activities. The proposed fragnet must be

approved by the Contracting Officer prior to incorporation into the project schedule.

3.9.5 Time Extension

The Contracting Officer must approve the Justification of Delay including the time impact analysis before a time extension will be granted. No time extension will be granted unless the delay consumes all available Project Float and extends the projected finish date ("End Project" milestone) beyond the Contract Completion Date. The time extension will be in calendar days.

Actual delays that are found to be caused by the Contractor's own actions, which result in a calculated schedule delay will not be a cause for an extension to the performance period, completion date, or interim milestone dates.

a. Notwithstanding other provisions of this Contract, it is mutually understood that the time extensions for changes in the work will depend upon the extent by which the changes cause delay in the completion of the various elements of construction. The change order granting the time extension may provide that the Contract completion date will be extended only for those specific elements so delayed and that the remaining Contract completion dates for all other portions of the work will not be altered and may further provide for an equitable readjustment of liquidated damages under the new completion schedule. (FAR 52.212 6)

b. TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER:

1. This provision specifies the procedure for determination of time extension for usually severe weather in accordance with the Contract clause entitled “Default: (Fixed Price Construction).” In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

    a. The weather experienced at the project site during the Contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

    b. The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the Contractor.

2. ADVERSE WEATHER FOR WORK: The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The Contractor’s progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities. Adverse weather days are to be applied as followed: Apply approximately 20 percent onto weekends, 80 percent onto work weekdays including work weekday holidays and special event days.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY (West Point, NY) WORKDAYS ARE BASED ON A 5 DAYS WORK WEEK. (Note: Anticipated adverse weather delay workdays will differ on a 7 days workweek)											
JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
8	7	8	8	9	6	6	6	5	6	7	8

3. Upon acknowledgment of the Notice to Proceed (NTP) and continuing throughout the Contract, the Contractor must record on the daily CQC report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delay days must prevent work on critical activities for 50 percent or more of the Contractor's scheduled workday. The number of actual adverse weather delay days must include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph 2 above, the Contracting Officer will convert qualifying delays to calendar days, giving full consideration for equivalent fair-weather workdays, and issue a modification in accordance with the Contract clause entitled "Default (Fixed Price Construction)".

3.9.6 Impact to Early Completion Schedule

No extended overhead will be paid for delay prior to the original Contract Completion Date for an Early Completion IPS unless the Contractor actually performed work in accordance with that Early Completion Schedule. The Contractor must show that an early completion was achievable had it not been for the impact.

3.10 FAILURE TO ACHIEVE PROGRESS

Should the progress fall behind the approved project schedule for reasons other than those that are excusable within the terms of the Contract, the Contracting Officer may require provision of a written recovery plan for approval. Submit the recovery plan within five calendar days of falling behind. The plan must detail how progress will be made-up to include which activities will be accelerated by adding additional crews, longer work hours, extra workdays and resources.

3.10.1 Artificially Improving Progress

Artificially improving progress by means such as, but not limited to, revising the schedule logic, modifying or adding constraints, shortening activity durations, or changing calendars in the project schedule is prohibited. Indicate assumptions made and the basis for any logic, constraint, duration and calendar changes used in the creation of the recovery plan. Any additional resources, manpower, or daily and weekly work hour changes proposed in the recovery plan must be evident at the work site and documented in the daily report along with the Schedule Narrative Report.

3.10.2 Failure to Perform

Failure to perform work and maintain progress in accordance with the

supplemental recovery plan may result in an interim and final unsatisfactory performance rating and may result in corrective action directed by the Contracting Officer pursuant to FAR 52.236-15 Schedules for Construction Contracts, FAR 52.249-10 Default (Fixed-Price Construction), and other Contract provisions.

3.10.3 Recovery Schedule

Throughout the project duration, when the Contracting Officer finds it necessary, submit a recovery schedule pursuant to FAR 52.236-15 Schedules for Construction Contracts. Recovery schedule is due within five calendar days of Government Notification.

3.11 OWNERSHIP OF FLOAT

Except for the provision given in the paragraph IMPACT TO EARLY COMPLETION SCHEDULE, float available in the schedule, at any time, may not be considered for the exclusive use of either the Government or the Contractor including activity and/or project float. Activity float is the number of workdays that an activity can be delayed without causing a delay to the "End Project" finish milestone. Project float (if applicable) is the number of work days between the projected early finish and the Contract completion date milestone. Contractor is to report use of Free and/or Total Float in the monthly update Narrative, including the reasons for its use.

3.12 TRANSFER OF SCHEDULE DATA INTO RMS/RMS CM

Import the schedule data into the Resident Management System Contractor Mode (RMS CM) and export the RMS CM data to the Government. This data is considered to be additional supporting data in a form and detail required by the Contracting Officer pursuant to FAR 52.232-5 Payments under Fixed-Price Construction Contracts. The receipt of a proper payment request pursuant to FAR 52.232-27 Prompt Payment for Construction Contracts is contingent upon the Government receiving both acceptable and provable hard copies and matching electronic export from RMS CM of the application for progress payment.

3.13 PRIMAVERA P6 MANDATORY REQUIREMENTS

If Primavera P6 is being used, request a backup file template (.xer) from the Government, if one is available, prior to building the schedule. The following settings are mandatory and required in all schedule submissions to the Government:

a. Activity Codes must be Project Level, not Global or EPS level.

b. Calendars must be Project Level, not Global or Resource level.

c. Activity Duration Types must be set to "Fixed Duration & Units".

d. Percent Complete Types must be set to "Physical".

e. Time Period Admin Preferences must remain the default "8.0 hr/day, 40 hr/week, 172 hr/month, 2000 hr/year". Set Calendar Work Hours/Day to 8.0 Hour days.

f. Set Schedule Option for defining Critical Activities to "Longest Path".

g. Set Schedule Option for defining progressed activities to "Retained Logic".

h. Set up cost loading using a single lump sum labor resource. The Price/Unit must be $1/hr, Default Units/Time must be "8h/d", and settings "Auto Compute Actuals" and "Calculate costs from units" selected.

i. Activity ID's must not exceed 10 characters.

j. Activity Names must have clarity, definition and detailed description within the first 30 characters. Refer and utilize schedule specification verbiage. Activity Names verbiage and acronyms are to be consistent and accurate throughout the schedule(s). It is the discretion of the Government which verbiage and acronyms will be utilized.

-- End of Section --

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section covers procedures to be used in making submittals called for the contract documents. In contracts which contain specific “Contractor Quality Control” requirements, the Contractor's Quality Control representative shall carry out duties associated with submittal procedures. In contracts which do not contain specific CQC requirements, references to “CQC Representative” shall be interpreted as reference to the Contractor's authorized representative, and references to “CQC Requirements”, or “CQC Clauses” shall be interpreted as” requirements or clauses elsewhere in the contract”.

1.03 DEFINITIONS

A. The A/E (Architect/Engineer) is the design entity.

B. Action Submittals: Written and graphic information that requires A/E and Contracting Officer's responsive action.

C. Informational Submittals: Written information that does not require A/E and Contracting Officer's responsive action. Submittals may be rejected for not complying with requirements.

1.04 SUBMITTAL PROCEDURES

A. General: Electronic copies of CAD Drawings of the Contract Drawings will be provided by the Government for Contractor's use in preparing submittals.

B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.

1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

    a. Contracting Officer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.

3. Submittals required are identified by SD numbers and titles as follows:

    a. SD-01 Preconstruction Submittals

        1) A document, required of the contractor or through the Contractor, from a supplier, installer, manufacturer or other lower tier Contractor the purpose of which is to confirm the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications or other verifications of quality.

    b. SD-02 Shop Drawings

        1) Submittals which graphically show relationships of various components of the work, schematic diagrams of systems, details of fabrication, layouts of particular elements, connections and other relational aspects of the work.

c. SD-03 Product Data

1) Preprinted manufacturer material describing a product, system or material such as catalog cuts.

d. DS-04 Samples

1) Samples, including both fabricated and un-fabricated physical examples of materials, products and units of work as complete units or as portions of units.

e. DS-05 Design Data

1) Submittals, which provide calculations, descriptions or documentation regarding the work.

f. DS-06 Test Reports

1) Reports of inspections or tests, including analysis and interpretation of test results.

g. SD-07 Certificates

1) Statement signed by an official authorized to certify on behalf of the manufacturer of a product, system or material, attesting that the item(s) meet the specified requirements. The statement must be dated after the award of the contract, must state the Prime Contractor's name and address, must name the project and location, and must list the specific requirements, which are being certified.

h. SD-08 Manufacturer's Instructions

1) Preprinting material describing installation of a product, system or material, including special notices and material safety data sheets, if any, concerning impedances, hazards, and safety procedures.

i. SD-09 Manufacturer's Field Reports
j. SD-10 Operation and Maintenance Data

1) Data which forms a part of an operation and maintenance manual

k. SD-11 Closeout Submittals

1) All data, documentations, information, and drawings to achieve contact closeout.

l. SD-12 Schedules

1) All closeout, documentations, information, and drawings to achieve contract closeout.

m. SD-13 Records

1) Documentation to record compliance with technical / administrative requirements.

C. Submittal Classifications: Submittals are classified as follows:

1. (G) Government Approved/ Acceptance:

a. Government approval is required for all submittal items found in specifications having structural steel connections, extensions of design, Fire protection/Life Safety devices, steam piping, valves and accessory components, including commissioning of HVAC and other items as designated by the Contracting Officer. Government approval/ acceptance (G) is also required for all submittals designated as such in the technical specifications. With the terms of the Contract Clause entitled “specifications and Drawings for Construction” they are considered “Shop Drawings”. The Government will review all submittals designated as deviating from the Solicitation or Accepted Proposal, as described below.

b. All submittals classified for Government Approval/Acceptance (G) are identified in the approved submittal register. A code following the “G” designation indicates the approving authority. Codes of “RO” for Resident Office approval, “DO” for Engineering approval, and “AE” for Architect/Engineer approval.

2. (FIO) For Information Only:

a. All Contractor submittals not requiring Government approval/acceptance will be for information only. FIO submittals will be identified in the approved submittal register. They are not considered to be “Shop Drawings” within the terms of the Contract Clause referred to above. FIO submittals will be retained on the project site and reviewed prior to preparatory Meetings in accordance the Contractor's Quality Control.

D. Approved/Acceptance Submittals:

1. The Contracting Officer's approval/acceptance of submittals shall not be construed as a complete check but will indicate only that the general method of construction, materials, detailing, and other information are satisfactory. Approval 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 no resubmittal for the purposes of substituting materials or equipment will be considered unless accompanied by an explanation of why a substitution is necessary. Upon completion of review of submittals requiring Government approval the submittal shall be identified as having received approval/acceptance by being so stamped and dated. The Contracting Officer will retain a digital copy and return a digital copy to the Contractor.

E. Disapproved Submittals:

1. The Contractor shall make all corrections required by the Contracting Officer or Architect and promptly furnish a corrected submittal in the form specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, a notice in accordance with the contract clause “Changes” shall be given promptly to the Architect.

F. Withholding of Payment:

1. Payment for materials incorporated in the work will not be made if required approvals have not been submitted.

G. Scheduling:

1. Submittals covering component items forming a system or items that are interrelated shall be scheduled to be coordinated and submitted concurrently. Certifications to be submitted with the pertinent drawings shall be so scheduled. No delay damages or time extensions will be allowed for time lost in late submittals.

H. Transmittal Form: Use attached Eng Form 4025 for submitting both Government approved/accepted and information only submittals in accordance with the instructions on the reverse side of the form. This form will be furnished to the Contractor. Properly complete the form by filling out all the blank spaces and indentifying each item submitted.

I. Processing Time: Allow enough time for submittal review, including time for re-submittals, as follows. Time for review shall commence on the Contracting Officer's Representative’s receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including re-submittals.

1. Submittal Review: Allow 15 business days for review of each submittal. Allow additional time if coordination with subsequent submittals is required. The Contracting Officer will advise Contractor when a submittal being processed must be delayed for coordination.

J. Identification: Place a title page on each submittal for identification.

1. Indicate name of firm or entity that prepared each submittal on title page.
2. Provide a space approximately 6 by 8 inches (150 by 200 mm) on title page to record Contractor's review and approval markings and action taken by the Contracting Officer's Representative.
3. Include the following information on the title page for processing and recording action taken:

a. Project name.
b. Date.
c. Name and address of Contracting Officer
d. Name and address of Contracting Officer's Representative
e. Name and Address of the A/E.
f. Name and address of Prime Contractor.
g. Name and address of Sub Contractor (if applicable).
h. Name and address of supplier.
i. Name of manufacturer.
j. Submittal number or other unique identifier, including revision identifier.

1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

k. Number and title of appropriate Specification Section.
l. Drawing number and detail references, as appropriate.
m. Location(s) where product is to be installed, as appropriate.
n. Other necessary identification.

K. Deviations: For submittals which include proposed deviations requested by the Contractor, the column "variation" of ENG Form 4025 shall be checked. The Contractor shall set forth in writing the reason for any deviations and annotate such deviations in the submittal. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted deviations

L. Re-submittals: Make re-submittals in same form and number of copies as initial submittal.

1. Note date and content of previous submittal.
2. Note date and content of revision in the label or title block of the submitted document(s) and clearly indicate extent of revision.
3. Resubmit submittals until they are marked Approved

M. Distribution: Furnish copies of final submittals to manufacturers, Contractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.

N. Use for Construction: Use only final submittals with mark indicating Approved by the Contracting Officer.

PART 2 PRODUCTS

2.01 ACTION SUBMITTALS

A. General: Prepare and submit Action Submittals required by individual Specification Sections.

1. Submit electronic format submittals directly to extranet system specifically established for Project at the time of contract award.
2. Submit physical materials as specified for SD-04 Sample Submittals in addition to the electronic format copies submitted through the extranet system.

B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.

1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
2. Mark each copy of each submittal to show which products and options are applicable.
3. Include the following information, as applicable:

a. Manufacturer's written recommendations.
b. Manufacturer's product specifications.
c. Manufacturer's installation instructions.
d. Standard color charts.
e. Manufacturer's catalog cuts.
f. Wiring diagrams showing factory-installed wiring.
g. Operational range diagrams and printed performance curves.
h. Mill reports.
i. Standard product operation and maintenance manuals.
j. Compliance with specified referenced standards.
k. Testing by recognized testing agency with application of testing agency labels/seals.
l. Notation of coordination requirements.
m. Submit Product Data before or concurrent with Samples.

C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on/ or use reproductions of the Contract Documents or standard printed data.

1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:

a. Dimensions.
b. Identification of products.
c. Fabrication and installation drawings.
d. Roughing-in and setting diagrams.
e. Wiring diagrams showing field-installed wiring, including power, signal and control wiring. Differentiate between manufacturer-installed and field-installed wiring.
f. Shopwork manufacturing instructions.
g. Templates and patterns.
h. Schedules.
i. Design calculations.
j. Compliance with specified standards.
k. Notation of coordination requirements.
l. Notation of dimensions established by field measurement.
m. Relationship to adjoining construction clearly indicated.
n. Seal and signature of professional engineer if specified.
o. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings in a digital format that can be printed legibly on sheets not larger than 30 by 40 inches.

D. Samples: Furnish samples in the following sizes, unless otherwise indicated or unless the manufacture has prepackaged samples of approximately the same size as specified:

1. Samples of device or anchorage accessories: Full size.
2. Color Selection Samples: Submit (3) - 6 by 6 inch copies for each sample submittal.
   a. Where samples are specified to match existing submit a range of finishes as necessary for the Architect to select the most appropriate matching finish. Continue to submit samples until selection is approved.
   b. Where samples are specified to be selected from manufacturer’s full available range, submit samples of all available finishes for selection.

E. Submittals Schedule: Comply with requirements specified in Section 01 33 00 CONSTRUCTION SUBMITTAL PROCEDURES.

F. Application for Payment: Comply with the Contract.

G. Schedule of Values: Comply with the Contract requirements including Section 00 80 00.

H. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A. Include the following information in tabular form:

1. Name, address, and telephone number of entity performing subcontract or supplying products.
2. Number and title of related Specification Section(s) covered by subcontract.
3. Drawing number and detail references, as appropriate, covered by subcontract.

2.02 INFORMATIONAL SUBMITTALS

A. General: Prepare and submit Informational Submittals required by other Specification Sections.

1. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
2. Test and Inspection Reports: Comply with requirements specified in Section 00 80 00 SPECIAL CONTRACT REQUIREMENTS (USMA).

B. Coordination Drawings: Comply with requirements specified in Section 00 80 00 SPECIAL CONTRACT REQUIREMENTS (USMA).

C. Contractor's Construction Schedule: Comply with requirements specified in Section 00 80 00 SPECIAL CONTRACT REQUIREMENTS (USMA).

D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.

F. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

G. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.

H. Product Certificates: Prepare written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.

I. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.

J. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.

K. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.

L. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.

M. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements specified in Section 01 78 23 "Operation and Maintenance Data."

N. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

O. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:

1. Preparation of substrates.
2. Required substrate tolerances.
3. Sequence of installation or erection.
4. Required installation tolerances.
5. Required adjustments.
6. Recommendations for cleaning and protection.

P. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.

Q. Material Safety Data Sheets (MSDSs): Submit information directly to COR.

1. Do not submit to A/E. A/E will not review submittals that include MSDSs and will return the entire submittal for resubmittal.

2.03 DELEGATED DESIGN

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to A/E.

B. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 EXECUTION

3.01 CONTRACTOR'S REVIEW

A. Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to A/E.

B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.02 CONTRACTING OFFICER / A/E'S ACTION

A. General: Contracting Officer and A/E will not review submittals that do not bear Subcontractor's approval stamp and will return them with a D-Action as indicated below.

1. Partial submittals are not acceptable, will be considered non-responsive, and will be returned with a D-Action as indicated below.

B. Action Submittals: A/E will review each submittal, make marks to indicate corrections or modifications required, and return it. A/E action stamp will be affixed to each submittal and will be marked appropriately to indicate the action taken, as follows:

1. **A-Action:** Proceed with work. Final acceptance will be contingent upon compliance with Contract Documents.

2. **B-Action:** Proceed with the work. Final acceptance will be contingent upon compliance with all notations and with all requirements of the Contract Documents.

   Re-submission may be requested for record purposes.

3. **C-Action:** REVISE AND RESUBMIT – limit corrections to items marked. Direct specific attention to revisions other than those requested by the Architect on previous submittals.

4. **D-Action:** RE-SUBMIT – Not reviewed –

   Submittal lacks the required Contractor review stamp or are not complete.

C. Informational Submittals: A/E will review each submittal and will not return it or will return it if it does not comply with requirements. A/E will forward each submittal to appropriate party.

D. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

3.03 SUBMITTAL REGISTER FORM

A. Refer to attachment at the end of this section

END OF SECTION 01 33 00

TRANSMITTAL OF SHOP DRAWINGS, EQUIPMENT DATA, MATERIAL SAMPLES, OR MANUFACTURER'S CERTIFICATES OF COMPLIANCE *(Read instructions on the reverse side prior to initiating this form)*	DATE:	TRANSMITTAL NO. 1

SECTION 1 REQUEST FOR APPROVAL OF THE FOLLOWING ITEMS (This section will be initiated by the contractor)

TO: ATTN: PUBLIC WORKS CONSTRUCTION BRANCH	From:	CONTRACT NO.	CHECK ONE: ☐ THIS IS A NEW TRANSMITTAL ☐ THIS IS A RESUBMITTAL OF TRANSMITTAL NO.
SPECIFICATION SEC. NO. (Cover Only One Section With Each Transmittal)	PROJECT TITLE AND LOCATION		

ITEM NO.	DESCRIPTION OF ITEM SUBMITTED *(Type, size, model number / etc.)*	MFG. OR CONT. CAT., CURVE Drawing or Brochure No. *(See instruciton No. 8)*	No. of Copies	Contract reference Document: Spec. Para No.	Contract reference Document: Drawing sheet no.	FOR CONTRACTOR USE CODE	VARIATION (SEE INSTRUCTION NO. 6)	For CE USE CODE
a.	b	c	d	e	f	g	H.	I
1			3					

REMARKS:	I certify that the above submitted items have been reviewed in detail and are correct and in strict conformance with the contract drawings and specifications except as otherwise stated. NAME AND SIGNATURE OF CONTRACTOR

SECTION II - APPROVAL ACTION

ENCLOSURES RETURNED (LIST BY ITEM NO.)	NAME, TITLE AND SIGNATURE OF APPROVING AUTHORITY	DATE

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SECTION 01 33 29

SUSTAINABILITY REQUIREMENTS AND REPORTING
02/21

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.

COUNCIL ON ENVIRONMENTAL QUALITY (CEQ) (WHITE HOUSE)

HPSB Guiding Principles	(2016) Guiding Principles for Sustainable Federal Buildings and Determining Compliance with the Guiding Principles for Sustainable Federal Buildings

INTERNATIONAL CODE COUNCIL (ICC)

ICC IGCC	(2018) International Green Construction Code

U.S. DEPARTMENT OF AGRICULTURE (USDA)

FSRIA 9002	Farm Security and Rural Investment Act Section 9002 (USDA BioPreferred Program)

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 1-200-02	(2020) High Performance and Sustainable Building Requirements
UFC 3-600-01	(2016; with Change 6, 2021) Fire Protection Engineering for Facilities

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

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

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

1.2 SUMMARY

This section includes requirements for Sustainability documentation and reporting submittals per the federally mandated High Performance and Sustainable Building (HPSB) or HPSB "Guiding Principles" (GP), in accordance with UFC 1-200-02 High Performance and Sustainable Building Requirements, and other identified requirements.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification 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

Preliminary High Performance and Sustainable Building Checklist; G, RO

Sustainability Action Plan; G, RO

Preliminary Sustainability eNotebook; G, RO

SD-11 Closeout Submittals

Final High Performance and Sustainable Building Checklist; G, RO

Final Sustainability eNotebook; G, RO

Amended Final Sustainability eNotebook; G, RO

Amended Final High Performance and Sustainable Building Checklist; G, RO

Third Party Certification Certificate, Assessment, or Validation and Compliance Report; G, RO

1.4 GUIDING PRINCIPLES VALIDATION (GPV)

Provide the following sustainability activities and documentation to verify achievement of HPSB Guiding Principles Validation (GPV):

a. Analysis of each Guiding Principle Requirement and how project complies. Include final government approved narrative(s) in the HPSB Checklist submittal. Multiple checklists indicate multiple buildings that require individual HPSB Checklist tracking.

b. No changes to the HPSB Checklist are allowed without approval from the Contracting Officer, in accordance with Section 01 33 00 SUBMITTAL REQUIREMENTS. Immediately bring to the attention of the Contracting Officer any project changes that impact meeting the approved HPSB Guiding Principles Requirements for this project. Demonstrate the change will not increase the life-cycle cost and maintains or improves the building performance.

c. Documentation of all work required to incorporate the applicable HPSB Guiding Principles requirements indicated on the HPSB Checklist and in this contract, including all "S" submittals.

d. Sustainability Action Plan.

e. Construction related documentation for the project Sustainability eNotebook and keep updated with regularly-scheduled Construction Quality Control Meetings. Include construction related documentation

containing the following components:

(1) HPSB Checklist(s)

(2) Sustainability Action Plan

(3) Documentation illustrating HPSB Guiding Principles Requirements compliance, including "S" submittals

1.4.1 Sustainability Action Plan

Include the following information in the Sustainability Action Plan:

a. Analysis of each HPSB Guiding Principles Requirement and how project will comply. Final government approved narrative(s) must be included in the HPSB Checklist submittal.

b. Name and contact information for: Contractor's Point of Contact (POC) ensuring sustainability goals are accomplished and documentation is assembled. For TPC that include on-site visit by third party representative, provide list of required attendees.

c. Indoor Air Quality plan.

1.4.2 Calculations

Provide all calculations, product data, labels and product certifications required in this specification to demonstrate compliance with the HPSB Guiding Principles Requirements.

1.5 SUSTAINABILITY SUBMITTALS

Provide HPSB Checklist and other documentation in the Sustainability eNotebook to indicate compliance with the sustainability requirements of the project.

1.5.1 High Performance Sustainable Building (HPSB) Checklist

Provide construction documentation that provides proof of, and supports compliance with, the completed HPSB Checklist.

1.5.1.1 HPSB Checklist Submittals

Submit updated HPSB Checklist with each Sustainability eNotebook submittal. Include the final HPSB Checklist(s) with the interim DD1354 Real Property Record Submittal.

1.5.2 "S" Submittals for Sustainability Documentation

"S" submittals are the sustainability documentation requirements cited in the various sections of this contract. Submit the GPV and TPC sustainability documentation required in this section as "S" submittals in all affected UFGS Sections.

a. Highlight GPV and TPC compliance data in "S" submittal.

b. Add "S" submittals to the Sustainability eNotebook only after submittal approval, and bookmark them as required in paragraph SUSTAINABILITY ENOTEBOOK below.

c. Ensure all approved "S" submittals are included in each Sustainability eNotebook submittal.

1.5.3 Sustainability eNotebook

The Sustainability eNotebook is an electronic organizational file that serves as a repository for all required sustainability submittals. To support documentation of compliance with an approved HPSB and TPC checklist, provide and maintain a comprehensive and current Sustainability eNotebook. Include all required data in Sustainability eNotebook, to support full compliance with the HPSB Guiding Principles Requirements, including:

a. HPSB checklist

b. Sustainability Action Plan

c. Calculations

d. Labels

e. "S" submittals

f. Certifications, assessments, or validations and compliance report

g. TPC documentation required in paragraph THIRD PARTY CERTIFICATION (TPC).

1.5.3.1 Sustainability eNotebook Format

Provide Sustainability eNotebook in the form of an Adobe PDF file; bookmark each HPSB Guiding Principles Requirement, TPC requirement, and sub-bookmark at each document. Match format to HPSB Guiding Principles numbering system indicated herein. Maintain up-to-date information, such as spreadsheets, templates, with each current submittals. For TPC projects, provide a second Table of Contents using TPC numbering system, for maintaining documentation unique to TPC.

Contracting Officer may deduct from the monthly progress payment accordingly if Sustainability eNotebook information is not current and on track per project goals.

1.5.3.2 Sustainability eNotebook Submittal Schedule

Provide Sustainability eNotebook Submittals at the following milestones of the project:

a. Preliminary Sustainability eNotebook

Submit preliminary Sustainability eNotebook with updated Preliminary High Performance and Sustainable Building Checklist and TPC checklist at the first post award meeting in accordance with Section 01 30 00 ADMINISTRATIVE REQUIREMENTS.

b. Final Sustainability eNotebook

Submit updated Sustainability eNotebook with updated Final High Performance and Sustainable Building Checklist with TPC Checklist, in

accordance with Section 01 33 00.05 20 CONSTRUCTION SUBMITTAL PROCEDURES at Beneficial Occupancy Date (BOD). Final progress payment retainage may be held by Contracting Officer until Final Sustainability construction phase documentation is complete.

c. Amended Final Sustainability eNotebook

Amend and resubmit the Amended Final Sustainability eNotebook with Amended Final High Performance and Sustainable Building Checklist, to include post-occupancy corrections, updates, and requirements. Final progress payment retainage may be held by Contracting Officer until amended final sustainability documentation is complete. Submit the Amended Final Sustainability eNotebook Submittal on DVDs to the Contracting Officer no later than 30 days after final GP determination.

1.6 DOCUMENTATION REQUIREMENTS

a. Incorporate each of the following HPSB Guiding Principles requirements into project and provide documentation that proves compliance with each listed requirement. Items below are organized by HPSB Guiding Principles. For life-cycle cost analysis requirements, one document with all analyses is acceptable, with Contracting Officer approval.

b. For each of the following paragraphs that require the use of products listed on Government-required websites, provide documentation of the process used to select products, or process used to determine why listed products do not meet project performance requirements.

1.6.1 Energy Efficient Products

Provide only energy-using products that are Energy Star rated or have Federal Energy Management Program (FEMP) recommended efficiency. Where Energy Star or FEMP recommendations have not been established, provide most efficient products that are life-cycle cost-effective. Provide only energy using products that meet FEMP requirements for low standby power consumption. Energy efficient products can be found at: https://www.energy.gov/eere/femp/federal-energy-management-program and http://www.energystar.gov/.

For construction submittal documentation, provide proof that product is labeled energy efficient and complies with the cited requirements.

1.6.2 Building-level Power Metering

Provide building-level meters for electricity, natural gas, and steam where applicable.

1.6.2.1 Construction Submittal Documentation

Provide manufacturer's data validating compatibility with base-wide system and component advanced meter requirements.

1.6.3 Indoor Water Use

Provide Construction Documentation proof that fixtures are labeled EPA WaterSense, for products available with EPA WaterSense labeling; for all other fixtures, proof they comply with EPA WaterSense efficiency requirements.

1.6.4 Indoor Water Metering

Provide building-level meters for potable water use. Provide the requirements cited in the following paragraphs:

1.6.4.1 Construction Submittal Documentation

Provide manufacturer's data validating compatibility with base-wide system and component advanced meter requirements.

1.6.5 Outdoor Water Use

Where new irrigation is required, provide only non-potable sources. Provide the requirements cited in the following paragraphs:

1.6.5.1 Construction Submittal Documentation

Provide manufacturer's data validating compatibility with base-wide system and component advanced meter requirements.

1.6.6 Outdoor Water Meters

Provide meters for outdoor systems that use potable water. Provide the requirements cited in the following paragraphs:

1.6.6.1 Construction Submittal Documentation

Provide manufacturer's data validating compatibility with base-wide system and component advanced meter requirements.

1.6.7 Moisture Control

Provide the following:

1.6.7.1 Construction Submittal Documentation

Ensure construction materials are separated and protected in accordance with other sections in this contract document, with adequate humidity controls during construction. In accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA, includes plan for ongoing building moisture control.

Coordinate with the moisture control requirements of Section 01 45 00.00 10 QUALITY CONTROL.

1.6.8 Reduce Volatile Organic Compounds (VOC) (Low-Emitting Materials)

Meet the requirements of Table 3-1 at the end of this specification.

For Construction submittal documentation, provide certifications or labels that demonstrate compliance with cited requirements, based on the attached TABLE 3-1.

1.6.9 Indoor Air Quality During Construction

Prior to construction, create indoor air quality plan. Develop and implement an IAQ construction management plan during construction and flush building air before occupancy.

For new construction and for renovation of unoccupied existing buildings, meet the requirements of ICC IGCC 1001.3.1.5 (10.3.1.4) Indoor Air Quality (IAQ) Construction Management. Coordinate with moisture control requirements in Section 01 45 00.00 20 Quality Control.

Provide documentation showing that after construction ends and prior to occupancy, HVAC filters were replaced and building air was flushed out in accordance with the cited standard. Maximum concentration limits of contaminants are not exceeded per TPC requirements.

1.6.10 Recycled Content

Contractor shall select materials so that the sum of post-consumer recycled content value plus one-half of post-industrial recycled content value constitutes at least 20 percent of the total materials cost for the project. Comply with 40 CFR 247. Refer to: https://www.epa.gov/smm/comprehensive-procurement-guideline-cpg-program for assistance identifying products cited in 40 CFR 247. Selected products must comply with non-proprietary requirements of the Federal Acquisition Regulation and must meet performance requirements.

1.6.10.1 Construction Submittal Documentation

a. Provide manufacturers' documents stating the recycled content by material, or written justification for claiming one of the exceptions allowed on the cited website.

b. Substitutions: Submit for Government approval for proposed alternative products or systems that provide equivalent performance and appearance and have greater contribution to project recycled content requirements. For all such proposed substitutions, submit with the Sustainability Action Plan accompanied by product data demonstrating equivalence.

c. In order to complete compliance with FAR 52.223-9 Estimate of Percentage of Recovered Material Content for EPA Designated Items, refer to submittal requirement for recycled/recovered material content in Section 01 77 00 CLOSEOUT SUBMITTALS.

1.6.11 Bio-Based Products

Provide products and materials composed of the highest percentage of bio-based materials (including rapidly renewable resources and certified sustainably harvested products), consistent with FSRIA 9002 USDA BioPreferred Program, to the maximum extent possible without jeopardizing the intended end use or detracting from the overall quality delivered to the end user and when available at a reasonable cost. Use only supplies and materials of a type and quality that conform to applicable specifications and standards.

Comply with FSRIA 9002 USDA BioPreferred Program. Refer to www.biopreferred.gov for the product categories and BioPreferred Catalog. Selected products must comply with non-proprietary requirements of the Federal Acquisition Regulation and must meet performance requirements. Provide the following documentation:

a. USDA BioPreferred label for each product; for bio-based products used on project but not listed with BioPreferred program, provide bio-based

content and percentage.

1.6.12 Waste Material Management (Recycling – Construction)

Divert at least 75 percent of clean, nonhazardous construction and demolition debris in accordance with Section01 57 20 CONSTRUCTION DEMOLITION WASTE MANAGEMENT.

1.6.13 Regional Materials

Use 20 percent of building materials or products (based on total materials cost) that have been extracted, harvested, or recovered, as well as manufactured,within 500 miles of Project Site. Mechanical, electrical, and plumbing components (included elevators) are excluded from this calculation).

1.6.14 Performance and Certification Requirements

For all products used, a statement shall be included indicating material cost (exclude labor and markup) for each product provided under this Section, in addition to the following details when products are specified with one or more of these attributes:

a. Recycled Content: Indicate percentage of post-consumer and pre-consumer recycled content.

b. Regional Content: When a material is extracted, manufactured and purchased within 100 miles of project site, provide a manufacturer's letter validating the location of extraction, manufacture and purchase.

c. For products with Product Disclosure and Optimization documentation in the form of an Environmental Product Declaration (EPD), provide a verified manufacturer's report for the specified attribute or certification:

1. Environmental Product Disclosure (EPD), Type III. Classify EPD as Product Specific, Industry wide and as Internally Reviewed or Third-Party Certified.

2. Life Cycle Impact Reduction Action Plan (LCA).

3. Life Cycle Impact Reduction in Embodied Carbon: Third-Party LCA or Third-Party EPD.

d. For products with Product Disclosure in the form of Material Ingredient Reporting, provide documentation demonstrating chemical inventory of the product to at least 0.1 percent (1000 ppm) under one of the following programs:

1. CAS Registry Number (CASRN).

2. Ingredient Chemical disclosure using GreenScreen List Translator Score or Full GreenScreen.

3. Health Product Declaration published with full disclosure of known hazards in compliance with the Health Product Declaration Open Standard.

4. Cradle to Cradle Certified under standard 3 or Material Health Certificate at the Bronze level or higher.

5. Declare label designated as Red List Free, Declared, or demonstrating Living Building Center compliance to 0.1 percent.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 SUSTAINABILITY COORDINATION

Provide sustainability focus and coordination at all meetings to achieve sustainability goals. Coordinate meeting requirements with other UFGS Sections meeting requirements in this project. Ensure the designated TPC accredited sustainability professional responsible for GP and TPC documentation participates in these meetings to coordinate documentation completion. Review GP and TPC sustainability requirements, HPSB Checklist and TPC documentation, Sustainability Action Plan, and completeness status of Sustainability eNotebook, and TPC status at the following meetings:

a. Pre-Construction Conference

b. Construction Quality Control Meetings

c. TPC On-site Visit

Execute, coordinate, and facilitate on-site visit by third party representative no later than 60 days before final turnover, or as required by TPC organization, whichever is greater.

d. Facility Turnover Meetings

Conduct review no later than 60 days before final turnover and identify any outstanding issues that affect correct completion of all documentation and final TPC certification, assessment or validation, and actions that will achieve requirements. Conduct corrective actions prior to turnover, to ensure all requirements are achieved.

3.2 THIRD PARTY CERTIFICATION CERTIFICATE, ASSESSMENT, OR VALIDATION AND COMPLIANCE REPORT

Finalize the process requirements and obtain the TPC Plaque and Certificate, assessment, or validation, and compliance report, indicating completion of the project's sustainability goals. Include TPC compliance report with final TPC scoresheet as applicable.

3.3 TABLE 3-1 VOLATILE ORGANIC COMPOUNDS (VOC) (LOW EMITTING MATERIALS) REQUIREMENTS

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements

Source: ICC IGCC Chapter 8 (Materials) (Interior Applications Only)

MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	EMISSIONS REQUIREMENTS
Adhesives and Sealants	**CDPH/EHLB/Standard method V1.1 (California Section 01350)** (Use "office" or "classroom" space limits for all applications)	or	Adhesives (carpet, resilient, wood flooring; base cove; ceramic tile; drywall and panel; primers) Sealants (acoustical; firestop; HVAC Air duct; primers) Caulks	**SCAQMD Rule 1168** (Use "other" category for HVAC duct sealant) (for firestop adhesive, UFC 3-600-01 overrides conflicting requirements)
			Aerosol adhesives	**Section 3 of Green Seal Standard GS-36** (except: cleaners, solvent cements, and primers used with plastic piping and conduit in plumbing, fire suppression, and electrical systems; HVAC air duct sealants when the application space air temp is less than 40 F (4.5 C).

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements

Source: ICC IGCC Chapter 8 (Materials) (Interior Applications Only)

MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	EMISSIONS REQUIREMENTS
Paints and Coatings	**CDPH/EHLB/Standard method V1.1 (California Section 01350)** (Use "office" or "classroom" space limits for all applications)	or	Flat and nonflat, nonflat high-gloss, specialty, basement specialty, fire-resistive, floor, low-solids, rust preventative, wood, reflective wall coatings; concrete/masonry sealers; primers; sealers; undercoaters; shellacs (clear and opaque); stains; varnishes; conjugated oil varnish; lacquer; clear brushing lacquer	**Green Seal Standard GS-11**

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements

Source: ICC IGCC Chapter 8 (Materials) (Interior Applications Only)

MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	EMISSIONS REQUIREMENTS
Paints and Coatings	**CDPH/EHLB/Standard method V1.1 (California Section 01350)** (Use "office" or "classroom" space limits for all applications)	or	Concrete curing compounds; dry fog, faux finishing, graphic arts (sign paints), industrial maintenance, mastic texture, metallic pigmented, multicolor, recycled coatings; pretreatment wash primers, reactive penetrating sealers; specialty primers, wood preservatives, and zinc primers	**California Air Resources Board (CARB) Suggested Control Measure for Architectural Coatings** or **SCAQMD Rule 1113r**
Paints and Coatings	**CDPH/EHLB/Standard method V1.1 (California Section 01350)** (Use "office" or "classroom" space limits for all applications)	or	High-temperature coatings; stone consolidants; swimming-pool coatings; tub- and tile-refining coatings; and waterproofing membranes	**California Air Resources Board (CARB) Suggested Control Measure for Architectural Coatings**

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements

Source: ICC IGCC Chapter 8 (Materials) (Interior Applications Only)

MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	EMISSIONS REQUIREMENTS
Floor Covering Materials	For carpet, all locations: **CDPH/EHLB/Standard Method V1.1 (California Section 01350)** or label for **Section 9** of **CDPH/EHLB/Standard Method V1.1 (California Section 01350)**		none	none
Insulation	**CDPH/EHLB/Standard method V1.1** (California Section 01350) (Use "office" or "classroom" space limits for all applications)		none	none

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements

Source: ICC IGCC Chapter 8 (Materials) (Interior Applications Only)

MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	EMISSIONS REQUIREMENTS
Composite Wood, Wood Structural Panel, and Agrifiber Products, no added urea-formaldehyde resins including laminating adhesives for composite wood and agrifiber assemblies - particleboard, medium density fiberboard (MDF), wheatboard, strawboard, panel substrates, door cores	Third-party certification (approved by CARB) of **California Air Resource Board's (CARB) regulation**, Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products	or	none	**CDPH/EHLB/Standard method V1.1** (California Section 01350) (Use "office" or "classroom" space limits for all applications) (except: Structural panel components such as plywood, particle board, wafer board, and oriented strand board identified as "EXPOSURE 1," "EXTERIOR," or "HUD-APPROVED" are considered acceptable for interior use.)
Office Furniture Systems and Seating installed prior to occupancy	**ANSI/BIFMA X7.1 ANSI/BIFMA X7.1:** (95-percent of installed office furniture system workstations and seating units) **Section 7.6.2 of ANSI/BIFMA e3** (50-percent of office furniture system workstations and seating units)		none	none

TABLE 3-1 Volatile Organic Compounds (VOC) (Low Emitting Materials) Requirements

Source: ICC IGCC Chapter 8 (Materials) (Interior Applications Only)

MATERIAL CATEGORY	EMISSIONS REQUIREMENT		MATERIALS WITH ADDED VOC REQUIREMENT	EMISSIONS REQUIREMENTS
Ceiling and Wall assemblies and systems including: acoustical treatments; ceiling panels and tiles; tackable wall panels and coverings; wall coverings; wall and ceiling paneling and planking	**CDPH/EHLB/Standard method V1.1 (California Section 01350)** (Use "office" or "classroom" space limits for all applications)		none	none

-- End of Section --

SECTION 01 35 29

SAFETY AND OCCUPATIONAL HEALTH REQUIREMENTS

PART 1 GENERAL

1.01 REFERENCES

A. 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. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)
      a. ANSI A10.32
         1) Personal Fall Protection - Safety Requirements for Construction and Demolition Operations
      b. ANSI/ASSE A10.34
         1) (2001) Protection of the Public on or Adjacent to Construction Sites
      c. ANSI Z359.1
         1) (1992; R 1999) Safety Requirements for Personal Fall Arrest Systems, Subsystems and Components
   2. ASME INTERNATIONAL (ASME)
      a. ASME B30.22
         1) (2000) Articulating Boom Cranes
      b. ASME B30.3
         1) (1996) Construction Tower Cranes
      c. ASME B30.5
         1) (2000) Mobile and Locomotive Cranes
   3. NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)
      a. NFPA 10
         1) (2002) Portable Fire Extinguishers
      b. NFPA 241
         1) (2000) Safeguarding Construction, Alteration, and Demolition Operations
      c. NFPA 51B
         1) (2003) Fire Prevention During Welding, Cutting, and Other Hot Work
      d. NFPA 70
         1) (2002) National Electrical Code
      e. NFPA 70E
         1) (2004) Electrical Safety in the Workplace
   4. U.S. ARMY CORPS OF ENGINEERS (USACE)
      a. EM 385-1-1
         1) (2003) Safety -- Safety and Health Requirements; Available at http://www.hq.usace.army.mil
   5. U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
      a. 29 CFR 1910.146
         1) Permit-required Confined Spaces
      b. 29 CFR 1926
         1) Safety and Health Regulations for Construction
      c. 29 CFR 1926.500
         1) Fall Protection

1.02 SUBMITTALS

A. 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 Construction Submittal Procedures whether or not shown on submittal register:

1. SD-01 Preconstruction Submittals: Submit no later than at the time of the Project kick-off meeting.
   a. Accident Prevention Plan (APP); G, RO
   b. Activity Hazard Analysis (AHA); G, RO
   c. Crane Critical Lift Plan; G, RO
   d. Proof of qualification for Crane Operators; G, RO
   e. SD-06 Test Reports
   f. Reports; G
2. Submit reports as the incidence occurs, in accordance with the requirements of the paragraph entitled, "Reports."
   a. Accident Reports
   b. Monthly Exposure Reports
   c. Crane Reports
   d. Regulatory Citations and Violations
   e. SD-07 Certificates
   f. Confined Space Entry Permit
   g. Hot work permit
   h. Machinery & Mechanized Equipment Certification Form
   i. FAA Registration
3. Submit evidence of FAA registration on clearance of crane operation prior to lifting of the crane to POC Joe White - airfield operations (315) 772-4480.

1.03 DEFINITIONS

A. Competent Person for Fall Protection. A person who is capable of identifying hazardous or dangerous conditions in the personal fall arrest system or any component thereof, as well as their application and use with related equipment, and has the authority to take prompt corrective measures to eliminate the hazards of falling.

B. High Visibility Accident. Any mishap which may generate publicity and/or high visibility.

C. Medical Treatment. Treatment administered by a physician or by registered professional personnel under the standing orders of a physician. Medical treatment does not include first aid treatment even through provided by a physician or registered personnel.

D. Recordable Injuries or Illnesses. Any work-related injury or illness that results in:
   1. Death, regardless of the time between the injury and death, or the length of the illness.
   2. Days away from work (any time lost after day of injury/illness onset).
   3. Restricted work.
   4. Transfer to another job.
   5. Medical treatment beyond first aid.
   6. Loss of consciousness; or
   7. A significant injury or illness diagnosed by a physician or other licensed health care professional, even if it did not result in (1) through (6) above.

E. "USACE" property and equipment specified in USACE EM 385-1-1 should be interpreted as Government property and equipment. The latest edition of the U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1 and its changes are available at http://www.hq.usace.army.mil (at the HQ homepage select Safety and Occupational Health).

1.04 SAFETY - GENERAL CONSTRUCTION

A. General construction includes temporary construction, roofing, excavations, steel placement, paving, roads, site work, flood control structures, incidental removal of lead paint. Other sections of the contract documents may also require separate specially qualified individuals in such areas as chemical data acquisition, sampling and analysis, medical monitoring, industrial hygiene, quality control, etc. The Contractor must comply with all safety requirements in the contract. In addition to plans as required by this section, submit safety plans for other sections as indicated therein.

1.05 REGULATORY REQUIREMENTS

A. As a minimum, and in addition to the detailed requirements included in the provisions of this contract, work performed shall comply with USACE EM 385-1-1, OSHA, local military base rules, and any other federal, state, and local, laws, ordinances, criteria, rules and regulations which may apply. Submit matters of interpretation of standards to the appropriate administrative agency for resolution before starting work. Where the requirements of this specification, applicable laws, criteria, ordinances, regulations, and referenced documents vary, the most stringent requirements shall apply.

1.06 SITE SAFETY AND HEALTH OFFICER (SSHO)

A. Site Safety and Health Officer (SSHO) shall be provided at the work site to perform safety and occupational health management, surveillance, inspections, and safety enforcement for the Subcontractor as indicated herein and in EM 385-1-1. The SSHO or alternate(s) shall be on duty at the construction site at all times when construction is being performed and shall be available to resolve safety issues at any time. Safety duties shall be documented. The SSHO may not be the same person as the Quality Control System Manager or Construction Quality Control Manager where separate individuals are required elsewhere in the contract."

B. The SSHO or alternate shall meet the following requirements:
   1. A minimum of 7 years experience with construction safety as a major job duty with at least 3 years of experience on projects of similar complexity and scope.
   2. Must have completed 30-hour OSHA construction safety class or equivalent within the last 5 years.
   3. Must have completed an average of at least 24 hours of formal safety training each year for the past 3 years with training for competent person status for at least the following 4 areas of competency: Excavation; Scaffolding; Fall protection; Confined space. Additional areas of competence are required if special hazards will be encountered on the project.
   4. Must have a minimum of one year's experience or possess competence (via training) in arctic climate construction including the use of personal protective equipment (applies if project located in arctic area).
   5. Familiarity with the Corps of Engineers Safety Manual (EM 385-1-1), and any applicable Federal, State, or Local safety requirements.

1.07 COMPETENT PERSON FOR CONFINED SPACE ENTRY

A. Provide a competent person for confined space meeting the definition and requirements of EM 385-1-1.

1.08 CRANE OPERATORS

A. Crane operators shall meet the requirements in USACE EM 385-1-1, Section 16 and Appendix G. In addition, for mobile cranes with Original Equipment Manufacturer (OEM) rated capacitates of 50,000 pounds or greater, crane operators shall be designated as qualified by a source that qualifies crane operators (i.e., union, a government agency, or and organization that tests and qualifies crane operators). Proof of current qualification shall be provided.

1.09 ADDITIONAL SAFETY STAFF

A. Additional Safety Staff having specialized safety competence shall be provided on a part-time basis during the time the applicable part of construction is ongoing, and as applicable to the project. The additional staff shall have competence in hazardous energy, health hazard recognition, evaluation and control of chemical, physical, and biological agents, CPR/First Aid certification (current), electrical personal protective equipment and clothing, including selection, use, and maintenance, plus any other special hazards of the project. These individuals must be identified in the Accident Prevention Plan. They may be employees of the Prime Contractor or of subcontractors. Some or all of these competences may be fulfilled by the SSHO if qualified.

1.10 SITE SAFETY AND HEALTH OFFICER (SSHO)

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

B. Conduct mishap investigations and complete required reports. Maintain the OSHA Form 300 and Daily Production reports for prime and subcontractors.

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

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

E. Implement and enforce accepted APPS and AHAs.

F. Maintain a safety and health deficiency tracking system that monitors outstanding deficiencies until resolution. A list of unresolved safety and health deficiencies shall be posted on the safety bulletin board. Coordinate with the QC system manager.

G. Ensure subcontractor compliance with safety and health requirements.

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

1.11 PRECONSTRUCTION SAFETY CONFERENCE

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

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

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

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

1.12 SAFETY MEETINGS

A. Shall be conducted and documented as required by EM 385-1-1. Minutes showing contract title, signatures of attendees and a list of topics discussed shall be attached to the Contractors' daily quality control report.

1.13 ACCIDENT PREVENTION PLAN (APP)

A. The Subcontractor shall use a qualified person to prepare the written site-specific APP. Prepare the APP in accordance with the format and requirements of USACE EM 385-1-1 and as supplemented herein. Cover all paragraph and subparagraph elements in USACE EM 385-1-1, Appendix A, "Minimum Basic Outline for Accident Prevention Plan". Specific requirements for some of the APP elements are described below. The APP shall be job-specific and shall address any unusual or unique aspects of the project or activity for which it is written. The APP shall interface with the Contractor's and Subcontractor's overall safety and health program. Any portions of the Contractor's overall safety and health program referenced in the APP shall be included in the applicable APP element and made site-specific. The Government considers the Prime Contractor to be the "controlling authority" for all work site safety and health of the subcontractors. Subcontractor is responsible for informing their subcontractors of the safety provisions under the terms of the contract and the penalties for noncompliance, coordinating the work to prevent one craft from interfering with or creating hazardous working conditions for other crafts, and inspecting subcontractor operations to ensure that accident prevention responsibilities are being carried out. The APP shall be signed by the person and firm (senior person) preparing the APP, the Contractor, the on-site superintendent, the designated site safety and health officer and any designated CSP and/or CIH.

B. Submit the APP to the Contracting Officer 14 calendar days prior to the date of the preconstruction safety conference for acceptance. Work cannot proceed without an accepted APP.

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

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

E. Copies of the accepted plan will be maintained at the resident engineer's office and at the job site. The APP shall be continuously reviewed and amended, as necessary, throughout the life of the contract. Unusual or high-hazard activities not identified in the original APP shall be incorporated in the plan as they are discovered.

1.14 EM 385-1-1 Contents

A. In addition to the requirements outlines in Appendix A of USACE EM 385-1-1, the following is required:
   1. Crane Critical Lift Plan. Prepare and sign weight handling critical lift plans for lifts over 75 percent of the capacity of the crane or hoist (or lifts over 50 percent of the capacity of a barge mounted mobile crane's hoists) at any radius of lift; lifts involving more than one crane or hoist; lifts of personnel; and lifts involving non-routine rigging or operation, sensitive equipment, or unusual safety risks. The plan shall be submitted 15 calendar days prior to on-site work and include the requirements of USACE EM 385-1-1, paragraph 16.C.18. and the following:
      a. For lifts of personnel, the plan shall demonstrate compliance with the requirements of 29 CFR 1926.550(g).
      b. For barge mounted mobile cranes, barge stability calculations identifying barge list and trim based on anticipated loading; and load charts based on calculated list and trim. The amount of list and trim shall be within the crane manufacturer's requirements.

2. Site Safety and Health Plan. The safety and health aspects prepared in accordance with Section SAFETY HEALTH AND EMERGENCY RESPONSE (HTRW/UST).
3. Site Demolition Plan. The safety and health aspects prepared in accordance with Section 02 41 00 DEMOLITION and referenced sources.
4. Excavation Plan. The safety and health aspects prepared in accordance with Section 31 00 00 EARTHWORK.

1.15 ACTIVITY HAZARD ANALYSIS (AHA)

A. The Activity Hazard Analysis (AHA) format shall be in accordance with USACE EM 385-1-1. Submit the AHA for review at least 5 calendar days prior to the start of each phase. Format subsequent AHAs as amendments to the APP. The analysis should be used during daily inspections to ensure the implementation and effectiveness of the activity's safety and health controls.

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

C. The activity hazard analyses shall be developed for each definable feature of work within the Quality Control system. The AHAs will be developed by the contractor, supplier or subcontractor and provided to the prime contractor for submittal to the Contracting Officer.

1.16 DISPLAY OF SAFETY INFORMATION

A. Within (5) calendar days after commencement of work, erect a safety bulletin board at the job site. The safety bulletin board shall include information and be maintained as required by EM 385-1-1, section 01.A.06. Additional items required to be posted as applicable include:
   1. Confined space entry permit.
   2. Hot work permit.

1.17 SITE SAFETY REFERENCE MATERIALS

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

1.18 EMERGENCY MEDICAL TREATMENT

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

1.19 REPORTS

A. Accident Reports
   1. For recordable injuries and illnesses, and property damage accidents resulting in at least $2,000 in damages, the Subcontractor shall assist the Prime Contractor in conducting an accident investigation to establish the root cause(s) of the accident, complete the USACE Accident Report Form 3394 and provide the report to the Contracting Officer within (3) calendar days of the accident. The Contracting Officer will provide copies of any required or special forms.

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

1.20 MONTHLY EXPOSURE REPORTS

A. Monthly exposure reporting to the Contracting Officer is required to be attached to the monthly billing request. This report is a compilation of employee-hours worked each month for all site workers, both prime and subcontractor. The Contracting Officer will provide copies of any special forms.

1.21 CRANE REPORTS

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

1.22 CERTIFICATE OF COMPLIANCE

A. The Subcontractor shall provide a Certificate of Compliance for each crane entering an activity under this contract (see Contracting Officer for a blank certificate). Certificate shall state that the crane and rigging gear meet applicable OSHA regulations (with the Subcontractor citing which OSHA regulations are applicable, e.g., cranes used in construction, demolition, or maintenance shall comply with 29 CFR 1926 and USACE EM 385-1-1 section 16 and Appendix H. Certify on the Certificate of Compliance that the crane operator(s) is qualified and trained in the operation of the crane to be used. The Subcontractor shall also certify that all of its crane operators working on the DOD activity have been trained in the proper use of all safety devices (e.g., anti-two block devices). These certifications shall be posted on the crane.

B. HOT WORK

C. Prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, a written permit shall be requested from the Fire Division of the military base or the municipality where the work is being performed. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. The Subcontractor will provide at least two (2) twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in accordance with NFPA 51B and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the hot work permit.

D. When starting work in the facility, contractors shall require their personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency Fire Division phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO THE RESPONSIBLE FIRE DIVISION IMMEDIATELY.

E. Obtain services from a NFPA Certified Marine Chemist for "HOT WORK" within or around flammable materials (such as fuel systems, welding/cutting on fuel pipes) or confined spaces (such as sewer wet wells, manholes, vaults, etc.) that have the potential for flammable or explosive atmospheres.

1.23 HOT WORK

A. Prior to performing "Hot Work" (welding, cutting, etc.) or operating other flame-producing/spark producing devices, a written permit shall be requested from the Fire Division of the military base or the municipality where the work is being performed. CONTRACTORS ARE REQUIRED TO MEET ALL CRITERIA BEFORE A PERMIT IS ISSUED. The Subcontractor will provide at least two (2) twenty (20) pound 4A:20 BC rated extinguishers for normal "Hot Work". All extinguishers shall be current inspection tagged, approved safety pin and tamper resistant seal. It is also mandatory to have a designated FIRE WATCH for any "Hot Work" done at this activity. The Fire Watch shall be trained in accordance with NFPA 51B and remain on-site for a minimum of 30 minutes after completion of the task or as specified on the hot work permit.

B. When starting work in the facility, contractors shall require their personnel to familiarize themselves with the location of the nearest fire alarm boxes and place in memory the emergency Fire Division phone number. ANY FIRE, NO MATTER HOW SMALL, SHALL BE REPORTED TO THE RESPONSIBLE FIRE DIVISION IMMEDIATELY.

C. Obtain services from a NFPA Certified Marine Chemist for "HOT WORK" within or around flammable materials (such as fuel systems, welding/cutting on fuel pipes) or confined spaces (such as sewer wet wells, manholes, vaults, etc.) that have the potential for flammable or explosive atmospheres.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONSTRUCTION AND/OR OTHER WORK

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

3.02 HAZARDOUS MATERIAL EXCLUSIONS

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

3.03 UNFORESEEN HAZARDOUS MATERIAL

A. Hazardous materials are not expected to be encountered during construction, such as PCB, lead paint, and friable and non-friable asbestos. If additional material that may be hazardous to human health upon disturbance during construction operations is encountered, stop that portion of work and notify the Contracting Officer and Environmental Management Division (EMD) immediately. Within (14) calendar days the Government will determine if the material is hazardous. If material is not hazardous or poses no danger, the Government will direct the Contractor to proceed without change. If material is hazardous and handling of the material is necessary to accomplish the work, the Government will issue a modification pursuant to "FAR 52.243-4, Changes" and "FAR 52.236-2, Differing Site Conditions." Contractor is required to execute this modification.

3.04 PRE-OUTAGE COORDINATION MEETING

A. Contractors are required to apply for utility outages at least (14) days in advance. As a minimum, the request should include the location of the outage, utilities being affected, duration of outage and any necessary sketches. Special requirements for electrical outage requests are contained elsewhere in this specification section. Once approved, and prior to beginning work on the utility system requiring shut down, the Subcontractor shall attend a pre-outage coordination meeting with the Contracting Officer and the Installation representative or Public Utilities representative to review the scope of work and the lock-out/tag-out procedures for worker protection. No work will be performed on energized electrical circuits unless proof is provided that no other means exist.

3.05 FALL HAZARD PROTECTION AND PREVENTION PROGRAM

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

3.06 TRAINING

A. The Subcontractor shall institute a fall protection training program. As part of the Fall Hazard Protection and Prevention Program, the Subcontractor shall provide training for each employee who might be exposed to fall hazards. A competent person for fall protection shall provide the training. Training requirements shall be in accordance with USACE EM 385-1-1, section 21.A.16.

3.07 FALL PROTECTION EQUIPMENT AND SYSTEMS

A. The Subcontractor shall enforce use of the fall protection equipment and systems designated for each specific work activity in the Fall Protection and Prevention Plan and/or AHA at all times when an employee is exposed to a fall hazard. Employees shall be protected from fall hazards as specified in EM 385-1-1, section 21. In addition to the required fall protection systems, safety skiff, personal floatation devices, life rings etc., are required when working above or next to water in accordance with USACE EM 385-1-1, paragraphs 05.H. and 05.I. Personal fall arrest systems are required when working from an articulating or extendible boom, swing stages, or suspended platform. In addition, personal fall arrest systems are required when operating other equipment such as scissor lifts if the work platform is capable of being positioned outside the wheelbase. The need for tying-off in such equipment is to prevent ejection of the employee from the equipment during raising, lowering, or travel. Fall protection must comply with 29 CFR 1926.500, Subpart M, USACE EM 385-1-1 and ANSI A10.32.

3.08 PERSONAL FALL ARREST EQUIPMENT

A. Personal fall arrest equipment, systems, subsystems, and components shall meet ANSI Z359.1. Only a full-body harness with a shock-absorbing lanyard or self-retracting lanyard is an acceptable personal fall arrest body support device. Body belts may only be used as a positioning device system (for uses such as steel reinforcing assembly and in addition to an approved fall arrest system). Harnesses shall have a fall arrest attachment affixed to the body support (usually a Dorsal D-ring) and specifically designated for attachment to the rest of the system. Only locking snap hooks and carabineers shall be used. Webbing, straps, and ropes shall be made of synthetic fiber. The maximum free fall distance when using fall arrest equipment shall not exceed 1.8 m (6 feet). The total fall distance and any swinging of the worker (pendulum-like motion) that can occur during a fall shall always be taken into consideration when attaching a person to a fall arrest system.

3.09 EXISTING ANCHORAGE

A. Existing anchorages, to be used for attachment of personal fall arrest equipment, shall be certified (or re-certified) by a qualified person for fall protection in accordance with ANSI Z359.1. Exiting horizontal lifeline anchorages shall be certified (or re-certified) by a registered professional engineer with experience in designing horizontal lifeline systems.

3.10 HORIZONTAL LIFELINES

A. Horizontal lifelines shall be designed, installed, certified and used under the supervision of a qualified person for fall protection as part of a complete fall arrest system which maintains a safety factor of 2 (29 CFR 1926.500).

3.11 RESCUE AND EVACUATION PROCEDURES

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

3.12 EQUIPMENT

A. MATERIAL HANDLING EQUIPMENT
   1. Material handling equipment such as forklifts shall not be modified with work platform attachments for supporting employees unless specifically delineated in the manufacturer's printed operating instructions.
   2. The use of hooks on equipment for lifting of material must be in accordance with manufacturer's printed instructions.
   3. Operators of forklifts or power industrial trucks shall be licensed in accordance with OSHA.

B. WEIGHT HANDLING EQUIPMENT
   1. Cranes and derricks shall be equipped as specified in EM 385-1-1, section 16.
   2. The Subcontractor shall comply with the crane manufacturer's specifications and limitations for erection and operation of cranes and hoists used in support of the work. Erection shall be performed under the supervision of a designated person (as defined in ASME B30.5). All testing shall be performed in accordance with the manufacturer's recommended procedures.
   3. The Subcontractor shall comply with ASME B30.5 for mobile and locomotive cranes, ASME B30.22 for articulating boom cranes, ASME B30.3 for construction tower cranes, and ASME B30.8 for floating cranes and floating derricks.
   4. Under no circumstance shall a Contractor make a lift at or above 90% of the cranes rated capacity in any configuration.
   5. When operating in the vicinity of overhead transmission lines, operators and riggers shall be alert to this special hazard and shall follow the requirements of USACE EM 385-1-1 section 11 and ASME B30.5 or ASME B30.22 as applicable.
   6. Crane suspended personnel work platforms (baskets) shall not be used. Personnel shall not be lifted with a line hoist or friction crane.
   7. Portable fire extinguishers shall be inspected, maintained, and recharged as specified in NFPA 10, Standard for Portable Fire Extinguishers.
   8. All employees shall be kept clear of loads about to be lifted and of suspended loads.
   9. The Subcontractor shall use cribbing when performing lifts on outriggers.
   10. The crane hook/block must be positioned directly over the load. Side loading of the crane is prohibited.
   11. A physical barricade must be positioned to prevent personnel from entering the counterweight swing (tail swing) area of the crane.
   12. Certification records which include the date of inspection, signature of the person performing the inspection, and the serial number or other identifier of the crane that was inspected shall always be available for review by Contracting Officer personnel.
   13. Written reports listing the load test procedures used along with any repairs or alterations performed on the crane shall be available for review by Contracting Officer personnel.
   14. Certify that all crane operators have been trained in proper use of all safety devices (e.g. anti-two block devices).
   15. Cranes/derricks: The contractor shall follow and document to Contracting Officer that the FAA crane registration procedures at EACH location - before set up.

3.13 EXCAVATIONS

A. The competent person shall perform soil classification in accordance with 29 CFR 1926.

3.14 UTILITY LOCATIONS

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

3.15 UTILITY LOCATION VERIFICATION

A. The Subcontractor must physically verify underground utility locations by hand digging using wood or fiberglass handled tools when any adjacent construction work is expected to come within three feet of the underground system. Digging within 0.061 m (2 feet) of a known utility must not be performed by means of mechanical equipment; hand digging shall be used. If construction is parallel to an existing utility the utility shall be exposed by hand digging every 30.5 m (100 feet) if parallel within 1.5 m (5 feet) of the excavation.

3.16 SHORING SYSTEMS

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

3.17 TRENCHING MACHINERY

A. Trenching machines with digging chain drives shall be operated only when the spotters/laborers are in plain view of the operator. Operator and spotters/laborers shall be provided training on the hazards of the digging chain drives with emphasis on the distance that needs to be maintained when the digging chain is operating. Documentation of the training shall be kept on file at the project site.

3.18 UTILITIES WITHIN CONCRETE SLABS

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

3.19 PORTABLE EXTENSION CORDS

A. Portable extension cords shall be sized in accordance with manufacturer ratings for the tool to be powered and protected from damage. All damaged extension cords shall be immediately removed from service. Portable extension cords shall meet the requirements of NFPA 70.

3.20 WORK IN CONFINED SPACES

A. The Subcontractor shall comply with the requirements in Section 06.I of USACE EM 385-1-1, OSHA 29 CFR 1910.146 and OSHA 29 CFR 1926.21(b)(6). Any potential for a hazard in the confined space requires a permit system to be used.
   1. Comply with Prime Contractors Health and Safety Plan.

2. Entry Procedures. Prohibit entry into a confined space by personnel for any purpose, including hot work, until the qualified person has conducted appropriate tests to ensure the confined or enclosed space is safe for the work intended and that all potential hazards are controlled or eliminated and documented. (See Section 06.I.06 of USACE EM 385-1-1 for entry procedures.) All hazards pertaining to the space shall be reviewed with each employee during review of the AHA.
3. Forced air ventilation is required for all confined space entry operations and the minimum air exchange requirements must be maintained to ensure exposure to any hazardous atmosphere is kept below its' action level.

B. The Subcontractor shall prepare written procedures for confined space entry specifying the following:
1. At least one attendant must be present during work in confined spaces.
2. Specific rescue procedures to be followed in each type of confined space (i.e., wet well, dry well, lift station, manhole, etc.)
3. Alarms for continuous monitoring must be audible to able to be heard over the noise of power equipment, sump pump motors, vehicles, etc.
4. A calibration and maintenance schedule for all monitoring equipment (following the manufacturers' recommendations).
5. Gases/atmospheres to be tested (including as a minimum, H2S, CO, combustible gas, and oxygen deficiency).

3.21 CONFINED SPACE

A. The Subcontractor shall specify prior to commencing work:
1. Locations where confined space entry may occur (e.g., all manholes, wet wells, dry wells, vaults, pipelines and other underground construction sites).
2. Detailed plans and provisions for:
a. Rescue procedures for entering into any spaces in the event of an emergency, including, who may enter confined spaces for any rescues (the site safety and health officer or a competent person):
1) Training of employees.
2) Locations of emergency equipment to be used.

END OF SECTION 01 35 29

UNITED STATES MILITARY ACADEMY
DIRECTORATE OF PUBLIC WORKS
WEST POINT, NY 10996-1592

SOP 11-17
ANNEX A

1 May 2019

CONFINED SPACE ENTRY

1. **PURPOSE:** To define a confined space, participant responsibilities, and outline the equipment and procedures required prior to entry and while working in a confined space which will ensure the safety of Directorate of Public Works (DPW) employees.

2. **DEFINITIONS:**
   A. **CONFINED SPACE:** A large enough opening that an employee can bodily enter, has limited or restricted openings for entry, and is not designed for continuous occupancy.

   B. **PERMIT REQUIRED CONFINED SPACE** (Appendix 1: Permit for Confined Space)**:** A permit required confined space has all the elements of a confined space plus ANY of the following conditions:
      - Contains or has the potential to contain a hazardous atmosphere.
      - Contains a material with the potential to engulf an entrant.
      - Has an internal configuration that could trap or asphyxiate an entrant.
      - Contains any other serious safety or health hazard.

      Permit required confined spaces may include, but are not limited to: storage tanks (above- and belowground), pits, vats, boilers, sewers, manholes, ventilation ducts, steam tunnels, pipelines, excavations, and utility vaults.

   C. **ATTENDANT:** An individual who remains outside the confined space to supervise operations and monitor the authorized entrants. The attendant performs all attendants' duties assigned by the entry permit and has the authority to permit only individuals who have successfully completed confined space entry training and are authorized as entrants.

   D. **ENTRANT:** An individual who works inside a confined space. Only individuals who have successfully completed confined space entry training are authorized to enter a confined space.

   E. **CONFINED SPACE ENTRY SUPERVISOR:** An individual who has been trained in all aspects of confined space entry, has the ability to analyze potential hazards, and possesses the authority to stop work if the safety of confined space entrants is in question.

   F. **ATMOSPHERE TESTER CALIBRATION PERSON** (Appendix 2: Authorized Atmosphere Testers)**:** An individual who has received training in the operations, maintenance, and calibration of atmosphere testers from the DPW Safety Officer or a representative of the atmosphere tester manufacturer.

3. RESPONSIBILITIES:

A. BRANCH CHIEF:

1) Arrange/ present/ document initial and annual confined space entry training which is specific to the designated confined space duties. Employees will not participate in confined space entry until training is completed. Documentation of training will be maintained on file for three (3) years.
2) Designate, by name, in writing, which employees are trained and authorized to perform the following confined space duties:
   a. Attendant
   b. Entrant
   c. Confined Space Entry Supervisor
   d. Atmosphere Tester Calibration Person
3) Provide all equipment required for confined space entry, including:
   a. Atmosphere tester
   b. Lifting harness/ life line
   c. Tripod/ winch
   d. Barricades
   e. Ventilator
   f. Radios
   g. Personal protective equipment (PPE)
4) Identify and label all permit required confined spaces and the danger posed by the permit spaces. (Appendix 3, TAB 1, Bldg 604, Power Plant; TAB 2, Bldg 848, Sewage Treatment Plant; TAB 3, Bldg 726, Lusk Water Treatment Plant; TAB 4, Manhole Index Information). Post danger signs on the Confined Space. Exception to Policy: Signage will not be posted to Manholes at this time, pending further investigation.

   NOTE: A sign reading DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER or using other similar language would satisfy the requirement for a sign.

   Exception to Policy: Signage will not be posted to Manholes at this time, pending further investigation.

5) Maintain a log book to document equipment inspections/ service (Appendix 4: Equipment Inspection Log Book). App add:
   a. Atmosphere tester calibration and service
   b. Tripod and winch inspections
   c. Safety harness inspections
6) Retain all completed confined space entry permits for three (3) years (Appendix 4: Equipment Inspection Log Book).
7) Monitor "in the field" entry procedures.
8) Coordinate confined space entry with contractor personnel or other activities, when necessary (Appendix 4: Equipment Inspection Log Book).

B. **CONFINED SPACE ENTRY SUPERVISOR:**
1) Ensure that all entry equipment listed in para. 3.A.3 above is operational and available at the work site.
2) Notify the section supervisor of any defective equipment.
3) Issue the entry permit to the confined space entrant (Appendix 1).
4) Ensure that all elements of the confined space entry procedure are followed by all participants.

C. **ATTENDANT:**
1) Inspect all PPE and emergency equipment for proper operation before each use.
2) Supervise the setup of the work site. Erect rescue equipment.
3) Test the confined space atmosphere prior to entry and document results on the entry permit. Complete all other sections of the entry permit.
4) Oversee the entrants, conditions, and equipment in and outside the confined space. Stop work and order entrants to leave the confined space when conditions may endanger their safety.
5) Monitor the entrants and call the work control desk 845-938-2316 (0745-1630, Mon.-Fri.) or the Central Power Plant (after duty hours, weekends, holidays) to call the Fire Department for emergency assistance if a worker collapses in a confined space. Fire Department (x3001 or x3333) 845-938-3001/3333.

D. **ATMOSPHERE TESTER CALIBRATION PERSON:**
1) Perform atmosphere tester calibration at least monthly and document in the tester log book.
2) Notify the section supervisor and the DPW Safety Officer 845-938-0134 whenever a tester does not operate properly.

4. **REQUIRED EQUIPMENT:**
A. Two (2) trained workers (minimum)
B. Confined Space Entry Permit
C. Atmosphere Tester (for oxygen/ hydrogen sulfide or carbon monoxide/ combustible gases), which has been calibrated
D. Two-way radios (2 minimum)
E. Manhole ventilator
F. Lifting tripod/ winch/ harness/ life line
G. Barricades

5. **ENTRY PROCEDURE:**
A. NOTIFY the Fire Department (x3001) and DPW Safety Officer (x0134) of when and where you are working in a confined space before entering.
B. ASSEMBLE all the required equipment before entering the space.
C. BARRICADE the side to prevent entry by unauthorized persons.
D. ERECT rescue equipment.
E. DO NOT smoke in or around a confined space until the atmosphere has tested clear of combustible gases.
F. BEGIN filling out the Confined Space Entry Permit while working through the entry procedure.

G. **REMOVE/ OPEN** the cover carefully to avoid creating sparks.
H. **INSPECT** the atmosphere tester for proper operation.
I. **TEST** the atmosphere from top to bottom to determine if there is sufficient oxygen and confirm the absence of combustible and toxic gases.

ATMOSPHERE TESTER READINGS FOR ENTRY MUST BE:

Carbon monoxide (CO).....0 ppm
Combustibles (LEL*).....<10% LEL*
Hydrogen sulfide (H_2S).....0 ppm
Oxygen.....19.5 – 23.5 %

*LEL is Lower Explosive Limit

J. **STOP** all work and notify the Fire Department (x3001 or x3333) if combustible gases are present.
K. **VENTILATE** continually by blowing fresh air INTO the space to maintain a 21% oxygen atmosphere.
L. **ASSIGN** one (1) attendant, with two-way radio, to remain outside the space, monitor the wellbeing of workers inside the space, and to call for emergency assistance if needed.
M. **DON** a lifting harness/ life line before entering the space.
N. **ENTER** the space with a two-way radio, operating atmosphere tester, wearing a lifting harness/ life line only after ALL previous steps have been completed.
O. **LOCK OUT/ TAG OUT** all hazardous energy inside the confined space. (DPW SOP 11-17, ANNEX F, Appendix 1 & 2).
P. **MONITOR** the atmosphere and stay in radio contact with outside workers constantly while occupying the space.
Q. **LEAVE** the space immediately if the atmosphere tester alarm sounds.
R. **PHONE** the Fire Department if a worker needs emergency assistance while in a confined space.
S. **NEVER ENTER THE CONFINED SPACE TO RESCUE A DOWNED WORKER. WAIT FOR EMERGENCY ASSISTANCE!!!**
T. **COMPLETE** the Confined Space Entry Permit and maintain it on file for three (3) years after the date of entry.

6. **ADDITIONAL INFORMATION:**
   A. **Carbon monoxide (CO)** is a toxic, odorless, colorless gas which is a byproduct of the operation of fossil fueled equipment and is approximately the same weight as air.
   B. **Hydrogen sulfide (H_2S)** is a toxic, odorless, colorless gas which is a byproduct of the operation of fossil fueled equipment and is approximately the same weight as air.
   C. **Methane (CH_4)** is a combustible, colorless gas which is a byproduct of organic decomposition, is lighter than air, and is commonly found in sewers.
   D. If the atmosphere is **oxygen deficient**, the atmosphere tester cannot measure combustible gases accurately.
   E. **Atmosphere testers** can be damaged or operate improperly when wet or exposed to high humidity atmospheres.

F. **Always place the ventilator intake in fresh air**, away from fossil fuel powered equipment and traffic. When using gasoline powered ventilators, be sure not to draw exhaust fumes into the fresh air intake.

G. **Atmosphere testers** require regular maintenance whether they are used or not; calibration must be performed and documented (Appendix 4: Equipment Inspection Log Book) at least monthly. During the "Bump Test", the sensors are tested and shall be replaced when notified. The calibration gas used in our calibration testers have a shelf life/expiration date and shall be replaced when date has expired.

H. **Ask your supervisor** or the DPW Safety Officer (x0134) if you have any questions about Confined Space Entry.

7. **REFERENCES:**

A. Occupational Safety and Health Administration, 29 CFR 1910.146, "Permit Required Confined Spaces".

B. US Army Corps of Engineers, EM 385-1-1, Section 6, "Safety and Health Requirements Manual".

C. SOP 11-17, ANNEX F, LOCK OUT/TAG OUT, dated 12 Apr 10,.APPENDIX 1 (LOCK OUT/ TAG OUT).

D. SOP 11-17, ANNEX F, dated 12 Apr 10, LOCK OUT/TAG OUT, dated 12 Apr 10, APPENDIX 2 (LOCK OUT/ TAG OUT LOG).

8. **ENCLOSURES**

A. APPENDIX 1 (CONFINED SPACE PERMIT) to SOP 11-17, ANNEX A, dated 12 Apr 10.

B. APPENDIX 2 (ATMOSPHERE TESTERS) to SOP 11-17, ANNEX A, dated 12 Apr 10.

C. APPENDIX 3 ("PERMIT REQUIRED" CONFINED SPACE LOCATIONS) to SOP 11-17, ANNEX A, dated 12 Apr 10.

1) TAB 1 (BLDG 604, POWER PLANT) to SOP 11-17, ANNEX A, APPENDIX 3, dated 12 Apr 10.
2) TAB 2 (BLDG 848, SEWAGE TREATMENT PLANT) to SOP 11-17, ANNEX A, APPENDIX 3, dated 12 Apr 10.
3) TAB 3 (BLDG 726, LUSK WATER TREATMENT PLANT) to SOP 11-17, ANNEX A, APPENDIX 3, dated 12 Apr 10.
4) TAB 4 (MANHOLE INDEX INFORMATION)

D. APPENDIX 4 (EQUIPMENT INSPECTION LOG BOOK) to SOP 11-17, ANNEX A, dated 12 Apr 10.

This Annex, dated 1 May 2019, supersedes all previous editions.

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9/26/2019

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APPENDIX 1 to SOP 11-17, ANNEX A

CONFINED SPACE PERMIT

LOCATION OF SPACE _____

DESCRIPTION OF SPACE _____

ENTRY SUPERVISOR _____

PURPOSE OF ENTRY _____

ENTRY AUTHORIZED FROM _____ TO _____ DATE _____

AUTHORIZED ENTRANTS: _____ _____

_____ _____

_____ _____

AUTHORIZED ATTENDANTS: _____

_____

PRE-ENTRY CHECKLIST

Was the Fire Department notified of the entry time and location? [ ] YES [ ] NO

Are all personnel trained in confined space entry procedures? [ ] YES [ ] NO

Equipment on site:
[ ] Atmosphere tester
[ ] Ventilator
[ ] PPE
[ ] 2-way radio
[ ] Tripod/ winch/ harness/ lifeline
[ ] Traffic barricades

Is the area secured from unauthorized personnel? [ ] YES [ ] NO

Is the atmosphere tester operational? [ ] YES [ ] NO

Time	_____	_____	_____	_____
% LEL (flammable)	_____	_____	_____	_____
Hydrogen sulfide (H_2S)	_____	_____	_____	_____
Carbon Monoxide (CO)	_____	_____	_____	_____
Chlorine ($C_{1,2}$)	_____	_____	_____	_____

APPENDIX 1 to SOP 11-17, ANNEX A

CONFINED SPACE PERMIT

Location of Work: _____

Description of Work (Purpose): _____

Authorized Attendants: _____

_____

_____

Authorized Entrants: _____

_____

Entry Date: _____ Entry Time: _____

Outside Contractors: _____

Isolation Checklist (Safe Clearance):

- Blanking and/or Disconnecting _____
- Electrical _____
- Mechanical _____
- Other _____

Hazardous Work:

- Burning _____
- Welding _____
- Brazing _____
- Open Flame _____
- Other _____

Hazards Expected:

- Corrosive Materials _____
- Hot Equipment _____
- Flammable Materials _____
- Toxic Materials _____
- Drains Open _____
- Cleaning (Ex: chemical or water lance) _____
- Spark Producing Operations _____
- Spilled Liquids _____
- Pressure Systems _____
- Other _____

Vessel Cleaned:

- Deposits _____
- Method _____
- Inspection _____

Neutralized With _____

Fire Safety Precautions: _____

_____

Personal Safety:

Ventilation Requirements _____
Respirators _____
Life Lines and Harness _____
Lighting _____
Communications _____
Buddy System _____
Name of Attendant _____

Atmospheric Gas Tests:

	Tests Performed	Location	Reading
Example:	(Oxygen)		(19.5%) Example:
	(Flammability)		(< 10% LFL)
	Hydrogen Sulfide		0 ppm
	Carbon Monoxide		0 ppm

Time	_____	_____	_____	_____
% LEL (flammable)	_____	_____	_____	_____
Hydrogen sulfide (H_2S)	_____	_____	_____	_____
Carbon Monoxide (CO)	_____	_____	_____	_____
Chlorine ($C_{1,2}$)	_____	_____	_____	_____

Remarks: _____

_____

Test Performed By: _____
Signature

Time: _____

Authorizations:

Entry Supervisor: _____
Safety Supervisor/Qualified Person: _____

Emergency Phone Numbers:

Fire Department _____

Ambulance_____
Hospital_____
Doctor _____

Permit Expires: _____

APPENDIX 2 to SOP 11-17, ANNEX A

AUTHORIZED ATMOSPHERE TESTERS

Branch/Shop	Name	Date Trained
1.		

APPENDIX 3 to SOP 11-17, ANNEX A, TAB 1

BLDG 604 CONFINED SPACE PLAN

BOILERS #1 & 2

Label No.	General Location	Specific Location
#1	Fire Box Access	Front
#2	Wind Box Access	Bottom
#3	Wind Box Access	Bottom
#4	Wind Box Access	Side
#5	Mud Drum Access	Front
#6	Mud Drum Access	Back
#7	Steam Drum Access	Front Fan Deck
#8	Steam Drum Access	Back Fan Deck
#9	Economizer Access	Side Lower
#10	Economizer Access	Side Upper
#11	FD Fan Access	Turbine Side Fan Deck
#12	FD Fan Access	Motor Side Fan Deck

BOILER #3

Label No.	General Location	Specific Location
#1	Fire Box Access	Front
#2	Wind Box Access	Side Lower
#3	Mud Drum Access	Front Lower
#4	Mud Drum Access	Back Lower
#5	Steam Drum Access	Front Upper
#6	Steam Drum Access	Back Upper
#7	Economizer Access	Front Lower
#8	Economizer Access	Back Lower
#9	Economizer Access	Side Lower
#10	Economizer Access	Side Upper
#11	FD Fan Access	Front Side Fan Deck

APPENDIX 3 to SOP 11-17, ANNEX A, TAB 2

BLDG 848 CONFINED SPACE PLAN

Label No.	General Location	Specific Location
#1	Primary Sludge Pit	Near Exit Door
#2	Primary Wet Well	Bldg 849B G Floor
#3	Primary Tanks 1, 2 & 3	Bldg 849B G Floor
#4	Primary Tanks (Clarifiers) 1, 2 & 3	Adjacent to Bldg 849
#5	Primary Sludge (Grease) Pit	Adjacent to Bldg 849
#6	Chlorine Contact Chamber	Adjacent to Bldg 849C
#7	Final Tanks 1, 2 & 3	Adjacent to Bldg 849C
#8	Final Tank Scum Pit	Adjacent Clarifiers
#9	Return Activated Sludge Pit	In Back of Bldg 849C
#10	Aeration Tanks North & South	Front of Bldg 849C
#11	Digesters New Primary, New Secondary, Old Primary & Old Secondary	Primary Stair Access
#12	Digester Overflow Pit	Access to Digester

APPENDIX 3 to SOP 11-17, ANNEX A, TAB 3

BLDG 726 CONFINED SPACE PLAN

Label No.	General Location	Specific Location
#1	Inside Settling Basin Lid	Near Exit Door
#2	Pre-Settling Basin Pit	After Clarifier
#3	Raw Water Intake Pit	By Upflow Clarifier
#4	Valve Pit	Outside Settling Tank
#5	Outside Settling Basin	(blank)
#6	Settling Basin Access Pit	Break Room
#7	Filters 1-4 Actuator	Valve Pit
#8	Chemical Dosing Tank	(blank)

APPENDIX 3 to SOP 11-17, ANNEX A, TAB 4

	MHOLE NO.	PH NO.	ZONE AREA	MANHOLE INDEX INFORMATION
1	AA	13	J	Steam supply to Bldg. 600, 603, 601, 605, 607, 609
2	A1	13	J	Steam supply South end of Bldg. 603
3	A2	13	J	Steam supply East end of Bldg. 609
4	B	13	J	Steam supply to Bldg. 752 South & West to Bldg. 600
5	B1	13	J	Steam supply to 752 South
6	B2	7	F	Steam supply to 752 South (under tunnel)
7	C & CA	13	J	Steam supply to Bldg 600 East end
8	D	13	J	Steam supply to 753 & 757 East (Electric Vault)
9	E & EA	13	J	Steam supply 753 South end & Lab
10	F & FA	13	J	Steam supply 602 & on Brewerton Rd to Central Apts
11	F-1	13	J	Steam Supply & Return in chase front of 602
12	F-2	13	J	Steam supply North end 740 to Central Apts
13	F-3	7	F	Steam supply South end 740 bottom of ramp
14	F-4	7	F	Steam supply South end middle ramp 606 & 738 & 740
15	F-5	7	F	Steam supply & return in chase of 606 Front North end
16	F-6	7	F	Steam supply Central Apts.
17	G & GA & GB	13	J	Steam supply to 602 & 720
18	H	13	J	Steam supply to Bldg. 751
19	H1	13	J	Steam Expansion Joints In Tunnel
20	B-6	1	A	Steam supply Buffalo Fld parking lot across Thayer Hotel(674)
21	B-7	1	a	Steam Supply to Hotel Thayer(674) located outside Main MR
22	B-5	1	A	Steam supply Buffalo Fld North East corner
23	B-5A	1	A	Steam supply to 634
24	B-5B	2	B	Steam supply to 646 & 648
25	B-5C	2	B	Steam supply to 626
26	B-5D	2	B	Steam supply to 624
27	B-5E	2	B	Steam supply to 622
28	B-5F	2	B	Steam supply main line drip from 616 & 620
25	B-5G	2	B	Steam supply to 616 & 620
26	B-3	6	C	Steam supply to Qtrs 25-34 (1st mhole across Thayer Rd Wall)
27	B-4A	6	C	Steam supply to Buffalo Fld & 632
28	B-4B	6	C	Steam supply to Qtrs 42-48
29	B-4C	6	C	Steam supply Expansion Joint, double barreled
30	B-4D	6	C	Steam supply to 40-41
31	B-4E	6	C	Steam supply Expanion Joint, double barreled
32	B-4F	6	C	Steam supply Expansion Joint, single barreled
33	B-4G	6	C	Steam supply to Bldg. 632 & Mills Road, (edge wood line)
34	I	13	J	Steam supply to 756 A&B
35	I1 & IA	13	J	Steam supply to 747 & 745C
36	K	13	J	Steam supply to 745A Mech Room
37	L	13	J	Main steam line shutoff valves (Vic Linen room closet)
38	L1	13	J	Steam supply lines in Tunnel
39	L2	13	J	Steam supply in Tunnel (Vic outside B Mech Room)
40	M	13	J	Steam supply (Vic 745B, Top of Stairs to Bakery)
41	M1	13	J	Steam Supply in Tunnel
42	N & NA	13	J	Steam supply to 745D
43	N1	13	J	Steam supply old 23rd division steam room (In front of 745D)
44	O & OA	8	K	Steam supply to 745E
45	P	8	K	Steam supply to 735
46	Q & QA	8	K	Steam supply to South end of Bldg. 727 South Mech Rm
47	R & RA	8	K	Steam supply to Central Gym, Qtrs 100 & 101
48	SA	8	K	Steam supply to North end of 727 East Side
49	S	8	K	Steam supply to 104 Manhole & Bldg. 750 (Jewish Chapel)
50	T & TA	8	K	Steam supply to 104 Manhole to Professor's Row
51	U	9	P	Steam supply Washington Rd. to Ruger Rd. (Other side of wall)
52	V Left 7	9	P	Steam supply Ruger Rd 160 lbs. For The Following Areas
53	V-1	9	P	Steam supply to Bldg. 635
54	V1-A	9	P	Steam supply to Qtrs. 146, Bldgs. 147 & 639
55	V-2	9	P	Steam supply to Bldg. 671 & 671A Vic Bldg. 635 Compound
56	VA	9	P	Steam supply to 655 Stage Area
57	VC	9	P	Steam supply vic 655 tunnel blow-down main steam line
58	W	11	P	Steam supply to Bldg. 667-A
59	W1 & W1A	11	Q	Steam supply to Bldg. 144
				Steam supply parking lot between Bldg. 667A & 681

60	X	11	Q	Steam supply parking lot between Bldg. 667A & 681
61	X1	11	Q	Steam supply to Bldg. 681
62	X2	11	Q	Steam supply & return Expansion Joints NE Corner Bldg. 681
63	X3	11	Q	Steam supply to Bldgs. 685 & 687
				BUILDING STATIONS
64	STATION #1	3	F	1st Station======Vic Thayer Rd Wall South of Bldg. 752
65	STATION #2	4	E	2nd Station======Vic Thayer Rd Wall Across from Qtrs 8
66	STATION #3	4	E	3rd Station======Vic Thayer Rd Wall Across from Qtrs. 10
67	STATION #4	5	C	4th Station======Vic Thayer Rd Wall Across Qtrs. 25C

APPENDIX 4 to SOP 11-17, ANNEX A

EQUIPMENT INSPECTION LOG BOOK

	EQUIPMENT NAME MANUFACTURER / MODEL NUMBER	DATE INSPECTED INSPECTED BY	SERVICABLE	UNSERVICABLE
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

SECTION 01 35 50

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.01 REFERENCES

A. 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. U.S. ARMY CORPS OF ENGINEERS (USACE)
      a. EM-385-1-1
         1) (2003) Safety – Safety and Health Requirements
   2. U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)
      a. 33 CFR 328
         1) Definitions of Waters of the United States
      b. 40 CFR 260
         1) Hazardous Waste Management System: General
      c. 40 CFR 302
         1) Designation, Reportable Quantities, and Notification
      d. 40 CFR 355
         1) Emergency Planning and Notification
      e. 40 CFR 68
         1) Chemical Accident Prevention Provisions
      f. 49 CFR 171-178
         1) Hazardous Materials Regulations

1.02 ENVIRONMENTAL POLLUTION AND DAMAGE

A. Environmental pollution and damage is the presence of chemical, physical or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the environment aesthetically, culturally and/or historically.

1.03 ENVIRONMENTAL PROTECTION

A. Environmental protection is the prevention/control of pollution and habitat disruption that may occur to the environment during construction. The control of environmental pollution and damage requires consideration of land, water, and air; biological historical, archaeological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.04 SURFACE DISCHARGE

A. The term "Surface Discharge" implies that the water is discharged with possible sheeting action and subsequent soil erosion may occur. Waters that are surface discharged may terminate in drainage ditches, storm sewers, creeks, and/or "waters of the United States" and would require a permit to discharge water from the governing agency.

1.05 WATERS OF THE UNITED STATES

A. All waters which are under the jurisdiction of the Clean Water Act, as defined in 33 CFR 328.

1.06 GENERAL REQUIREMENTS

A. The Contractor shall minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected during the entire duration of this contract. The Contractor shall comply with all applicable environmental Federal, State, and local laws and regulations. The Contractor shall be responsible for any delays resulting from failure to comply with environmental laws and regulations.

1.07 SUBCONTRACTORS

A. The Contractor shall ensure Compliance with this section by subcontractors.

1.08 PAYMENT

A. No separate payment will be made for work covered under this section. The Contractor shall be responsible for payment of fees associated with environmental permits, application, and/or notices obtained by the Contractor. All costs associated with this section shall be included in the contract price. The Contractor shall be responsible for payment of all fines/fees for violation or non-compliance with Federal, State, Regional and local laws and regulations.

1.09 SUBMITTALS

A. Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be· submitted in accordance with Section 01 33 00 CONSTRUCTION SUBMITTAL REQUIREMENTS:
   1. SD-01 Preconstruction Submittals
      a. Environmental Protection Plan; G
      b. Construction and Demolition Waste Management plan

1.10 ENVIRONMENTAL PROTECTION PLAN

A. Prior to commencing construction activities or delivery of materials to the site and no later than the time of the Project kick-off meeting, the Contractor shall submit an Environmental Protection Plan for review and approval by the Contracting Officer. The purpose of the Environmental Protection Plan is to present a comprehensive overview of known or potential environmental issues which the Contractor must address during construction. Issues of concern shall be defined within the Environmental Protection Plan as outlined in this section. The Contractor shall address each topic at a level of detail commensurate with the environmental issue and required construction task(s). Topics or issues which are not identified in this section, but which the Contractor considers necessary, shall be identified and discussed after those items formally identified in this section. Prior to submittal of the Environmental Protection Plan, the Contractor shall meet with the Contracting Officer for the purpose of discussing the implementation of the initial Environmental Protection Plan; possible subsequent additions and revisions to the plan including any reporting requirements; and methods for administration of the Contractor's Environmental Plans. The Environmental Protection Plan shall be current and maintained onsite by the Contractor.

1.11 COMPLIANCE

A. No requirement in this Section shall be construed as relieving the Contractor of any applicable Federal, State, and local environmental protection laws and regulations. During Construction, the Contractor shall be responsible for identifying, implementing, and submitting for approval any additional requirements to be included in the Environmental Protection Plan.

1.12 CONTENTS

A. The environmental protection plan shall include, but shall not be limited to, the following:
   1. Name(s) of person(s) within the Contractor's organization who is (are) responsible for ensuring adherence to the Environmental Protection Plan.
   2. Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from the site, if applicable.
   3. Name(s) and qualifications of person(s) responsible for training the Contractor's environmental protection personnel.
   4. An erosion and sediment control plan which identifies the type and location of the erosion and sediment controls to be provided. The plan shall include monitoring and reporting requirements to assure that the measures are in compliance with the erosion and sediment control plan, Federal, State, and local laws and regulations. A Storm Water Pollution Prevention Plan (SWPPP) may be substituted for this plan.

5. Description of the Contractor's environmental protection personnel training program.
6. Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on the site.
7. Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plan shall include measures to minimize the amount of mud transported onto paved public roads by vehicles or runoff.
8. Work area plan showing the proposed activity in each portion of the area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas including methods for protection of features to be preserved within authorized work areas.
9. Drawing showing the location of borrow areas.
10. The Spill Control plan shall include the procedures, instructions, and reports to be used in the event of an unforeseen spill of a substance regulated by 40 CFR 68, 40 CFR 302, 40 CFR 355, and/or regulated under State or Local laws and regulations. The Spill Control Plan supplements the requirements of EM 385-1-1
11. A non-hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris. The plan shall include schedules for disposal. The Contractor shall identify any subcontractors responsible for the transportation and disposal of solid waste. Licenses or permits shall be submitted for solid waste disposal sites that are not a commercial operating facility. Evidence of the disposal facility's acceptance of the solid waste shall be attached to this plan during the construction. The Contractor shall attach a copy of each of the Non-hazardous Solid Waste Diversion Reports to the disposal plan. The report shall be submitted on the first working day after the first quarter that non-hazardous solid waste has been disposed and/or diverted and shall be for the previous quarter (e.g. the first working day of January, April, July and October). The report shall indicate the total amount of waste generated and total amount of waste diverted in cubic yards or tons along with the percent that was diverted.
12. Recycling and solid waste minimization (NOT USED)
13. An air pollution control plan detailing provisions to assure that dust, debris, materials, trash, etc., do not become airborne and travel off the project site.
14. A contaminant prevention plan that: identifies potentially hazardous substances to be used on the job site; identifies the intended actions to prevent introduction of such materials into the air, water, or ground; and details provisions for compliance with Federal, State, and local laws and regulations for storage and handling of these materials. In accordance with EM 385-1-1, a copy of the Material Safety Data Sheets (MSDS) and the maximum quantity of each hazardous material to be on site at any given time shall be included in the contaminant prevention plan. As new hazardous materials are brought on site or removed from the site, the plan shall be updated.
15. A waste water management plan that identifies the methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines. If a settling/retention pond is required, the plan shall include the design of the pond including drawings, removal plan, and testing requirements for possible pollutants. If land application will be the method of disposal for the waste water, the plan shall include a sketch showing the location for land application along with a description of the pretreatment methods to be implemented. If surface discharge will be the method of disposal, a copy of the permit and associated documents shall be included as an attachment prior to discharging the waste water. If disposal is to a sanitary sewer, the plan shall include documentation that the Waste Water Treatment Plant Operator has approved the flow rate, volume, and type of discharge.

16. A historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on the project site: and/or identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in the area are discovered during construction. The plan shall include methods to assure the protection of known or discovered resources and shall identify lines of communication between Contractor personnel and the Contracting Officer.
17. Pesticide treatment plan (NOT USED)
18. Updating plans shall be required as conditions are uncovered and components are exposed that have not been included in the Contract Documents. These updated plans shall be submitted to the Contracting Officer for approval and then added to the job site plans.

1.13 APPENDIX

A. Copies of all environmental permits, permit application packages, approvals to construct, notifications, certifications, reports, and termination documents shall be attached, as an appendix, to the Environmental Protection Plan.

1.14 PROTECTION FEATURES

A. Prior to start of any onsite construction activities, the Contractor and the Contracting Officer shall make a joint condition survey. Immediately following the survey, the Contractor shall prepare a brief report including a plan describing the features requiring protection under the provisions of the Contract Clauses, which are not specifically identified on the drawings as environmental features requiring protection along with the condition of trees, shrubs and grassed areas immediately adjacent to the site of work and adjacent to the Contractor's assigned storage area and access route(s), as applicable. This survey report shall be signed by both the Contractor and the Contracting Officer upon mutual agreement as to its accuracy and completeness. The Contractor shall protect those environmental features included in the survey report and any indicated on the drawings, regardless of interference which their preservation may cause to the Contractor's work under the contract.

1.15 ENVIRONMENTAL ASSESSMENT OF CONTRACT DEVIATIONS

A. Any deviations, requested by the Contractor, from the drawings, plans and specifications which may have an environmental impact will be subject to approval by the Contracting Officer and may require an extended review, processing, and approval time. The Contracting Officer reserves the right to disapprove alternate methods, even if they are more cost effective, if the Contracting Officer determines that the proposed alternate method will have an adverse environmental impact.

1.16 NOTIFICATION

A. The Contracting Officer will notify the Contractor in writing of any observed noncompliance with Federal, State or local environmental laws or regulations, permits, and other elements of the Contractor's Environmental Protection plan. Within (3) working days after receipt of such notice, the Contractor shall inform the Contracting Officer of the proposed corrective action and take such action when approved by the Contracting Officer. The Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No time extensions shall be granted or equitable adjustments allowed to the Contractor for any such suspensions. This is in addition to any other actions the Contracting Officer may take under the contract, or in accordance with the Federal Acquisition Regulation or Federal Law.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION

3.01 ENVIRONMENTAL PERMITS AND COMMITMENTS

A. The Contractor shall be responsible for obtaining and complying with all environmental permits and commitments required by Federal, State, Regional, and local environmental laws and regulations.

3.02 LAND RESOURCES

A. The Contractor shall confine all activities to areas defined by the drawings and specifications. Prior to the beginning of any construction, the Contractor shall identify any land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without approval. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized. The Contractor shall provide effective protection for land and vegetation resources at all times as defined in the following subparagraphs. Stone, soil, or other materials displaced into uncleared areas shall be removed by the Contractor.

3.03 WORK AREA LIMITS

A. Prior to commencing construction activities, the Contractor shall mark the areas that need not be disturbed under this contract. Isolated areas within the general work area which are not to be disturbed shall be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, any markers shall be visible in the dark. The Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

3.04 LANDSCAPE

A. Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques. The Contractor shall restore landscape features damaged or destroyed during construction operations outside the limits of the approved work area.

3.05 EROSION AND SEDIMENT CONTROLS

A. The Contractor shall be responsible for providing erosion and sediment control measures in accordance with Federal, State, and local laws and regulations. The erosion and sediment controls selected and maintained by the Contractor shall be such that water quality standards are not violated as a result of the Contractor's construction activities. The area of bare soil exposed at anyone time by construction operations should be kept to a minimum. Prior to performing any construction activity, the Contractor shall construct or install temporary and permanent erosion and sediment control best management practices (BMPs) as indicated on the drawings, and as specified in Section 33 40 00 for storm water pollution prevention measures. BMPs may include, but not be limited to, vegetation cover, silt fences, hay bales, stabilized construction entrances, inlet protection and outfall protection. The Contractor's best management practices shall be in accordance with the National Pollutant Discharge Elimination System (NPDES) Storm Water pollution Prevention Plan (SWPPP), and the New York Guidelines for Urban Erosion and Sediment Control.

3.06 CONTRACTOR FACILITIES AND WORK AREAS

A. The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings or as directed by the Contracting Officer. Temporary movement or relocation of Contractor facilities shall be made only when approved. Erosion and sediment controls shall be provided for on-site borrow and spoil areas to prevent sediment from entering nearby waters. Temporary excavation and embankments for plant and/or work areas shall be controlled to protect adjacent areas.

3.07 WATER RESOURCES

A. The Contractor shall monitor construction activities to prevent pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation unless otherwise indicated. All water areas affected by construction activities shall be monitored by the Contractor. For construction activities immediately adjacent to impaired surface waters, the Contractor shall be capable of quantifying sediment or pollutant loading to that· surface water when required by State or Federally issued Clean Water Act permits.

3.08 AIR RESOURCES

A. (NOT USED)

3.09 HTRW AIR EMISSION CONTROL

A. (NOT USED)

3.10 AIR EMISSION CONTROL TO MEET ACTION LEVELS

A. (NOT USED)

3.11 CHEMICAL MATERIALS MANAGEMENT AND WASTE DISPOSAL

A. Disposal of wastes shall be as directed below, unless otherwise specified in other sections and/or shown on the drawings.

3.12 SOLID WASTES

A. Solid wastes (excluding clearing debris) shall be placed in containers which are emptied on a regular schedule. Handling, storage, and disposal shall be conducted to prevent contamination. Segregation measures shall be employed so that no hazardous or toxic waste will become co-mingled with solid waste. The Contractor shall transport solid waste off Government property and dispose of it in compliance with Federal, State, and local requirements for solid waste, disposal. A Subtitle D RCRA permitted landfill shall be the minimum acceptable off-site solid waste disposal option. The Contractor shall verify that the selected transporters and disposal facilities have the necessary permits and licenses to operate. The Contractor shall comply with Federal, State, and local laws and regulations pertaining to the use of landfill areas.

3.13 CHEMICALS AND CHEMICAL WASTES

A. Chemicals shall be dispensed ensuring no spillage to the ground or water. Chemical waste shall be collected in corrosion resistant, compatible containers and removed from the site; no temporary storage will be permitted. Wastes shall be classified, managed, and disposed of in accordance with Federal, State, and local laws and regulations.

3.14 CONTRACTOR GENERATED HAZARDOUS WASTES/EXCESS HAZARDOUS MATERIALS

A. Hazardous wastes are defined in 40 CFR 261 and are as further defined by applicable State and local regulations. Hazardous materials are defined in 49 CFR 171 -178. The Contractor shall, at a minimum, manage and store hazardous waste in compliance with 40 CFR 262.

3.15 FUEL AND LUBRICANTS

A. Storage, fueling and lubrication of equipment and motor vehicles shall be conducted in a manner that affords the maximum protection against spill and evaporation. Fuel, lubricants and oil shall be managed and stored in accordance with all Federal, State, Regional, and local laws and regulations. Used lubricants and used oil to be discarded shall be stored in marked corrosion-resistant containers and recycled or disposed in accordance with 40 CFR 279, State, and local laws and regulations. There shall be no storage of fuel on the project site. Fuel must be brought to the project site each day that work is performed.

3.16 WASTE WATER

A. Disposal of waste water shall be as specified below.
   1. Waste water from construction activities, such as onsite material processing, concrete curing, foundation and concrete clean-up, water used in concrete trucks, forms, etc. shall not be allowed to enter water ways or to be discharged prior to being treated to remove pollutants. The Contractor shall dispose of the construction related waste water off-Government property in accordance with all Federal, State, Regional and Local laws and regulations.
   2. Ground waters (NOT USED)
   3. Water generated from the flushing of lines shall be discharged into the sanitary sewer with the prior approval and notification to the Waste Water Treatment Plant's Operator.

3.17 RECYCLING AND WASTE MINIMIZATION

A. The Contractor shall participate in State and local government sponsored recycling programs. The Contractor is further encouraged to minimize solid waste generation throughout the duration of the project

3.18 NON-HAZARDOUS SOLID WASTE DIVERSION REPORT

A. The Contractor shall maintain an inventory of non-hazardous solid waste diversion and disposal of construction and demolition debris. The Contractor shall submit a report to the Contracting Officer on the first working day after each fiscal quarter, starting the first quarter that non-hazardous solid waste has been generated. The following shall be included in the report; use the same unit of measurement for all quantities:
   1. Construction and Demolition (C&D) Debris Disposed = [___] 1 in cubic yards or tons, as appropriate.
   2. Construction and Demolition (C&D) Debris Recycled = [___] 1 in cubic yards or tons, as appropriate.
   3. Total C&D Debris Generated = [___] in cubic yards or tons, as appropriate.

3.19 HISTORICAL ARCHAEOLOGICAL AND CULTURAL RESOURCES

A. The Contractor shall protect historical, and cultural resources within the Contractors work area and shall be responsible for their preservation during the life of the Contract. If during excavation or other construction activities any previously unidentified or unanticipated historical, archaeological, and cultural resources are discovered or found, all activities that may damage or alter such resources shall be temporarily suspended. Resources covered by this paragraph include but are not limited to: any human skeletal remains or burials; artifacts; shell, midden, bone, charcoal or other deposits; rock or coral alignments, paving, walls or other constructed features; and any indication of agricultural or other human activities. Upon such discovery or find, the Contractor shall immediately notify the Contracting Officer so that the appropriate authorities may be notified and a determination made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in impact to or the destruction of these resources. The Contractor sha11 secure the area and prevent employees or other persons from trespassing on, removing, or otherwise disturbing such resources.

3.20 BIOLOGICAL RESOURCES

A. (NOT USED)

3.21 INTEGRATED PEST MANAGMENT

A. (NOT USED)

3.22 PREVIOUSLY USED EQUIPMENT

A. The Contractor shall clean all previously used construction equipment prior to bringing it onto the project site. The Contractor shall ensure that the equipment is free from soil residuals, egg deposits from plant pests, noxious weeds, and plant seeds. The Contractor shall consult with the USDA jurisdictional office for additional cleaning requirements.

3.23 MAINTENANCE OF POLLUTION FACILITIES

A. The Contractor shall maintain permanent and temporary pollution control facilities and devices for the duration of the contract or for that length of time construction activities create the particular pollutant.

3.24 MILITARY MUNITIONS

A. In the event the Contractor discovers or uncovers military munitions as defined in 40 CFR 260, the Contractor shall immediately stop work in that area and immediately inform the Contracting Officer.

3.25 TRAINING OF CONTRACTOR PERSONNEL

A. The Contractor's personnel shall be trained in all phases of environmental protection and pollution control. The Contractor shall conduct environmental protection/pollution control meetings for all Contractor personnel prior to commencing construction activities. Additional meetings shall be conducted for new personnel and when site conditions change. The training and meeting agenda shall include: methods of detecting and avoiding pollution: familiarization with statutory and contractual pollution standards; installation and care of devices, vegetative covers, and instruments required for monitoring purposes to ensure adequate and continuous environmental protection/pollution control: anticipated hazardous or toxic chemicals or wastes; and other regulated contaminants; recognition and protection of archaeological sites, artifacts, wetlands, and endangered species and their habitat that are known to be in the area.

3.26 POST CONSTRUCTION CLEANUP

A. The Contractor shall clean up all areas used for construction in accordance with Contract Clause: "Cleaning Up". The Contractor shall, unless otherwise instructed in writing by the Contracting Officer, obliterate all signs of temporary, construction facilities such as haul roads, work area, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. The disturbed area shall be graded, filled and the entire area seeded unless otherwise indicated. The Contractor shall provide additional excavation and/or clearing needed to achieve the minimum 4-inch depth of topsoil required for seeding.

END OF SECTION 01 35 50

SECTION 01 41 50

SOURCES FOR REFERENCE PUBLICATIONS

PART 1 GENERAL

1.01 REFERENCES

A. Various publications are referenced in other sections of the specifications to establish requirements for the work. These references are identified in each section by document number, date and title. The document number used in the citation is the number assigned by the standards producing organization (e.g. AS1M B 564 Nickel Alloy Forgings). However, when the standards producing organization has not assigned a number to a document, an identifying number has been assigned for reference purposes.

1.02 ORDERING INFORMATION

A. The address of the standards publishing organizations whose documents are referenced in other sections of these specifications are listed below, and if the source of the publications is different from the address of the sponsoring organization, that information is also provided. Documents listed in the specifications with numbers which were not assigned by the standards producing organizations should be ordered from the source by title rather than by number.

1.03 ACI INTERNATIONAL (ACI)

A. P.O. Box 9094

B. Farmington Hills, MI 48333-9094

C. Ph: 248-848-3700

D. Fax: 248-848-3701

E. E-mail: bkstore@concrete.org

F. Internet: <http://www.aci-inl.org>

1.04 AIR-CONDITIONING AND REFRIGERATION INSTITUTE (AR!)

A. 4100 North Fairfax Drive, Suite 200

B. Arlington, VA 22203

C. Ph: 703-524-8800

D. Fax: 703-528-3816

E. E-mail: ari@ari.org

F. Internet: <http://www.ari.org>

1.05 AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)

A. 2800 Shirlington Road, Suite 300

B. Arlington, VA 22206

C. Ph: 703-575-4477

D. Fax: 703-575-4449

E. E-mail: info@acca.org

F. Internet: <http://www.acca.org>

1.06 AIR DIFFUSION COUNCIL (ADC)

A. 1000 East Woodfield Road, Suite 102

B. Shaumburg, IL 60173-5921

C. Ph: 847-706-6750

D. Fax: 847-706-6751

E. E-mail: info@flexib1educt.org <mailto:info@flexib1educt.org>

F. Internet: <http://www.flexibleduct.org>

1.07 ATR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL(AMCA)

A. 30 West University Drive

B. Arlington Heights, IL 60004-1893

C. Ph: 847-394-0150

D. Fax: 847-253-0088

E. E-mail: amca@amca.org

F. Internet: <http://www.amca.org>

1.08 AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

A. 1827 Walden Office Square

B. Suite 550

C. Schaumburg,IL 60173-4268

D. Ph: 847-303-5664

E. ax: 847-303-5774

F. E-mail: webmaster@aamanet.org

G. Internet: <http://www.aamanet.org>

1.09 AMERICAN IRON AND STEEL INSTITUTE (ATSI)

A. 1140 Connecticut Avenue, NW, Suite 705

B. Washington, DC 20036

C. Ph: 202-452-7100

D. Fax: 202-463-6573

E. Internet: <http://www.steel.org>

1.10 AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

A. 1819 L Street, NW, 6th Floor

B. Washington, DC 20036

C. Ph: 202-293-8020

D. Fax: 202-293-9287

E. E-mail: info@ansi.org

F. Internet: <http://www.ansi.org/>

G. Note: ANSI documents beginning with the letter "S" can be ordered from:

1.11 AMERICAN PUBLIC HEALTH ASSOCIATION (APRA)

A. 800 I Street, NW

B. Washington, DC 20001

C. Ph: 202-777-2742

D. Fax: 202-777-2534

E. E-mail: comments@apha.org

F. Internet: <http://www.apha.org>

1.12 AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

A. 1711 Arlingate Lane

B. P.O. Box 28518

C. Columbus, OH 43228-0518

D. Ph: 800-222-2768; 614-274-6003

E. Fax: 614-274-6899

F. E-mail: webmaster@asnt.org

G. Internet: <http://www.asnt.org>

1.13 AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

A. 1791 Tullie Circle, NE

B. Atlanta, GA 30329

C. Ph: 800-527-4723 Or 404-636-8400

D. Fax: 404-321-5478

E. E-mal: ashrae@ashrae.org

F. Internet: <http://www.ashrae.org>

1.14 AMERICAN WELDING SOCIETY (AWS)

A. 550 N.W. LeJeune Road

B. Miami, FL 33126

C. Ph: 800-443-9353 - 305-443-9353

D. Fax: 305-443-7559

E. E-mail: info@aws.org

F. Internet: <http://www.aws.org>

1.15 ASME INTERNATIONAL (ASME)

A. Three Park Avenue

B. New York, NY 10016-5990

C. Ph: 212-591-7722

D. Fax: 212-591-7674

E. E-mail: infocentral@asme.org

F. Internet: <http://www.asme.org>

1.16 ASSOCIATED AIR BALANCE COUNCIL (AABC)

A. 1518 K Street, NW

B. Washington, DC 20005

C. Ph: 202-737-0202

D. Fax: 202-638-4833

E. E-mail: aabchq@aol.com

F. Internet: <http://www.aabchg.com>

1.17 AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A. 100 Barr Harbor Drive, P.O. Box C700

B. West Conshohocken, PA 19428-2959

C. Ph: 610-832-9500

D. Fax: 610-832-9555

E. E-mail: service@astm.org

F. Internet: <http://www.astm.org>

1.18 BRICK INDUSTRY ASSOCIATION (BIA)

A. 11490 Commerce Park Drive

B. Reston, VA 22091-1525

C. Ph: 703-620-0010

D. Fax: 703-620-3928

E. E-mail: briekinfo@bia.org

F. Internet: http://www.bia.org

1.19 BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

A. 355 Lexington Avenue

B. 17th Floor

C. New York, NY 10017

D. Ph. 212-299-2122

E. Fax: 212-370-9047

F. E-mail: assoemgmt@aol.com

G. Internet: <http://www.buildershardware.com>

1.20 CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

A. 933 North Plum Grove Road

B. Schaumburg, IL 60173-4758

C. Ph: 847-517-1200

D. Fax: 847-517-1206

E. Internet: <http://www.crsi.org>

1.21 CONSUMER PRODUCT SAFETY COMMISSION (CPSC)

A. 4330 East-West Highway

B. Bethesda, MD 20814-4408

C. Ph: 301-504-6816

D. Fax: 301-504-0124 and 301-504-0025

E. E-mail: info@cpse.gov

F. Internet: <http://www.epse.gov>

1.22 COOLING TECHNOLOGY INSTITUTE (CTI)

A. 2611 FM 1960 West

B. Suite H-200

C. Houston, TX 77068-3730

D. Ph: 281-583-4087

E. Fax: 281-537-1721

F. Internet: <http://www.eti.org>

1.23 COPPER DEVELOPMENT ASSOCIATION (CDA)

A. 260 Madison Avenue

B. New York, NY 10016

C. Ph: 212-251-7200

D. Fax: 212-251-7234

E. E-mail: questions@eda.copper.org

F. Internet: <http://www.copper.org>

1.24 FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

A. 1301 Atwood Avenue

B. P.O. Box 7500

C. Johnston, RI 02919

D. Ph: 401-275-3000

E. Fax: 401-275-3029

F. E-mail: information@fmglobal.com

G. Internet: <http://www.fmglobal.com>

1.25 INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

A. 445 Hoes Lane

B. Piscataway, NJ 08855-1331

C. Ph: 732 981 llll6ll

D. Fax: 732-981-1712

E. E-mail: customer-services@ieee.org

F. Internet: .http://www.ieee.org

1.26 INSTITUTE OF ENVIRONMENTAL SCIENCES AND TECHNOLOGY (IEST)

A. 5005 Newport Drive, Suite 506
B. Rolling Meadows, IL 60008-3841
C. Ph: 847-255-1561
D. Fax: 847-255-1699
E. E-mail: iest@iest.org
F. Internet: <http://www.iest.org>

1.27 INTERNATIONAL CODE COUNCIL (ICC)

A. 5203 Leesburg Pike, Suite 600
B. Falls Church, VA 22041
C. Ph: 703-931-4533
D. Fax: 703-379-1546
E. E-mail: webmaster@iccsafe.org
F. Internet: <http://www.intlcode.org>

1.28 INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

A. 166 South River Road, Suite 132
B. Des Plaines, IL 60018
C. Ph: 847-827-0830
D. Fax: 847-827-0832
E. Internet: <http://www.icri.org>

1.29 INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

A. P.O. Box 687
B. 106 Stone Street
C. Morristown, CO 80465
D. Ph: 303-697-8441
E. Fax: 303-697-8431
F. E-mail: neta@netaworld.org
G. Internet: <http://www.netaworld.org>

1.30 ISA - THE INSTRUMENTATION, SYSTEMS AND AUTOMATION SOCIETY (ISA)

A. 67 Alexander Drive
B. PO. Box 12277
C. Research Triangle Park, NC 27709
D. Ph: 919-549-8411
E. Fax: 919-549-8288
F. E-mail: info@isa.org
G. Internet: <http://www.isa.org>

1.31 MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

A. 127 Park Street, NE

B. Vienna, VA 22186-4662

C. Ph: 703-281-6613

D. Fax: 703-281-6671

E. E-mail: info@mss-hq.com

F. Internet: <http://www.mss-hq.com>

1.32 MASTER PAINTERS INSTITUTE (MPI)

A. 4090 Graveley Street

B. Burnaby, BC CANADA V5C 3T6

C. Ph: 888-674-8937

D. Fax: 888-211-8708

E. E-mail: info@paintinfo.com <mailto:info@paintinfo.com>

F. Internet: <http://www.paintinfo.com/mpi>

1.33 NATIONAL CONCRETE MASONRY ASSOCIATION (NCMA)

A. 13750 Sunrise Valley Drive

B. Herndon, VA 20171-4662

C. Ph: 703-713-1900

D. Fax: 703-713-1910

E. E-mail: recepti@ncma.org

F. Internet: <http://www.ncma.org>

1.34 NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

A. 1300 North 17th Street, Suite 1847

B. Rosslyn, VA 22209

C. Ph: 703-841-3200

D. Fax: 703-841-3300

E. E-mail: webmaster@nema.org

F. Internet: <http://www.nema.org/>

1.35 NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

A. 1 Batterymarch Park

B. P.O. Box 9101

C. Quincy, MA 02269-9101

D. Ph: 617-770-3000

E. Fax: 617-770-0700

F. E-mail: webmaster@nfpa.org

G. Internet: <http://www.nfpa.org>

1.36 NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

A. 1420 King Street

B. Alexandria, VA 22314-2794

C. Ph: 888-476-4238

D. E-mail: tech@nicet.org

E. Internet: <http://www.nicet.org>

1.37 NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH)

A. Mail Stop C-13

B. 4676 Columbia Parkway

C. Cincinnati, OH 45226-1998

D. Ph: 800-356-4674

E. Fax: 513-533-8573

F. E-mail: pubstaff@cdc.gov

G. Internet: <http://www.cdc.gov/nioshlhomepage.htrnl>

1.38 NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

A. 100 Bureau Drive

B. Stop 3460, Gaithersburg, MD 20899-3460

C. Gaithersburg, MD 20899-3460
   1. Ph: 301-975-NIST
   2. Internet: <http://www.nist.gov>

D. Order Publications From:
   1. Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9325
      a. Ph: 866-512-1800 or 202-512-1800; Fax: 202-512-2250
      b. E-mail: gpoinfo@gpo.gov <mailto:gpoinfo@gpo.gov>
      c. Internet: <http://www.gpo.gov>
   2. National Tecnical Information Services
      a. 5285 Port Royal Road, Springfield, VA 22161
      b. E-mail: webmaster@ntis.gov
      c. Internet: <http://www.ntis.gov>

1.39 NATIONAL LIME ASSOCIATION (NLA)

A. 200 North Glebe Road, Suite 800

B. Arlington, VA 22203

C. Ph: 703-243-5463

D. Fax: 703-243-5489

E. E-mail: natlime@lime.org

F. Internet: <http://www.lime.org>

1.40 NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

A. 900 Spring Street

B. Silver Spring, MD 20910

C. Ph: 301-587-1400

D. Fax: 301-585-4219

E. Internet: <http://www.nrmca.org>

1.41 NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

A. 10255 West Higgins Road, Suite 600 .

B. Rosemont, IL 60018

C. Ph: 847-299-9070

D. Fax: 847-299-1183

E. Internet: <http://www.urca.net>

1.42 PIPE FABRICATION INSTITUTE (PH)

A. 655 32ndAvenue, Suite 201

B. Lachine, QC, Canada H8T 3G6

C. Ph: 514-634-3434

D. Fax: 514-634-9736

E. E-mail: pfi@pfi-institnte.org

F. Internet: <http://www.pfi-institute.org>

1.43 PLUMBING AND DRAINAGE INSTITUTE (PDI)

A. 45 Bristol Drive

B. South Easton, MA 02375

C. Ph: 508-230-3516 or 800-589-8956

D. Fax: 508-230-3529

E. E-Mail: info@pdionline.org <mailto:info@pdionline.org>

F. Internet: <http://www.pdionline.org>

1.44 PLUMBING AND MECHANICAL CONTRACTORS ASSOCIATION (PMCA)

A. 9450 SW Commerce Circle, Suite 310

B. Wilsonville, OR 97070

C. Ph: 503-682-7919

D. Fax: 503-682-6241

E. Internet: <http://www.pmcaoregon.com>/

1.45 PLUMBING-HEATING-COOLING CONTRACTORS NATIONAL ASSOCIATION (PHCC)

A. 180 South Washington Street

B. P.O. Box 6808

C. Falls Church, VA 22040

D. Ph: 800-533-7694 or 703-237-8100

E. Fax: 703-237-7442

F. E-mail: naphcc@naphcc.org

G. Internet: <http://www.phccweb.org>

1.46 SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

A. 4261 Lafayette Center Drive

B. Chantilly, VA 20151-1209

C. Ph: 703-803-2980

D. Fax: 703-803-3732

E. E-mail: info@smacna.org

F. Internet: <http://www.smacna.org>

1.47 STEEL DOOR INSTITUTE (SDI)

A. 30200 Detroit Road

B. Cleveland, OR 44145-1967

C. Ph: 440-899-0010

D. Fax: 440-892-1404

E. Internet: <http://www.steeldoor.org>

1.48 STEEL STRUCTURES PAINTING COUNCIL (SSPC)

A. 40 24th Street, 6th Floor

B. Pittsburgh, PA 15222-4656

C. Ph: 412-281-2331

D. Fax: 412-281-9992

E. Internet: <http://www.sspc.org>

1.49 UNDERWRITERS LABORATORIES (UL)

A. 333 Pfingsten Road

B. Northbrook, IL 60062-2096

C. Ph: 847-272-8800

D. Fax: 847-272-8129

E. E-mail: northbrook@us.ul.com

F. Internet: http://www.u1.com/

1.50 U.S. ARMY (DA)

A. U.S. Army Publications Directorate

B. Internet: <http://www.usapa.army.mil/>

C. AOK: 5/03

D. LOK: 5/03

1.51 U.S. ARMY CORPS OF ENGINEERS (USACE) Order CRD-C DOCUMENTS from

A. U.S. Army Engineer Waterways Experiment Station

B. ATTN: Technical Report Distribution Section, Services Branch, TIC

C. 3909 Halls Ferry Rd., Vicksburg, MS 39190-6199

D. Order Other Documents from:
   1. USACE Publications Depot
   2. Attu: CEIM-SP-D
   3. 2803 52nd Avenue, Hyattsville, MD 20781-1102
      a. Ph: 301-394-0081
      b. Fax: 301-394-0084
      c. E-mail: pubs-anny@usace.anny.mil <mailto:pubs-anny@usace.anny.mil>
      d. Internet: <http://www.usace.army.mil/publicatious>or <http://www.hnd.usace.anny.mil/techinfo/engpubs.htm>

1.52 USACE EM 385-1-1 (2003) Safety and Health Requirements can be found at the following web site

A. Internet: <URL>http://www.usace.army.mil/publications/eng-manuals/em385-1-1/toc.htm</URL>

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

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SECTION 01 45 00.00 10

QUALITY CONTROL
11/16, CHG 1: 02/20

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 D3740	(2019) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
ASTM E329	(2020) Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection

1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program. Include all associated costs in the applicable Bid Schedule item.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification 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

Contractor Quality Control (CQC) Plan; G, RO

SD-06 Test Reports

Verification Statement

SD-07 Certificates

QCR Report; G, RO

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Establish and maintain an effective quality control (QC) system that complies with FAR 52.246-12 Inspection of Construction. QC consist of plans, procedures, and organization necessary to produce an end product which complies with the Contract requirements. The QC system covers all construction operations, both onsite and offsite, and be keyed to the proposed construction sequence. The project superintendent and project manager will be held responsible for the quality of work and is subject to removal by the Contracting Officer for non-compliance with the quality requirements specified in the Contract. In this context the highest level manager responsible for the overall construction activities at the site, including quality and production is the project superintendent. The project superintendent maintains a physical presence at the site at all times and is responsible for all construction and related activities at the site, except as otherwise acceptable to the Contracting Officer.

3.2 CONTRACTOR QUALITY CONTROL (CQC) PLAN

Submit no later than 15 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements FAR 52.246-12 Inspection of Construction. The Government will not consider an interim plan for this project. Construction will be permitted to begin only after acceptance of the CQC Plan.

3.2.1 Content of the CQC Plan

Include, as a minimum, the following to cover all construction-operations, both onsite and offsite, including work by subContractors fabricators, suppliers and purchasing agents:

a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff will implement the three phase control system for all aspects of the work specified. Include a CQC System Manager that reports to the project superintendent.

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

c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the Contract. Letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities will be issued by the CQC System Manager. Furnish copies of these letters to the Contracting Officer.

d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subContractors, offsite fabricators, suppliers, and purchasing agents. These procedures must be in accordance with Section 01 33 00 SUBMITTAL PROCEDURES.

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

person responsible for each test. (Laboratory facilities approved by the Contracting Officer are required to be used.)

f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.

g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. Establish verification procedures that identified deficiencies have been corrected.

h. Reporting procedures, including proposed reporting formats.

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

3.2.2 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in the Contractor Quality Control(CQC) Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.3 Notification of Changes

After acceptance of the CQC Plan, notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING

After, if not completed during, the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, meet with the Contracting Officer and discuss the Contractor's quality control system. Submit the CQC Plan a minimum of 14 calendar days prior to the Coordination Meeting.

Routine coordination meetings will be scheduled by the Contracting Officer throughout the life of this Contract. Coordination meetings will be held to discuss Contract administration, Contractor quality control, phasing, scheduling, and other aspects relating to this construction. The Corps of Engineers and the Contractor will be represented at each of these meetings. Similar information concerning replacement personnel must be forwarded to the Contracting Officer, should any replacement be required at any time during the life of this Contract. Coordination meetings will be scheduled to occur on a weekly basis.

Furthermore, during the meeting, a mutual understanding of the system details must be developed, including the forms for recording the CQC operations,, control activities, testing, administration of the system for

both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting will be prepared by the Contractor, signed by both the Contractor and the Contracting Officer and will become a part of the Contract file. There can be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings or address deficiencies in the CQC system or procedures which can require corrective action by the Contractor.

The Contractor must provide typed minutes of each meeting within three days of meeting.

3.4 QUALITY CONTROL ORGANIZATION

3.4.1 Personnel Requirements

The requirements for the CQC organization are a Safety and Health Manager, CQC System Manager, and additional qualified personnel as specified in 01 30 00 ADMINISTRATIVE REQUIREMENTS to ensure safety and Contract compliance. The Safety and Health Manager reports directly to a senior project (or corporate) official independent from the CQC System Manager. The Safety and Health Manager will also serve as a member of the CQC Staff Personnel identified in the technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor's CQC staff maintains a presence at the site at all times during progress of the work and have complete authority and responsibility to take any action necessary to ensure Contract compliance. The CQC staff will be subject to acceptance by the Contracting Officer. Provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Promptly complete and furnish all letters, material submittals, shop drawing submittals, schedules and all other project documentation to the CQC organization. The CQC organization is responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2 CQC System Manager

Identify as CQC System Manager an individual within the onsite work organization that is responsible for overall management of CQC and has the authority to act in all CQC matters for the Contractor. This CQC System Manager is on the site at all times during construction and is employed by the prime Contractor. The CQC System Manager is assigned no other duties. Identify in the plan an alternate to serve in the event of the CQC System Manager's absence. The requirements for the alternate are the same as the CQC System Manager.

3.4.3 CQC Personnel

In addition to CQC personnel specified elsewhere in the Contract, provide as part of the CQC organization specialized personnel to assist the CQC System Manager for the following areas: electrical, mechanical, civil, structural, . These individuals or specialized technical companies are directly employed by the prime Contractor and can not be employed by a supplier or subContractor on this project ; be responsible to the CQC System Manager; be physically present at the construction site during work on the specialized peronnel's areas of responsibility; have the necessary education or experience in accordance with the experience matrix listed herein. It may be acceptable for a single member of the CQC organization

to meet multiple experience matrix criteria.

Experience Matrix	
Area	Qualifications
CQC System Manager	Minimum 15 years of construction
CQC Civil	Graduate Civil Engineer or Construction Manager with 2 years experience in the type of work being performed on this project or technician with 5 yrs related experience
CQC Mechanical	Graduate Mechanical Engineer with 2 yrs experience or person with 5 years of experience supervising mechanical features of work in the field with a construction company
CQC Electrical	Graduate Electrical Engineer with 2 years related experience or person 5 years of experience supervising electrical features of work in the field with a construction company
Assistant CQC System Manager	Minimum 7 years of construction experience
Structural	Graduate Civil Engineer (with Structural Track or Focus) or Construction Manager with 2 years experience or person 5 years of experience supervising structural features of work in the field with a construction company
Testing, Adjusting and Balancing (TAB) Personnel	Specialist must be a member of AABC or an experienced technician of the firm certified by the NEBB

3.4.4 Additional Requirement

In addition to the above experience and education requirements, the Contractor Quality Control(CQC) System Manager and Assistant CQC System Manager are required to have completed the Construction Quality Management (CQM) for Contractors course. If the CQC System Manager does not have a current certification, obtain the CQM for Contractors course certification within 90 days of award. This course is periodically offered by the Naval Facilities Engineering Command and the Army Corps of Engineers. Contact the Contracting Officer for information on the next scheduled class.

The Construction Quality Management Training certificate expires after 5 years. If the CQC System Manager's certificate has expired, retake the course to remain current.

3.4.5 Organizational Changes

Maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

3.5 SUBMITTALS AND DELIVERABLES

Submittals, if needed, have to comply with the requirements in Section 01 33 00 SUBMITTAL PROCEDURES. The CQC organization is responsible for certifying that all submittals and deliverables are in compliance with the Contract requirements.

3.6 CONTROL

CQC is the means by which the Contractor ensures that the construction, to include that of subContractors and suppliers, complies with the requirements of the Contract. At least three phases of control are required to be conducted by the CQC System Manager for each definable feature of the construction work as follows:

3.6.1 Preparatory Phase

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

a. A review of each paragraph of applicable specifications, reference codes, and standards. Make available during the preparatory inspection a copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field. Maintain and make available in the field for use by Government personnel until final acceptance of the work.

b. Review of the Contract drawings.

c. Check to assure that all materials and equipment have been tested, submitted, and approved.

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

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

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

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

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

i. Check to ensure that the portion of the plan for the work to be

performed has been accepted by the Contracting Officer.

j. Discussion of the initial control phase.

k. The Government needs to be notified at least 48 hours in advance of beginning the preparatory control phase. Include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. Document the results of the preparatory phase actions by separate minutes prepared by the CQC System Manager and attach to the daily CQC report. Instruct applicable workers as to the acceptable level of workmanship required in order to meet Contract specifications.

3.6.2 Initial Phase

This phase is accomplished at the beginning of a definable feature of work (DFW) when the accomplishment of a representative sample of the work is impending. Accomplish the following:

a. Check work to ensure that it is in full compliance with Contract requirements. Review minutes of the preparatory meeting.

b. Verify adequacy of controls to ensure full Contract compliance. Verify required control inspection and testing are in compliance with the Contract.

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

d. Resolve all differences.

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

f. The Government needs to be notified at least 48 hours in advance of beginning the initial phase for definable feature of work. Prepare separate minutes of this phase by the CQC System Manager and attach to the daily CQC report. Indicate the exact location of initial phase for definable feature of work for future reference and comparison with follow-up phases.

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

3.6.3 Follow-up Phase

Perform daily checks to assure control activities, including control testing, are providing continued compliance with Contract requirements, until completion of the particular feature of work. Record the checks in the CQC documentation. Conduct final follow-up checks and correct all deficiencies prior to the start of additional features of work which may be affected by the deficient work. Do not build upon nor conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

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

3.7 TESTS

3.7.1 Testing Procedure

Perform specified or required tests to verify that control measures are adequate to provide a product which conforms to Contract requirements. Upon request, furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and acceptance tests when specified. Procure the services of a Corps of Engineers approved testing laboratory or establish an approved testing laboratory at the project site. Perform the following activities and record and provide the following data:

a. Verify that testing procedures comply with Contract requirements.

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

c. Check test instrument calibration data against certified standards.

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

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

3.7.2 Testing Laboratories

All testing laboratories must be validated by the USACE Material Testing Center (MTC) for the tests to be performed. Information on the USACE MTC with web-links to both a list of validated testing laboratories and for the laboratory inspection request for can be found at: https://mtc.erdc.dren.mil/.

3.7.2.1 Capability Check

The Government reserves the right to check laboratory equipment in the proposed laboratory for compliance with the standards set forth in the Contract specifications and to check the laboratory technician's testing procedures and techniques. Laboratories utilized for testing soils, concrete, asphalt, and steel is required to meet criteria detailed in ASTM D3740 and ASTM E329.

3.7.2.2 Capability Recheck

If the selected laboratory fails the capability check, the Contractor will be assessed a charge of 1,000 dollars to reimburse the Government for each succeeding recheck of the laboratory or the checking of a subsequently selected laboratory. Such costs will be deducted from the Contract amount due the Contractor.

3.7.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests, and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Conduct an inspection of the work by the CQC System Manager near the end of the work, or any increment of the work established by a time stated in FAR 52.211-10 Commencement, Prosecution, and Completion of Work, or by the specifications. Prepare and include in the CQC documentation a punch list of items which do not conform to the approved drawings and specifications, as required by paragraph DOCUMENTATION. Include within the list of deficiencies the estimated date by which the deficiencies will be corrected. Make a second inspection the CQC System Manager or staff to ascertain that all deficiencies have been corrected. Once this is accomplished, notify the Government that the facility is ready for the Government Pre-Final inspection.

3.8.2 Pre-Final Inspection

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

3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative is required to be in attendance at the final acceptance inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands can also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notify the Contracting Officer at least 14 days prior to the final acceptance inspection and include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the Contract, will be complete and acceptable by the date scheduled for the

final acceptance inspection. Failure of the Contractor to have all Contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance FAR 52.246-12 Inspection of Construction.

3.9 DOCUMENTATION

3.9.1 Quality Control Activities

Maintain current records providing factual evidence that required quality control activities and tests have been performed. Include in these records the work of subContractors and suppliers on an acceptable form that includes, as a minimum, the following information:

a. The name and area of responsibility of the Contractor/SubContractor.

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

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

d. Test and control activities performed with results and references to specifications/drawings requirements. Identify the control phase (Preparatory, Initial, Follow-up). List of deficiencies noted, along with corrective action.

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

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

g. Offsite surveillance activities, including actions taken.

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

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

3.9.2 Verification Statement

Indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. Cover both conforming and deficient features and include a statement that equipment and materials incorporated in the work and workmanship comply with the Contract. Furnish the original and one copy of these records in report form to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, prepare and submit one report for every 7 days of no work and on the last day of a no work period. All calendar days need to be accounted for throughout the life of the Contract. The first report following a day of no work will be for that day only. Reports need to be signed and dated by the Contractor Quality Control(CQC) System Manager. Include copies of test reports and copies of reports prepared by all subordinate quality control personnel within the CQC System Manager Report.

3.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. Take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, will be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer can issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop orders will be made the subject of claim for extension of time or for excess costs or damages by the Contractor. Deficiencies cited and verbal instructions given to the Contractor by the Government Representative must be entered into that day's CQC Report.

-- End of Section --

SECTION 01 50 00

TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS
11/20, CHG 1: 08/21

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 WATER WORKS ASSOCIATION (AWWA)

AWWA C511	(2017) Reduced-Pressure Principle Backflow Prevention Assembly

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 241	(2019) Standard for Safeguarding Construction, Alteration, and Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety and Health Requirements Manual

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

MUTCD	(2015) Manual on Uniform Traffic Control Devices

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification 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

Construction Site Plan; G, RO

Traffic Control Plan; G, RO

Haul Road Plan; G, RO

Contractor Computer Cybersecurity Compliance Statements; G, RO

Contractor Temporary Network Cybersecurity Compliance Statements; G, RO

SD-06 Test Reports

Backflow Preventer Tests

SD-07 Certificates

Backflow Tester Certification

Backflow Preventers Certificate of Full Approval

1.3 LAYOUT OF WORK

a. The Government will establish the following base lines and bench marks at the site of the work: (Monuments and bench marks as shown on the drawings.)

b. From the base lines and bench marks established by the Government, complete the layout of the work and provide measurements for the execution of the work to the location and limit marks indicated, subject to such modifications as the Contracting Officer may require to meet changed conditions or as a result of necessary modifications to the Contract work.

c. Provide stakes, templates, platforms, equipment, tools and material, and labor as required for laying out the work from the base lines and bench marks established by the Government. Maintain and preserve all stakes and other marks established by the Contracting Officer until authorized to remove them, and if such marks are destroyed by the Contractor or through his negligence prior to their authorized removal, they may be replaced by the Contracting Officer, at his discretion, and the expense of replacement will be deducted from any amounts due or to become due the Contractor. The Contracting Officer may require that work be suspended at any time when location and limit marks established by the Contractor are not reasonably adequate to permit checking of the work.

1.4 CONSTRUCTION SITE PLAN

All construction site plans within USAG WP are pre-planned and coordinated with various Directorates. All construction site elements are included in the RTA drawing set. Refer to drawings for details on the construction site plan.

1.5 BACKFLOW PREVENTERS CERTIFICATE

1.5.1 Backflow Tester Certificate

Prior to testing, submit to the Contracting Officer certification issued by the State or local regulatory agency attesting that the backflow tester has successfully completed a certification course sponsored by the regulatory agency. Tester must not be affiliated with a company participating in other phases of this Contract.

1.5.2 Backflow Prevention Training Certificate

Submit a certificate recognized by the State or local authority that

states the Contractor has completed at least 10 hours of training in backflow preventer installations. The certificate must be current.

1.6 DOD CONDITION OF READINESS (COR)

DOD will set the Condition of Readiness (COR) based on the weather forecast for sustained winds 50 knots (58 mph) or greater. Contact the Contracting Officer for the current COR setting.

Monitor weather conditions a minimum of twice a day and take appropriate actions according to the approved Emergency Plan in the accepted Accident Prevention Plan, EM 385-1-1 Section 01 Emergency Planning and the instructions below.

Unless otherwise directed by the Contracting Officer, comply with:

a. Condition FOUR (Sustained winds of 58 mph or greater expected within 72 hours): Normal daily jobsite cleanup and good housekeeping practices. Collect and store in piles or containers scrap lumber, waste material, and rubbish for removal and disposal at the close of each work day. Maintain the construction site including storage areas, free of accumulation of debris. Stack form lumber in neat piles less than 3.3 feet high. Remove all debris, trash, or objects that could become missile hazards. Review requirements pertaining to "Condition THREE" and continue action as necessary to attain "Condition FOUR" readiness. Contact Contracting Officer for weather and COR updates and completion of required actions.

b. Condition THREE (Sustained winds of 58 mph or greater expected within 48 hours): Maintain "Condition FOUR" requirements and commence securing operations necessary for "Condition ONE" which cannot be completed within 18 hours. Cease all routine activities which might interfere with securing operations. Commence securing and stow all gear and portable equipment. Make preparations for securing buildings. Reinforce or remove formwork and scaffolding. Secure machinery, tools, equipment, materials, or remove from the jobsite. Expend every effort to clear all missile hazards and loose equipment from general base areas. Contact Contracting Officer for weather and COR updates and completion of required actions. Review requirements pertaining to "Condition TWO" and continue action as necessary to attain "Condition THREE" readiness.

c. Condition TWO (Sustained winds of 58 mph or greater expected within 24 hours): Secure the jobsite, and leave Government premises.

d. Condition ONE. (Sustained winds of 58 mph or greater expected within 12 hours): Contractor access to the jobsite and Government premises is prohibited.

1.7 CYBERSECURITY DURING CONSTRUCTION

{For Reference Only: This subpart (and its subparts) relates to AC-18, SA-3, CCI-00258.} Meet the following requirements throughout the construction process.

1.7.1 Contractor Computer Equipment

Contractor owned computers may be used for construction. When used, Contractor computers must meet the following requirements:

1.7.1.1 Operating System

The operating system must be an operating system currently supported by the manufacturer of the operating system. The operating system must be current on security patches and operating system manufacturer required updates.

1.7.1.2 Anti-Malware Software

The computer must run anti-malware software from a reputable software manufacturer. Anti-malware software must be a version currently supported by the software manufacturer, must be current on all patches and updates, and must use the latest definitions file. All computers used on this project must be scanned using the installed software at least once per day.

1.7.1.3 Passwords and Passphrases

The passwords and passphrases for all computers must be changed from their default values. Passwords must be a minimum of eight characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.7.1.4 Contractor Computer Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Computer Cybersecurity Compliance Statements for each company using Contractor owned computers. Contractor Computer Cybersecurity Compliance Statements must use the template published at http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables. Each Statement must be signed by a cybersecurity representative for the relevant company.

1.7.2 Temporary IP Networks

Temporary Contractor-installed IP networks may be used during construction. When used, temporary Contractor-installed IP networks must meet the following requirements:

1.7.2.1 Network Boundaries and Connections

The network must not extend outside the project site and must not connect to any IP network other than IP networks provided under this project or Government furnished IP networks provided for this purpose. Any and all network access from outside the project site is prohibited.

1.7.3 Government Access to Network

Government personnel must be allowed to have complete and immediate access to the network at any time in order to verify compliance with this specification.

1.7.4 Temporary Wireless IP Networks

In addition to the other requirements on temporary IP networks, temporary wireless IP (WiFi) networks must not interfere with existing wireless network and must use WPA2 security. Network names (SSID) for wireless networks must be changed from their default values.

1.7.5 Passwords and Passphrases

The passwords and passphrases for all network devices and network access must be changed from their default values. Passwords must be a minimum 8 characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.7.6 Contractor Temporary Network Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Temporary Network Cybersecurity Compliance Statements for each company implementing a temporary IP network. Contractor Temporary Network Cybersecurity Compliance Statements must use the template published at http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-graphics-tables. Each Statement must be signed by a cybersecurity representative for the relevant company. If no temporary IP networks will be used, provide a single copy of the Statement indicating this.

PART 2 PRODUCTS

2.1 TEMPORARY SIGNAGE

2.1.1 Bulletin Board

Prior to the commencement of work activities, provide a clear weatherproof covered bulletin board not less than 36 by 48 inches in size for displaying the Equal Employment Opportunity poster, a copy of the wage decision contained in the Contract, Wage Rate Information poster, Safety and Health Information as required by EM 385-1-1 Section 01 and other information approved by the Contracting Officer. Coordinate requirements herein with 01 35 29 SAFETY AND OCCUPATIONAL HEALTH REQUIREMENTS. Locate the bulletin board at the project site in a conspicuous place easily accessible to all employees, and in location as approved by the Contracting Officer.

2.1.2 Project Identification Signs

The requirements for the signs, their content, and location are as specified in Section 01 58 00 PROJECT IDENTIFICATION. Erect signs within 15 days after receipt of the notice to proceed. Correct the data required by the safety sign daily, with light colored metallic or non-metallic numerals.

2.1.3 Warning Signs

Post temporary signs, tags, and labels to give workers and the public adequate warning and caution of construction hazards according to the EM 385-1-1 Section 04. Attach signs to the perimeter fencing every 150 feet warning the public of the presence of construction hazards. Signs must require unauthorized persons to keep out of the construction site. Correct the data required by safety signs daily. Post signs at all points of entry designating the construction site as a hard hat area.

2.2 TEMPORARY TRAFFIC CONTROL

2.2.1 Haul Roads

Construct access and haul roads necessary for proper prosecution of the

work under this Contract in accordance with EM 385-1-1 Section 04. Construct with suitable grades and widths; avoid sharp curves, blind corners, and dangerous cross traffic. Submit haul road plan for approval. Provide necessary lighting, signs, barricades, and distinctive markings for the safe movement of traffic. The method of dust control, although optional, must be adequate to ensure safe operation at all times. Location, grade, width, and alignment of construction and haul roads are subject to approval by the Contracting Officer. Lighting must be adequate to assure full and clear visibility for full width of haul road and work areas during any night work operations.

2.2.2 Barricades

Erect and maintain temporary barricades to limit public access to hazardous areas. Barricades are required whenever safe public access to paved areas such as roads, parking areas or sidewalks is prevented by construction activities or as otherwise necessary to ensure the safety of both pedestrian and vehicular traffic. Securely place barricades clearly visible with adequate illumination to provide sufficient visual warning of the hazard during both day and night.

2.3 FENCING

Provide fencing along the construction site and at all open excavations and tunnels to control access by unauthorized personnel. Safety fencing must be highly visible to be seen by pedestrians and vehicular traffic. All fencing must include plastic strip inserts and meet the requirements of EM 385-1-1. Remove the fence upon completion and acceptance of the work.

2.3.1 Polyethylene Mesh Safety Fencing

Temporary safety fencing must be a high visibility orange colored, high density polyethylene grid, a minimum of 48 inches high and maximum mesh size of 2 inches. Fencing must extend from the grade to a minimum of 48 inches above the grade and be tightly secured to T-posts spaced as necessary to maintain a rigid and taut fence. Fencing must remain rigid and taut with a minimum of 200 pounds of force exerted on it from any direction with less than 4 inches of deflection.

2.3.2 Chain Link Panel Fencing

Temporary panel fencing must be black powder coated in color steel chain link panels 6 feet high. Plastic strip inserts for fencing required. Color to be approved by Contracting officer with input from USAG WP DPW. Multiple fencing panels may be linked together at the bases to form long spens as needed. Each panel base must be weighted down using sand bags or other suitable materials in order ofr the fencing to withstand anticipated winds while remaining upright. Fencing must remain rigid and taut with a minimum of 200 pounds of force exerted on it from any direction with less than 4 inches of deflection.

2.3.3 Post-Driven Chain Link Fencing

Temporary post-driven fencing must be galvanized chain link fencing 8 feet high supported by an tightly secured to galvanized steel posts driven below grade. Plastic strip inserts for fencing required. Color to be approved by Contracting officer with input from USAG WP DPW. Fence posts must be located on minimum 10 foot centers. Posts may be set in various

surfaces such as sand, soil, asphalt or concrete as necessary. Chain link fencing must remain rigid and taut with a minimum of 200 pounds of force exerted on it from any direction with less than 4 inches of deflection. Completely remove fencing and posts at the completion of construction and restore surfaces disturbed or damaged to its original condition. Locate and identify underground utilities prior to setting fence posts. Equip fence with a lockable gate. Gate must remain locked when construction personnel are not present.

2.4 TEMPORARY WIRING

Provide temporary wiring in accordance with EM 385-1-1 Section 11, NFPA 241 and NFPA 70. Include monthly inspection and testing of all equipment and apparatus.

2.5 BACKFLOW PREVENTERS

Certificate of Full Approval from FCCCHR List, University of Southern California, attesting that the design, size and make of each backflow preventer has satisfactorily passed the complete sequence of performance testing and evaluation for the respective level of approval. Certificate of Provisional Approval is not acceptable.

Reduced pressure principle type conforming to the applicable requirements AWWA C511. Provide backflow preventers complete with 150 pound flanged cast iron, mounted gate valve and strainer, 304 stainless steel or bronze, internal parts.

USAG WP DPW requirements for backflow preventers can be acquired by the Water Department via Thomas Armstrong at thomas.w.armstrong20.civ@mail.mil

PART 3 EXECUTION

3.1 EMPLOYEE PARKING

No designated space for construction vehicles parking has been assigned within the designated staging area(s) The contracting officer will designate an available off-site parking area.

The existing parking for visitors and Government employees must not be used by the Contractor. Contractor must refer to the U.S. Army Garrison West Point Policy Letter #42 for current parking restrictions. Refer to 01 14 00 WORK RESTRICTION.

a. Limited construction Contractor(s) or subContractor(s) employee parking bay be available near the immediate site. The Contractor will need to identify and locate additional parking facilities for general and subContractors off of West Point and provide a means for shuttling workers to the site. West Point shuttle services will not be used for transporting workers to the site.

b. Under no circumstances will General Construction Contractors park in any Central Parking Area (CPA) Lots. No Contractors are to park outside of or adjacent to the construction fence at any time during the project.

c. General construction Contractor(s) or subContractor(s) will not park in designated loading zone or drop off areas for longer than 15 minutes.

3.1.1 Violation of Parking Policy

a. Implied Consent to Tow and/or Impound a Vehicle. However, before a vehicle is removed from West Point, reasonable attempts will be made to locate the owner of the POV. IAW AR 190-5 and West Point Regulation 190-5, persons who operate a motor vehicle on West Point must be deemed to have given consent for the removal and temporary impoundment of a Privately Owned Vehicle when:

(1) Remaining parked on the Installation for more than 72 hours.

(2) Illegally parked and/or interfering with Installation activities or operations.

(3) Causing a safety hazard.

(4) Disabled as the result of an accident and left at the scene.

(5) Left unattended in a restricted or controlled area.

(6) Parked in a Central Parking Area (CPA) lot without an authorized decal displayed to indicate the vehicle is approved to park in that area.

3.2 AVAILABILITY AND USE OF UTILITY SERVICES

3.2.1 Temporary Utilities

Provide temporary utilities required for construction. Materials may be new or used, must be adequate for the required usage, not create unsafe conditions, and not violate applicable codes and standards. Remove temporary utilities upon project's completion.

3.2.2 Provision of Utility Services

a. The Government will make all reasonably required utilities available from existing outlets and supplies, as specified in the Contract. Carefully conserve utilities furnished without charge.

b. USAG WP has privatized water, wastewater and electrical service. All utility work on these systems must be coordinated with the Utility System Owners; Electric = City Light and Power; Water and Wastewater = American Water Federal Services. Primary point of contact for coordination is Rangi Mathew, rangi.k.mathew2.civ@mail.mil.

c. The Contractor must be responsible to pay all costs incurred in connecting, converting, and transferring temporary utilities to the work. Make connections, including providing backflow-preventing devices on connections to domestic water lines; providing meters; and providing transformers; and make disconnections.

d. Utilities will be paid for via a reimbursement to the Contract.

e. The Contractor must provide their own utilities.

3.2.3 Temporary Connections

Provide and maintain necessary temporary connections and distribution lines. Notify the Contracting Officer, in writing, 5 working days before final

electrical connection is desired so that a utilities Contract can be established. Do not make the final electrical connection. The Government will not make the final inspection. The Contractor is to use USAG WP Utility Privatization Contractor, City, Light & Power for all high voltage electrical work.

3.2.4 Sanitation

Provide and maintain within the construction area minimum field-type sanitary facilities in accordance with EM 385-1-1 Section 02. Locate the facilities behind the construction fence or out of the public view. Clean units and empty wastes at least once a week or more frequently into a municipal, district, or station sanitary sewage system, or remove waste to a commercial facility. Obtain approval from the system owner prior to discharge into a municipal, district, or commercial sanitary sewer system. Penalties or fines associated with improper discharge will be the responsibility of the Contractor. Coordinate with the Contracting Officer and follow station regulations and procedures when discharging into the station sanitary sewer system. Maintain these conveniences at all times. Include provisions for pest control and elimination of odors. Government toilet facilities will not be available to Contractor's personnel.

3.2.5 Telephone

Make arrangements and pay all costs for telephone facilities desired.

3.2.6 Fire Protection

Provide temporary fire protection equipment for the protection of personnel and property during construction in accordance with Section 9 of EM 385-1-1. Remove debris and flammable materials daily to minimize potential hazards.

3.3 ACCESS ROUTES

Contractor's personnel and construction equipment will not be permitted in any place other than the project site and the haul route for the borrow and spoil sites, unless specifically authorized by the Contracting Officer. A request for authorization to use alternate limited access must be made by the Contractor to the Contracting Officer at least 7 calendar days in advance.

3.4 TRAFFIC PROVISIONS

3.4.1 Maintenance of Traffic

The Contractor must be responsible for the maintenance of access roads at the construction site. Maintenance of access roads must include snow removal. The Contractor must remove snow piles and rows when they affect safety, hamper emergency and fire vehicles, or block proper drainage. The Contractor must provide and allow full access to the project site to all traffic, except as noted, to other Contractors and authorized personnel as designated by the Contracting Officer.

The Contractor must not inflict damage upon land properties, roads outside the authorized construction areas by unwarranted entry upon, driving over curbs, passage through, damage to or disposal of, material on such land or property, or overloading of roads. The Contractor may make a separate agreement with any other party, regarding the use of, or right to, land or

facilities outside the Installation. If such an agreement is made, it must be in writing and a copy must be furnished to the Contracting Officer. The Contractor must hold and save the Government, its officers and agents free from liability of any nature or kind arising from any trespassing or damage occasioned by Contractor operations.

a. Conduct operations in a manner that will not close a thoroughfare or interfere with traffic on railways or highways except with written permission of the Contracting Officer at least 15 calendar days prior to the proposed modification date, and provide a Traffic Control Plan for Government approval detailing the proposed controls to traffic movement for approval. The plan must be in accordance with State and local regulations and the MUTCD, Part VI.. Contractor may move oversized and slow-moving vehicles to the worksite provided requirements of the highway authority have been met.

b. Conduct work so as to minimize obstruction of traffic, and maintain traffic on at least half of the roadway width at all times. Obtain approval from the Contracting Officer prior to starting any activity that will obstruct traffic.

c. Provide, erect, and maintain, at Contractor's expense, lights, barriers, signals, passageways, detours, and other items, that may be required by the Life Safety Signage, overhead protection authority having jurisdiction.

d. Provide cones, signs, barricades, lights, or other traffic control devices and personnel required to control traffic. Do not use foil-backed material for temporary pavement marking because of its potential to conduct electricity during accidents involving downed power lines.

3.4.2 Protection of Traffic

Maintain and protect traffic on all affected roads during the construction period except as otherwise specifically directed by the Contracting Officer. Measures for the protection and diversion of traffic, including the provision of watchmen and flagmen, erection of barricades, placing of lights around and in front of equipment the work, and the erection and maintenance of adequate warning, danger, and direction signs, will be as required by the State and local authorities having jurisdiction. Provide self-illuminated (lighted) barricades during hours of darkness. Brightly-colored (orange) vests are required for all personnel working in roadways. Protect the traveling public from damage to person and property. Minimize the interference with public traffic on roads selected for hauling material to and from the site. Investigate the adequacy of existing roads and their allowable load limit. Contractor is responsible for the repair of damage to roads caused by construction operations.

3.4.3 Dust Control

Dust control methods and procedures must be approved by the Contracting Officer. Coordinate dust control methods with 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS.

3.5 REDUCED PRESSURE BACKFLOW PREVENTERS

Provide an approved reduced pressure backflow prevention assembly at each location where the Contractor taps into the Government potable water

supply.

Perform backflow preventer tests using test equipment, procedures, and certification forms conforming to those outlined in the latest edition of the Manual of Cross-Connection Control published by the FCCCHR Manual. Test and tag each reduced pressure backflow preventer upon initial installation (prior to continued water use) and monthly thereafter. Tag must contain the following information: make, model, serial number, dates of tests, results, maintenance performed, and signature of tester. Record test results on certification forms conforming to requirements cited earlier in this paragraph.

3.6 CONTRACTOR'S TEMPORARY FACILITIES

Temporary facilities must meet requirements as identified in EM 385-1-1 Section 04. Government offices and warehouse facilities will NOT be available to the Contractor.

Contractor is responsible for security of their property. Provide adequate outside security lighting at the temporary facilities. Trailers must be anchored to resist high winds and meet applicable state or local standards for anchoring mobile trailers. Coordinate anchoring with EM 385-1-1 Section 04. The Contract Clause entitled "FAR 52.236-10, Operations and Storage Areas" and the following apply:

3.6.1 Administrative Field Offices

Provide and maintain administrative field office facilities within the construction area at the designated site.

Trailers provided and used by the Contractor must present a clean and neat exterior appearance and must be in a state of good repair. Trailers, which, in the opinion of the Contracting Officer, require exterior painting or maintenance, will not be allowed on the Installation. The trailer must be a minimum of 720 square feet with a minimum of 7 feet headroom. Trailers must be equipped with approved electrical wiring, at least six (6) double convenience outlets and the required switches and fuses to provide 110-220 volt power. The trailer must be waterproof, must have a minimum of two doors, electric lights, a battery operated smoke detector alarm, a sufficient number of screened and adjustable windows with blinds for adequate light and ventilation. Trailer shall accommodate dedicated speace for Government Field Office as specified under 3.7.

Windows and doors must be capable of being locked with dead bolt type locking devices or a padlock and heavy-duty hasp bolted to the door. Door hinge pins must be non-removable. Windows must be arranged to open and to be securely fastened from the inside. Electrical lighting must be sufficient for office use with power and electrical outlets sufficient to support office equipment described in this paragraph. Heating and air conditioning must be provided. In warm weather, air conditioning capable of maintaining the office at 50 percent relative humidity and a room temperature of 70 degrees F. In cold weather heat must be capable of maintaining 78 degrees. Necessary power, telephone and internet services to support building and office equipment must be furnished by the Contractor. Coordinate with Government (ACE-IT) for required internet speed.

Office space for Government use is not required within Administrative Field Office.

3.6.2 Storage Area

Construct a temporary 6 foot high chain link fence around trailers and materials. Include plastic strip inserts, colored brown, so that visibility through the fence is obstructed. Fence posts may be driven, in lieu of concrete bases, where soil conditions permit. Do not place or store trailers, materials, or equipment outside the fenced area unless such trailers, materials, or equipment are assigned a separate and distinct storage area by the Contracting Officer away from the vicinity of the construction site but within the installation boundaries. Trailers, equipment, or materials must not be open to public view with the exception of those items which are in support of ongoing work on the current day. Do not stockpile materials outside the fence in preparation for the next day's work. Park mobile equipment, such as tractors, wheeled lifting equipment, cranes, trucks, and like equipment within the fenced area at the end of each work day.

All materials, trailers, and storage sheds in staging and construction areas must be elevated and stored a minimum of 3 feet from any structure or fixed object. Trailers must have doors on both ends.

Keep fencing in a state of good repair and proper alignment. Grassed or unpaved areas, which are not established roadways, and will be traversed with construction equipment or other vehicles, must be covered with a layer of gravel as necessary to prevent rutting and the tracking of mud onto paved or established roadways, should the Contractor elect to traverse them with construction equipment or other vehicles. Mow and maintain grass located within the boundaries of the construction site for the duration of the project. Grass and vegetation along fences, buildings, under trailers, and in areas not accessible to mowers must be edged or trimmed neatly.

3.6.3 Supplemental Storage Area

Upon request, and pending availability, the Contracting Officer will designate another or supplemental area for the use and storage of trailers, equipment, and materials. This area may not be in close proximity of the construction site but will be within the installation boundaries. Maintain the area in a clean and orderly fashion and secured if needed to protect supplies and equipment. Utilities will not be provided to this area by the Government. Contracting Officer does not have to approve the request to designate another or supplemental area.

3.6.4 Appearance of Trailers

a. Trailers must be roadworthy and comply with all appropriate state and local vehicle requirements. Trailers which are rusted, have peeling paint or are otherwise in need of repair will not be allowed on Installation property. Trailers must present a clean and neat exterior appearance and be in a state of good repair and maintained. Failure to do so will be sufficient reason to require their removal within 5 working days.

b. Confirm Contractor trailer identification information with USAG DPW.

3.6.5 Safety Systems

Protect the integrity of all installed safety systems or personnel safety

devices. Obtain prior approval from the Contracting Officer if entrance into systems serving safety devices is required. If it is temporarily necessary to remove or disable personnel safety devices in order to accomplish Contract requirements, provide alternative means of protection prior to removing or disabling any permanently installed safety devices or equipment and obtain approval from the Contracting Officer.

3.6.6 Staging Area

The Contractor must utilize the project site areas for his daily staging. Trailers, materials, or equipment must not be placed or stored outside the project site unless such trailers, materials or equipment are assigned a separate and distant storage area by the Contracting Officer away from the vicinity of the staging area but within military boundaries. At the end of each work day mobile equipment, such as tractors, wheeled lifting equipment, cranes, backhoes and like equipment, must be parked within the project site. The following must remain fully accessible: sally ports, hydrants, standpipes and access ways. The Contractor must be responsible for all temporary connections (power, water telephone, etc.) to the project site. The Contractor must maintain the area in a clean and neat condition. The Contractor will return all disturbed areas to their original condition unless specifically authorized by the Contracting Officer.

All materials, trailers, and storage sheds in staging and construction areas must be elevated and stored a minimum of 3 feet from any structure or fixed object. Trailers must have doors on both ends.

Staging areas must not be used for long term storage or disposal of solid waste. At conclusion of the Contract all solid waste must be removed from the site.

3.6.7 Weather Protection of Temporary Facilities and Stored Materials

Take necessary precautions to ensure that roof openings and other critical openings in the building are monitored carefully. Take immediate actions required to seal off such openings when rain or other detrimental weather is imminent, and at the end of each workday. Ensure that the openings are completely sealed off to protect materials and equipment in the building from damage.

3.6.7.1 Building and Site Storm Protection

When a warning of gale force winds is issued, take precautions to minimize danger to persons, and protect the work and nearby Government property. Precautions must include, but are not limited to, closing openings; removing loose materials, tools and equipment from exposed locations; and removing or securing scaffolding and other temporary work. Close openings in the work when storms of lesser intensity pose a threat to the work or any nearby Government property.

3.6.8 Color

The color of dumpsters, trailers, and storage sheds and portable latrines must be approved by the Contracting Officer with input from USAG WP DPW.

3.7 PLANT COMMUNICATIONS

Whenever the individual elements of the plant are located so that

operation by normal voice between these elements is not satisfactory, install a satisfactory means of communication, such as telephone or other suitable devices and make available for use by Government personnel.

3.8 TEMPORARY PROJECT SAFETY FENCING

As soon as practicable, but not later than 15 days after the date established for commencement of work, furnish and erect temporary project safety fencing at the work site. Maintain the safety fencing during the life of the Contract and, upon completion and acceptance of the work, remove from the work site.

3.9 CLEANUP

Remove construction debris, waste materials, packaging material, flammable materials and the like from the work site daily. Any dirt or mud which is tracked onto paved or surfaced roadways must be cleaned away. Store all salvageable materials resulting from demolition activities within the fenced area described above or at the supplemental storage area. Neatly stack stored materials not in trailers, whether new or salvaged.

3.10 RESTORATION OF STORAGE AREA

Upon completion of the project remove the bulletin board, signs, barricades, haul roads, and all other temporary products from the site. After removal of trailers, materials, and equipment from within the fenced area, remove the fence. Restore areas used during the performance of the Contract to the original or better condition. Remove gravel used to traverse grassed areas and restore the area to its original condition, including top soil and seeding as necessary.

-- End of Section --

SECTION 01 57 19

TEMPORARY ENVIRONMENTAL CONTROLS
11/15, CHG 5: 08/21

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Sediment

Sediment is soil and other debris that have eroded and have been transported by runoff water or wind.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification 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

Environmental Control Plan; G

1.3 ENVIRONMENTAL CONTROL PLAN

1.3.1 General Site Information

1.3.1.1 Drawings

Drawings showing locations of proposed erosion control devices, material storage areas, structures, storm drains and conveyances.

1.3.1.2 Work Area

Work area plan showing the proposed activity in each portion of the area and identify the areas of limited use or nonuse. Include measures for marking the limits of use areas, including methods for protection of features to be preserved within authorized work areas and methods to control runoff and to contain materials on site, and a traffic control plan.

1.3.2 Stormwater Management and Control

a. Ground cover

b. Erodible soils

c. Temporary measures

(1) Structural Practices

(2) Temporary and permanent stabilization

d. Effective selection, implementation and maintenance of Best Management

Practices (BMPs).

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 PROTECTION OF NATURAL RESOURCES

Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work that is consistent with the requirements of the Installation Environmental Office or as otherwise specified. Confine construction activities to within the limits of the work indicated or specified.

3.1.1 Flow Ways

Do not alter water flows or otherwise significantly disturb the native habitat adjacent to the project and critical to the survival of fish and wildlife, except as specified and permitted.

3.1.2 Vegetation

Except in areas to be cleared, do not remove, cut, deface, injure, or destroy trees or shrubs without the Contracting Officer's permission. Do not fasten or attach ropes, cables, or guys to existing nearby trees for anchorages unless authorized by the Contracting Officer. Where such use of attached ropes, cables, or guys is authorized, the Contractor is responsible for any resultant damage.

Protect existing trees that are to remain to ensure they are not injured, bruised, defaced, or otherwise damaged by construction operations. Remove displaced rocks from uncleared areas.

3.1.3 Protection of Trees and Plants in West Point

Refer to U.S MILITARY ACADEMY SPECIFICATION, PROTECTION OF TREES AND PLANTS, attached.

a. The Contractor must engage the services of a Certified Arborist, as certified by the International Society of Arboriculture (ISA). The Certified Arborist must review the tree protection plans and determine what specific measures are necessary to comply with this specification.

b. Pre-Construction pruning: The arborist must direct or perform the cutting and trimming of branches of all trees and plant material. The cutting or trimming of lower branches, for clear access to the work site, must be accomplished prior to the start of construction.

c. Pre-Construction Tying: The arborist must direct or perform the ‘tying –in” of branches which temporarily obstruct a construction area or access to a construction site. Lower branches that could be injured by equipment must be "tied-in" using ropes or props with protective padding.

d. Pre-Construction Barricade Fencing: Following preliminary trimming or tying-in of overhanging branches, the Contractor must construct barriers around existing trees. Barriers must be 4 foot high, orange polyethylene

barricade fence supported on steel or wood posts on 6 foot centers. Barriers must be placed a minimum of ten feet (10') outside of the protected trees' outermost branches (drip line). Attached to each fence must be weather-proof signs in black on yellow stating: TREE PROTECTION ZONE--KEEP OUT. (see detail A)

e. The protection zone for other protected plants such as shrubs, must be the soil area underneath the plant's canopy. Where indicated in the plans or specifications the Contractor must place a (4") four to (6") six inch layer of wood chip mulch over soil surface to protect root zones of plants in close proximity to the work site.

f. On the lower sides of slopes where rocks are likely to roll against and injure tree trunks or bark of valuable trees, Contractor must install boards or poles lashed with rope or wire in an upright position against the trunk. (see detail B).

g. The Contractor must maintain plant material protection devices installed as part of this Contract until all work on site has been completed.

h. The Contractor must be responsible for prompt corrective action if despite precautions taken a trunk or branch is damaged. Removal of loose bark and cutting of the bark edge to a streamlined shape around the wound area must be accomplished prior to close of business on the day the injury occurred. (see detail C)

i. "Tree wound" coatings are not to be applied without the approval of the Contracting Officer. The acceptable tree wound coating must be ETISSO Lac Balsam or equivalent.

j. The Contractor must repair injuries, at his own expense, to trees or plant material, bark, limbs and roots damaged by the construction operation. All repairs must be performed by or under the direction of a Certified Arborist. The use of climbing spurs or spikes on protected trees is not permitted.

k. Mutilated cuts made to roots during excavation must be re-cut with the appropriate horticultural tool(s), making oblique cuts facing away from the soil surface. (see detail D)

l. All traffic must be controlled away from all protected trees and other plant material. Protective devices, signs or other objects must not be fastened directly to trees or plant material. Trees must not be used as temporary utility poles or for anchorage. The Contractor must not permit parking, movement or storage or any vehicle or equipment near trees which are to be protected or are adjacent to the job site. Should violations occur the Contractor must be required at his own expense, to install additional fencing to eliminate further encroachment.

m. Equipment must not be parked or stored within a root protection zone. Material stockpiles must not be located within a root protection zone.

n. Trees or other plants damaged by the Contractor must be replaced at Contractor expense. The Contractor must not remove damaged plant material without prior approval of the Contracting Officer. Replacement trees and trees must be of like species, variety, and size. Replacements must be guaranteed for one year from date of planting.

o. Where replacement is not feasible, the Contracting Officer will secure monetary compensation from the Contractor. The Contracting Officer will determine the replacement compensation costs based on the most current edition of the Council of Tree and Landscape Appraisers (CTLA) "Guide for Plant Appraisal".

3.2 Erosion and Sediment Control Measures

Provide erosion and sediment control measures in accordance with state and local laws and regulations. Preserve vegetation to the maximum extent practicable.

Erosion control inspection reports may be compiled as part of a stormwater pollution prevention plan inspection reports.

3.2.1 Erosion Control

Prevent erosion by Compost Blankets. Stabilize slopes by sodding, seeding, or such combination of these methods necessary for effective erosion control. Use of hay bales is prohibited.

Provide seeding in accordance with Section 32 92 19 SEEDING.

3.2.2 Sediment Control Practices

Implement sediment control practices to divert flows from exposed soils, temporarily store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site. Implement sediment control practices prior to soil disturbance and prior to creating areas with concentrated flow, during the construction process to minimize erosion and sediment laden runoff. Include the following devices: silt fence, temporary diversion dikes, storm drain inlet protection, Location and details of installation and construction are indicated on the drawings.

3.3 Work Area Limits

Mark the areas that need not be disturbed under this Contract prior to commencing construction activities. Mark or fence isolated areas within the general work area that are not to be disturbed. Protect monuments and markers before construction operations commence. Where construction operations are to be conducted during darkness, any markers must be visible in the dark. Personnel must be knowledgeable of the purpose for marking and protecting particular objects.

3.4 Contractor Facilities and Work Areas

Place field offices, staging areas, stockpile storage, and temporary buildings in areas designated on the drawings or as directed by the Contracting Officer. Move or relocate the Contractor facilities only when approved by the Government. Provide erosion and sediment controls for onsite borrow and spoil areas to prevent sediment from entering nearby waters. Control temporary excavation and embankments for plant or work areas to protect adjacent areas. -- End of Section --

SECTION 01 57 20

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

PART 1 GENERAL

1.01 GOVERNMENT POLICY

A. Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy the Contractor shall: (I) practice efficient waste management when sizing, cutting, and installing products and materials and (2) use all reasonable means to divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse.

1.02 MANAGEMENT

A. The Contractor shall take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. Construction and demolition waste includes products of demolition or removal excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling shall accrue to the Contractor. Firms and facilities used for recycling, reuse, and disposal shall be appropriately permitted for the intended use to the extent required by federal, state, and local regulations.

1.03 PLAN

A. A waste management plan shall be submitted to the Contracting Officer and Environmental Branch within 15 days after contract award and prior to initiating any site preparation work. The plan shall include the following:
   1. Name of individuals on the Contractor's staff responsible for waste prevention and management.
   2. Actions that will be taken to reduce solid waste generation.
   3. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas and equipment to be used for processing, sorting, and temporary storage of wastes.
   4. Characterization, including estimated types and quantities, of the waste to be generated.
   5. Name of landfill and/or incinerator to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.
   6. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity.
   7. List of specific waste materials that will be salvaged for resale, salvaged and reused, or recycled. Recycling facilities that will be used shall be identified.
   8. Identification of materials that cannot be recycled/reused with an explanation or justification.
   9. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

1.04 RECORDS

A. Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration.

B. The records shall be made available to the Contracting Officer upon request at any time during construction.

C. A copy of the records shall be delivered to the Contracting Officer on a quarterly basis and upon full completion of the construction.

1.05 COLLECTION

A. The necessary containers, bins and storage areas to facilitate effective waste management shall be provided by the Contractor at no additional cost to the Government and shall be clearly and appropriately identified. Recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials and separated by one of the following methods:
   1. Source Separated Method. Waste products and materials that are recyclable shall be separated from trash and sorted into appropriately marked separate containers and then transported to the respective recycling facility for further processing.
   2. Co-Mingled Method. Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.
   3. Other Methods. Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

1.06 DISPOSAL

A. Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:
   1. Reuse. First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Sale or donation of waste suitable for reuse shall be considered. Salvaged materials, other than those specified in other sections to be salvaged and reinstalled, shall not be used in this project.
   2. Recycle. Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling whenever economically feasible.
   3. Waste. Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION 01 57 20

SECTION 01 58 00

PROJECT IDENTIFICATION
08/19, CHG 2: 11/20

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.

U.S. ARMY CORPS OF ENGINEERS (USACE)

EP 310-1-6a	(2006) Sign Standards Manual, VOL 1
EP 310-1-6b	(2006) Sign Standards Manual, VOL 2, Appendices

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification 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

Sign Legend Orders; G, RO

1.3 PROJECT IDENTIFICATION SIGN

1.3.1 Construction Project Signs

Furnish the construction project sign package, maintain the signs during construction, and remove the signs from the job site upon completion of the project. The construction project sign package consists of two signs: one for project identification and the other to show the on-the-job safety performance of the Contractor. Ensure that the package conforms to the requirements of EP 310-1-6a and EP 310-1-6b, specifically Section 16. Submit the sign legend orders as described in Section 16 of EP 310-1-6a before erecting the signs.

a. Sample sign drawings together with mounting and fabrication details are provided at the end of this section. No separate payment will be made for erecting and maintaining the signs and all costs in connection therewith will be considered the obligation of the Contractor. Upon completion of the project, remove the signs from the project site. The project identification and safety performance signs are to be displayed side-by-side and mounted for reading by passing viewers. The public safety sign must be the same size as the project signs. The Contracting Officer will designate exact placement locations. Panels are fabricated using HDO (High Density Overlay) plywood with dimensional lumber uprights and bracing. The sign faces are non-reflecting vinyl. All legends are to be die-cut or

computer-cut in the sizes and type-faces specified and applied to the white panel background following the graphic formats shown on the attached sheets. The Communications Red panel on the left side of the construction project sign with Corps signature (reverse version) is screen printed onto the white background.

b. Maintain the signs in good condition throughout the construction period. No separate payment will be made for erecting and maintaining the signs and all costs in connection therewith will be considered the obligation of the Contractor. Upon completion of the project, remove the signs from the project site.

1.3.2 Public Safety Sign

For the public safety sign, refer to the Warning Signs paragraph in section 01 50 00 TEMPORARY CONSTRUCTION FACILITIES AND CONTROLS

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

Not Used

-- End of Section --

SECTION 01 77 00

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.01 SUBMITTALS

A. Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval and for information only. The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:
   1. SD-IO Operation and Maintenance Data
      a. Equipment/product warranty list; G
      b. Submit Data Package 1 in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.
   2. SD-11 Closeout Submittals
      a. As-built drawings; G
      b. Record of materials; G
      c. Utility Record Drawings G
      d. Utility as-built drawings; G
      e. Equipment/product warranty tag; G
      f. Monthly project waste summary report; G
      g. Hazardous material reporting; G
      h. Certification of EPA Designated Items; G

1.02 SUBMITTAL FORMAT

A. Submit documents in the following formats:

   1. Drawing Files: Submit in .dwg and pdf format.
   2. Remaining File types: Submit in the format the file was generated in and in pdf format.

1.02 UTILITY AS-BUILT DRAWINGS

A. Submit scaled, dimensioned drawings locating any new underground installations.

1.03 MONTHLY PROJECT WASTE SUMMARY REPORT

A. Submit the final submission of the monthly project waste summary reports specified in Section 01 57 20 Construction and Demolition Waste Management.

1.04 HAZARDOUS MATERIAL REPORTING

A. Submit hazardous material reporting information which includes actual quantities of hazardous materials stored and used during the project as specified in Section 01 35 29 Safety and Occupational Health Requirements.

1.05 CERTIFICATION OF EPA DESIGNATED ITEMS

A. Submit the Certification of EPA Designated Items as required by FAR 52.223-9, "Certification and Estimate of Percentage of Recovered Material Content for EPA Designated Items".

1.06 PROJECT RECORD DOCUMENTS

A. Submit a full set of edited contract construction documents with all revisions indicated.

1.07 AS-BUILT DRAWINGS

A. Submit scaled, dimensioned drawings locating any new construction that does not comply with construction documents.

1.08 UTILITY RECORD DRAWINGS

A. Submit a full set of edited utility documents with all revisions indicated.

1.09 AS-BUILT RECORD OF MATERIALS

A. Furnish a record of materials.

B. Where several manufacturers' brands or types of the item listed have been used in the project, designate specific areas where each item was used. Designations shall be keyed to the areas and spaces shown on the contract drawing. Furnish the material record in the following format:

MATERIAL(S) DESIGNATION	SPECIFICATION	MANUFACTURER	MATERIALS USED (MANUFACTURER'S DESIGNATION)	WHERE USED

1.10 EQUIPMENT/PRODUCT WARRANTY LIST

A. Furnish to the Contracting Officer a bound and indexed notebook containing written warranties for equipment/products furnished under the contract and prepare a complete listing of such equipment/products. The equipment/products list shall state the specification section applicable to the equipment/product, duration of the warranty therefore, start date of the warranty, ending date of the warranty, and the point of contact for fulfillment of the warranty. The warranty period shall begin on the same date as project acceptance and shall continue for the full product warranty period. Execute the full list and deliver to the Contracting Officer prior to final acceptance of the facility.

1.11 EQUIPMENT WARRANTY TAGS AND GUARANTOR'S LOCAL REPRESENTATIVE

A. Furnish with each warranty the name, address, and telephone number of the guarantor's representative nearest to the location where the equipment and appliances are installed. The guarantor's representative, upon request of the station representative, shall honor the warranty during the warranty period, and shall provide the services prescribed by the terms of the warranty. At the time of installation, tag each item of warranted equipment with a durable, oil- and water-resistant tag approved by the Contracting Officer. Attach tag with copper wire and spray with a clear silicone waterproof coating. Leave the date of acceptance and QC's signature blank until project is accepted for beneficial occupancy. Tag shall show the following:

EQUIPMENT/PRODUCT WARRANTY TAG
Type of Equipment/Product _____
Warranty Period _____From _____To _____
Contract No. _____
Inspector's Signature _____ Date Accepted _____

Construction Contractor Contact:
Name: _____
Address: _____
Telephone: _____

Warranty Contact:
Name: _____
Address: _____
Telephone: _____
STATION PERSONNEL TO PERFORM ONLY OPERATIONAL MAINTENANCE

1.12 CLEANUP

A. Leave premises "broom clean." Clean interior and exterior glass surfaces exposed to view; remove temporary labels, stains and foreign substances; polish transparent and glossy surfaces; vacuum carpeted and soft surfaces. Clean equipment and fixtures to a sanitary condition. Replace filters of operating equipment. Clean debris from roofs, gutters, downspouts and drainage systems. Sweep paved areas and rake clean landscaped areas. Remove waste and surplus material, rubbish and construction facilities from the site.

PART 2 PRODUCTS – Not Used

PART 3 EXECUTION – Not Used

END OF SECTION

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SECTION 01 78 23

OPERATION AND MAINTENANCE DATA
08/15, CHG 2: 08/21

PART 1 GENERAL

1.1 SUBMITTALS

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

SD-10 Operation and Maintenance Data

O&M Database; G, RO

Training Plan; G, RO

Training Outline; G, RO

Training Content; G, RO

SD-11 Closeout Submittals

Training Video Recording; G, RO

Validation of Training Completion; G, RO

1.2 OPERATION AND MAINTENANCE DATA

Submit Operation and Maintenance (O&M) Data for the provided equipment, product, or system, defining the importance of system interactions, troubleshooting, and long-term preventive operation and maintenance. Compile, prepare, and aggregate O&M data to include clarifying and updating the original sequences of operation to as-built conditions. Organize and present information in sufficient detail to clearly explain O&M requirements at the system, equipment, component, and subassembly level. Include an index preceding each submittal. Submit in accordance with this section and Section 01 33 00 SUBMITTAL PROCEDURES.

1.2.1 Package Quality

Documents must be fully legible. Operation and Maintenance data must be consistent with the manufacturer's standard brochures, schematics, printed instructions, general operating procedures, and safety precautions.

1.2.2 Package Content

Provide data package content in accordance with paragraph SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES. Comply with the data package requirements specified in the individual technical sections, including the content of the packages and addressing each product, component, and system designated for data package submission, except as follows. Use Data Package 5 for commissioned items without a specified data package

requirement in the individual technical sections. Provide a Data Package 5 instead of Data Package 1 or 2, as specified in the individual technical section, for items that are commissioned.

1.2.3 Changes to Submittals

Provide manufacturer-originated changes or revisions to submitted data if a component of an item is so affected subsequent to acceptance of the O&M Data. Submit changes, additions, or revisions required by the Contracting Officer for final acceptance of submitted data within 30 calendar days of the notification of this change requirement.

1.2.4 Commissioning Authority Review and Approval

Submit the commissioned systems and equipment submittals to the Commissioning Authority (CxA) to review for completeness and applicability. Obtain validation from the CxA that the systems and equipment provided meet the requirements of the Contract documents and design intent, particularly as they relate to functionality, energy performance, water performance, maintainability, sustainability, system cost, indoor environmental quality, and local environmental impacts. The CxA communicates deficiencies to the Contracting Officer. Submit the O&M manuals to the Contracting Officer upon a successful review of the corrections, and with the CxA recommendation for approval and acceptance of these O&M manuals. This work is in addition to the normal review procedures for O&M data.

1.3 O&M DATABASE

Develop an editable, electronic spreadsheet based on the equipment in the Operation and Maintenance Manuals that contains the information required to start a preventive maintenance program. As a minimum, provide list of system equipment, location installed, warranty expiration date, manufacturer, model, and serial number.

1.4 OPERATION AND MAINTENANCE MANUAL FILE FORMAT

Assemble data packages into electronic Operation and Maintenance Manuals. Assemble each manual into a composite electronically indexed file using the most current version of Adobe Acrobat or similar software capable of producing PDF file format. Provide compact disks (CD) or data digital versatile disk (DVD) as appropriate, so that each one contains operation, maintenance and record files, project record documents, and training videos. Include a complete electronically linked operation and maintenance directory.

1.4.1 Organization

Bookmark Product and Drawing Information documents using the current version of CSI MasterFormat numbering system, and arrange submittals using the specification sections as a structure. Use CSI MasterFormat and UFGS numbers along with descriptive bookmarked titles that explain the content of the information that is being bookmarked.

1.4.2 CD or DVD Label and Disk Holder or Case

Provide the following information on the disk label and disk holder or case:

a. Building Number

b. Project Title

c. Activity and Location

d. Construction Contract Number

e. Prepared For: (Contracting Agency)

f. Prepared By: (Name, title, phone number and email address)

g. Include the disk content on the disk label

h. Date

i. Virus scanning program used

1.5 TYPES OF INFORMATION REQUIRED IN O&M DATA PACKAGES

The following are a detailed description of the data package items listed in paragraph SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES.

1.5.1 Operating Instructions

Provide specific instructions, procedures, and illustrations for the following phases of operation for the installed model and features of each system:

1.5.1.1 Safety Precautions and Hazards

List personnel hazards and equipment or product safety precautions for operating conditions. List all residual hazards identified in the Activity Hazard Analysis provided under Section 01 35 26 GOVERNMENT SAFETY REQUIREMENTS. Provide recommended safeguards for each identified hazard.

1.5.1.2 Operator Prestart

Provide procedures required to install, set up, and prepare each system for use.

1.5.1.3 Startup, Shutdown, and Post-Shutdown Procedures

Provide narrative description for Startup, Shutdown and Post-shutdown operating procedures including the control sequence for each procedure.

1.5.1.4 Normal Operations

Provide Control Diagrams with data to explain operation and control of systems and specific equipment. Provide narrative description of Normal Operating Procedures.

1.5.1.5 Emergency Operations

Provide Emergency Procedures for equipment malfunctions to permit a short period of continued operation or to shut down the equipment to prevent further damage to systems and equipment. Provide Emergency Shutdown Instructions for fire, explosion, spills, or other foreseeable contingencies. Provide guidance and procedures for emergency operation of

utility systems including required valve positions, valve locations and zones or portions of systems controlled.

1.5.1.6 Operator Service Requirements

Provide instructions for services to be performed by the operator such as lubrication, adjustment, inspection, and recording gauge readings.

1.5.1.7 Environmental Conditions

Provide a list of Environmental Conditions (temperature, humidity, and other relevant data) that are best suited for the operation of each product, component or system. Describe conditions under which the item equipment should not be allowed to run.

1.5.1.8 Operating Log

Provide forms, sample logs, and instructions for maintaining necessary operating records.

1.5.1.9 Additional Requirements for HVAC Control Systems

Provide Data Package 5 and the following for control systems:

a. Narrative description on how to perform and apply functions, features, modes, and other operations, including unoccupied operation, seasonal changeover, manual operation, and alarms. Include detailed technical manual for programming and customizing control loops and algorithms.

b. Full as-built sequence of operations.

c. Copies of checkout tests and calibrations performed by the Contractor (not Cx tests).

d. Full points list. Provide a listing of rooms with the following information for each room:

(1) Floor

(2) Room number

(3) Room name

(4) Air handler unit ID

(5) Reference drawing number

(6) Air terminal unit tag ID

(7) Heating or cooling valve tag ID

(8) Minimum cfm

(9) Maximum cfm

e. Full print out of all schedules and set points after testing and acceptance of the system.

f. Full as-built print out of software program.

g. Marking of system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.

1.5.2 Preventive Maintenance

Provide the following information for preventive and scheduled maintenance to minimize repairs for the installed model and features of each system. Include potential environmental and indoor air quality impacts of recommended maintenance procedures and materials.

1.5.2.1 Lubrication Data

Include the following preventive maintenance lubrication data, in addition to instructions for lubrication required under paragraph OPERATOR SERVICE REQUIREMENTS:

a. A table showing recommended lubricants for specific temperature ranges and applications.

b. Charts with a schematic diagram of the equipment showing lubrication points, recommended types and grades of lubricants, and capacities.

c. A Lubrication Schedule showing service interval frequency.

1.5.2.2 Preventive Maintenance Plan, Schedule, and Procedures

Provide manufacturer's schedule for routine preventive maintenance, inspections, condition monitoring (predictive tests) and adjustments required to ensure proper and economical operation and to minimize repairs. Provide instructions stating when the systems should be retested. Provide manufacturer's projection of preventive maintenance work-hours on a daily, weekly, monthly, and annual basis including craft requirements by type of craft. For periodic calibrations, provide manufacturer's specified frequency and procedures for each separate operation.

a. Define the anticipated time required to perform each of each test (work-hours), test apparatus, number of personnel identified by responsibility, and a testing validation procedure permitting the record operation capability requirements within the schedule. Provide a remarks column for the testing validation procedure referencing operating limits of time, pressure, temperature, volume, voltage, current, acceleration, velocity, alignment, calibration, adjustments, cleaning, or special system notes. Delineate procedures for preventive maintenance, inspection, adjustment, lubrication and cleaning necessary to minimize repairs.

b. Repair requirements must inform operators how to check out, troubleshoot, repair, and replace components of the system. Include electrical and mechanical schematics and diagrams and diagnostic techniques necessary to enable operation and troubleshooting of the system after acceptance.

1.5.3 Repair

Provide manufacturer's recommended procedures and instructions for correcting problems and making repairs.

1.5.3.1 Troubleshooting Guides and Diagnostic Techniques

Provide step-by-step procedures to promptly isolate the cause of typical malfunctions. Describe clearly why the checkout is performed and what conditions are to be sought. Identify tests or inspections and test equipment required to determine whether parts and equipment may be reused or require replacement.

1.5.3.2 Wiring Diagrams and Control Diagrams

Provide point-to-point drawings of wiring and control circuits including factory-field interfaces. Provide a complete and accurate depiction of the actual job specific wiring and control work. On diagrams, number electrical and electronic wiring and pneumatic control tubing and the terminals for each type, identically to actual installation configuration and numbering.

1.5.3.3 Repair Procedures

Provide instructions and a list of tools required to repair or restore the product or equipment to proper condition or operating standards.

1.5.3.4 Removal and Replacement Instructions

Provide step-by-step procedures and a list of required tools and supplies for removal, replacement, disassembly, and assembly of components, assemblies, subassemblies, accessories, and attachments. Provide tolerances, dimensions, settings and adjustments required. Use a combination of text and illustrations.

1.5.3.5 Spare Parts and Supply Lists

Provide lists of spare parts and supplies required for repair to ensure continued service or operation without unreasonable delays. Special consideration is required for facilities at remote locations. List spare parts and supplies that have a long lead-time to obtain.

1.5.3.6 Repair Work-Hours

Provide manufacturer's projection of repair work-hours including requirements by type of craft. Identify, and tabulate separately, repair that requires the equipment manufacturer to complete or to participate.

1.5.4 Real Property Equipment

Provide a list of installed equipment furnished under this Contract. Include all information usually listed on manufacturer's name plate. In the "EQUIPMENT-IN-PLACE LIST" include, as applicable, the following for each piece of equipment installed: description of item, location (by room number), model number, serial number, capacity, name and address of manufacturer, name and address of equipment supplier, condition, spare parts list, manufacturer's catalog, and warranty. Submit the final list 30 days after transfer of the completed facility.

Sample form with West Point specific formatting is attached and will be provided electronically.

1.5.5 Appendices

Provide information required below and information not specified in the preceding paragraphs but pertinent to the maintenance or operation of the product or equipment. Include the following:

1.5.5.1 Product Submittal Data

Provide a copy of SD-03 Product Data submittals documented with the required approval.

1.5.5.2 Certificates

Provide a copy of SD-07 Certificates submittals documented with the required approval.

1.5.5.3 Manufacturer's Instructions

Provide a copy of SD-08 Manufacturer's Instructions submittals documented with the required approval.

1.5.5.4 O&M Submittal Data

Provide a copy of SD-10 Operation and Maintenance Data submittals documented with the required approval.

1.5.5.5 Parts Identification

Provide identification and coverage for the parts of each component, assembly, subassembly, and accessory of the end items subject to replacement. Include special hardware requirements, such as requirement to use high-strength bolts and nuts. Identify parts by make, model, serial number, and source of supply to allow reordering without further identification. Provide clear and legible illustrations, drawings, and exploded views to enable easy identification of the items. When illustrations omit the part numbers and description, both the illustrations and separate listing must show the index, reference, or key number that will cross-reference the illustrated part to the listed part. Group the parts shown in the listings by components, assemblies, and subassemblies in accordance with the manufacturer's standard practice. Parts data may cover more than one model or series of equipment, components, assemblies, subassemblies, attachments, or accessories, such as typically shown in a master parts catalog.

1.5.5.6 Warranty Information

List and explain the various warranties and clearly identify the servicing and technical precautions prescribed by the manufacturers or Contract documents in order to keep warranties in force. Include warranty information for primary components of the system. Provide copies of warranties required by Section 01 78 00 CLOSEOUT SUBMITTALS.

1.5.5.7 Extended Warranty Information

List all warranties for products, equipment, components, and sub-components whose duration exceeds one year. For each warranty listed, indicate the applicable specification section, duration, start date, end date, and the point of contact for warranty fulfillment. Also, list or reference the specific operation and maintenance procedures that must be

performed to keep the warranty valid. Provide copies of warranties required by Section 01 78 00 CLOSEOUT SUBMITTALS.

1.5.5.8 Personnel Training Requirements

Provide information available from the manufacturers that is needed for use in training designated personnel to properly operate and maintain the equipment and systems.

1.5.5.9 Testing Equipment and Special Tool Information

Include information on test equipment required to perform specified tests and on special tools needed for the operation, maintenance, and repair of components. Provide final set points.

1.5.5.10 Testing and Performance Data

Include completed prefunctional checklists, functional performance test forms, and monitoring reports. Include recommended schedule for retesting and blank test forms. Provide final set points.

1.5.5.11 Field Test Reports and Manufacturer's Field Reports

Provide a copy of Field Test Reports (SD-06) and Manufacturer's Field Reports (SD-09) submittals documented with the required approval.

1.5.5.12 Contractor Information

Provide a list that includes the name, address, and telephone number of the General Contractor and each SubContractor who installed the product or equipment, or system. For each item, also provide the name address and telephone number of the manufacturer's representative and service organization that can provide replacements most convenient to the project site. Provide the name, address, and telephone number of the product, equipment, and system manufacturers.

1.6 SCHEDULE OF OPERATION AND MAINTENANCE DATA PACKAGES

Provide the O&M data packages specified in individual technical sections. The information required in each type of data package follows:

1.6.1 Data Package 1

a. Safety precautions and hazards

b. Cleaning recommendations

c. Maintenance and repair procedures

d. Warranty information

e. Extended warranty information

f. Contractor information

g. Spare parts and supply list

1.6.2 Data Package 2

a. Safety precautions and hazards

b. Normal operations

c. Environmental conditions

d. Lubrication data

e. Preventive maintenance plan, schedule, and procedures

f. Cleaning recommendations

g. Maintenance and repair procedures

h. Removal and replacement instructions

i. Spare parts and supply list

j. Parts identification

k. Warranty information

l. Extended warranty information

m. Contractor information

1.6.3 Data Package 3

a. Safety precautions and hazards

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Environmental conditions

g. Operating log

h. Lubrication data

i. Preventive maintenance plan, schedule, and procedures

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. Product submittal data

q. O&M submittal data

r. Parts identification

s. Warranty information

t. Extended warranty information

u. Testing equipment and special tool information

v. Testing and performance data

w. Contractor information

x. Field test reports

1.6.4 Data Package 4

a. Safety precautions and hazards

b. Operator prestart

c. Startup, shutdown, and post-shutdown procedures

d. Normal operations

e. Emergency operations

f. Operator service requirements

g. Environmental conditions

h. Operating log

i. Lubrication data

j. Preventive maintenance plan, schedule, and procedures

k. Cleaning recommendations

l. Troubleshooting guides and diagnostic techniques

m. Wiring diagrams and control diagrams

n. Repair procedures

o. Removal and replacement instructions

p. Spare parts and supply list

q. Repair work-hours

r. Product submittal data

s. O&M submittal data

t. Parts identification

u. Warranty information

v. Extended warranty information

w. Personnel training requirements

x. Testing equipment and special tool information

y. Testing and performance data

z. Contractor information

aa. Field test reports

1.6.5 Data Package 5

a. Safety precautions and hazards

b. Operator prestart

c. Start-up, shutdown, and post-shutdown procedures

d. Normal operations

e. Environmental conditions

f. Preventive maintenance plan, schedule, and procedures

g. Troubleshooting guides and diagnostic techniques

h. Wiring and control diagrams

i. Maintenance and repair procedures

j. Removal and replacement instructions

k. Spare parts and supply list

l. Product submittal data

m. Manufacturer's instructions

n. O&M submittal data

o. Parts identification

p. Testing equipment and special tool information

q. Warranty information

r. Extended warranty information

s. Testing and performance data

t. Contractor information

u. Field test reports

v. Additional requirements for HVAC control systems

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 TRAINING

Prior to acceptance of the facility by the Contracting Officer for Beneficial Occupancy, provide comprehensive training for the systems and equipment specified in the technical specifications. The training must be targeted for the building maintenance personnel, and applicable building occupants. Instructors must be well-versed in the particular systems that they are presenting. Address aspects of the Operation and Maintenance Manual submitted in accordance with Section 01 77 00 CLOSEOUT SUBMITTALS. Training must include classroom or field lectures based on the system operating requirements. The location of classroom training requires approval by the Contracting Officer.

3.1.1 Training Plan

Submit a written training plan to the Contracting Officer for approval at least 60 calendar days prior to the scheduled training. Training plan must be approved by the Quality Control Manager (QC) prior to forwarding to the Contracting Officer. Also, coordinate the training schedule with the Contracting Officer and QC. Include within the plan the following elements:

a. Equipment included in training

b. Intended audience

c. Location of training

d. Dates of training

e. Objectives

f. Outline of the information to be presented and subjects covered including description

g. Start and finish times and duration of training on each subject

h. Methods (e.g. classroom lecture, video, site walk-through, actual operational demonstrations, written handouts)

i. Instructor names and instructor qualifications for each subject

j. List of texts and other materials to be furnished by the Contractor that are required to support training

k. Description of proposed software to be used for video recording of training sessions.

3.1.2 Training Content

The core of this training must be based on manufacturer's recommendations and the operation and maintenance information. The QC is responsible for overseeing and approving the content and adequacy of the training. Spend 95 percent of the instruction time during the presentation on the OPERATION AND MAINTENANCE DATA. Include the following for each system training presentation:

a. Start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, controls set-up and programming, troubleshooting, and alarms.

b. Relevant health and safety issues.

c. Discussion of how the feature or system is environmentally responsive. Advise adjustments and optimizing methods for energy conservation.

d. Design intent.

e. Use of O&M Manual Files.

f. Review of control drawings and schematics.

g. Interactions with other systems.

h. Special maintenance and replacement sources.

i. Tenant interaction issues.

3.1.3 Training Outline

Provide the Operation and Maintenance Manual Files (Bookmarked PDF) and a written course outline listing the major and minor topics to be discussed by the instructor on each day of the course to each trainee in the course. Provide the course outline 14 calendar days prior to the training.

3.1.4 Training Video Recording

Record classroom training session(s) on video. Provide to the Contracting Officer two copies of the training session(s) in DVD video recording format. Capture within the recording, in video and audio, the instructors' training presentations including question and answer periods with the attendees. The recording camera(s) must be attended by a person during the recording sessions to assure proper size of exhibits and projections during the recording are visible and readable when viewed as training.

3.1.5 Unresolved Questions from Attendees

If, at the end of the training course, there are questions from attendees that remain unresolved, the instructor must send the answers, in writing, to the Contracting Officer for transmittal to the attendees, and the training video must be modified to include the appropriate clarifications.

3.1.6 Validation of Training Completion

Ensure that each attendee at each training session signs a class roster

daily to confirm Government participation in the training. At the completion of training, submit a signed validation letter that includes a sample record of training for reporting what systems were included in the training, who provided the training, when and where the training was performed, and copies of the signed class rosters. Provide two copies of the validation to the Contracting Officer, and one copy to the Operation and Maintenance Manual Preparer for inclusion into the Manual's documentation.

3.1.7 Quality Control Coordination

Coordinate this training with the QC in accordance with Section 01 45 00.00 10 QUALITY CONTROL.

-- End of Section --

SECTION 01 78 24.00 10

FACILITY DATA REQUIREMENTS
05/18

PART 1 GENERAL

This specification requires the collection, organization, and turnover of electronic Facility Data for specific assets designed and constructed as part of this Contract. Provide a Facility Document Set (FDS) and Facility Data Workbook (FDW) as defined in this specification. See Sections 01 33 00 SUBMITTAL PROCEDURES, 01 77 00 CLOSEOUT SUBMITTALS, 01 78 23 OPERATION AND MAINTENANCE DATA, for additional Facility Data delivery requirements.

1.1 DEFINITIONS AND ABBREVIATIONS

1.1.1 Assets

Assets are specific items of property or equipment.

1.1.2 Attributes

Attributes are individual pieces of Facility Data that describe facilities and their associated assets.

1.1.3 Facility Data

Information defined and collected in the Facility Data Workbook (FDW) and Facility Document Set (FDS).

1.1.4 Facility Document Set (FDS)

An electronically compiled and organized document containing the supporting documents and data used to populate the Facility Data Workbook during its respective phase of development.

b. For construction-based deliverables, the FDS is comprised of the project Operation and Maintenance Data Packages and Government-Approved Record drawings.

1.1.5 Facility Data Workbook (FDW)

A pre-formatted spreadsheet template used to compile Asset, Attribute, Facility, and Space Data that the Government wishes to manage via electronic means. The FDW also contains all requirements associated with proper collection, organization, and turnover of the Facility Data.

1.1.6 Facility Data Project Execution Plan (FDPxP)

A document that describes the clear and organized plan for the collection, organization, and turnover of the Facility Data deliverables required by this specification.

1.2 UNITS OF MEASURE

Provide Facility Data deliverables utilizing the units of measure

identified in the Contract documents.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification 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

Facility Data Project Execution Plan(FDPxP)

SD-10 Operation and Maintenance Data

Facility Data Workbook, Construction Progress; G, RO

Facility Document Set, Construction Progress; G, RO

SD-11 Closeout Submittals

Facility Data Workbook, Construction Final; G, RO

Facility Document Set, Construction Final; G, RO

1.4 QUALITY ASSURANCE

1.4.1 Facility Data Project Execution Plan (FDPxP)

Provide the Government with a plan for the collection, organization, and turnover of the Facility Data deliverables to the Government. At a minimum, include the following items in the FDPxP:

1.4.1.1 Front Matter

Provide a Cover Page, Table of Contents, and Executive Summary/Objectives.

1.4.1.2 Project Information

List the Project Owner, Project Name, Project Location and address, Contract Type, Project Description, Project/Contract Number, Project Milestones.

1.4.1.3 Submittal Schedule

Identify delivery schedule for all deliverables in compliance with the submission requirements identified in this specification.

1.4.1.4 Personnel

Identify key personnel involved in the development of the Facility Data deliverables including Contractor and Government personnel.

1.4.1.5 Facility Data Workbook(s)

Identify Facility and Space Data as applicable at time of FDPxP submission. Individually list every asset group from the FDW Requirements

that will require Facility Data collection. No attribute data is required at this time. Identify any asset groups from the FDW Requirements that are not required within the scope of this Contract. Document the version of FDW to be used through the duration of the project.

1.4.1.6 Facility Document Set(s)

Define structure and format of the submittal. Provide a comprehensive outline of the final FDS to be delivered. Organize the outline with headings, titles, and descriptions such that the Government may ascertain that working documents comply with the formatting requirements defined by this specification.

1.4.1.7 Protocols

Detailed procedures:

a. Facility Data documentation/collection process.

b. Facility Document Set production/development process.

c. Collaboration procedures including strategy, meetings, communication, and subContractor/consultant involvement.

d. Quality Control, including site verification of FDW, as applicable.

e. File and folder naming structure.

f. Hardware and software being used for collection and organization of Facility Data. Identify type, format, and anticipated organization of digital storage media to be provided as part of required deliverables. Include means and methods for checking deliverables for malicious content.

1.4.2 Meetings

To assure that Facility Data requirements are being met through the duration of the project, organize the following meetings and discuss the subsequent topics:

1.4.2.1 Pre-Construction Meeting

At a minimum, discuss the following:

a. The requirement for Facility Data deliverables under this Contract.

b. Primary roles and responsibilities associated with the development and delivery of the Facility Data deliverables, and.

c. Identify and agree upon a date and attendance list for the meetings described below:

1.4.2.2 FDPxP Coordination Meeting

a. Facilitate a meeting following submission and Government review of the FDPxP. Include the Facility Data Preparer(s), Designer of Record (DOR),, Quality Control (QC) Manager, Government's Facility Data Proponent, Contracting Officer's Representative, and Directorate of Public Works (DPW) Facilities Management Specialist (FMS). Also

include any Government personnel required for obtaining security clearances and waivers for proper Facility Data collection in this meeting.

b. The purpose of this meeting is to coordinate the efforts necessary by Contract parties to ensure an accurate collection, preparation, quality control, and submittal of these deliverables.

c. The FDPxP serves as the primary agenda for this meeting. At a minimum, discuss the following:

(1) Processes and methods of gathering facility data during construction. Discuss and obtain special permissions and/or waivers as necessary (photo waivers, data encryption, etc.);

(2) Contractor Quality Control practices and procedures;

(3) Corrective actions necessary for Government approval of FDPxP;

(4) Necessity for additional or recurring Facility Data Coordination Meetings outside of those required by this specification, as requested by the Contractor. Intent of these meetings would be to maintain regular contact between responsible parties of the Contractor and Government with regard to development of the facility data deliverables. Conduct status meetings with a frequency agreed upon at this meeting.

1.4.2.3 Submittal Coordination Meeting

a. Facilitate a meeting following submission and Government review of each design or progress submittal of the Facility Data. Include the Facility Data Preparer(s), Designer of Record (DOR), Quality Control (QC) Manager, Commissioning Authority (CA), Government's Facility Data Proponent, Contracting Officer's Representative, and Directorate of Public Works (DPW) Facilities Management Specialist (FMS). Include Mechanical, Electrical, Plumbing, and Fire Protection subContractors as applicable.

b. The purpose of this meeting is to demonstrate ongoing compliance with the requirements identified in this specification.

c. The applicable deliverables, along with Government remarks associated with review of these submittals serve as the primary guide and agenda for this meeting. At a minimum, discuss the following during this meeting:

(1) Review assets, applicable attributes, facility, and space data in FDW at time of submittal;

(2) Demonstrate Quality Control and site verification procedures, as applicable, by Contractor QC;

(3) Review contents and organization of FDS at time of submittal;

(4) Discuss Government review comments and/or unresolved items preventing completion and Government approval of the Facility Data Workbook and Facility Document Set.

1.4.3 Facility Turnover and Contract Closeout

Include the Facility Document Set, Construction Final as a deliverable in Facility Turnover and Contract Closeout procedures as defined in 01 78 00 CLOSEOUT SUBMITTALS.

1.4.4 Facility Data Workbook Quality Requirements

For each submittal, ensure that the information contained in the FDW(s) reflects the minimum content requirements defined in the PART 3 EXECUTION portion of this section. Ensure that information provided as part of the FDW(s) conforms to the standards described below:

a. Compile FDW(s) using approved spreadsheet templates. Do not alter the formatting or organizational layout of the templates in any way. For this Contract, templates are available for download from the USACE CAD/BIM Technology Center website, site information provided in the PART 2 PRODUCTS portion of this section.

b. Instructions for the proper maintenance and completion of these FDWs are contained in the FDW Requirements contained within the FDW template.

1.4.5 Facility Document Set Quality Requirements

Ensure that information provided as part of each FDS conforms to the electronic and data formatting standards identified in 01 33 00 SUBMITTAL REQUIREMENTS and 01 78 23 OPERATION AND MAINTENANCE DATA.

1.4.6 Facility Document Set Integrity Requirements

Ensure that information provided as part of each FDS conforms to the integrity standards identified below:

1.4.6.1 File Protection

Do not restrict data files, document files or photographic files from being printed, exported, modified or copied. Do not deliver files with any restrictions (expiration date, locks, etc.) for access, viewing, archiving, or editing.

1.4.6.2 Manufacturer-Specific Documents

Provide text-searchable, vector-based document files from the manufacturer's online or electronic documentation. Color documents are preferred. Provide documents specific to the product(s) installed under this Contract. When possible, do not submit document files containing multiple product catalogs from the same manufacturer, or product data from multiple manufacturers in the same file. Provide documents directly from the manufacturer whenever possible. Do not provide scanned copies of hardcopy documents.

1.5 DELIVERY, STORAGE, AND HANDLING

Deliver facility data submittals in an organized and legible manner. Provide submittals adhering to the requirements of of 01 33 00 SUBMITTAL REQUIREMENTS and 01 78 23 OPERATION AND MAINTENANCE DATA.

1.5.1 Number of Copies

Provide three identical copies of disks for approval; for each submittal and each facility required. Provide on approved electronic media (one copy per disk or set of disks) as defined below. Provide submittal files on electronic storage media in compliance with the quality requirements identified in this specification.

1.5.2 Malicious Content

Scan all files for malicious viruses using a commercially available scanning program that is routinely updated to identify and remove current virus threats.

1.5.3 Storage Media

Provide facility data on disk-based (DVD-R/RW) media. Any deviations from the required storage media must be approved by the Government. Select and apply technology used for electronic data transmission to ensure that the full Facility Data submittal for each facility is provided on one single disk, whenever possible. When separation of the submittal is required, first separate the FDS and the FDW onto separate media. Second, separate FDS into logical segments or components. Any further divisions must be documented in the FDPxP and approved by the Government.

Provide Facility Data on disk-based (DVD-R/RW) media. Any deviations from the required storage media must be approved by the Government. Select and apply technology used for electronic data transmission to ensure that the full Facility Data submittal for each facility is provided on one single disk, whenever possible. When separation of the submittal is required, first separate the FDS and the FDW onto separate media. Second, separate FDS into logical segments or components. Any further divisions must be documented in the FDPxP and approved by the Government.

a. Apply a label directly printed to storage media. Do not provide adhesive, paper-based labels. List the name of the facility, Project, Project location, Contract number, Designer of Record firm/Prime Contractor company's name, title of submission, and security classification (in accordance with the appropriate security classification labeling regulations) on the label. If multiple disks are provided, clearly document the contents of each disk on the label.

b. Include the name and contact information of the individual who produced the final data disk to ensure that any problems with the data or media can be easily resolved.

c. When browsed on any computer, the disk must display the following folders and their associated content:

    (1) Facility Data Workbook (containing 1 FDW per facility);
    (2) Facility Document Set (containing 1 FDS per facility);
    (3) FDPxP (containing 1 PxP per Contract);
    (4) Readme (Containing 1 TXT, PDF, or HTML file with general use information, organizational instructions, and basic preparer contact information. Include all information included on the storage media label).

PART 2 PRODUCTS

2.1 FACILITY DATA WORKBOOK(S)

Provide one compiled FDW for the entire facility. Complete all portions of the FDW including facility, space, asset, and attribute data in compliance with the FDW Requirements. The current FDW template (.xlsm format) must be downloaded from the USACE CAD/BIM Technology Center website at https://cadbimcenter.erdc.dren.mil.

2.1.1 Spaces

Provide data for all applicable spaces in the facility. Minimum space definitions are as follows:

a. Provide all rooms as defined in the design documents.
b. If not otherwise defined, provide a minimum of one "roof" space in the FDW.
c. If not otherwise defined, provide a minimum of one "site" space in the FDW.
d. Provide all spaces not otherwise described, but necessary to accurately indicate the location of all FDW assets required by this specification.

2.1.2 Assets

a. Provide data for all applicable asset types described in the "Required Assets" portion of the FDW template and any additional assets defined in the FDPxP. Populate each FDW with every instance of equipment within the scope of the Contract fitting the asset descriptions identified therein. This includes all assets in Contract scope including assets inside and outside of the building footprint, as well as on the site, underground, and anywhere within the project extents.

b. Sub-component assets that are an integral and functional part of another component (e.g. An electric motor that serves as part of an air-handling unit) need not be duplicated or listed separately as its own asset.

c. Definitions, descriptions, and formatting requirements for these assets can be found in the FDW Requirements contained within the FDW template.

d. If an asset type is not included in the scope of the Project, no Facility Data (assets or attributes) are to be included in the FDW (even as a placeholder) for that asset type.

2.1.3 Attributes

a. Populate each individual asset with all required attributes defined in the "Required Attributes" portion of the FDW template.

b. Definitions, descriptions, and formatting requirements for these attributes can be found in the FDW Requirements contained within the FDW template.

c. If an attribute is not applicable, populate that field with "N/A." Do not leave it blank.

2.2 FACILITY DOCUMENT SET

2.2.1 Organization

Organize the FDS in a hierarchical manner as follows. Use electronic bookmarks to create an easily navigable document. The first and primary hierarchical level must contain the following bookmarks:

a. "O&M Data" - See subordinate hierarchical requirements in the "O&M DATA HIERARCHY" paragraph.

b. "Record Drawings" - See subordinate hierarchical requirements in paragraph RECORD DRAWINGS HIERARCHY.

2.2.1.1 O&M Data Hierarchy

Under "O&M Data" provide all Government-Approved O&M Data Packages as defined in 01 78 23 OPERATION AND MAINTENANCE DATA and as required by technical specifications contained within this Contract. Further organize this information under the following hierarchical levels:

a. The Contract specification and title under which the Data Package and the associated equipment or system references. (e.g. 26 23 00.00 40 - SWITCHBOARDS AND SWITCHGEAR)

b. The Data Package Number as defined in 01 78 23 OPERATION AND MAINTENANCE DATA. (e.g. Data Package 2)

2.2.1.2 Record Drawings Hierarchy

Under "Record Drawings" provide an electronic copy of the Government-Approved record drawings, as specified in 01 77 00 CLOSEOUT SUBMITTALS, for the project in PDF format. Further group discipline sheets under the following hierarchical levels:

a. The full discipline heading represented by the contents of the sheet and as shown in the Record Drawing Sheet Index. Organize these headings in the order that the drawings set is organized. (General, Civil, Structural, Architectural, Interiors, Plumbing, Mechanical, Electrical, Telecommunications, etc.)

b. The Sheet ID and Sheet Name as found in the Record Drawing Sheet Index and in accordance with the AEC CAD Standard referenced in 01 77 00 CLOSEOUT SUBMITTALS. (e.g. G-001 - LEGEND; CS101 - SITE PLAN AREA 101; A-101 - OVERALL FIRST FLOOR PLAN; P-601 - FIRST FLOOR DWS WATER RISER DIAGRAM, etc.)

PART 3 EXECUTION

3.1 CONSTRUCTION PROGRESS SUBMITTALS

Submit the FDW and FDS construction progress submittals together. Meet the following completeness and formatting requirements listed below:

a. Provide Facility Data Workbook, Construction Progress submittal(s) when all assets are identified, but not later than 90 days prior to Beneficial Occupancy Date (BOD) as identified in the

Government-Approved construction schedule. Clearly identify any assets or asset groups missing in the "variations" section of the ENG Form 4025 Transmittal Form provided with the submittal. Populate assets with any front-loaded attribute data that is available at the time of asset input. See the FDW Requirements contained within the FDW template for a list of attributes to be completed for this submittal.

b. Submit individual FDW templates for each facility identified in the "FACILITIES" paragraph. While FDWs are not required to be complete for this submittal, any data provided must be accurate and formatted correctly according to the FDW Requirements.

c. Submit a sample or working Facility Document Set, Construction Progress submittal containing "draft" or "example" documents that are organized in the manner defined by this specification. Draft or example documents need not be technically accurate or complete in their content, but defined and separated in a manner such that all organizational and formatting requirements defined by this specification may be evaluated.

3.2 CONSTRUCTION FINAL SUBMITTALS

Submit the FDW and FDS construction final submittals as they are completed. Coordinate the Facility Data Workbook, Construction Final submittal with data verification procedures as defined in the accepted FDPxP. Provide the Facility Document Set, Construction Final submittal only after Government acceptance of its individual components as defined by 01 77 00 CLOSEOUT SUBMITTALS and 01 78 23 OPERATION AND MAINTENANCE DATA.

3.3 FACILITY DATA WORKBOOK VERIFICATION

Verify the FDW through the quality control personnel and procedures as defined in the FDPxP. One-hundred percent accuracy of FDW information is required for Government acceptance of the Facility Data Workbook, Construction Final submittal.

--Attachments--
Project Facility Data Worksheets

-- End of Section --

SECTION 02 41 00

DEMOLITION
05/10, CHG 2: 02/19

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-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI Guideline K	(2009) Guideline for Containers for Recovered Non-Flammable Fluorocarbon Refrigerants

AMERICAN SOCIETY OF SAFETY PROFESSIONALS (ASSP)

ASSP A10.6	(2006) Safety & Health Program Requirements for Demolition Operations - American National Standard for Construction and Demolition Operations

U.S. ARMY CORPS OF ENGINEERS (USACE)

EM 385-1-1	(2014) Safety Safety and Health Requirements Manual

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

40 CFR 61	National Emission Standards for Hazardous Air Pollutants
40 CFR 82	Protection of Stratospheric Ozone

1.2 PROJECT DESCRIPTION

1.2.1 Definitions

1.2.1.1 Demolition

Demolition is the process of wrecking or taking out any load-supporting structural member of a facility together with any related handling and disposal operations.

1.2.1.2 Demolition Plan

Demolition Plan is the planned steps and processes for managing demolition activities and identifying the required sequencing activities and disposal mechanisms.

1.2.2 Demolition/Deconstruction Plan

Prepare a Demolition Plan and submit proposed demolition, and removal

procedures for approval before work is started. Include in the plan procedures for careful removal and disposition of materials specified to be salvaged, coordination with other work in progress, a disconnection schedule of a detailed description of methods and equipment to be used for each operation and of the sequence of operations. Coordinate with Waste Management Plan in accordance with Section 01 57 20 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT. Provide procedures for safe conduct of the work in accordance with EM 385-1-1. Plan shall be approved by Contracting Officer prior to work beginning.

1.2.3 General Requirements

Do not begin demolition until authorization is received from the Contracting Officer. Remove rubbish and debris from the project site; do not allow accumulations inside or outside the building . The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Remove rubbish and debris from Government property daily. In the interest of occupational safety and health, perform the work in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections.

1.3 ITEMS TO REMAIN IN PLACE

Take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government. Repair or replace damaged items as approved by the Contracting Officer. Coordinate the work of this section with all other work indicated. Construct and maintain shoring, bracing, and supports as required. Ensure that structural elements are not overloaded. Increase structural supports or add new supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract. Do not overload structural elements . Provide new supports and reinforcement for existing construction weakened by demolition, deconstruction, or removal work. Repairs, reinforcement, or structural replacement require approval by the Contracting Officer prior to performing such work.

1.3.1 Existing Construction Limits and Protection

Do not disturb existing construction beyond the extent indicated or necessary for installation of new construction. Provide protective measures to control accumulation and migration of dust and dirt in all work areas. Remove dust, dirt, and debris from work areas daily.

1.3.2 Weather Protection

For portions of the building to remain, protect building interior and materials and equipment from the weather at all times.

1.3.3 Trees

Protect trees within the project site which might be damaged during demolition and which are indicated to be left in place, by a 6 foot high fence. Erect and secure fence a minimum of 5 feet from the trunk of individual trees or follow the outer perimeter of branches or clumps of trees. Replace any tree designated to remain that is damaged during the work under this contract with like-kind or as approved by the Contracting Officer.

1.3.4 Utility Service

Maintain existing utilities indicated to stay in service and protect against damage during demolition operations. Prior to start of work, coordinate disconnection of utilities serving each area of alteration or removal with the Contracting Officer.

1.3.5 Facilities

Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities. Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, must remain standing without additional bracing, shoring, or lateral support until demolished unless directed otherwise by the Contracting Officer. Ensure that no elements determined to be unstable are left unsupported and place and secure bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, deconstruction, or demolition work performed under this contract.

1.4 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.5 AVAILABILITY OF WORK AREAS

Areas in which the work is to be accomplished will be available in accordance with the phasing drawings.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Demolition Plan; G

Existing Conditions

SD-07 Certificates

Notification; G

SD-11 Closeout Submittals

Receipts

1.7 QUALITY ASSURANCE

Submit timely notification of demolition projects to Federal, State, regional, and local authorities in accordance with 40 CFR 61, Subpart M. Notify the and the Contracting Officer in writing 10 working days prior to

the commencement of work in accordance with 40 CFR 61, Subpart M. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the "Contract Clauses," conform to the safety requirements contained in ASSP A10.6. Comply with the Environmental Protection Agency requirements specified. Use of explosives will not be permitted.

1.7.1 Dust and Debris Control

Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution. Vacuum and dust the work area daily. Sweep pavements as often as necessary to control the spread of debris that may result in pedestrian hazard.

1.8 PROTECTION

1.8.1 Traffic Control Signs

a. Where pedestrian and driver safety is endangered in the area of removal work, use traffic barricades with flashing lights. Notify the Contracting Officer prior to beginning such work.

1.8.2 Protection of Personnel

Before, during and after the demolition work continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the project site.

1.9 RELOCATIONS

Perform the removal and reinstallation of relocated items as indicated with workmen skilled in the trades involved. Repair or replace items to be relocated which are damaged by the Contractor with new undamaged items as approved by the Contracting Officer.

1.10 EXISTING CONDITIONS

Before beginning any demolition work, survey the site and examine the drawings and specifications to determine the extent of the work. Record existing conditions in the presence of the Contracting Officer showing the condition of structures and other facilities adjacent to areas of alteration or removal. Photographs sized 4 inch will be acceptable as a record of existing conditions. Include in the record the elevation of the top of foundation walls, finish floor elevations, possible conflicting electrical conduits, plumbing lines, alarms systems, the location and extent of existing cracks and other damage and description of surface conditions that exist prior to before starting work. It is the Contractor's responsibility to verify and document all required outages which will be required during the course of work, and to note these outages on the record document. Submit survey results.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EXISTING FACILITIES TO BE REMOVED

3.1.1 Utilities and Related Equipment

3.1.1.1 General Requirements

Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by the Contracting Officer. Do not interrupt existing utilities serving facilities occupied and used by the Government except when approved in writing and then only after temporary utility services have been approved and provided. Do not begin demolition work until all utility disconnections have been made. Shut off and cap utilities for future use, as indicated.

3.1.1.2 Disconnecting Existing Utilities

Remove existing utilities, as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by the Contracting Officer. When utility lines are encountered but are not indicated on the drawings, notify the Contracting Officer prior to further work in that area.

3.1.2 Paving and Slabs

Remove concrete and asphaltic concrete paving and slabs including aggregate base as indicated to a depth sufficient to install new work at indicated elevations. Provide neat sawcuts at limits of pavement removal as indicated. Pavement and slabs not to be used in this project shall be removed from the Installation at Contractor's expense.

3.1.3 Masonry

Sawcut and remove masonry so as to prevent damage to surfaces to remain and to facilitate the installation of new work. Provide square, straight edges and corners where existing masonry adjoins new work and other locations.

3.1.4 Concrete

Saw concrete along straight lines to a depth of a minimum 2 inch. Make each cut in walls perpendicular to the face and in alignment with the cut in the opposite face. Break out the remainder of the concrete provided that the broken area is concealed in the finished work, and the remaining concrete is sound. At locations where the broken face cannot be concealed, grind smooth or saw cut entirely through the concrete.

3.1.5 Acoustic Ceiling Tile

Remove, neatly stack, and recycle acoustic ceiling tiles. Recycling may be available with manufacturer. Otherwise, priority shall be given to a local recycling organization. Recycling is not required if the tiles contain or may have been exposed to asbestos material.

3.1.6 Patching

Where removals leave holes and damaged surfaces exposed in the finished work, patch and repair these holes and damaged surfaces to match adjacent finished surfaces, using on-site materials when available. Where new work is to be applied to existing surfaces, perform removals and patching in a manner to produce surfaces suitable for receiving new work. Finished surfaces of patched area shall be flush with the adjacent existing surface and shall match the existing adjacent surface as closely as possible as to texture and finish.

3.1.7 Air Conditioning Equipment

Remove air conditioning, refrigeration, and other equipment containing refrigerants without releasing chlorofluorocarbon refrigerants to the atmosphere in accordance with the Clean Air Act Amendment of 1990. Recover all refrigerants prior to removing air conditioning, refrigeration, and other equipment containing refrigerants and dispose of in accordance with the paragraph entitled "Disposal of Ozone Depleting Substance (ODS)." Turn in salvaged Class I ODS refrigerants as specified in paragraph, "Salvaged Materials and Equipment."

3.1.8 Mechanical Equipment and Fixtures

Disconnect mechanical hardware at the nearest connection to existing services to remain, unless otherwise noted. Disconnect mechanical equipment and fixtures at fittings. Remove service valves attached to the unit. Salvage each item of equipment and fixtures as a whole unit; listed, indexed, tagged, and stored. Salvage each unit with its normal operating auxiliary equipment. Transport salvaged equipment and fixtures, including motors and machines, to a designated storage area as directed by the Contracting Officer. Do not remove equipment until approved. Do not offer low-efficiency equipment for reuse.

3.1.8.1 Preparation for Storage

Remove water, dirt, dust, and foreign matter from units; tanks, piping and fixtures shall be drained; interiors, if previously used to store flammable, explosive, or other dangerous liquids, shall be steam cleaned. Seal openings with caps, plates, or plugs. Secure motors attached by flexible connections to the unit. Change lubricating systems with the proper oil or grease.

3.1.8.2 Piping

Disconnect piping at unions, flanges and valves, and fittings as required to reduce the pipe into straight lengths for practical storage. Store salvaged piping according to size and type. If the piping that remains can become pressurized due to upstream valve failure, end caps, blind flanges, or other types of plugs or fittings with a pressure gage and bleed valve shall be attached to the open end of the pipe to ensure positive leak control. Carefully dismantle piping that previously contained gas, gasoline, oil, or other dangerous fluids, with precautions taken to prevent injury to persons and property. Store piping outdoors until all fumes and residues are removed. Box prefabricated supports, hangers, plates, valves, and specialty items according to size and type. Wrap sprinkler heads individually in plastic bags before boxing. Classify piping not designated for salvage, or not reusable, as scrap metal.

3.1.8.3 Ducts

Classify removed duct work as scrap metal.

3.1.8.4 Fixtures, Motors and Machines

Remove and salvage fixtures, motors and machines associated with plumbing, heating, air conditioning, refrigeration, and other mechanical system installations. Salvage, box and store auxiliary units and accessories with the main motor and machines. Tag salvaged items for identification, storage, and protection from damage. Classify broken, damaged, or otherwise unserviceable units and not caused to be broken, damaged, or otherwise unserviceable as debris to be disposed of by the Contractor.

3.1.9 Electrical Equipment and Fixtures

Salvage motors, motor controllers, and operating and control equipment that are attached to the driven equipment. Salvage wiring systems and components. Box loose items and tag for identification. Disconnect primary, secondary, control, communication, and signal circuits at the point of attachment to their distribution system.

3.1.9.1 Fixtures

Remove and salvage electrical fixtures. Salvage unprotected glassware from the fixture and salvage separately. Salvage incandescent, mercury-vapor, and fluorescent lamps and fluorescent ballasts manufactured prior to 1978, boxed and tagged for identification, and protected from breakage.

3.1.9.2 Electrical Devices

Remove and salvage switches, switchgear, transformers, conductors including wire and nonmetallic sheathed and flexible armored cable, regulators, meters, instruments, plates, circuit breakers, panelboards, outlet boxes, and similar items. Box and tag these items for identification according to type and size.

3.1.9.3 Wiring Ducts or Troughs

Remove and salvage wiring ducts or troughs. Dismantle plug-in ducts and wiring troughs into unit lengths. Remove plug-in or disconnecting devices from the busway and store separately.

3.1.9.4 Conduit and Miscellaneous Items

Salvage conduit except where embedded in concrete or masonry. Consider corroded, bent, or damaged conduit as scrap metal. Sort straight and undamaged lengths of conduit according to size and type. Classify supports, knobs, tubes, cleats, and straps as debris to be removed and disposed.

3.2 DISPOSITION OF MATERIAL

3.2.1 Title to Materials

Except for salvaged items specified in related Sections, and for materials or equipment scheduled for salvage, all materials and equipment removed and not reused or salvaged, shall become the property of the Contractor

and shall be removed from Government property. Title to materials resulting from demolition and deconstruction, and materials and equipment to be removed, is vested in the Contractor upon approval by the Contracting Officer of the Contractor's demolition, and removal procedures, and authorization by the Contracting Officer to begin demolition. The Government will not be responsible for the condition or loss of, or damage to, such property after contract award. Showing for sale or selling materials and equipment on site is prohibited.

3.2.2 Reuse of Materials and Equipment

Remove and store materials and equipment indicated to be reused or relocated to prevent damage, and reinstall as the work progresses. Coordinate the re-use of materials and equipment with the re-use requirements in accordance with Section 01 57 20 CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT Capture re-use of materials in the diversion calculations for the project.

3.2.3 Disposal of Ozone Depleting Substance (ODS)

Class I and Class II ODS are defined in Section, 602(a) and (b), of The Clean Air Act. Prevent discharge of Class I and Class II ODS to the atmosphere. Place recovered ODS in cylinders meeting AHRI Guideline K suitable for the type ODS (filled to no more than 80 percent capacity) and provide appropriate labeling. Recovered ODS shall be removed from Government property and disposed of in accordance with 40 CFR 82. Products, equipment and appliances containing ODS in a sealed, self-contained system (e.g. residential refrigerators and window air conditioners) shall be disposed of in accordance with 40 CFR 82. Submit Receipts or bills of lading, as specified. Submit a shipping receipt or bill of lading for all containers of ozone depleting substance (ODS) shipped to the Defense Depot, Richmond, Virginia.

3.2.3.1 Special Instructions

No more than one type of ODS is permitted in each container. A warning/hazardous label shall be applied to the containers in accordance with Department of Transportation regulations. All cylinders including but not limited to fire extinguishers, spheres, or canisters containing an ODS shall have a tag with the following information:

a. Activity name and unit identification code

b. Activity point of contact and phone number

c. Type of ODS and pounds of ODS contained

d. Date of shipment

e. National stock number (for information, call (804) 279-4525).

3.2.4 Unsalvageable and Non-Recyclable Material

Dispose of unsalvageable and non-recyclable combustible material in a legal sanitary fill area located off the site.

3.3 CLEANUP

Remove debris and rubbish throughout. Remove and transport the debris in

a manner that prevents spillage on streets or adjacent areas. Apply local regulations regarding hauling and disposal.

3.4 DISPOSAL OF REMOVED MATERIALS

3.4.1 Regulation of Removed Materials

Dispose of debris, rubbish, scrap, and other nonsalvageable materials resulting from removal operations with all applicable federal, state and local regulations as contractually specified off the West Point property. Storage of removed materials on the project site is prohibited.

3.4.2 Burning on Government Property

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

3.4.3 Removal from Government Property

Transport waste materials removed from demolished structures, except waste soil, from Government property for legal disposal. Dispose of waste soil as directed.

3.5 REUSE OF SALVAGED ITEMS

Recondition salvaged materials and equipment designated for reuse before installation. Replace items damaged during removal and salvage operations or restore them as necessary to usable condition.

-- End of Section --

SECTION 07 60 00

FLASHING AND SHEET METAL
05/17, CHG 2: 11/18

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 A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM D41/D41M	(2011; R 2016) Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1793	(2012) Architectural Sheet Metal Manual, 7th Edition

1.2 GENERAL REQUIREMENTS

Finished sheet metal assemblies must form a weathertight enclosure without waves, warps, buckles, fastening stresses or distortion, while allowing for expansion and contraction without damage to the system. The sheet metal installer is responsible for cutting, fitting, drilling, and other operations in connection with sheet metal modifications required to accommodate the work of other trades. Coordinate installation of sheet metal items used in conjunction with roofing with roofing work to permit continuous, uninterrupted roofing operations.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

(Show all thicknesses, materials, profiles and attachment methods)

Gutters; G

Downspouts; G

Recycled Content; S

SD-03 Product Data

Factory fabricated gutter systems

SD-04 Samples

Finish Samples; G

1.4 MISCELLANEOUS REQUIREMENTS

1.4.1 Product Data

Indicate thicknesses, dimensions, fastenings, anchoring methods, expansion joints, and other provisions necessary for thermal expansion and contraction. Scaled manufacturer's catalog data may be submitted for factory fabricated items.

1.4.2 Finish Samples

Submit two color charts and two finish sample chips from manufacturer's standard color and finish options for each type of finish indicated.

1.5 DELIVERY, HANDLING, AND STORAGE

Package and protect materials during shipment. Uncrate and inspect materials for damage, dampness, and wet-storage stains upon delivery to the job site. Remove from the site and replace damaged materials that cannot be restored to like-new condition. Handle sheet metal items to avoid damage to surfaces, edges, and ends. Store materials in dry, weather-tight, ventilated areas until installation.

PART 2 PRODUCTS

2.1 RECYCLED CONTENT

Provide products with recycled content. Provide data for each product with recycled content, identifying percentage of recycled content.

2.2 MATERIALS

Use any metal listed by SMACNA 1793 for a particular item, unless otherwise indicated. Provide materials, thicknesses, and configurations in accordance with SMACNA 1793 for each material. Different items need not be of the same metal, except that contact between dissimilar metals must be avoided.

Furnish sheet metal items in 8 to 10 foot lengths. Single pieces less than 8 feet long may be used to connect to factory-fabricated inside and outside corners, and at ends of runs. Factory fabricate corner pieces with minimum 12 inch legs. Provide accessories and other items essential to complete the sheet metal installation. Provide accessories made of the same or compatible materials as the items to which they are applied. Fabricate sheet metal items of the materials specified below and to the gage, thickness, or weight shown in Table I and Table II at the end of this section. Provide sheet metal items with mill finish unless specified otherwise. Where more than one material is listed for a particular item in Table I, each is acceptable and may be used, except as follows:

2.2.1 Exposed Sheet Metal Items

Must be of the same material. Consider the following as exposed sheet metal: gutters, including hangers; downspouts; and related accessories.

2.2.2 Steel Sheet, Zinc-Coated (Galvanized)

Provide in accordance with ASTM A653/A653M.

Field verify that material is the same as existing metal roof panels.

2.2.3 Finishes

Provide exposed exterior sheet metal with a baked on, factory applied color coating of polyvinylidene fluoride (PVF2) or approved equal fluorocarbon coating. Dry film thickness of coatings must be 0.8 to 1.3 mils. Color to be selected from manufacturer's full range of color choices.

Field applications of color coatings are prohibited and will be rejected.

2.2.4 Asphalt Primer

Provide in accordance with ASTM D41/D41M.

2.2.5 Fasteners

Provide new as required made of the same metal as, or a metal compatible with the item fastened. Confirm compatibility of fasteners and items to be fastened to avoid galvanic corrosion due to dissimilar materials.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Workmanship

Make lines and angles sharp and true. Free exposed surfaces from visible wave, warp, buckle, and tool marks. Fold back exposed edges neatly to form a 1/2 inch hem on the concealed side. Make sheet metal exposed to the weather watertight with provisions for expansion and contraction.

Make surfaces to receive sheet metal plumb and true, clean, even, smooth, dry, and free of defects and projections. For installation of items not shown in detail or not covered by specifications conform to the applicable requirements of SMACNA 1793, Architectural Sheet Metal Manual. Provide sheet metal flashing in the angles formed where roof decks abut walls, curbs, ventilators, pipes, or other vertical surfaces and wherever indicated and necessary to make the work watertight. Join sheet metal items together as shown in Table II.

3.1.2 Bolts, Rivets, and Screws

Install bolts, rivets, and screws where indicated or required. Provide compatible washers where required to protect surface of sheet metal and to provide a watertight connection. Provide mechanically formed joints in aluminum sheets 0.040 inches or less in thickness.

3.1.3 Seams

Straight and uniform in width and height with no sealant showing on the face.

3.1.3.1 Flat-lock Seams

Finish not less than 3/4 inch wide.

3.1.3.2 Loose-Lock Expansion Seams

Not less than 3 inches wide; provide minimum one inch movement within the joint. Completely fill the joints with the specified sealant, applied at not less than 1/8 inch thick bed.

3.1.3.3 Flat Seams

Make seams in the direction of the flow.

3.1.4 Protection from Contact with Dissimilar Materials

3.1.4.1 Metal Surfaces

Paint surfaces in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.1.4.2 Wood or Other Absorptive Materials

Paint surfaces that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

3.1.5 Expansion and Contraction

Provide expansion and contraction joints at not more than 32 foot intervals for aluminum and at not more than 40 foot intervals for other metals. Provide an additional joint where the distance between the last expansion joint and the end of the continuous run is more than half the required interval. Space joints evenly. Join extruded aluminum gravel stops and fascia by expansion and contraction joints spaced not more than 12 feet apart.

3.1.6 Gutters

The hung type of shape indicated and supported as shown to match existing conditions that permit free thermal movement of the gutter. Provide gutters in sizes indicated complete with mitered corners, end caps, outlets, brackets, and other accessories necessary for installation. Bead with hemmed edge or reinforce the outer edge of gutter with a stiffening bar not less than 3/4 by 3/16 inch of material compatible with gutter. Fabricate gutters in sections not less than 8 feet. Provide with concealed splice plate 6 inches minimum. Join gutters with riveted sealed joints. Provide expansion-type slip joints midway between outlets. Install and support gutters to match existing conditions as indicated. Adjust gutters to slope uniformly to outlets, with high points occurring midway between outlets. Fabricate hangers and fastenings from compatible metals.

3.1.7 Downspouts

Space supports for downspouts according to the manufacturer's recommendation for the masonry substrate. Type, shape and size to match existing. Provide complete including elbows and offsets. Provide downspouts in approximately 10 foot lengths. Provide end joints to telescope not less than 1/2 inch and lock longitudinal joints. Provide gutter outlets with wire ball strainers for each outlet. Provide strainers to fit tightly into outlets and be of the same material used for gutters. Keep downspouts not less than one inch away from walls. Fasten to the walls at top, bottom, and at an intermediate point not to exceed 5 feet on center with leader straps or concealed rack-and-pin type fasteners. Form straps and fasteners of metal compatible with the downspouts.

3.1.7.1 Terminations

Neatly fit into the below grade piped storm water drainage system as shown on Civil Drawings.

3.2 CLEANING

Clean exposed sheet metal work at completion of installation. Remove grease and oil films, handling marks, contamination from steel wool, fittings and drilling debris, and scrub-clean. Free the exposed metal surfaces of dents, creases, waves, scratch marks, and solder or weld marks.

3.3 REPAIRS TO FINISH

Scratches, abrasions, and minor surface defects of finish may be repaired in accordance with the manufacturer's printed instructions and as approved. Repair damaged surfaces caused by scratches, blemishes, and variations of color and surface texture. Replace items which cannot be repaired.

3.4 FIELD QUALITY CONTROL

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES

Sheet Metal Items	Copper kilograms per square foot	Aluminum, inch	Stainless Steel, inch	Terne-Coated Stainless Steel, inch	Zinc-Coated Steel, U.S. Std. Gage
Downspouts and leaders	16	.032	.015	.015	24
Downspout clips and anchors	-	.040 clip .125 anchor	-	-	-
Downspout straps, 2-inch	48 (a)	.060	.050	-	-

TABLE I. SHEET METAL WEIGHTS, THICKNESSES, AND GAGES					
Sheet Metal Items	Copper kilograms per square foot	Aluminum, inch	Stainless Steel, inch	Terne-Coated Stainless Steel, inch	Zinc-Coated Steel, U.S. Std. Gage
Strainers, wire diameter or gage	No. 9 gage	.144 diameter	.109 diameter	-	
Gutters:					
Gutter section	16	.032	.015	.015	24
Continuous cleat	16	.032	.015	.015	24
Hangers, dimensions	1 inch by 1/8 inch (a)	1 inch by .0 inch (c)	1 inch by .03 inch	-	-

TABLE II. SHEET METAL JOINTS			
	TYPE OF JOINT		
Item Designation	Copper, Terne-Coated Stainless Steel, Zinc-Coated Steel and Stainless Steel	Aluminum	Remarks
Gutters	1.2 inch lap, reveted and soldered	One inch flat locked reveted and sealed	Aluminum producers recommended hard setting sealant for locked aluminum joints.
(a) Provide a 3 inch lap elastomeric flashing with manufacturer's recommended sealant.			

-- End of Section --

SECTION 07 84 00

FIRESTOPPING
05/10, CHG 1: 08/13

PART 1 GENERAL

1.1 SUMMARY

Furnish and install tested and listed firestopping systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps.

a. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents.

1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E814	(2013a; R 2017) Standard Test Method for Fire Tests of Penetration Firestop Systems

FM GLOBAL (FM)

FM 4991	(2013) Approval of Firestop Contractors
FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

INTERNATIONAL CODE COUNCIL (ICC)

ICC IBC	(2018) International Building Code

UNDERWRITERS LABORATORIES (UL)

UL 723	(2018) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
UL 1479	(2015; Reprint May 2021) Fire Tests of Through-Penetration Firestops
UL Fire Resistance	(2014) Fire Resistance Directory

1.3 SEQUENCING

Coordinate the specified work with other trades. Apply firestopping materials, at penetrations of pipes and ducts, prior to insulating, unless insulation meets requirements specified for firestopping. Apply firestopping materials. at building joints and construction gaps, prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible. Firestop material shall be inspected and approved prior to final completion and enclosing of any assemblies that may conceal installed firestop.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Firestopping System; G

SD-03 Product Data

Firestopping Materials; G

SD-07 Certificates

Firestopping Materials

Installer Qualifications; G

1.5 QUALITY ASSURANCE

1.5.1 Installer

Engage an experienced Installer who is:

a. FM Research approved in accordance with FM 4991, operating as a UL Certified Firestop Contractor, or

b. Certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products in accordance with specified requirements. Submit documentation of this experience. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer installer qualifications on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures. The installer shall obtain from the manufacturer and submit written certification of training, and retain proof of certification for duration of firestop installation.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver materials in the original unopened packages or containers showing name of the manufacturer and the brand name. Store materials off the ground, protected from damage and exposure to elements and temperatures in accordance with manufacturer requirements. Remove damaged or deteriorated materials from the site. Use materials within their indicated shelf life.

PART 2 PRODUCTS

2.1 FIRESTOPPING SYSTEM

Submit detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resistance or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal must indicate the firestopping material to be provided for each type of application. When more than a total of 5 penetrations and/or construction joints are to receive firestopping, provide drawings that indicate location, "F" "T" and "L" ratings, and type of application.

Also, submit a written report indicating locations of and types of penetrations and types of firestopping used at each location; record type by UL list printed numbers.

2.2 FIRESTOPPING MATERIALS

Provide firestopping materials, supplied from a single domestic manufacturer, consisting of commercially manufactured, asbestos-free, nontoxic products FM APP GUIDE approved, or UL listed, for use with applicable construction and penetrating items, complying with the following minimum requirements:

2.2.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resistance or by a nationally recognized testing laboratory.

2.2.2 Toxicity

Material shall be nontoxic and carcinogen free to humans at all stages of application or during fire conditions and shall not contain hazardous chemicals or require harmful chemicals to clean material or equipment.

2.2.3 Fire Resistance Rating

Firestop systems shall be UL Fire Resistance listed or FM APP GUIDE approved with "F" rating at least equal to fire-rating of fire wall or floor in which penetrated openings are to be protected. Where required, firestop systems shall also have "T" rating at least equal to the fire-rated floor in which the openings are to be protected.

2.2.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph SUMMARY, shall provide "F", "T" and "L" fire resistance ratings in accordance with ASTM E814 or UL 1479. Fire resistance ratings shall be as follows:

2.2.3.1.1 Penetrations of Fire Resistance Rated Roof-Ceiling Assemblies

F Rating = 1 hour, T Rating = 1 hour. Where the penetrating item is outside of a wall cavity the F rating must be equal to the fire resistance rating of the floor penetrated, and the T rating shall be in accordance with the requirements of ICC IBC.

2.2.4 Material Certification

Submit certificates attesting that firestopping material complies with the specified requirements. For all intumescent firestop materials used in through penetration systems, manufacturer shall provide certification of compliance with UL 1479.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping must be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement must be sound and capable of supporting device. Prepare surfaces as recommended by the manufacturer.

3.2 INSTALLATION

Completely fill void spaces with firestopping material regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 4 inches or more in any direction must be capable of supporting the same load as the floor is designed to support or be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Install firestopping in accordance with manufacturer's written instructions. Provide tested and listed firestop systems in the following locations.

a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated ceiling-floor assemblies.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Replace thermal insulation with a material having equal thermal insulating and firestopping characteristics.

3.2.2 Fire Dampers

Install and firestop fire dampers in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION. Firestop installed with fire damper must be tested and approved for use in fire damper system. Firestop installed with fire damper must be tested and approved for use in fire damper system.

-- End of Section --

SECTION 07 92 00

JOINT SEALANTS
08/16, CHG 3: 11/18

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 C509	(2006; R 2021) Standard Specifiaction for Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C1193	(2013) Standard Guide for Use of Joint Sealants
ASTM C1521	(2013) Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints
ASTM D1056	(2020) Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2017) Adhesive and Sealant Applications

UNDERWRITERS LABORATORIES (UL)

UL 2818	(2013) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for

information only. WSubmit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sealants; G

Primers; G

Bond Breakers; G

Backstops; G

SD-06 Test Reports

Field Adhesion; G

SD-07 Certificates

Indoor Air Quality For Interior Sealants; S

1.3 PRODUCT DATA

Include storage requirements, shelf life, curing time, instructions for mixing and application, and accessories. Provide manufacturer's Safety Data Sheets (SDS) for each solvent, primer and sealant material proposed.

1.4 CERTIFICATIONS

1.4.1 Indoor Air Quality Certifications

Submit required indoor air quality certifications in one submittal package.

1.4.1.1 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party program that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.5 ENVIRONMENTAL CONDITIONS

Apply sealant when the ambient temperature is between 40 and 90 degrees F.

1.6 DELIVERY AND STORAGE

Deliver materials to the jobsite in unopened manufacturers' sealed shipping containers, with brand name, date of manufacture, color, and material designation clearly marked thereon. Label elastomeric sealant containers to identify type, class, grade, and use. Handle and store materials in accordance with manufacturer's printed instructions. Prevent exposure to foreign materials or subjection to sustained temperatures exceeding 90 degrees F or lower than 0 degrees F. Keep materials and containers closed and separated from absorptive materials such as wood and insulation.

1.7 QUALITY ASSURANCE

1.7.1 Compatibility with Substrate

Verify that each sealant is compatible for use with each joint substrate in accordance with sealant manufacturer's printed recommendations for each application.

1.7.2 Joint Tolerance

Provide joint tolerances in accordance with manufacturer's printed instructions.

1.7.3 Adhesion

Provide in accordance with ASTM C1193 or ASTM C1521.

PART 2 PRODUCTS

2.1 SEALANTS

Provide sealant products that have been tested, found suitable, and documented as such by the manufacturer for the particular substrates to which they will be applied.

2.1.1 Interior Sealants

Provide ASTM C920, Type S or M, Grade NS, Class 12.5, Use NT. Provide sealant products used on the interior of the building (defined as inside of the weatherproofing system) meeting either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168. Provide certification or validation of indoor air quality for interior sealants. Location(s) and color(s) of sealant for the following. Note, color "as selected" refers to manufacturer's full range of color options

LOCATION	COLOR
a. Interior locations, not otherwise indicated or specified, where small voids exist between materials specified to be painted.	As selected

2.1.2 Exterior Sealants

For joints in vertical surfaces, provide ASTM C920, Type S or M, Grade NS, Class 50, Use NT. Provide location(s) and color(s) of sealant as follows.

LOCATION	COLOR
a. Joints and recesses formed where frames and subsills of windows, doors, louvers, and vents adjoin masonry, concrete, or metal frames. Use sealant at both exterior and interior surfaces of exterior wall penetrations.	Match adjacent frame color
b. Voids where items pass through exterior walls.	Match color of existing mortar
c. Joints at metal downspouts, gutters and roof panels	Match color of metal.

2.2 PRIMERS

Non-staining, quick drying type and consistency as recommended by the sealant manufacturer for the particular application. Provide primers for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

2.3 BOND BREAKERS

Type and consistency as recommended by the sealant manufacturer to prevent adhesion of the sealant to the backing or to the bottom of the joint. Provide bond breakers for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

2.4 BACKSTOPS

Provide glass fiber roving, neoprene, butyl, polyurethane, or polyethylene foams free from oil or other staining elements as recommended by sealant manufacturer. Provide 25 to 33 percent oversized backing for closed cell and 40 to 50 percent oversized backing for open cell material, unless otherwise indicated. Provide backstop material that is compatible with sealant. Do not use oakum or other types of absorptive materials as backstops.

2.4.1 Rubber

Provide in accordance with ASTM D1056, Type 2, closed cell, Class A, round cross section for cellular rubber sponge backing.

2.4.2 Synthetic Rubber

Provide in accordance with ASTM C509, Option I, Type I preformed rods or tubes for synthetic rubber backing.

2.4.3 Neoprene

Provide in accordance with ASTM D1056, closed cell expanded neoprene cord Type 2, Class C, for neoprene backing.

2.5 CLEANING SOLVENTS

Provide type(s) recommended by the sealant manufacturer and in accordance with environmental requirements herein. Protect adjacent aluminum and

bronze surfaces from solvents. Provide solvents for interior applications that meet the indoor air quality requirements of the paragraph SEALANTS above.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

Perform a field adhesion test in accordance with manufacturer's instructions and ASTM C1193, Method A or ASTM C1521, Method A, Tail Procedure. Remove sealants that fail adhesion testing; clean substrates, reapply sealants, and re-test. Test sealants adjacent to failed sealants. Submit field adhesion test report indicating tests, locations, dates, results, and remedial actions taken.

3.2 SURFACE PREPARATION

Prepare surfaces according to manufacturer's printed installation instructions. Clean surfaces from dirt, frost, moisture, grease, oil, wax, lacquer, paint, or other foreign matter that would destroy or impair adhesion. Remove oil and grease with solvent; thoroughly remove solvents prior to sealant installation. Wipe surfaces dry with clean cloths. When resealing an existing joint, remove existing caulk or sealant prior to applying new sealant. For surface types not listed below, provide in accordance with sealant manufacturer's printed instructions for each specific surface.

3.2.1 Steel Surfaces

Remove loose mill scale by sandblasting or, if sandblasting is impractical or would damage finished work, scraping and wire brushing. Remove protective coatings by sandblasting or using a residue free solvent. Remove resulting debris and solvent residue prior to sealant installation.

3.2.2 Aluminum or Bronze Surfaces

Remove temporary protective coatings from surfaces that will be in contact with sealant. When masking tape is used as a protective coating, remove tape and any residual adhesive prior to sealant application. For removing protective coatings and final cleaning, use non-staining solvents recommended by the manufacturer of the item(s) containing aluminum or bronze surfaces.

3.2.3 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing. Remove laitance, efflorescence and loose mortar from the joint cavity. Remove resulting debris prior to sealant installation.

3.3 SEALANT PREPARATION

Do not add liquids, solvents, or powders to sealants. Mix multicomponent elastomeric sealants in accordance with manufacturer's printed instructions.

3.4 APPLICATION

3.4.1 Joint Width-To-Depth Ratios

Acceptable Ratios:

JOINT WIDTH	JOINT DEPTH	
	Minimum	Maximum
For metal, or other nonporous surfaces:		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch	1/2 of width	Equal to width
For :		
1/4 inch (minimum)	1/4 inch	1/4 inch
over 1/4 inch to 1/2 inch	1/4 inch	Equal to width
over 1/2 inch to 1 inch	1/2 inch	5/8 inch
Over 1 inch	prohibited	

Unacceptable Ratios: Where joints of acceptable width-to-depth ratios have not been provided, clean out joints to acceptable depths and grind or cut to acceptable widths without damage to the adjoining work. Grinding is prohibited at metal surfaces.

3.4.2 Unacceptable Sealant Use

Do not install sealants in lieu of other required building enclosure weatherproofing components such as flashing, drainage components, and joint closure accessories, or to close gaps between walls, floors, roofs, windows, and doors, that exceed acceptable installation tolerances. Remove sealants that have been used in an unacceptable manner and correct building enclosure deficiencies to comply with contract documents requirements.

3.4.3 Masking Tape

Place masking tape on the finished surface on one or both sides of joint cavities to protect adjacent finished surfaces from primer or sealant smears. Remove masking tape within 10 minutes of joint filling and tooling.

3.4.4 Backstops

Provide backstops dry and free of tears or holes. Tightly pack the back or bottom of joint cavities with backstop material to provide joints in specified depths. Provide backstops where indicated and where backstops are not indicated but joint cavities exceed the acceptable maximum depths specified in JOINT WIDTH-TO-DEPTH RATIOS Table.

3.4.5 Primer

Clean out loose particles from joints immediately prior to application of. Apply primer to joints in concrete masonry units, wood, and other porous surfaces in accordance with sealant manufacturer's printed instructions. Do not apply primer to exposed finished surfaces.

3.4.6 Bond Breaker

Provide bond breakers to surfaces not intended to bond in accordance with, sealant manufacturer's printed instructions for each type of surface and sealant combination specified.

3.4.7 Sealants

Provide sealants compatible with the material(s) to which they are applied. Do not use a sealant that has exceeded its shelf life or has jelled and cannot be discharged in a continuous flow from the sealant gun. Apply sealants in accordance with the manufacturer's printed instructions with a gun having a nozzle that fits the joint width. Work sealant into joints so as to fill the joints solidly without air pockets. Tool sealant after application to ensure adhesion. Apply sealant uniformly smooth and free of wrinkles. Upon completion of sealant application, roughen partially filled or unfilled joints, apply additional sealant, and tool smooth as specified. Apply sealer over sealants in accordance with the sealant manufacturer's printed instructions.

3.5 PROTECTION AND CLEANING

3.5.1 Protection

Protect areas adjacent to joints from sealant smears. Masking tape may be used for this purpose if removed 5 to 10 minutes after the joint is filled and no residual tape marks remain.

3.5.2 Final Cleaning

Upon completion of sealant application, remove remaining smears and stains and leave the work in a clean and neat condition.

a. Masonry and Other Porous Surfaces: Immediately remove fresh sealant that has been smeared on adjacent masonry, rub clean with a solvent, and remove solvent residue, in accordance with sealant manufacturer's printed instructions. Allow excess sealant to cure for 24 hour then remove by wire brushing or sanding. Remove resulting debris.

b. Metal and Other Non-Porous Surfaces: Remove excess sealant with a solvent moistened cloth. Remove solvent residue in accordance with solvent manufacturer's printed instructions.

-- End of Section --

SECTION 08 91 00

METAL WALL LOUVERS
08/20

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, INC. (AMCA)

AMCA 500-L	(2015) Laboratory Methods of Testing Louvers for Rating
AMCA 511	(2010; R 2016) Certified Ratings Program for Air Control Devices

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2605	(2020) Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels

ASTM INTERNATIONAL (ASTM)

ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	(2021) Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Wall Louvers, including chart of all available color options

SD-03 Product Data

Metal Wall Louvers

1.3 DELIVERY, STORAGE, AND PROTECTION

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers must be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

1.4 DETAIL DRAWINGS

Show all information necessary for fabrication and installation of wall louvers, including chart of all available color options. Indicate materials, sizes, thicknesses, fastenings, and profiles.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aluminum Sheet

ASTM B209, alloy 3003 or 5005 with temper as required for forming.

2.1.2 Extruded Aluminum

ASTM B221, alloy 6063-T5 or -T52.

2.2 METAL WALL LOUVERS

Drainable type, with bird screens and made to withstand a wind load of not less than 30 pounds per square foot. Wall louvers must bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-L and AMCA 511. The rating must show a water penetration of 0.20 or less ounce per square foot of free area at a free velocity of 800 feet per minute.

2.2.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall thickness of not less than 0.081 inch.

2.2.2 Screens and Frames

For aluminum louvers, provide 1/2 inch square mesh, 14 or 16 gage aluminum or 1/4 inch square mesh, 16 gage aluminum bird screening. Mount screens in removable, rewirable frames of same material and finish as the louvers.

2.3 FASTENERS AND ACCESSORIES

Provide stainless steel screws and fasteners for aluminum louvers and zinc-coated or stainless steel screws and fasteners for steel louvers. Provide other accessories as required for complete and proper installation.

2.4 FINISHES

2.4.1 Aluminum

Exposed aluminum surfaces must be factory finished with an organic coating. Color as selected by Architect.

2.4.1.1 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a superior performance finish in accordance with AAMA 2605 with total dry film thickness of not less than 1.2 mil.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Wall Louvers

Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations.

3.1.2 Screens and Frames

Attach frames to louvers with screws or bolts.

3.2 PROTECTION FROM CONTACT OF DISSIMILAR MATERIALS

3.2.1 Aluminum

Where aluminum contacts metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint.

3.2.2 Metal

Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

3.2.3 Wood

Paint wood or other absorptive materials that may become repeatedly wet and in contact with metal with two coats of aluminum paint or a coat of heavy-bodied bituminous paint.

-- End of Section --

SECTION 09 51 00

ACOUSTICAL CEILINGS
08/20

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 A641/A641M	(2019) Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
ASTM C423	(2009a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM C635/C635M	(2017) Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C636/C636M	(2013) Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E795	(2016) Standard Practices for Mounting Test Specimens During Sound Absorption Tests
ASTM E1111/E1111M	(2014) Standard Test Method for Measuring the Interzone Attenuation of Open Office Components
ASTM E1264	(2019) Acoustical Ceiling Products

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Acoustical Ceiling Systems; G

SD-04 Samples

Acoustical Units; G

1.3 DELIVERY, STORAGE. AND HANDLING

Deliver materials to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Carefully handle and store materials in dry, watertight enclosures. Immediately before installation, store acoustical units for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.4 ENVIRONMENTAL REQUIREMENTS

Maintain a uniform temperature of not less than 60 degrees F nor more than 85 degrees F and a relative humidity of not more than 70 percent for 24 hours before, during, and 24 hours after installation of acoustical units.

1.5 SCHEDULING

Complete mechanical, electrical, and other work above the ceiling line; install and start operating heating, ventilating, and air conditioning systems in order to maintain temperature and humidity requirements.

1.6 WARRANTY

Provide manufacturer's warranty to repair or replace defective materials and workmanship including but not limited to, sagging and warping of panels and rusting and of grid systems, for a period of ten years from date of final acceptance of the work.

1.7 EXTRA MATERIALS

Furnish spare tiles, from the same lot as those installed, of each color at the rate of 5 tiles for each 1000 tiles installed.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Provide acoustical ceiling systems consisting of sound controlling units set within ceiling suspension system for acoustical treatment. Provide the unit size, texture, finish, and color to match existing materials.

2.1.1 Acoustical Performance

2.1.1.1 Ceiling Sound Absorption

Determine the Noise Reduction Coefficient (NRC) in accordance with ASTM C423. Determine Articulation Class (AC) in accordance with ASTM E1111/E1111M.

2.2 ACOUSTICAL UNITS

Submit samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color. Conform acoustical units to ASTM E1264, Class A, and the following requirements:

2.2.1 Units for Exposed-Grid System

2.2.1.1 Type

AcP-1: Provide Type IV (non-asbestos mineral fiber with membrane-faced overlay) Acoustical Ceiling Tiles containing a minimum of 60 percent recycled content.

AcP-2: Provide Type IX (mineral fiber with scrubbable finish) Acoustical Ceiling Tiles containing a minimum 50 percent recycled content.

2.2.1.2 Flame Spread

Class A, 25 or less

2.2.1.3 Pattern

Match existing.

2.2.1.4 Minimum NRC

AcP-1: 0.80 when tested on mounting Type E-400 of ASTM E795.

2.2.1.5 Nominal Size

24 by 24 inch

2.2.1.6 Edge Detail

AcP-1: Tegular

AcP-2: Square

2.2.1.7 Finish

Factory-applied standard finish. See paragraph COLORS AND PATTERNS.

2.3 SUSPENSION SYSTEM

Provide standardexposed-grid standard width flange suspension system conforming to ASTM C635/C635M for heavy-duty systems. Provide surfaces exposed to view of steel with a factory-applied white baked-enamel finish. Provide wall molding having a flange of not less than 15/16 inch. Provide a suspension system with a maximum deflection of 1/360 of the span length capable of supporting the finished ceiling, light fixtures, air diffusers, and accessories, as shown.

2.4 HANGERS

Provide hangers and attachment capable of supporting a minimum 300 pound ultimate vertical load without failure of supporting material or attachment.

2.4.1 Wires

Conform wires to ASTM A641/A641M, Class 1, 0.16 inch (2.69 mm) in diameter.

2.5 FINISHES

Use manufacturer's standard textures, patterns and finishes as specified for acoustical units and suspension system members. Treat ceiling suspension system components to inhibit corrosion.

2.6 COLORS AND PATTERNS

Use colors and patterns for acoustical units and suspension system components as required to match existing ceiling materials being replaced.

PART 3 EXECUTION

3.1 INSTALLATION

Do not install building construction materials that show visual evidence of biological growth.

Complete and approve mechanical, electrical, and other work above the ceiling line prior to the start of acoustical ceiling installation. Provide acoustical work complete with necessary fastenings, clips, and other accessories required for a complete installation. Do not expose mechanical fastenings in the finished work. Lay out hangers for each individual room or space. Provide hangers to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Keep main runners and carrying channels clear of abutting walls and partitions. Provide at least two main runners for each ceiling span. Wherever required to bypass an object with the hanger wires, install a subsuspension system so that all hanger wires will be plumb.

3.1.1 Suspension System

Install suspension system in accordance with ASTM C636/C636M and as specified herein. Do not suspend hanger wires or other loads from underside of steel decking.

3.1.1.1 Plumb Hangers

Install hangers plumb and not pressing against insulation covering ducts and pipes. Where lighting fixtures are supported from the suspended ceiling system, provide hangers at a minimum of four hangers per fixture and located not more than 6 inch from each corner of each fixture.

3.1.1.2 Splayed Hangers

Splay (slope or slant) hangers around obstructions, offsetting the resulting horizontal force by bracing, countersplaying, or other acceptable means.

3.1.2 Wall Molding

Provide wall molding where ceilings abut vertical surfaces. Miter corners where wall moldings intersect or install corner caps. Secure wall molding not more than 3 inch from ends of each length and not more than 16 inch on centers between end fastenings. Provide wall molding springs at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Install acoustical units in accordance with the approved installation instructions of the manufacturer. Ensure that edges of acoustical units are in close contact with metal supports, with each other, and in true alignment. Arrange acoustical units so that units less than one-half width are minimized.

3.2 CLEANING

Following installation, clean dirty or discolored surfaces of acoustical units and leave them free from defects. Remove units that are damaged or improperly installed and provide new units as directed.

-- End of Section --

SECTION 23 05 15

COMMON PIPING FOR HVAC
02/14

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	(2017) Steel Construction Manual

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.18.1/CSA B125.1	(2018) Plumbing Supply Fittings
ASME A112.19.2/CSA B45.1	(2018; ERTA 2018) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals
ASME B1.20.7	(1991; R 2013) Standard for Hose Coupling Screw Threads (Inch)
ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250
ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2016) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.5	(2017) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded
ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.25	(2017) Buttwelding Ends
ASME B16.26	(2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300

ASME B31.3	(2016) Process Piping
ASME B36.10M	(2015; Errata 2016) Welded and Seamless Wrought Steel Pipe
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications
ASME BPVC SEC VIII D1	(2019) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2019) Specification for Filler Metals for Brazing and Braze Welding
AWS WHB-2.9	(2004) Welding Handbook; Volume 2, Welding Processes, Part 1

ASTM INTERNATIONAL (ASTM)

ASTM A6/A6M	(2017a) Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A74	(2020) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A105/A105M	(2018) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A106/A106M	(2019a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A126	(2004; R 2019) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A183	(2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A197/A197M	(2000; R 2019) Standard Specification for Cupola Malleable Iron
ASTM A216/A216M	(2016) Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
ASTM A234/A234M	(2019) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy

	Steel for Moderate and High Temperature Service
ASTM A276/A276M	(2017) Standard Specification for Stainless Steel Bars and Shapes
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM A312/A312M	(2019) Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
ASTM A563	(2015) Standard Specification for Carbon and Alloy Steel Nuts
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B62	(2017) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B88	(2020) Standard Specification for Seamless Copper Water Tube
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B370	(2012; R 2019) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B749	(2020) Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products
ASTM C67/C67M	(2020) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C109/C109M	(2020b) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C404	(2018) Standard Specification for Aggregates for Masonry Grout
ASTM C476	(2020) Standard Specification for Grout for Masonry
ASTM C553	(2013; R 2019) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C564	(2020a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C920	(2018) Standard Specification for

	Elastomeric Joint Sealants
ASTM D2000	(2018) Standard Classification System for Rubber Products in Automotive Applications
ASTM D2308	(2007; R 2013) Standard Specification for Thermoplastic Polyethylene Jacket for Electrical Wire and Cable
ASTM E1	(2014) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E814	(2013a; R 2017) Standard Test Method for Fire Tests of Penetration Firestop Systems
ASTM F104	(2011; R 2020) Standard Classification System for Nonmetallic Gasket Materials
ASTM F2389	(2019) Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems

FLUID SEALING ASSOCIATION (FSA)

FSA-0017	(1995e6) Standard for Non-Metallic Expansion Joints and Flexible Pipe Connectors Technical Handbook

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 515	(2017) Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Heat Tracing for Industrial Applications
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-67	(2017; Errata 1 2017) Butterfly Valves
MSS SP-70	(2011) Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-72	(2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-80	(2019) Bronze Gate, Globe, Angle and Check Valves

MSS SP-125	(2010) Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators
NEMA MG 10	(2017) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

NSF INTERNATIONAL (NSF)

NSF/ANSI 14	(2019) Plastics Piping System Components and Related Materials

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-C-18480	(1982; Rev B; Notice 2 2009) Coating Compound, Bituminous, Solvent, Coal-Tar Base
MIL-DTL-17813	(2009; Rev H; Supp 1 2009; Notice 1 2013) Expansion Joints, Pipe, Metallic Bellows, General Specification for

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

CID A-A-1922	(Rev A; Notice 3) Shield, Expansion (Caulking Anchors, Single Lead)
CID A-A-1923	(Rev A; Notice 3) Shield, Expansion (Lag, Machine and Externally Threaded Wedge Bolt Anchors)
CID A-A-1924	(Rev A; Notice 3) Shield, Expansion (Self Drilling Tubular Expansion Shell Bolt Anchors
CID A-A-1925	(Rev A; Notice 3) Shield Expansion (Nail Anchors)
CID A-A-55614	(Basic; Notice 2) Shield, Expansion (Non-Drilling Expansion Anchors)
CID A-A-55615	(Basic; Notice 3) Shield, Expansion (Wood Screw and Lag Bolt Self-Threading Anchors

UNDERWRITERS LABORATORIES (UL)

UL 1479	(2015) Fire Tests of Through-Penetration Firestops

1.2 GENERAL REQUIREMENTS

Section 23 30 00 HVAC AIR DISTRIBUTION applies to work specified in this section

Submit Records of Existing Conditions consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work constitutes acceptance of the existing conditions.

Include with Equipment Foundation Data for piping systems all plan dimensions of foundations and relative elevations, equipment weight and operating loads, horizontal and vertical loads, horizontal and vertical clearances for installation, and size and location of anchor bolts.

Submit Fabrication Drawings for pipes, valves and specialties consisting of fabrication and assembly details to be performed in the factory.

Submit Material, Equipment, and Fixture Lists for pipes, valves and specialties including manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information. Provide a complete list of construction equipment to be used.

Submit Manufacturer's Standard Color Charts for pipes, valves and specialties showing the manufacturer's recommended color and finish selections.

Include with Listing of Product Installations for piping systems identification of at least 5 units, similar to those proposed for use, that have been in successful service for a minimum period of 5 years. Include in the list purchaser, address of installation, service organization, and date of installation.

Submit Record Drawings for pipes, valves and accessories providing current factual information including deviations and amendments to the drawings, and concealed and visible changes in the work.

Submit Connection Diagrams for pipes, valves and specialties indicating the relations and connections of devices and apparatus by showing the general physical layout of all controls, the interconnection of one system (or portion of system) with another, and internal tubing, wiring, and other devices.

Submit Coordination Drawings for pipes, valves and specialties showing coordination of work between different trades and with the structural and architectural elements of work. Detail all drawings sufficiently to show overall dimensions of related items, clearances, and relative locations of work in allotted spaces. Indicate on drawings where conflicts or clearance problems exist between various trades.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval When used, a code following the "G" classification 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

Material, Equipment, and Fixture Lists; G

SD-02 Shop Drawings

Record Drawings ; G
Connection Diagrams; G

Coordination Drawings; G

Fabrication Drawings; G

Installation Drawings; G

SD-03 Product Data

Pipe and Fittings; G

Piping Specialties; G

Valves; G

Miscellaneous Materials; G

Supporting Elements; G

Equipment Foundation Data; G

SD-04 Samples

Manufacturer's Standard Color Charts; G

SD-05 Design Data

Pipe and Fittings; G

Piping Specialties; G,

Valves; G

SD-06 Test Reports

Hydrostatic Tests; G

Air Tests; G

Valve-Operating Tests; G

Drainage Tests; G

Pneumatic Tests; G

Non-Destructive Electric Tests; G

System Operation Tests; G

SD-07 Certificates

Record of Satisfactory Field Operation; G

List of Qualified Permanent Service Organizations; G

Listing of Product Installations; G

Records of Existing Conditions; G

Surface Resistance; G

Shear and Tensile Strengths; G

Temperature Ratings; G

Bending Tests; G

Flattening Tests; G

Transverse Guided Weld Bend Tests; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; 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. Provide standard products in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use includes applications of equipment and materials under similar circumstances and of similar size. Ensure the product has been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.4.2 Alternative Qualifications

Products having less than a two-year field service record are acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.4.3 Service Support

Ensure the equipment items are supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. Select service organizations that are reasonably convenient to the

equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.4.4 Manufacturer's Nameplate

Provide a nameplate on each item of equipment bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent is not acceptable.

1.4.5 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.

1.4.5.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions are considered mandatory, the word "should" is interpreted as "shall." Reference to the "code official" is interpreted to mean the "Contracting Officer." For Navy owned property, interpret references to the "owner" to mean the "Contracting Officer." For leased facilities, references to the "owner" is interpreted to mean the "lessor." References to the "permit holder" are interpreted to mean the "Contractor."

1.4.5.2 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, are applied as appropriate by the Contracting Officer and as authorized by his administrative cognizance and the FAR.

1.5 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.6 ELECTRICAL REQUIREMENTS

Furnish motors, controllers, disconnects and contactors with their respective pieces of equipment. Ensure motors, controllers, disconnects and contactors conform to and have electrical connections provided under Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Extended voltage range motors is not permitted. Provide controllers and contactors with a maximum of 120 volt control circuits, and auxiliary contacts for use with the controls furnished. When motors and equipment

furnished are larger than sizes indicated, include the cost of additional electrical service and related work under the section that specified that motor or equipment. Provide power wiring and conduit for field installed equipment under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

1.7 ELECTRICAL INSTALLATION REQUIREMENTS

Ensure electrical installations conform to IEEE C2, NFPA 70, and requirements specified herein.

1.7.1 New Work

Provide electrical components of mechanical equipment, such as motors, motor starters , control or push-button stations, float or pressure switches, solenoid valves, integral disconnects, and other devices functioning to control mechanical equipment, as well as control wiring and conduit for circuits rated 100 volts or less, to conform with the requirements of the section covering the mechanical equipment. Extended voltage range motors are not permitted. Provide under Division 26, the interconnecting power wiring and conduit, control wiring rated 120 volts (nominal) and conduit, and the electrical power circuits, except internal wiring for components of package equipment is provided as an integral part of the equipment. When motors and equipment furnished are larger than sizes indicated, provide any required changes to the electrical service as may be necessary and related work as a part of the work for the section specifying that motor or equipment.

1.7.2 Modifications to Existing Systems

Where existing mechanical systems and motor-operated equipment require modifications, provide electrical components under Division 26.

1.7.3 High Efficiency Motors

1.7.3.1 High Efficiency Single-Phase Motors

Unless otherwise specified, provide high efficiency single-phase fractional-horsepower alternating-current motors corresponding to the applications listed in NEMA MG 11.

1.7.3.2 High Efficiency Polyphase Motors

Unless otherwise specified, select polyphase motors based on high efficiency characteristics relative to the applications as listed in NEMA MG 10. Additionally, ensure polyphase squirrel-cage medium induction motors with continuous ratings meet or exceed energy efficient ratings in accordance with Table 12-6C of NEMA MG 1.

1.7.4 Three-Phase Motor Protection

Provide controllers for motors rated one one horsepower and larger with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent

instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Provide instructors thoroughly familiar with all parts of the installation and trained in operating theory as well as practical operation and maintenance work.

Give instruction 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 is as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.9 ACCESSIBILITY

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 ELECTRICAL HEAT TRACING

Provide heat trace systems for pipes, valves, and fittings that are in accordance with IEEE 515 and be UL listed. System include all necessary components, including heaters and controls to prevent freezing.

Provide self-regulating heaters consisting of two 16 AWG tinned-copper bus wires embedded in parallel in a self-regulating polymer core that varies its power output to respond to temperature along its length. Ensure heater is able to be crossed over itself without overheating. Obtain approval before used directly on plastic pipe. Cover heater with a radiation cross-linked modified polyolefin dielectric jacket in accordance with ASTM D2308.

For installation on plastic piping, apply the heater using aluminum tape. Provide heater with an outer braid of tinned-copper and an outer jacket of modified polyolefin in accordance with ASTM D2308, to provide a good ground path and to enhance the heater's ruggedness.

Provide heater with self-regulating factor of at least 90 percent, in order to provide energy conservation and to prevent overheating.

Operate heater on line voltages of 120 208volts without the use of transformers.

Size Heater according to the following table:

Pipe Size

(Inch, Diameter)	Minus 10 degrees F	Minus 20 degrees F
3 inches or less	5 watts per foot (wpf)	5 wpf
4 inch	5 wpf	8 wpf
6 inch	8 wpf	8 wpf
8 inch	2 strips/5 wpf	2 strips/8 wpf
12 inch	2 strips/8 wpf	2 strips/8 wpf

Control systems by an ambient sensing thermostat set at 40 degrees F either directly or through an appropriate contactor.

2.2 PIPE AND FITTINGS

Submit equipment and performance data for pipe and fittings consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis. Submit design analysis and calculations consisting of surface resistance, rates of flow, head losses, inlet and outlet design, required radius of bend, and pressure calculations. Also include in data pipe size, shape, and dimensions, as well as temperature ratings, vibration and thrust limitations minimum burst pressures, shut-off and non-shock pressures and weld characteristics.

2.2.1 Type BCS, Black Carbon Steel

Ensure pipe 1/8 through 12 inches is Schedule 40 black carbon steel, conforming to ASTM A53/A53M.

Ensure pipe 1/8 through 10 inches is Schedule 40 seamless or electric-resistance welded black carbon steel, conforming to ASTM A53/A53M, Type E, Grade B (electric-resistance welded). Grade A should be used for permissible field bending, in both cases.

Ensure pipe 12 through 24 inches is 0.375-inch wall seamless black carbon steel, conforming to ASTM A53/A53M, Type E, Grade B (electric-resistance welded).

Ensure fittings 2 inches and under are 150-pounds per square inch, gage (psig) working steam pressure (wsp) banded black malleable iron screwed, conforming to ASTM A197/A197M and ASME B16.3.

Ensure unions 2 inches and under are 250 pounds per square inch, wsp female, screwed, black malleable iron with brass-to-iron seat, and ground joint, conforming to ASME B16.39.

Ensure fittings 2-1/2 inches and over are Steel butt weld, conforming to ASTM A234/A234M and ASME B16.9 to match pipe wall thickness.

Ensure flanges 2-1/2 inches and over are 150-pound forged-steel conforming to ASME B16.5, welding neck to match pipe wall thickness.

2.2.2 Type BCS-125, 125-psi Service

Ensure pipe 1/8 through 1-1/2 inches is Schedule 40 steam, Schedule 80

condensate, furnace butt weld, black carbon steel, conforming to ASTM A53/A53M, Type F (furnace butt welded, continuous welded) and ASME B36.10M.

Ensure pipe 2 through 10 inches is Schedule 40 steam, Schedule 80 condensate, seamless or electric-resistance welded black carbon steel, conforming to ASTM A53/A53M Type E, Grade B (electric-resistance welded) and ASME B36.10M.

Ensure pipe 12 through 24 inches is 0.375-inch wall, welded black carbon steel, conforming to ASTM A53/A53M Type E, Grade B (electric-resistance welded)

Ensure fittings 2 inches and under are 125-psig wsp, cast iron, screwed end, conforming to ASTM A126 Class A and ASME B16.4.

Ensure fittings 2 inches and under are 150-psig wsp banded black malleable iron screwed, conforming to ASTM A197/A197M and ASME B16.3.

Ensure fittings 1 through 2 inches are 2,000-or 3,000-psi water, oil, or gas (wog) to match pipe wall, forged carbon steel socket weld, conforming to ASTM A105/A105M and ASME B16.11.

Ensure fittings 2 inches and under are 125-psig wsp, cast iron, screwed end, conforming to ASTM A126 Class A and ASME B16.4.

Ensure fittings 2-1/2 inches and over are wall thickness to match pipe, long radius butt weld, black carbon steel, conforming to ASTM A234/A234M, Grade WPB and ASME B16.9.

Ensure couplings 2 inches and under are commercial standard weight for Schedule 40 pipe and commercial extra heavy weight for Schedule 80 pipe, black carbon steel where threaded, and 2,000-or 3,000-psi wog forged carbon steel, conforming to ASTM A105/A105M and ASME B16.11, where welded.

Ensure flanges 2-1/2 inches and over are 150-pound, forged carbon-steel welding neck, with raised face or flat face and concentric serrated finish, conforming to ASTM A105/A105M and ASME B16.5.

Conform grooved pipe couplings and fittings in accordance with paragraph GROOVED PIPE COUPLINGS AND FITTINGS.

2.2.3 Type GCS, Galvanized Carbon Steel

Ensure pipe 1/2 through 10 inches, and where indicated is Schedule 40 seamless or electric-resistance welded galvanized steel conforming to ASTM A53/A53M, Type E, Grade B (electric-resistance welded) or Type S (seamless).

Ensure pipe 12 inches and over is 0.375-inchwall, seamless, galvanized steel, conforming to ASTM A53/A53M, Grade B.

Ensure fittings 2 inches and under are 150-psig wsp banded galvanized malleable iron screwed, conforming to ASTM A197/A197M and ASME B16.3.

Ensure unions 2 inches and under are 150-psig wsp female, screwed, galvanized malleable iron with brass-to-iron seat and ground joint.

Ensure fittings 2-1/2 inches and over are 125-psig wsp cast-iron flanges

and flanged fittings, conforming to ASTM A126, Class A and ASME B16.1.

Conform grooved pipe couplings and fittings in accordance with paragraph GROOVED PIPE COUPLINGS AND FITTINGS.

As an option, use 150-psig wsp banded galvanized malleable iron screwed fittings, conforming to ASTM A197/A197M and ASME B16.3.

2.2.4 Type GCS-DWV, Galvanized Steel Drain, Waste and Vent

Ensure pipe (all sizes) is Schedule 40 galvanized carbon steel, conforming to ASTM A53/A53M, Grade A.

Furnace butt weld pipe is acceptable for sizes less than 2 inches.

Provide risers 3 inches and larger are Type CISP-DWV.

Ensure fittings are galvanized, , screwed, cast iron, recessed pattern drainage fittings, conforming to ASTM A126.

Use long radius fittings wherever space permits. Short-turn tees, branches, and ells may be used for vent piping and connections of branch lines to battery fixtures, except wall-hung water closets.

2.2.5 Type CISP-DWV, Cast-Iron Drain, Waste and Vent

Provide soil pipe drain, waste, and vent bell-and-spigot type pipe cast iron, conforming to ASTM A74. Caulk and lead all joints in lines where necessary to provide proper leaktight support and alignment; other-wise joints may be two-gasket system type chloroprene, conforming to ASTM C564. Select the extra heavy (CISP-DWV-XH) pipe class.

2.2.6 Type CPR, Copper

2.2.6.1 Type CPR-A, Copper Above Ground

Ensure tubing 2 inches and under is seamless copper tubing, conforming to ASTM B88, Type L (hard-drawn for all horizontal and all exposed vertical lines, annealed for concealed vertical lines).

Ensure fittings 2 inches and under are 150-psig wsp wrought-copper solder joint fittings conforming to ASME B16.22.

Ensure unions 2 inches and under are 150-psig wsp wrought-copper solder joint, conforming to ASME B16.22.

Provide brazing rod with Classification BCuP-5, conforming to AWS A5.8/A5.8M.

Use solder, alloy Sb-5, conforming to ASTM B32.

2.2.6.2 Type CPR-U, Copper Under Ground

Provide Type K seamless copper tube piping, conforming to ASTM B88. Use wrought copper socket-joint fittings, conforming to ASME B16.22. Ensure fittings for connection to corporation cocks are cast bronze, flared-type, conforming to ASME B16.26. Braze the joints.

2.2.6.3 Type CPR-INS, Copper Under Ground Insulated

Provide insulated Type K seamless copper tube piping conforming to ASTM B88. Use wrought copper socket-joint fittings, conforming to ASME B16.22. Braze the joints.

Provide insulation not less than 2 inches thick, suitable for continuous service temperatures of not less than 250 degrees F. Use factory-molded, closed-cell polyurethane foam insulation of not less than 2.5 pounds per cubic foot density. Waterproof insulation with an extruded rigid Type II virgin polyvinylchloride, with minimum wall thickness of 60 mils through 4 inches outside diameter, 85 mils through 6.625 inches and 110 mils through 12.750 inches. Provide fitting covers fabricated from the same materials and thickness as adjacent pipe covering according to the manufacturer's directions.

2.2.7 Polypropylene Pipe

Pipe is manufactured from a PP-R resin meeting the short-term properties and long-term strength requirements of ASTM F2389 Pipe is made in a three layer extrusion process. Piping contains a fiber layer (faser) to restrict thermal expansion. Pipe complies with the rated pressure requirements of ASTM F 2389 Ensure layers are incorporated in the pipe wall to limit thermal expansion to 2 1/4-inches per 100 F per 100-ft. If the hydronic system includes ferrous components, an oxygen barrier is required in pipe wall.

Ensure pipe is certified by NSF International as complying with NSF/ANSI 14, and ASTM F2389

Ensure pipe wrap or insulation meets the requirements of ASTM E84. Ensure the system has a Flame Spread Classification of less than 25 and Smoke Development rating of less than 50.

Where pipe is exposed to direct UV light for more than 30 days, provide a Factory applied, UV-resistant coating or alternative UV protection.

2.2.8 Grooved Pipe Couplings and Fittings

Provide housing for all couplings, fabricated in two or more parts, of black, ungalvanized malleable iron castings. Ensure coupling gasket is molded synthetic rubber, conforming to ASTM D2000. Ensure coupling bolts are oval-neck, track-head type, with hexagonal heavy nuts conforming to ASTM A183.

Fabricate all pipe fittings used with couplings of black, ungalvanized malleable iron castings. Where a manufacturer's standard-size malleable iron fitting pattern is not available, approved fabricated fittings may be used.

Fabricate fittings from Schedule 40 or 0.75-inch wall ASTM A53/A53M, Grade B seamless steel pipe; long radius seamless welding fittings with wall thickness to match pipe, conforming to ASTM A234/A234M and ASME B16.9.

2.3 PIPING SPECIALTIES

Submit equipment and performance data for piping specialties consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis. Submit design analysis and calculations consisting of surface

resistance, rates of flow, head losses, inlet and outlet design, required radius of bend, and pressure calculations. Also include in data pipe size, shape, and dimensions, as well as temperature ratings, vibration and thrust limitations minimum burst pressures, shut-off and non-shock pressures and weld characteristics.

2.3.1 Air Separator

Air separated from converter discharge water is ejected by a reduced-velocity device vented to the compression tank.

Provide a commercially constructed separator, designed and certified to separate not less than 80 percent of entrained air on the first passage of water and not less than 80 percent of residual on each successive pass. Provide shop drawings detailing all piping connections proposed for this work.

Ensure the air separator is carbon steel, designed, fabricated, tested, and stamped in conformance with ASME BPVC SEC VIII D1 for service pressures not less than 125 psi.

2.3.2 Air Vents

Provide manual air vents using 3/8-inch globe valves.

Provide automatic air vents on pumps, mains, and where indicated using ball-float construction. Ensure the vent inlet is not less than 3/4-inch ips and the outlet not less than 1/4-inch ips. Orifice size is 1/8 inch. Provide corrosion-resistant steel trim conforming to ASTM A276/A276M. Fit vent with try-cock. Ensure vent discharges air at any pressure up to 150 psi. Ensure outlet is copper tube routed.

2.3.3 Compression Tank

Provide compression tank designed, fabricated, tested, and stamped for a working pressure of not less than 125 psi in accordance with ASME BPVC SEC VIII D1. Ensure tank is hot-dip galvanized after fabrication to produce not less than 1.5 ounces of zinc coating per square foot of single-side surface.

Tank accessories include red-lined gage-glass complete with glass protectors and shutoff valves, air charger and drainer, and manual vent.

2.3.4 Dielectric Connections

Electrically insulate dissimlar pipe metals from each other by couplings, unions, or flanges commercially manufactured for that purpose and rated for the service pressure and temperature.

2.3.5 Expansion Vibration Isolation Joints

Construct single or multiple arch-flanged expansion vibration isolation joints of steel-ring reinforced chloroprene-impregnated cloth materials. Design joint to absorb the movement of the pipe sections in which installed with no detrimental effect on the pipe or connected equipment. Back flanges with ferrous-metal backing rings. Provide control rod assemblies to restrict joint movement. Coat all nonmetallic exterior surfaces of the joint with chlorosulphinated polyethylene. Provide grommets in limit bolt hole to absorb noise transmitted through the bolts.

Ensure joints are suitable for continuous-duty working temperature of at least 250 degrees F.

Fill arches with soft chloroprene.

Ensure joint, single-arch, movement limitations and size-related, pressure characteristics conform to FSA-0017.

2.3.6 Flexible Pipe

Construct flexible pipe vibration and pipe-noise eliminators of wire-reinforced, rubber-impregnated cloth and cord materials and be flanged. Back the flanges with ferrous-metal backing rings. Ensure service pressure-rating is a minimum 1.5 times actual service, with surge pressure at 180 degrees F.

Construct flexible pipe vibration and pipe noise eliminators of wire-reinforced chloroprene-impregnated cloth and cord materials. Ensure the pipe is flanged. Provide all flanges backed with ferrous-metal backing rings. Coat nonmetallic exterior surfaces of the flexible pipe with an acid- and oxidation-resistant chlorosulphinated polyethylene. Rate the flexible pipe for continuous duty at 130 psi and 250 degrees F.

Ensure unit pipe lengths, face-to-face, are not less than the following:

INSIDE DIAMETER	UNIT PIPE LENGTH
To 2-1/2 inches, inclusive	12 inches
3 to 4 inches, inclusive	18 inches
5 to 12 inches, inclusive	24 inches
To 3 inches, inclusive	18 inches
4 to 10 inches, inclusive	24 inches
12 inches and larger	36 inches

2.3.7 Flexible Metallic Pipe

Ensure flexible pipe is the bellows-type with wire braid cover and designed, constructed, and rated in accordance with the applicable requirements of ASME B31.3.

Minimum working pressure rating is 50 psi at 300 degrees F.

Ensure minimum burst pressure is four times working pressure at 300 degrees F. Bellows material is AISI Type 316L corrosion-resistant steel. Ensure braid is AISI 300 series corrosion-resistant steel wire.

Ensure welded end connections are Schedule 80 carbon steel pipe, conforming to ASTM A106/A106M, Grade B.

Provide threaded end connections; hex-collared Schedule 40, AISI Type 316L corrosion-resistant steel, conforming to ASTM A312/A312M.

Ensure flanged end connection rating and materials conform to

specifications for system primary-pressure rating.

2.3.8 Flexible Metal Steam Hose

Provide a bellows type hose with wire braid cover and designed, constructed, and rated in accordance with the applicable requirements of ASME B31.3.

Ensure the working steam pressure rating is 125 psi at 500 degrees F.

Ensure minimum burst pressure is nine times working steam pressure at 300 degrees F.

Ensure bellows material is AISI Type 316L corrosion-resistant steel. Braid is AISI Type 300-series corrosion-resistant steel wire.

Provide welded end connections; Schedule 80 carbon steel pressure tube, conforming to ASTM A106/A106M, Grade B .

Provide threaded end connections; hex-collared Schedule 40, AISI Type 316L corrosion-resistant steel, conforming to ASTM A312/A312M.

Ensure flanged end connection rating and materials conform to specifications for system primary-pressure rating.

2.3.9 Metallic Expansion Joints

Provide metallic-bellows expansion joints conforming to MIL-DTL-17813.

Provide Type I expansion joints; (corrugated bellows, unreinforced), Class 1 (single bellows, expansion joint).

Design and construct joints to absorb all of the movements of the pipe sections in which installed, with no detrimental effect on pipe or supporting structure.

Rate, design, and construct joints for pressures to 125 psigand temperatures to 500 degrees F.

Ensure joints have a designed bursting strength in excess of four times their rated pressure.

Ensure joints are capable of withstanding a hydrostatic test of 1.5 times their rated pressure while held at their uncompressed length without leakage or distortion that may adversely affect their life cycle.

Ensure life expectancy is not less than 10,000 cycles.

Ensure movement capability of each joint exceeds calculated movement of piping by 100 percent.

Provide bellows and internal sleeve material of AISI Type 304, 304L, or 321 corrosion-resistant steel.

End connections require no field preparation other than cleaning.

Butt weld end preparation of expansion joints conform to the same codes and standards requirements as applicable to the piping system materials at the indicated joint location.

Flanges of flanged-end expansion joints conforms to the same codes and standard requirements as are applicable to companion flanges specified for the given piping system at the indicated joint location.

Provide joints, 2-1/2 inches and smaller, with internal guides and limit stops.

Provide joints, 3 inches and larger, with removable external covers, internal sleeves, and purging connection. Size sleeves to accommodate lateral clearance required, with minimum reduction of flow area, and with oversized bellows where necessary. When a sleeve requires a gasket as part of a locking arrangement, provide the gasket used by the manufacturer. Joints without purging connection may be provided; however, remove these from the line prior to, or not installed until, cleaning operations are complete.

Provide the cylindrical end portion of the reinforced bellows element with a thrust sleeve of sufficient thickness to bring that portion within applicable code-allowable stress. Provide 360 degrees support for the element and end-reinforcing ring with the sleeve.

Ensure expansion joints have four, equidistant, permanent tram points clearly marked on each joint end. Locate points to prevent obliteration during installation. Include distance between tram points indicating installed lengths in shop drawings. Overall dimension after joint installation is subject to approval from the Contracting Officer.

Ensure each expansion joint has adjustable clamps or yokes provided at quarter points, straddling the bellows. Overall joint length is set by the manufacturer to maintain joints in manufacturer's recommended position during installation.

Permanently and legibly mark each joint with the manufacturer's name or trademark and serial number; the size, series, or catalog number; bellows material; and directional-flow arrow.

2.3.10 Hose Faucets

Construct hose faucets with 1/2 inch male inlet threads, hexagon shoulder, and 3/4 inch hose connection, conforming to ASME A112.18.1/CSA B125.1. Ensure hose-coupling screw threads conform to ASME B1.20.7.

Provide vandal proof, atmospheric-type vacuum breaker on the discharge of all potable water lines.

2.3.11 Pressure Gages

Ensure pressure gages conform to ASME B40.100 and to requirements specified herein. Pressure-gage size is 3-1/2 inches nominal diameter. Ensure case is corrosion-resistant steel, conforming to any of the AISI 300 series of ASTM A6/A6M, with an ASM No. 4 standard commercial polish or better. Equip gages with adjustable red marking pointer and damper-screw adjustment in inlet connection. Align service-pressure reading at midpoint of gage range. Ensure all gages are Grade B or better and be equipped with gage isolators.

Fit steam gages with black steel syphons and steam service pressure-rated gage cocks or valves.

2.3.12 Sight-Flow Indicators

Construct sight-flow indicators for pressure service on 3-inch ips and smaller of bronze with specially treated single- or double-glass sight windows and have a bronze, nylon, or tetrafluoroethylene rotating flow indicator mounted on an AISI Type 304 corrosion-resistant steel shaft. Body may have screwed or flanged end. Provide pressure- and temperature-rated assembly for the applied service. Flapper flow-type indicators are not acceptable.

2.3.13 Sleeve Couplings

Sleeve couplings for plain-end pipe consist of one steel middle ring, two steel followers, two chloroprene or Buna-N elastomer gaskets, and the necessary steel bolts and nuts.

2.3.14 Thermometers

Ensure thermometers conform to ASTM E1, except for being filled with a red organic liquid. Provide an industrial pattern armored glass thermometer, (well-threaded and seal-welded). Ensure thermometers installed 6 feet or higher above the floor have an adjustable angle body. Ensure scale is not less than 7 inches long and the case face is manufactured from manufacturer's standard polished aluminum or AISI 300 series polished corrosion-resistant steel. . Provide thermometers with nonferrous separable wells. Provide lagging extension to accommodate insulation thickness.

2.3.15 Pump Suction Strainers

Provide a cast iron strainer body, rated for not less than 25 psig at 100 degrees F, with flanges conforming to ASME B16.1, Class 125. Strainer construction is such that there is a machined surface joint between body and basket that is normal to the centerline of the basket.

Ensure minimum ratio of open area of each basket to pipe area is 3 to 1. Provide a basket with AISI 300 series corrosion-resistant steel wire mesh with perforated backing.

Ensure mesh is capable of retaining all particles larger than 1,000 micrometer, with a pressure drop across the strainer body of not more than 0.5 psi when the basket is two-thirds dirty at maximum system flow rate. Provide reducing fittings from strainer-flange size to pipe size.

Provide a differential-pressure gage fitted with a two-way brass cock across the strainer.

Provide manual air vent cocks in cap of each strainer.

2.3.16 Line Strainers, Water Service

Install Y-type strainers with removable basket. Ensure strainers in sizes 2-inch ips and smaller have screwed ends; in sizes 2-1/2-inch ipsand larger, strainers have flanged ends. Ensure body working-pressure rating exceeds maximum service pressure of installed system by at least 50 percent. Ensure body has cast-in arrows to indicate direction of flow. Ensure all strainer bodies fitted with screwed screen retainers have straight threads and gasketed with nonferrous metal. For strainer bodies

2-1/2-inches and larger, fitted with bolted-on screen retainers, provide offset blowdown holes. Fit all strainers larger than 2-1/2-inches with manufacturer's standard ball-type blowdown valve. Ensure body material is cast bronze conforming to ASTM B62. Where system material is nonferrous, use nonferrous metal for the metal strainer body material.

Ensure minimum free-hole area of strainer element is equal to not less than 3.4 times the internal area of connecting piping. Strainer screens perforation size is not to exceed 0.045-inch. Ensure strainer screens have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material is AISI Type 304 corrosion-resistant steel.

2.3.17 Line Strainers, Steam Service

Install Type Y strainers with removable strainer element.

Use flanged body end connections for all valves larger than 2 inches, unless butt weld ends are specified. Use screwed weld for sizes 2 inches and under to suit specified piping system end connection and maintenance requirements .

For strainers located in tunnels, trenches, manholes, and valve pits,use welded end connections.

Body working steam pressure rating is the same as the primary valve rating for system in which strainer is installed, except where welded end materials requirements result in higher pressure ratings. Ensure body has integral cast or forged arrows to indicate direction of flow. Provide strainer bodies with blowdown valves that have discharge end plugged with a solid metal plug. Make closure assembly with tetrafluoroethylene tape. Ensure bodies fitted with bolted-on screen retainers have offset blowdown holes.

Body materials are cast steel conforming to ASTM A216/A216M, Grade WCB .

Ensure minimum free-hole area of strainer element is equal to not less than 3.4 times the internal area of connecting piping. Strainer screens perforation size is not to exceed 0.020 inch or equivalent wire mesh. Strainer screens have finished ends fitted to machined screen chamber surfaces to preclude bypass flow. Strainer element material is AISI Type 304 corrosion-resistant steel and fitted with backup screens where necessary to prevent collapse.

2.4 VALVES

Submit equipment and performance data for valves consisting of corrosion resistance and life expectancy. Submit design analysis and calculations consisting of rates of flow, head losses, inlet and outlet design, and pressure calculations. Also include in data, pipe dimensions, as well as temperature ratings, vibration and thrust limitations, minimum burst pressures, shut-off and non-shock pressures and weld characteristics.

Polypropylene valves will comply with the performance requirements of ASTM F2389.

2.4.1 Ball and Butterfly Valves

Ensure ball valves conform to MSS SP-72 for Figure 1A, 1 piece body 1B,

vertically split body 1C, top entry 1D, three piece body and are rated for service at not less than 175 psig at 200 degrees F. For valve bodies in sizes 2 inches and smaller, use screwed-end connection-type constructed of Class A copper alloy. For valve bodies in sizes 2-1/2 inches and larger, use flanged-end connection type, constructed of Class D material. Balls and stems of valves 2 inches and smaller are manufacturer's standard with hard chrome plating finish. Balls and stems of valves 2-1/2 inches and larger are 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. Ensure valves are suitable for flow from either direction and seal equally tight in either direction. Valves with ball seals held in place by spring washers are not acceptable. Ensure all valves have adjustable packing glands. Seats and seals are fabricated from tetrafluoroethylene.

Ensure butterfly valves conform to MSS SP-67and are the wafer type for mounting between specified flanges. Ensure valves are rated for 150-psig shutoff and nonshock working pressure. Select bodies of cast ferrous metal conforming to ASTM A126, Class B, and to ASME B16.1 for body wall thickness. Seats and seals are fabricated from resilient elastomer designed for field removal and replacement.

2.4.2 Drain, Vent, and Gage Cocks

Provide T-head drain, vent, and gage cocks, ground key type, with washer and screw, constructed of polished ASTM B62 bronze, and rated 125-psi wsp. Ensure end connections are rated for specified service pressure.

Ensure pump vent cocks, and where spray control is required, are UL umbrella-hood type, constructed of manufacturer's standard polished brass. Ensure cocks are 1/2-inch ips male, end threaded, and rated at not less than 125 psi at 225 degrees F.

2.4.3 Gate Valves (GAV)

Ensure gate valves 2 inches and smaller conform to MSS SP-80. For valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated use union-ring bonnet, screwed-end type. Make packing of non-asbestos type materials. Use rising stem type valves.

Ensure gate valves 2-1/2 inches and larger, are Type I, (solid wedge disc, tapered seats, steam rated); Class 125 (125-psig steam-working pressure at 353 degrees F saturation); and 200-psig, wog (nonshock), conforming to MSS SP-70 and to requirements specified herein. Select flanged valves, with bronze trim and outside screw and yoke (OS&Y) construction. Make packing of non-asbestos type materials.

2.4.4 Globe and Angle Valves (GLV-ANV)

Ensure globe and angle valves 2 inches and smaller, are 125-pound, 125-psi conforming to MSS SP-80 and to requirements specified herein. For valves located in tunnels, equipment rooms, factory-assembled equipment, and where indicated, use union-ring bonnet, screwed-end type. Ensure disc is free to swivel on the stem in all valve sizes. Composition seating-surface disc construction may be substituted for all metal-disc construction. Make packing of non-asbestos type materials. Ensure disk and packing are suitable for pipe service installed.

Ensure globe and angle valves, 2-1/2 inches and larger, are cast iron with

bronze trim. Ensure valve bodies are cast iron conforming to ASTM A126, Class A, as specified for Class 1 valves under MSS SP-80. Select flanged valves in conformance with ASME B16.1. Valve construction is outside screw and yoke (OS&Y) type. Make packing of non-asbestos type materials.

2.4.5 Standard Check Valves (SCV)

Ensure standard check valves in sizes 2 inches and smaller are 125-psi swing check valves except as otherwise specified. Provide lift checks where indicated. Ensure swing-check pins are nonferrous and suitably hard for the service. Select composition type discs. Ensure the swing-check angle of closure is manufacturer's standard unless a specific angle is needed.

Use cast iron, bronze trim, swing type check valves in sizes 2-1/2 inches and larger. Ensure valve bodies are cast iron, conforming to ASTM A126, Class A and valve ends are flanged in conformance with ASME B16.1. Swing-check pin is AISI Type or approved equal corrosion-resistant steel. Angle of closure is manufacturer's standard unless a specific angle is needed. Ensure valves have bolted and gasketed covers.

Provide check valves with external spring-loaded, positive-closure devices and valve ends are mechanical joint.

2.4.6 Nonslam Check Valves (NSV)

Provide check valves at pump discharges in sizes 2 inches and larger with nonslam or silent-check operation conforming to MSS SP-125. Select a valve disc or plate that closes before line flow can reverse to eliminate slam and water-hammer due to check-valve closure. Ensure valve is Class 125 rated for 200-psi maximum, nonshock pressure at 150 degrees F in sizes to 12 inches. Use valves that are wafer type to fit between flanges conforming to ASME B16.1. Valve body may be cast iron, or equivalent strength ductile iron. Select disks using manufacturer's standard bronze, aluminum bronze, or corrosion-resistant steel. Ensure pins, springs, and miscellaneous trim are manufacturer's standard corrosion-resistant steel. Disk and shaft seals are Buna-N elastomer tetrafluoroethylene.

2.5 MISCELLANEOUS MATERIALS

Submit equipment and performance data for miscellaneous materials consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

2.5.1 Bituminous Coating

Ensure the bituminous coating is a solvent cutback, heavy-bodied material to produce not less than a 12-mil dry-film thickness in one coat, and is recommended by the manufacturer to be compatible with factory-applied coating and rubber joints.

For previously coal-tar coated and uncoated ferrous surfaces underground, use bituminous coating solvent cutback coal-tar type, conforming to MIL-C-18480.

2.5.2 Bolting

Ensure flange and general purpose bolting is hex-head and conforms to ASTM A307, Grade B (bolts, for flanged joints in piping systems where one

or both flanges are cast iron). Heavy hex-nuts conform to ASTM A563. Square-head bolts and nuts are not acceptable. Ensure threads are coarse-thread series.

2.5.3 Elastomer Caulk

Use two-component polysulfide- or polyurethane-base elastomer caulking material, conforming to ASTM C920.

2.5.4 Escutcheons

Manufacture escutcheons from nonferrous metals and chrome-plated except when AISI 300 series corrosion-resistant steel is provided. Ensure metals and finish conforms to ASME A112.19.2/CSA B45.1.

Use one-piece escutcheons where mounted on chrome-plated pipe or tubing, and one-piece of split-pattern type elsewhere. Ensure all escutcheons have provisions consisting of internal spring-tension devices for maintaining a fixed position against a surface.

2.5.5 Flashing

Ensure sheetlead conforms to ASTM B749, UNS Alloy Number L50049 (intended for use in laboratories and shops in general application).

Ensure sheet copper conforms to ASTM B370 and be not less than 16 ounces per square foot weight.

2.5.6 Flange Gaskets

Provide compressed non-asbestos sheets, conforming to ASTM F104, coated on both sides with graphite or similar lubricant, with nitrile composition, binder rated to 750 degrees F.

2.5.7 Grout

Provide shrink-resistant grout as a premixed and packaged metallic-aggregate, mortar-grouting compound conforming to ASTM C404 and ASTM C476.

Ensure shrink-resistant grout is a combination of pre-measured and packaged epoxy polyamide or amine resins and selected aggregate mortar grouting compound conforming to the following requirements:

Tensile strength		1,900 psi, minimum
Compressive strength	ASTM C109/C109M	14,000 psi, minimum
Shrinkage, linear		0.00012 inch per inch, maximum
Water absorption	ASTM C67/C67M	0.1 percent, maximum
Bond strength to		1,000 psi, minimum steel in shear minimum

2.5.8 Pipe Thread Compounds

Use polytetrafluoroethylene tape not less than 2 to 3 mils thick in potable and process water and in chemical systems for pipe sizes to and

including 1-inch ips. Use polytetrafluoroethylene dispersions and other suitable compounds for all other applications upon approval by the Contracting Officer; however, do not use lead-containing compounds in potable water systems.

2.6 SUPPORTING ELEMENTS

Submit equipment and performance data for the supporting elements consisting of corrosion resistance, life expectancy, gage tolerances, and grade line analysis.

Provide all necessary piping systems and equipment supporting elements, including but not limited to: building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; guides; and spring-cushion, variable, or constant supports. Ensure supporting elements are 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.

Ensure supporting elements conform to requirements of ASME B31.3, and MSS SP-58, except as noted.

Ensure attachments welded to pipe are made of materials identical to that of pipe or materials accepted as permissible raw materials by referenced code or standard specification.

Ensure supporting elements exposed to weather are hot-dip galvanized or stainless steel. Select materials of such a nature that their apparent and latent-strength characteristics are not reduced due to galvanizing process. Electroplate supporting elements in contact with copper tubing with copper.

Type designations specified herein are based on MSS SP-58. Ensure masonry anchor group-, type-, and style-combination designations are in accordance with CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925 , CID A-A-55614, and CID A-A-55615. Provide support elements, except for supplementary steel, that are cataloged, load rated, commercially manufactured products.

2.6.1 Building Structure Attachments

2.6.1.1 Anchor Devices, Concrete and Masonry

Ensure anchor devices conform to CID A-A-1922, CID A-A-1923, CID A-A-1924, CID A-A-1925 , CID A-A-55614, and CID A-A-55615

For cast-in, floor mounted, equipment anchor devices, provide adjustable positions.

Provide built-in masonry anchor devices.

Do not use powder-actuated anchoring devices to support any mechanical systems components.

2.6.1.2 Beam Clamps

Ensure beam clamps are center-loading MSS SP-58 Type 20.

When it is not possible to use center-loading beam clamps,

eccentric-loading beam clamps, MSS SP-58 Type 19 may be used for piping sizes 2 inches and less and for piping sizes 2 through 10 inches provided two counterbalancing clamps are used per point of pipe support. Where more than one rod is used per point of pipe support, determine rod diameter in accordance with referenced standards.

2.6.1.3 C-Clamps

Do not use C-clamps.

2.6.1.4 Inserts, Concrete

Use concrete MSS SP-58 Type 18 inserts When applied to piping in sizes 2 inches ips and larger and where otherwise required by imposed loads, insert and wire a 1-foot length of 1/2-inch reinforcing rod through wing slots. Submit proprietary-type continuous inserts for approval.

2.6.2 Horizontal Pipe Attachments

2.6.2.1 Single Pipes

Support piping in sizes to and including 2-inch ips by MSS SP-58 Type 6 solid malleable iron pipe rings, except that, use split-band-type rings in sizes up to 1-inch ips.

Support piping in sizes through 8-inch ips inclusive by MSS SP-58 Type 1 attachments.

Use MSS SP-58 Type 1 and Type 6 assemblies on vapor-sealed insulated piping and have an inside diameter larger than pipe being supported to provide adequate clearance during pipe movement.

Where thermal movement of a point in a piping system 4 inches and larger would cause a hanger rod to deflect more than 4 degrees from the vertical or where a horizontal point movement exceeds 1/2 inch, use MSS SP-58 Type 41 pipe rolls.

Support piping in sizes larger than 8-inch ips with MSS SP-58 Type 41 pipe rolls.

Use MSS SP-58 Type 40 shields on all insulated piping. Ensure area of the supporting surface is such that compression deformation of insulated surfaces does not occur. Roll away longitudinal and transverse shield edges from the insulation.

Provide insulated piping without vapor barrier on roll supports with MSS SP-58 Type 39 saddles.

Provide spring supports as indicated.

2.6.2.2 Parallel Pipes

Use trapeze hangers fabricated from structural steel shapes, with U-bolts, in congested areas and where multiple pipe runs occur. Ensure structural steel shapes conform to supplementary steel requirements.

2.6.3 Vertical Pipe Attachments

Ensure vertical pipe attachments are MSS SP-58 Type 8.

Include complete fabrication and attachment details of any spring supports in shop drawings.

2.6.4 Hanger Rods and Fixtures

Use only circular cross section rod hangers to connect building structure attachments to pipe support devices. Use pipe, straps, or bars of equivalent strength for hangers only where approved by the Contracting Officer.

Provide turnbuckles, swing eyes, and clevises as required by support system to accommodate temperature change, pipe accessibility, and adjustment for load and pitch. Rod couplings are not acceptable.

2.6.5 Supplementary Steel

Where it is necessary to frame structural members between existing members or where structural members are used in lieu of commercially rated supports, design and fabricate such supplementary steel in accordance with AISC 325.

PART 3 EXECUTION

3.1 PIPE INSTALLATION

Submit certificates for pipes, valves and specialties showing conformance with test requirements as contained in the reference standards contained in this section. Provide certificates verifying Surface Resistance, Shear and Tensile Strengths, Temperature Ratings, Bending Tests, Flattening Tests and Transverse Guided Weld Bend Tests.

Provide test reports for Hydrostatic Tests, Air Tests, Valve-Operating Tests, Drainage Tests, Pneumatic Tests, Non-Destructive Electric Tests and System Operation Tests, in compliance with referenced standards contained within this section.

Fabricate and install piping systems in accordance with ASME B31.3, MSS SP-58, and AWS WHB-2.9.

Submit Installation Drawings for pipes, valves and specialties. Drawings include the manufacturer's design and construction calculations, forces required to obtain rated axial, lateral, or angular movements, installation criteria, anchor and guide requirements for equipment, and equipment room layout and design. Ensure drawings specifically advise on procedures to be followed and provisions required to protect expansion joints during specified hydrostatic testing operations.

Ensure connections between steel piping and copper piping are electrically isolated from each other with dielectric couplings (or unions) rated for the service.

Make final connections to equipment with unions provided every 100 feet of straight run. Provide unions in the line downstream of screwed- and welded-end valves.

Ream all pipe ends before joint connections are made.

Make screwed joints with specified joint compound with not more than three

threads showing after joint is made up.

Apply joint compounds to the male thread only and exercise care to prevent compound from reaching the unthreaded interior of the pipe.

Provide screwed unions, welded unions, or bolted flanges wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system for maintenance.

Securely support piping systems with due allowance for thrust forces, thermal expansion and contraction. Do not subject the system to mechanical, chemical, vibrational or other damage as specified in ASME B31.3.

Ensure field welded joints conform to the requirements of the AWS WHB-2.9, ASME B31.3, and ASME BPVC SEC IX.

Make piping systems butt weld joints with backing rings. Use compatible backing ring materials with materials being joined. Ensure joint configuration conforms to ASME B16.25.

For polyropylene pipe, make fusion-weld joints in accordance with the pipe and fitting manufacturer's specifications and product standards. Use fusion-weld tooling, welding machines, and electrofusion devices specified by the pipe and fittings manufacturer. Prior to joining, prepare the pipe and fittings in accordance with ASTM F2389 and the manufacturer's specifications. Ensure joint preparation, setting and alignment, fusion process, cooling times and working pressure are in accordance with the pipe and fitting manufacturer's specifications.

Accomplish preheat and postheat treatment of welds in accordance with ASME BPVC SEC IX and ASME B31.3.

Take all necessary precautions during installation of flexible pipe and hose including flushing and purging with water, steam, and compressed air to preclude bellows failure due to pipe line debris lodged in bellows. Ensure installation conforms to manufacturer's instructions.

3.2 VALVES

Provide valves in piping mains and all branches and at equipment where indicated and as specified.

Provide valves to permit isolation of branch piping and each equipment item from the balance of the system.

Provide riser and downcomer drains above piping shutoff valves in piping 2-1/2 inches and larger. Tap and fit shutoff valve body with a 1/2-inch plugged globe valve.

Provide valves unavoidably located in furred or other normally inaccessible places with access panels adequately sized for the location and located so that concealed items may be serviced, maintained, or replaced.

3.3 SUPPORTING ELEMENTS INSTALLATION

Provide supporting elements in accordance with the referenced codes and standards.

Support piping from building structure. Do not support piping from roof deck or from other pipe.

Run piping parallel with the lines of the building. Space and install piping and components so that a threaded pipe fitting may be removed between adjacent pipes and so that there is no less than 1/2 inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Arrange hangars on different adjacent service lines running parallel with each other in line with each other and parallel to the lines of the building.

Install piping support elements at intervals specified hereinafter, at locations not more than 3 feet from the ends of each runout, and not over 1 foot from each change in direction of piping.

Base load rating for all pipe-hanger supports on insulated weight of lines filled with water and forces imposed. Deflection per span is not exceed slope gradient of pipe. Ensure supports are in accordance with the following minimum rod size and maximum allowable hanger spacing for specified pipe. For concentrated loads such as valves, reduce the allowable span proportionately:

PIPE SIZE INCHES	ROD SIZE INCHES	STEEL PIPE FEET	COPPER PIPE FEET
1 and smaller	3/8	8	6
1-1/4 to 1-1/2	3/8	10	8
2	3/8	10	8
2-1/2 to 3-1/2	1/2	12	12
4 to 5	5/8	16	14
6	3/4	16	16
8 to 12	7/8	20	20
14 to 18	1	20	20
20 and over	1-1/4	20	20

Provide vibration isolation supports where needed.

Support vertical risers independently of connected horizontal piping, whenever practicable, with fixed or spring supports at the base and at intervals to accommodate system range of thermal conditions. Ensure risers have guides for lateral stability. For risers subject to expansion, provide only one rigid support at a point approximately one-third down from the top. Place clamps under fittings unless otherwise specified. Support carbon-steel pipe at each floor and at not more than 15-foot intervals for pipe 2 inches and smaller and at not more than 20-foot intervals for pipe 2-1/2 inches and larger.

3.4 PENETRATIONS

Provide effective sound stopping and adequate operating clearance to

prevent structure contact where piping penetrates walls, floors, or ceilings into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur from pipe chases into occupied spaces. Occupied spaces include space above ceilings where no special acoustic treatment of ceiling is provided. Finish penetrations to be compatible with surface being penetrated.

Accomplish sound stopping and vapor-barrier sealing of pipe shafts and large floor and wall openings by packing to high density with properly supported fibrous-glass insulation or, where ambient or surface temperatures do not exceed 120 degrees F, by foaming-in-place with self-extinguishing, 2-pound density polyurethane foam to a depth not less than 6 inches. Finish foam with a rasp. Ensure vapor barrier is not less than 1/8-inch thick vinyl coating applied to visible and accessible surfaces. Where high temperatures and fire stopping are a consideration, use only mineral wool with openings covered by 16-gage sheet metal.

3.5 SLEEVES

Provide sleeves where piping passes through roofs, masonry, concrete walls and floors.

Continuously braze sleeves passing through steel decks to the deck.

Ensure sleeves that extend through floors, roofs, load bearing walls, and fire barriers are continuous and fabricated from Schedule 40 steel pipe, with welded anchor lugs. Form all other sleeves by molded linear polyethylene liners or similar materials that are removable. Ensure diameter of sleeves is large enough to accommodate pipe, insulation, and jacketing without touching the sleeve and provides a minimum 3/8-inch clearance. Install a sleeve size to accommodate mechanical and thermal motion of pipe precluding transmission of vibration to walls and the generation of noise.

Pack the space between a pipe, bare or insulated, and the inside of a pipe sleeve or a construction surface penetration solid with a mineral fiber conforming to ASTM C553 Type V (flexible blanket), (to 1,000 degrees F). Provide this packing wherever the piping passes through firewalls, equipment room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction surface penetrations occur between conditioned and unconditioned spaces, fill the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction surface penetration with an elastomer caulk to a depth of 1/2 inch. Ensure all caulked surfaces are oil- and grease-free.

Ensure through-penetration fire stop materials and methods are in accordance with ASTM E814 and UL 1479.

Caulk exterior wall sleeves watertight with lead and oakum or mechanically expandable chloroprene inserts with mastic-sealed metal components.

Ensure sleeve height above roof surface is a minimum of 12 and a maximum of 18-inches.

3.6 ESCUTCHEONS

Provide escutcheons at all penetrations of piping into finished areas. Where finished areas are separated by partitions through which piping

passes, provide escutcheons on both sides of the partition. Where suspended ceilings are installed, provide plates at the underside only of such ceilings. For insulated pipes, select plates large enough to fit around the insulation. Use chrome-plated escutcheons in all occupied spaces and of size sufficient to effectively conceal openings in building construction. Firmly attach escutcheons with setscrews.

3.7 FLASHINGS

Provide flashings at penetrations of building boundaries by mechanical systems and related work.

3.8 UNDERGROUND PIPING INSTALLATION

Prior to being lowered into a trench, clean all piping, visually inspected for apparent defects, and tapped with a hammer to audibly detect hidden defects.

Further inspect suspect cast-ferrous piping by painting with kerosene on external surfaces to reveal cracks.

Distinctly mark defective materials found using a road-traffic quality yellow paint; promptly remove defective material from the site.

After conduit has been inspected, and not less than 48 hours prior to being lowered into a trench, coat all external surfaces of cast ferrous conduit with a compatible bituminous coating for protection against brackish ground water. Apply a single coat, in accordance with the manufacturer's instructions, to result in a dry-film thickness of not less than 12 mils.

Ensure excavations are dry and clear of extraneous materials when pipe is being laid.

Use wheel cutters for cutting of piping or other machines designed specifically for that purpose. Electric-arc and oxyacetylene cutting is not permitted.

Begin laying of pipe at the low point of a system. When in final acceptance position, ensure it is true to the grades and alignment indicated, with unbroken continuity of invert. Blocking and wedging is not permitted.

Point bell or grooved ends of piping upstream.

Make changes in direction with long sweep fittings.

Provide necessary socket clamping, piers, bases, anchors, and thrust blocking. Protect rods, clamps, and bolting with a coating of bitumen.

Support underground piping below supported or suspended slabs from the slab with a minimum of two supports per length of pipe. Protect supports with a coating of bitumen.

On excavations that occur near and below building footings, provide backfilling material consisting of 2,000-psi cured compressive-strength concrete poured or pressure-grouted up to the level of the footing.

Properly support vertical downspouts; soil, waste, and vent stacks; water

risers; and similar work on approved piers at the base and provided with approved structural supports attached to building construction.

Provide cleanout, flushing, and observation risers.

3.9 HEAT TRACE CABLE INSTALLATION

Field apply heater tape and cut to fit as necessary, linearly along the length of pipe after piping has been pressure tested and approved by the Contracting Officer. Secure the heater to piping with cable ties . Label thermal insulation on the outside, "Electrical Heat Trace."

Install power connection, end seals, splice kits and tee kit components in accordance with IEEE 515 to provide a complete workable system. Terminate connection to the thermostat and ends of the heat tape in a junction box. Ensure cable and conduit connections are raintight.

3.10 HEAT TRACE CABLE TESTS

Test heat trace cable system in accordance with IEEE 515 after installation and before and after installation of the thermal insulation. Test heater cable using a 1000 vdc megger. Minimum insulation resistance is 20 to 1000 megohms regardless of cable length.

3.11 OPERATION AND MAINTENANCE

Provide Operation and Maintenance Manuals consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions. Submit test data that is clear and readily legible.

3.12 PAINTING OF NEW EQUIPMENT

Factory or shop apply new equipment painting, as specified herein, and provided under each individual section.

3.12.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied withstands 125 hours in a salt-spray fog test, except that equipment located outdoors withstand 500 hours in a salt-spray fog test. Conduct salt-spray fog test is in accordance with ASTM B117, and for that test the acceptance criteria is as follows: immediately after completion of the test, the inspected paint shows no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shows no signs of rust creepage beyond 0.125 inch on either side of the scratch mark.

Ensure the film thickness of the factory painting system applied on the equipment is not 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, design the factory painting system for the temperature service.

3.12.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and

solvent degreasing prior to application of paint, except clean to bare metal, surfaces subject to temperatures in excess of 120 degrees F.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Selected color of finish coat is aluminum or light gray.

a. Temperatures Less Than 120 Degrees F: Immediately after cleaning, the metal surfaces subject to temperatures less than 120 degrees F receives one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat.

b. Temperatures Between 120 and 400 Degrees F: Metal surfaces subject to temperatures between 120 and 400 degrees F Receives two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of 2 mils.

c. Temperatures Greater Than 400 Degrees F: Metal surfaces subject to temperatures greater than 400 degrees F receives two coats of 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of 2 mils.

-- End of Section --

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC
11/15

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 S1.4	(1983; Amendment 1985; R 2006) Specification for Sound Level Meters (ASA 47)
ASA S1.11 PART 1	(2014) American National Standard Electroacoustics – Octave-Band and Fractional-Octave-Band Filters – Part 1: Specifications

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 203	(1990; R 2011) Field Performance Measurements of Fan Systems

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 62.1	(2010) Ventilation for Acceptable Indoor Air Quality
ASHRAE HVAC APP IP HDBK	(2016) HVAC Applications Handbook, I-P Edition

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1	(2002; 6th ed) National Standards for Total System Balance
AABC MN-4	(1996) Test and Balance Procedures

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB MASV	(2006) Procedural Standards for Measurements and Assessment of Sound and Vibration
NEBB PROCEDURAL STANDARDS	(2015) Procedural Standards for TAB (Testing, Adjusting and Balancing) Environmental Systems

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1780	(2002) HVAC Systems - Testing, Adjusting and Balancing, 3rd Edition
SMACNA 1858	(2004) HVAC Sound And Vibration Manual - First Edition
SMACNA 1972 CD	(2012) HVAC Air Duct Leakage Test Manual - 2nd Edition

1.2 DEFINITIONS

a. AABC: Associated Air Balance Council

b. COTR: Contracting Officer's Technical Representative

c. DALT: Duct air leakage test

d. DALT'd: Duct air leakage tested

e. HVAC: Heating, ventilating, and air conditioning; or heating, ventilating, and cooling

f. NEBB: National Environmental Balancing Bureau

g. Out-of-tolerance data: Pertains only to field acceptance testing of Final DALT or TAB report. When applied to DALT work, this phase means "a leakage rate measured during DALT field acceptance testing which exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction and sealant class." When applied to TAB work this phase means "a measurement taken during TAB field acceptance testing which does not fall within the range of plus 5 to minus 5 percent of the original measurement reported on the TAB Report for a specific parameter."

h. Season of maximum heating load: The time of year when the outdoor temperature at the project site remains within plus or minus 30 degrees Fahrenheit of the project site's winter outdoor design temperature, throughout the period of TAB data recording.

i. Season of maximum cooling load: The time of year when the outdoor temperature at the project site remains within plus or minus 5 degrees Fahrenheit of the project site's summer outdoor design temperature, throughout the period of TAB data recording.

j. Season 1, Season 2: Depending upon when the project HVAC is completed and ready for TAB, Season 1 is defined, thereby defining Season 2. Season 1 could be the season of maximum heating load, or the season of maximum cooling load.

k. Sound measurements terminology: Defined in AABC MN-1, NEBB MASV, or SMACNA 1858 (TABB).

l. TAB: Testing, adjusting, and balancing (of HVAC systems)

m. TAB'd: HVAC Testing/Adjusting/Balancing procedures performed

n. TAB Agency: TAB Firm

o. TAB team field leader: TAB team field leader

p. TAB team supervisor: TAB team engineer

q. TAB team technicians: TAB team assistants

r. TABB: Testing Adjusting and Balancing Bureau

1.2.1 Similar Terms

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results.

The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC, NEBB, or TABB requirements where differences exist.

SIMILAR TERMS			
Contract Term	AABC Term	NEBB Term	TABB Term
TAB Standard	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems	International Standards for Environmental Systems Balance
TAB Specialist	TAB Engineer	TAB Supervisor	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures	Field Readiness Check & Prelim. Field Procedures

1.3 WORK DESCRIPTION

The work includes duct air leakage testing (DALT) and testing, adjusting, and balancing (TAB) of new and existing heating, ventilating, and cooling (HVAC) air and water distribution systems including equipment and performance data, ducts, and piping which are located within, on, under, between, and adjacent to buildings, including records of existing conditions.

Perform TAB in accordance with the requirements of the TAB procedural standard recommended by the TAB trade association that approved the TAB Firm's qualifications. Comply with requirements of AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 (TABB) as supplemented and modified by this specification section. All recommendations and suggested practices contained in the TAB procedural standards are considered mandatory.

Conduct DALT and TAB of the indicated existing systems and equipment and submit the specified DALT and TAB reports for approval. Conduct DALT testing in compliance with the requirements specified in SMACNA 1972 CD, except as supplemented and modified by this section. Conduct DALT and TAB work in accordance with the requirements of this section.

1.3.1 Air Distribution Systems

Test, adjust, and balance systems (TAB) in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to exterior of air distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.2 Water Distribution Systems

TAB systems in compliance with this section. Obtain Contracting Officer's written approval before applying insulation to water distribution systems as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. At Contractor's option and with Contracting Officer's written approval, the piping systems may be insulated before systems are TAB'd.

Terminate piping insulation immediately adjacent to each flow control valve, automatic control valve, or device. Seal the ends of pipe insulation and the space between ends of pipe insulation and piping, with waterproof vapor barrier coating.

After completion of work under this section, insulate the flow control valves and devices as specified under Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

1.3.3 TAB SCHEMATIC DRAWINGS

Show the following information on TAB Schematic Drawings:

1. A unique number or mark for each piece of equipment or terminal.

2. Air quantities at air terminals.

3. Air quantities and temperatures in air handling unit schedules.

4. Water quantities and temperatures in thermal energy transfer equipment schedules.

5. Water quantities and heads in pump schedules.

6. Water flow measurement fittings and balancing fittings.

7. Ductwork Construction and Leakage Testing Table that defines the DALT test requirements, including each applicable HVAC duct system ID or mark, duct pressure class, duct seal class, and duct leakage test pressure. This table is included in the file for Graphics for Unified Facilities Guide Specifications: http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/forms-gra

The Testing, Adjusting, and Balancing (TAB) Specialist must review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the effective and accurate TAB of the system, including records of existing conditions, and systems readiness check. The TAB Specialist must provide a Design Review Report

individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

Submit three copies of the TAB Schematic Drawings and Report Forms to the Contracting Officer, no later than 21 days prior to the start of TAB field measurements.

1.3.4 Related Requirements

1.4 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approavl When used, a code following the "G" classification 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

Records of Existing Conditions; G

TAB Firm; G

Designation of TAB Team Assistants; G

Designation of TAB Team Engineer; G or TAB Specialist; G, AE

Designation of TAB Team Field Leader; G

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G

SD-03 Product Data

Equipment and Performance Data; G

TAB Related HVAC Submittals; G

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB team engineer .

TAB Procedures; G

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Calibration; G

Systems Readiness Check; G

TAB Execution; G

TAB Verification; G

SD-06 Test Reports

Certified Final DALT Report; G

TAB Design Review Report; G G-AE ,

TAB Report for Season 1; G

TAB Report for Season 2; G

SD-07 Certificates

Independent TAB Agency and Personnel Qualifications; G

DALT and TAB Submittal and Work Schedule; G

TAB Pre-Field Engineering Report; G

TAB Firm; G

Design Review Report; G

Pre-field DALT Preliminary Notification; G

Prerequisite HVAC Work Check Out List For Season 1; G

1.5 QUALITY ASSURANCE

1.5.1 Independent TAB Agency and Personnel Qualifications

To secure approval for the proposed agency, submit information certifying that the TAB agency is a first tier subcontractor who is not affiliated with any other company participating in work on this contract, including design, furnishing equipment, or construction. Further, submit the following, for the agency, to Contracting Officer for approval:

a. Independent AABC or NEBB or TABB TAB agency:

TAB agency: AABC registration number and expiration date of current certification; or NEBB certification number and expiration date of current certification; or TABB certification number and expiration date of current certification.

TAB team supervisor: Name and copy of AABC or NEBB or TABB TAB supervisor certificate and expiration date of current certification.

TAB team field leader: Name and documented evidence that the team field leader has satisfactorily performed full-time supervision of TAB work in the field for not less than 3 years immediately preceding this contract's bid opening date.

TAB team field technicians: Names and documented evidence that each field technician has satisfactorily assisted a TAB team field leader in performance of TAB work in the field for not less than one year immediately preceding this contract's bid opening date.

Current certificates: Registrations and certifications are current, and valid for the duration of this contract. Renew Certifications which expire prior to completion of the TAB work, in a timely manner so that there is no lapse in registration or certification. TAB agency or TAB team personnel without a current registration or current certification are not to perform TAB work on this contract.

b. TAB Team Members: TAB team approved to accomplish work on this contract are full-time employees of the TAB agency. No other personnel is allowed to do TAB work on this contract.

c. Replacement of TAB team members: Replacement of members may occur if each new member complies with the applicable personnel qualifications and each is approved by the Contracting Officer.

1.5.2 TAB Standard

Perform TAB in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1, NEBB PROCEDURAL STANDARDS, or SMACNA 1780 unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard are considered mandatory. Use the provisions of the TAB Standard, including checklists, report forms, etc., as nearly as practical, to satisfy the Contract requirements. Use the TAB Standard for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, adhere to the manufacturer's recommendations.

All quality assurance provisions of the TAB Standard such as performance guarantees are part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures must be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC, NEBB, or TABB), the requirements and recommendations contained in these procedures and requirements are considered mandatory, including the latest requirements of ASHRAE 62.1.

1.5.3 Qualifications

1.5.3.1 TAB Firm

The TAB Firm must be either a member of AABC or certified by the NEBB or the TABB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including TAB of environmental systems .

Certification must be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor must immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm will be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be

performed by an approved successor.

These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm must be a prime subcontractor of the Contractor and be financially and corporately independent of the mechanical subcontractor, reporting directly to and paid by the Contractor.

1.5.3.2 TAB Specialist

The TAB Specialist must be either a member of AABC,an experienced technician of the Firm certified by the NEBB, or a Supervisor certified by the TABB. The certification must be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC, the NEBB, or the TABB within the five years preceding Contract Award is not eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist will be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

1.5.3.3 TAB Specialist Responsibilities

TAB Specialist responsibilities include all TAB work specified herein and in related sections under his direct guidance. The TAB specialist is required to be onsite on a daily basis to direct TAB efforts. The TAB Specialist must participate in the commissioning process

1.5.3.4 TAB Related HVAC Submittals

The TAB Specialist must prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. Accompany the submittals identified on this list with a letter of approval signed and dated by the TAB Specialist when submitted to the Government. Ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

1.5.4 Responsibilities

The Contractor is responsible for ensuring compliance with the requirements of this section. The following delineation of specific work responsibilities is specified to facilitate TAB execution of the various work efforts by personnel from separate organizations. This breakdown of specific duties is specified to facilitate adherence to the schedule listed in the paragraph TAB SUBMITTAL AND WORK SCHEDULE.

1.5.4.1 Contractor

a. TAB personnel: Ensure that the DALT work and the TAB work is accomplished by a group meeting the requirements specified in the paragraph TAB PERSONNEL QUALIFICATION REQUIREMENTS.

b. Pre-DALT/TAB meeting: Attend the meeting with the TAB Supervisor, and ensure that a representative is present for the sheetmetal contractor, mechanical contractor, electrical contractor, and automatic

temperature controls contractor.

c. HVAC documentation: Furnish one complete set of the following HVAC-related documentation to the TAB agency:

(1) Contract drawings and specifications

(2) Approved submittal data for equipment

(3) Construction work schedule

(4) Up-to-date revisions and change orders for the previously listed items

d. Submittal and work schedules: Ensure that the schedule for submittals and work required by this section and specified in the paragraph TAB SUBMITTAL AND WORK SCHEDULE is met.

e. Coordination of supporting personnel:

Provide the technical personnel, such as factory representatives or HVAC controls installer required by the TAB field team to support the DALT and the TAB field measurement work.

Provide equipment mechanics to operate HVAC equipment and ductwork mechanics to provide the field designated test ports to enable TAB field team to accomplish the DALT and the TAB field measurement work. Ensure these support personnel are present at the times required by the TAB team, and cause no delay in the DALT and the TAB field work.

Conversely, ensure that the HVAC controls installer has required support from the TAB team field leader to complete the controls check out.

f. Deficiencies: Ensure that the TAB Agency supervisor submits all Design/Construction deficiency notifications directly to the Contracting officer within 3 days after the deficiency is encountered. Further, ensure that all such notification submittals are complete with explanation, including documentation, detailing deficiencies.

g. Prerequisite HVAC work: Complete check out and debugging of HVAC equipment, ducts, and controls prior to the TAB engineer arriving at the project site to begin the TAB work. Debugging includes searching for and eliminating malfunctioning elements in the HVAC system installations, and verifying all adjustable devices are functioning as designed. Include as prerequisite work items, the deficiencies pointed out by the TAB team supervisor in the design review report.

h. Prior to the TAB field team's arrival, ensure completion of the applicable inspections and work items listed in the TAB team supervisor's pre-field engineering report. Do not allow the TAB team to commence TAB field work until all of the following are completed.

(1) HVAC system installations are fully complete.

(2) HVAC prerequisite checkout work lists specified in the paragraph PRE-FIELD TAB ENGINEERING REPORT are completed, submitted, and approved. Ensure that the TAB Agency gets a copy of the approved

prerequisite HVAC work checklist.

(3) DALT field checks for all systems are completed.

(4) HVAC system filters are clean for both Season 1 and Season 2 TAB field work.

i. Advance notice: Furnish to the Contracting Officer with advance written notice for the commencement of the DALT field work and for the commencement of the TAB field work.

j. Insulation work: For required DALT work , ensure that insulation is not installed on ducts to be DALT'd until DALT work on the subject ducts is complete. Later, ensure that openings in duct and machinery insulation coverings for TAB test ports are marked, closed and sealed.

1.5.4.2 TAB Agency

Provide the services of a TAB team which complies with the requirements of the paragraph INDEPENDENT TAB AGENCY PERSONNEL QUALIFICATIONS. The work to be performed by the TAB agency is limited to testing, adjusting, and balancing of HVAC air and water systems to satisfy the requirements of this specification section.

1.5.4.3 TAB Team Supervisor

a. Overall management: Supervise and manage the overall TAB team work effort, including preliminary and technical DALT and TAB procedures and TAB team field work.

b. Pre-DALT/TAB meeting: Attend meeting with Contractor.

c. Design review report: Review project specifications and accompanying drawings to verify that the air systems and water systems are designed in such a way that the TAB engineer can accomplish the work in compliance with the requirements of this section. Verify the presence and location of permanently installed test ports and other devices needed, including gauge cocks, thermometer wells, flow control devices, circuit setters, balancing valves, and manual volume dampers.

d. Support required: Specify the technical support personnel required from the Contractor other than the TAB agency; such as factory representatives for temperature controls or for complex equipment. Inform the Contractor in writing of the support personnel needed and when they are needed. Furnish the notice as soon as the need is anticipated, either with the design review report, or the pre-field engineering report, the during the DALT or TAB field work.

e. Pre-field DALT preliminary notification: Monitor the completion of the duct installation of each system and provide the necessary written notification to the Contracting Officer.

f. Pre-field engineering report: Utilizing the following HVAC-related documentation; contract drawings and specifications, approved submittal data for equipment, up-to-date revisions and change orders; prepare this report.

g. Prerequisite HVAC work checklist: Ensure the Contractor gets a copy of this checklist at the same time as the pre-field engineering report

is submitted.

h. Technical assistance for DALT work.

(1) Technical assistance: Provide immediate technical assistance to TAB field team.

(2) DALT field visit: Near the end of the DALT field work effort, visit the contract site to inspect the HVAC installation and the progress of the DALT field work. Conduct a site visit to the extent necessary to verify correct procedures are being implemented and to confirm the accuracy of the Pre-final DALT Report data which has been reported. Also, perform sufficient evaluation to allow the TAB supervisor to issue certification of the final report. Conduct the site visit full-time for a minimum of one 8 hour workday duration.

i. Final DALT report: Certify the DALT report. This certification includes the following work:

(1) Review: Review the Pre-final DALT report data. From these field reports, prepare the Certified Final DALT report.

(2) TAB Verification: Verify adherence, by the TAB field team, to the procedures specified in this section.

j. Technical Assistance for TAB Work: Provide immediate technical assistance to the TAB field team for the TAB work.

(1) TAB field visit: At the midpoint of the Season 1 and Season 2 TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of one 8 hour workday duration.

(2) TAB field visit: Near the end of the TAB field work effort, visit the contract site to inspect the HVAC installation and the progress of the TAB field work. Conduct site visit full-time for a minimum of one 8 hour workday duration. Review the TAB final report data and certify the TAB final report.

k. Certified TAB report: Certify the TAB report. This certification includes the following work:

(1) Review: Review the TAB field data report. From this field report, prepare the certified TAB report.

(2) Verification: Verify adherence, by the TAB field team, to the TAB plan prescribed by the pre-field engineering report and verify adherence to the procedures specified in this section.

l. Design/Construction deficiencies: Within 3 working days after the TAB Agency has encountered any design or construction deficiencies, the TAB Supervisor must submit written notification directly to the Contracting Officer, with a separate copy to the Contractor, of all such deficiencies. Provide in this submittal a complete explanation, including supporting documentation, detailing deficiencies. Where deficiencies are encountered that are believed to adversely impact

successful completion of TAB, the TAB Agency must issue notice and request direction in the notification submittal.

m. TAB Field Check: The TAB team supervisor must attend and supervise Season 1 TAB field check.

1.5.4.4 TAB Team Field Leader

a. Field manager: Manage, in the field, the accomplishment of the work specified in Part 3, EXECUTION.

b. Full time: Be present at the contract site when DALT field work or TAB field work is being performed by the TAB team; ensure day-to-day TAB team work accomplishments are in compliance with this section.

c. Prerequisite HVAC work: Do not bring the TAB team to the contract site until a copy of the prerequisite HVAC Checklist, with all work items certified by the Contractor to be working as designed, reaches the office of the TAB Agency.

1.5.5 Test Reports

1.5.5.1 Data from DALT Field Work

Report the data for the Pre-final DALT Report and Certified Final DALT Report in compliance the following requirements:

a. Report format: Submit report data on Air Duct Leakage Test Summary Report Forms as shown on Page 6-2 of SMACNA 1972 CD. In addition, submit in the report, a marked duct shop drawing which identifies each section of duct tested with assigned node numbers for each section. Include node numbers in the completed report forms to identify each duct section. The TAB supervisor must review and certify the report.

b. The TAB supervisor must include a copy of all calculations prepared in determining the duct surface area of each duct test section. In addition,provide the ductwork air leak testing (DALT) reports with a copy(s) of the calibration curve for each of the DALT test orifices used for testing.

c. Instruments: List the types of instruments actually used to measure the data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date. Instruments must have been calibrated within one year of the date of use in the field. Instrument calibration must be traceable to the measuring standards of the National Institute of Standards and Technology.

d. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

1.5.5.2 Certified TAB Reports

Submit: TAB Report for Season 1 and TAB Report for Season 2 in the following manner:

a. Report format: Submit the completed pre-field data forms approved in the pre-field TAB Engineering Report completed by TAB field team, reviewed and certified by the TAB supervisor. Bind the report with a

waterproof front and back cover. Include a table of contents identifying by page number the location of each report. Report forms and report data must be typewritten. Handwritten report forms or report data are not acceptable.

b. Temperatures: On each TAB report form reporting TAB work accomplished on HVAC thermal energy transfer equipment, include the indoor and outdoor dry bulb temperature range and indoor and outdoor wet bulb temperature range within which the TAB data was recorded. Include in the TAB report continuous time versus temperature recording data of wet and dry bulb temperatures for the rooms, or zones, as designated in the following list:

(1) Measure and compile data on a continuous basis for the period in which TAB work affecting those rooms is being done.

(2) Measure and record data only after the HVAC systems installations are complete, the systems fully balanced and the HVAC systems controls operating in fully automatic mode.

(3) Data may be compiled using direct digital controls trend logging where available. Otherwise, temporarily install calibrated time versus temperature/humidity recorders for this purpose. The HVAC systems and controls must be fully operational a minimum of 24 hours in advance of commencing data compilation. Include the specified data in the Season I TAB Report .

c. System Diagrams: Provide updated diagrams with final installed locations of all terminals and devices, any numbering changes, and actual test locations. Use a key numbering system on the diagram which identifies each outlet contained in the outlet airflow report sheets.

d. Static Pressure Profiles: Report static pressure profiles for air duct systems. Report static pressure data for all supply, return, relief, exhaust and outside air ducts for the systems listed. Include the following in the static pressure report data, in addition to AABC/NEBB/TABB required data:

(1) Report supply fan, return fan, relief fan, and exhaust fan inlet and discharge static pressures.

(2) Report static pressure drop across chilled water coils, DX coils, hot water coils, steam coils, electric resistance heating coils and heat reclaim devices installed in unit cabinetry or the system ductwork.

(3) Report static pressure drop across outside air, return air, and supply air automatic control dampers, both proportional and two-position, installed in unit cabinetry.

(4) Report static pressure drop across air filters, acoustic silencers, moisture eliminators, air flow straighteners, air flow measuring stations or other pressure drop producing specialty items installed in unit cabinetry, or in the system ductwork. Examples of these specialty items are smoke detectors, white sound generators, RF shielding, wave guides, security bars, blast valves, small pipes passing through ductwork, and duct mounted humidifiers.

Do not report static pressure drop across duct fittings provided for the sole purpose of conveying air, such as elbows, transitions, offsets, plenums, manual dampers, and branch takes-offs.

(5) Report static pressure drop across outside air and relief/exhaust air louvers.

(6) Report static pressure readings of supply air, return air, exhaust/relief air, and outside air in duct at the point where these ducts connect to each air moving unit.

e. Duct Traverses: Report duct traverses for main supply, return, exhaust, relief and outside air ducts. This includes all ducts, including those which lack 7 1/2 duct diameters upstream and 2 1/2 duct diameters downstream of straight duct unobstructed by duct fittings/offsets/elbows. The TAB Agency must evaluate and report findings on the duct traverses taken. Evaluate the suitability of the duct traverse measurement based on satisfying the qualifications for a pilot traverse plane as defined by AMCA 203, "Field Measurements", Section 8, paragraph 8.3, "Location of Traverse Plane."

f. Instruments: List the types of instruments actually used to measure the tab data. Include in the listing each instrument's unique identification number, calibration date, and calibration expiration date.

Instrumentation, used for taking wet bulb temperature readings must provide accuracy of plus or minus 5 percent at the measured face velocities. Submit instrument manufacturer's literature to document instrument accuracy performance is in compliance with that specified.

g. Certification: Include the typed name of the TAB supervisor and the dated signature of the TAB supervisor.

h. Performance Curves: The TAB Supervisor must include, in the TAB Reports, factory pump curves and fan curves for pumps and fans TAB'd on the job.

i. Calibration Curves: The TAB Supervisor must include, in the TAB Reports, a factory calibration curve for installed flow control balancing valves, flow venturi's and flow orifices TAB'd on the job.

1.6 PROJECT/SITE CONDITIONS

1.6.1 DALT and TAB Services to Obtain Existing Conditions

Conduct DALT and TAB of the indicated existing systems and equipment and submit the specified DALT and TAB reports for approval. Conduct this DALT and TAB work in accordance with the requirements of this section.

1.7 SEQUENCING AND SCHEDULING

1.7.1 Projects with Phased Construction

This specification section is structured as though the HVAC construction, and thereby the TAB work, will be completed in a single phase. When the construction is completed in phases, the DALT work and TAB work must be planned, completed, and accepted for each construction phase.

1.7.1.1 Phasing of Work

This specification section is structured as though the HVAC construction, and thereby the TAB work, is going to be completed in a single phase in spite of the fact that there will be two seasons. All elements of the TAB work are addressed on this premise. When a contract is to be completed in construction phases, including the TAB work, and the DALT work, the TAB work and DALT work must be planned for, completed and approved by the Contracting Officer with each phase. An example of this case would be one contract that requires the rehabilitation of the HVAC in each of several separated buildings. At the completion of the final phase, compile all approved reports and submit as one document.

1.7.2 DALT and TAB Submittal and Work Schedule

Submit this schedule,and TAB Schematic Drawings, adapted for this particular contract, to the Contracting Officer (CO) for review and approval. Include with the submittal the planned calendar dates for each submittal or work item. Resubmit an updated version for CO approval every 90 calendar days. Compliance with the following schedule is the Contractor's responsibility.

Qualify TAB Personnel: Within 45 calendar days after date of contract award, submit TAB agency and personnel qualifications.

Pre-DALT/TAB Meeting: Within 30 calendar days after the date of approval of the TAB agency and personnel, meet with the COTR.

Design Review Report: Within 60 calendar days after the date of the TAB agency personnel qualifications approval, submit design review report.

Pre-Field DALT Preliminary Notification: On completion of the duct installation for each system, notify the Contracting Officer in writing within 5 days after completion.

Ductwork Selected for DALT: Within 7 calendar days of Pre-Field DALT Preliminary Notification, the COTR will select which of the project ductwork must be DALT'd.

DALT Field Work: Within 48 hours of COTR's selection, complete DALT field work on selected.

Submit Pre-final DALT Report: Within one working day after completion of DALT field work, submit Pre-final DALT Report. Separate Pre-final DALT reports may be submitted to allow phased testing from system to system.

DALT Work Field Check: Upon approval of the Pre-final DALT Report,

schedule the COTR's DALT field check work with the Contracting Officer.

Submit Final DALT Report: Within 15 calendar days after completion of successful DALT Work Field Check, submit Season 1 TAB report.

Prerequisite HVAC Work Check Out List For Season 1 : At a minimum of 115 calendar days prior to CCD, submit prerequisite HVAC work check out list certified as complete, and submit advance notice of commencement of TAB field work.

Season 1 TAB Field Work: At a minimum of 90 calendar days prior to CCD, and when the ambient temperature is within Season 1 limits, accomplish Season 1 TAB field work.

1.7.2.1 TAB Design Review Report

Submit typed report describing omissions and deficiencies in the HVAC system's design that would preclude the TAB team from accomplishing the duct leakage testing work and the TAB work requirements of this section. Provide a complete explanation including supporting documentation detailing the design deficiency. State that no deficiencies are evident if that is the case.

1.7.2.2 Pre-Field DALT Preliminary Notification

Notification: On completion of the installation of each duct system indicated to be DALT'd, notify the Contracting Officer in writing within 7 calendar days after completion.

1.7.2.3 TAB Pre-Field Engineering Report

Submit report containing the following information:

a. Step-by-step TAB procedure:

(1) Strategy: Describe the method of approach to the TAB field work from start to finish. Include in this description a complete methodology for accomplishing each seasonal TAB field work session.

(2) Air System Diagrams: Use the contract drawings and duct fabrication drawings if available to provide air system diagrams in the report showing the location of all terminal outlet supply, return, exhaust and transfer registers, grilles and diffusers. Use a key numbering system on the diagrams which identifies each outlet contained in the outlet airflow report sheets. Show intended locations of all traverses and static pressure readings.

(3) Procedural steps: Delineate fully the intended procedural steps to be taken by the TAB field team to accomplish the required TAB

work of each air distribution system and each water distribution system. Include intended procedural steps for TAB work for subsystems and system components.

b. Pre-field data: Submit AABC or NEBB or SMACNA 1780 data report forms with the following pre-field information filled in:

(1) Design data obtained from system drawings, specifications, and approved submittals.

(2) Notations detailing additional data to be obtained from the contract site by the TAB field team.

(3) Designate the actual data to be measured in the TAB field work.

(4) Provide a list of the types of instruments, and the measuring range of each, which are anticipated to be used for measuring in the TAB field work. By means of a keying scheme, specify on each TAB data report form submitted, which instruments will be used for measuring each item of TAB data. If the selection of which instrument to use, is to be made in the field, specify from which instruments the choice will be made. Place the instrument key number in the blank space where the measured data would be entered.

c. Prerequisite HVAC work checkout list: Provide a list of inspections and work items which are to be completed by the Contractor. This list must be acted upon and completed by the Contractor and then submitted and approved by the Contracting Officer prior to the TAB team coming to the contract site.

At a minimum, a list of the applicable inspections and work items listed in the NEBB PROCEDURAL STANDARDS, Section III, "Preliminary TAB Procedures" under paragraphs titled, "Air Distribution System Inspection" and "Hydronic Distribution System Inspection" must be provided for each separate system to be TAB'd.

1.8 WARRANTY

Furnish workmanship and performance warranty for the DALT and TAB system work performed for a period not less than 1 years from the date of Government acceptance of the work; issued directly to the Government. Include provisions that if within the warranty period the system shows evidence of major performance deterioration, or is significantly out of tolerance, resulting from defective TAB or DALT workmanship, the corrective repair or replacement of the defective materials and correction of the defective workmanship is the responsibility of the TAB firm. Perform corrective action that becomes necessary because of defective materials and workmanship while system TAB and DALT is under warranty 7 days after notification, unless additional time is approved by the Contracting Officer. Failure to perform repairs within the specified period of time constitutes grounds for having the corrective action and repairs performed by others and the cost billed to the TAB firm. The Contractor must also provide a 1 year contractor installation warranty.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 WORK DESCRIPTIONS OF PARTICIPANTS

Comply with requirements of this section.

3.2 PRE-DALT/TAB MEETING

Meet with the Contracting Officer's technical representative (COTR)and the designing engineer of the HVAC systems to develop a mutual understanding relative to the details of the DALT work and TAB work requirements. Ensure that the TAB supervisor is present at this meeting. Requirements to be discussed include required submittals, work schedule, and field quality control.

3.3 DALT PROCEDURES

3.3.1 Instruments, Consumables and Personnel

Provide instruments, consumables and personnel required to accomplish the DALT field work. Follow the same basic procedure specified below for TAB Field Work, including maintenance and calibration of instruments, accuracy of measurements, preliminary procedures, field work, workmanship and treatment of deficiencies. Calibrate and maintain instruments in accordance with manufacturer's written procedures.

3.3.2 Advance Notice of Pre-Final DALT Field Work

On completion of the installation of each duct system indicated to be DALT'd, notify the Contracting Officer in writing prior to the COTR's duct selection field visit.

3.3.3 Ductwork To Be DALT'd

From each duct system indicated as subject to DALT, the COTR will randomly select sections of each completed duct system for testing by the Contractor's TAB Firm. The sections selected will not exceed 20 percent of the total measured linear footage of duct systems indicated as subject to DALT. Sections of duct systems subject to DALT will include 20 percent of main ducts, branch main ducts, branch ducts and plenums for supply, return, exhaust, and plenum ductwork.

3.3.4 Quality Assurance - COTR DALT Field Acceptance Testing

In the presence of the COTR and TAB team field leader, verify for accuracy Pre-final DALT Report data selected by the COTR. For each duct system, this acceptance testing shall be conducted on a maximum of 50 percent of the duct sections DALT'd.

Further, if any data on the Pre-final DALT report form for a given duct section is out-of-tolerance, then field acceptance testing shall be conducted on data for one additional duct section, preferably in the same duct system, in the presence of the COTR.

3.3.5 Additional COTR Field Acceptance Testing

If any of the duct sections checked for a given system are determined to

have a leakage rate measured that exceeds the leakage rate allowed by SMACNA Leak Test Manual for an indicated duct construction class and sealant class, terminate data checking for that section. The associated Pre-final DALT Report data for the given duct system will be disapproved. Make the necessary corrections and prepare a revised Pre-final DALT Report. Reschedule a field check of the revised report data with the COTR.

3.3.6 Certified Final DALT Report

On successful completion of all field checks of the Pre-final DALT Report data for all systems, the TAB Supervisor is to assemble, review, certify and submit the Final DALT Report to the Contracting Officer for approval.

3.3.7 Prerequisite for TAB Field Work

Do not commence TAB field work prior to the completion and approval, for all systems, of the Final DALT Report.

3.4 TAB PROCEDURES

3.4.1 TAB Field Work

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents.

That is, comply with the the requirements of AABC MN-1 or SMACNA 1780 (TABB) and SMACNA 1858 (TABB),except as supplemented and modified by this section.

Test, adjust, and balance the HVAC systems until measured flow rates (air and water flow) are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. Conduct TAB work, including measurement accuracy, and sound measurement work in conformance with the AABC MN-1 and AABC MN-4, or NEBB TABES and NEBB MASV, or SMACNA 1780 (used by TABB) and SMACNA 1858 sound measurement procedures, except as supplemented and modified by this section.

3.4.2 Preliminary Procedures

Use the approved pre-field engineering report as instructions and procedures for accomplishing TAB field work. TAB engineer is to locate, in the field, test ports required for testing. It is the responsibility of the sheet metal contractor to provide and install test ports as required by the TAB engineer.

3.4.3 TAB Air Distribution Systems

3.4.3.1 Units With Coils

Report heating and cooling performance capacity tests for hot water, chilled water, DX and steam coils for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

a. For air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units

and rooftop units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing."

Do not determine entering and leaving wet and dry bulb temperatures by single point measurement, but by the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

b. For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.4.3.2 Air Handling Units

Air handling unit systems including fans (air handling unit fans, exhaust fans and winter ventilation fans), coils, ducts, plenums, mixing boxes, terminal units, variable air volume boxes, and air distribution devices for supply air, return air, outside air, mixed air relief air, and makeup air.

3.4.3.3 Rooftop Air Conditioning

Rooftop air conditioning systems including fans, coils, ducts, plenums, and air distribution devices for supply air, return air, and outside air.

For refrigeration compressors/condensers/condensing units/evaporators, report data as required by NEBB, AABC, and TABB standard procedures, including refrigeration operational data.

3.4.3.4 Heating and Ventilating Units

Heating and ventilating unit systems including fans, coils, ducts, plenums, roof vents, registers, diffusers, grilles, and louvers for supply air, return air, outside air, and mixed air.

3.4.3.5 Makeup Air Units

Makeup air unit systems including fans, coils, ducts, plenums, registers, diffusers, grilles, and louvers for supply air, return air, outside air, and mixed air.

3.4.3.6 Return Air Fans

Return air fan system including fan ducts, plenums, registers, diffusers, grilles, and louvers for supply air, return air, outside air, and mixed air.

3.4.3.7 Fan Coils

Fan coil unit systems including fans, coils, ducts, plenums, and air distribution devices for supply air, return air, and outside air.

3.4.3.8 Exhaust Fans

Exhaust fan systems including fans, ducts, plenums, grilles, and hoods for exhaust air.

3.4.4 TAB Water Distribution Systems

3.4.4.1 Chilled Water

Chilled water systems including chillers, condensers, cooling towers, pumps, coils, system balance valves and flow measuring devices.

For water chillers, report data as required by AABC, NEBB and TABB standard procedures, including refrigeration operational data.

3.4.4.2 Heating Hot Water

Heating hot water systems including boilers, hot water converters (e.g., heat exchangers), pumps, coils, system balancing valves and flow measuring devices.

3.4.4.3 Dual Temperature Water

Dual temperature water systems including boilers, converters, chillers, condensers, cooling towers, pumps, coils, and system balancing valves, and flow measuring devices.

3.4.5 Sound Measurement Work

3.4.5.1 Areas To Be Sound Measured

In the following spaces, measure and record the sound power level for each octave band listed in ASHRAE HVAC APP IP HDBK Noise Criteria:

a. All HVAC mechanical rooms, including machinery spaces and other spaces containing HVAC power drivers and power driven equipment.

b. All spaces sharing a common barrier with each mechanical room, including rooms overhead, rooms on the other side of side walls, and rooms beneath the mechanical room floor.

3.4.5.2 ProcedureMeasure sound levels in each room, when unoccupied except for the TAB team, with all HVAC systems that would cause sound readings in the room operating in their noisiest mode. Record the sound level in each octave band. Attempt to mitigate the sound level and bring the level to within the specified ASHRAE HVAC APP IP HDBK noise criteria goals, if such mitigation is within the TAB team's control. State in the report the ASHRAE HVAC APP IP HDBK noise criteria goals. If sound level cannot be brought into compliance, provide written notice of the deficiency to the Contractor for resolution or correction.

3.4.5.3 Timing

Measure sound levels at times prescribed by AABC or NEBB or TABB.

3.4.5.4 Meters

Measure sound levels with a sound meter complying with ASA S1.4, Type 1 or 2, and an octave band filter set complying with ASA S1.11 PART 1. Use measurement methods for overall sound levels and for octave band sound levels as prescribed by NEBB.

3.4.5.5 Calibration

Calibrate sound levels as prescribed by AABC or NEBB or TABB, except that calibrators emitting a sound pressure level tone of 94 dB at 1000 hertz (Hz) are also acceptable.

3.4.5.6 Background Noise Correction

Determine background noise component of room sound (noise) levels for each (of eight) octave bands as prescribed by AABC or NEBB or TABB.

3.4.6 TAB Work on Performance Tests Without Seasonal Limitations

3.4.6.1 Performance Tests

In addition to the TAB proportionate balancing work on the air distribution systems and the water distribution systems, accomplish TAB work on the HVAC systems which directly transfer thermal energy. TAB the operational performance of the heating systems and cooling systems.

3.4.6.2 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. Record these temperatures at beginning and at the end of data taking.

3.4.6.3 Sound Measurements

Comply with the paragraph SOUND MEASUREMENT WORK, specifically, the requirement that a room must be operating in its noisiest mode at the time of sound measurements in the room. The maximum noise level measurements could depend on seasonally related heat or cooling transfer equipment.

3.4.6.4 Water Chillers

For water chillers, report data as required by NEBB Form TAB 15-83, NEBB PROCEDURAL STANDARDS, including refrigeration operational data.

3.4.6.5 Refrigeration Units

For refrigeration compressors/condensers/condensing units, report data as required by NEBB Form TAB 15-83, NEBB PROCEDURAL STANDARDS, including refrigeration operational data.

3.4.6.6 Coils

Report heating and cooling performance capacity tests for hot water, chilled water, for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations

with the coil test reports:

a. For Central station air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units and rooftop units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing".

   Entering and leaving wet and dry bulb temperatures are not determined by single point measurement, but the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

   Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

b. For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

   Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.4.7 TAB Work on Performance Tests With Seasonal Limitations

3.4.7.1 Performance Tests

Accomplish proportionate balancing TAB work on the air distribution systems and water distribution systems, in other words, accomplish adjusting and balancing of the air flows and water flows, any time during the duration of this contract, subject to the limitations specified elsewhere in this section. However, accomplish, within the following seasonal limitations, TAB work on HVAC systems which directly transfer thermal energy.

3.4.7.2 Season Of Maximum Load

Visit the contract site for at least two TAB work sessions for TAB field measurements. Visit the contract site during the season of maximum heating load and visit the contract site during the season of maximum cooling load, the goal being to TAB the operational performance of the heating systems and cooling systems under their respective maximum outdoor environment-caused loading. During the seasonal limitations, TAB the operational performance of the heating systems and cooling systems.

3.4.7.3 Ambient Temperatures

On each tab report form used for recording data, record the outdoor and indoor ambient dry bulb temperature range and the outdoor and indoor ambient wet bulb temperature range within which the report form's data was recorded. Record these temperatures at beginning and at the end of data taking.

3.4.7.4 Sound Measurements

Comply with the paragraph SOUND MEASUREMENT WORK, specifically, the requirement that a room must be operating in its noisiest mode at the time of sound measurements in the room. The maximum noise level measurements could depend on seasonally related heat or cooling transfer equipment.

3.4.7.5 Water Chillers

Water chillers: For water chillers,report data as required by NEBB Form TAB 15-83, NEBB PROCEDURAL STANDARDS, including refrigeration operational data.

3.4.7.6 Refrigeration Units

For refrigeration compressors/condensers/condensing units,report data as required by NEBB Form TAB 15-83, NEBB PROCEDURAL STANDARDS, including refrigeration operational data.

3.4.7.7 Coils

Report heating and cooling performance capacity tests for hot water, chilled water, for the purpose of verifying that the coils meet the indicated design capacity. Submit the following data and calculations with the coil test reports:

a. For Central station air handlers with capacities greater than 7.5 tons (90,000 Btu) cooling, such as factory manufactured units, central built-up units and rooftop units, conduct capacity tests in accordance with AABC MN-4, procedure 3.5, "Coil Capacity Testing."

   Entering and leaving wet and dry bulb temperatures are not determined by single point measurement, but by the average of multiple readings in compliance with paragraph 3.5-5, "Procedures", (in subparagraph d.) of AABC MN-4, Procedure 3.5, "Coil Capacity Testing."

   Submit part-load coil performance data from the coil manufacturer converting test conditions to design conditions; use the data for the purpose of verifying that the coils meet the indicated design capacity in compliance with AABC MN-4, Procedure 3.5, "Coil Capacity Testing," paragraph 3.5.7, "Actual Capacity Vs. Design Capacity" (in subparagraph c.).

b. For units with capacities of 7.5 tons (90,000 Btu) or less, such as fan coil units, duct mounted reheat coils associated with VAV terminal units, and unitary units, such as through-the-wall heat pumps:

   Determine the apparent coil capacity by calculations using single point measurement of entering and leaving wet and dry bulb temperatures; submit the calculations with the coil reports.

3.4.8 Workmanship

Conduct TAB work on the HVAC systems until measured flow rates are within plus or minus 5 percent of the design flow rates as specified or indicated on the contract documents. This TAB work includes adjustment of balancing valves, balancing dampers, and sheaves. Further, this TAB work includes changing out fan sheaves and pump impellers if required to obtain air and water flow rates specified or indicated. If, with these adjustments and

equipment changes, the specified or indicated design flow rates cannot be attained, contact the Contracting Officer for direction.

3.4.9 Deficiencies

Strive to meet the intent of this section to maximize the performance of the equipment as designed and installed. However, if deficiencies in equipment design or installation prevent TAB work from being accomplished within the range of design values specified in the paragraph WORKMANSHIP, provide written notice as soon as possible to the Contractor and the Contracting Officer describing the deficiency and recommended correction.

Responsibility for correction of installation deficiencies is the Contractor's. If a deficiency is in equipment design, call the TAB team supervisor for technical assistance. Responsibility for reporting design deficiencies to Contractor is the TAB team supervisor's.

3.4.10 TAB Reports

After completion of the TAB field work, prepare the TAB field data for TAB supervisor's review and certification, using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms is to be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and thereby the TAB report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph WORKMANSHIP.

After completion of the TAB work, prepare a pre-final TAB report using the reporting forms approved in the pre-field engineering report. Data required by those approved data report forms is to be furnished by the TAB team. Except as approved otherwise in writing by the Contracting Officer, the TAB work and the TAB report is considered incomplete until the TAB work is accomplished to within the accuracy range specified in the paragraph WORKMANSHIP of this section.

Prepare the report neatly and legibly; the pre-final TAB report is the final TAB report minus the TAB supervisor's review and certification. Obtain, at the contract site, the TAB supervisor's review and certification of the TAB report.

Verbally notify the COTR that the field check of the TAB report data can commence; give this verbal notice 48 hours in advance of field check commencement. Do not schedule field check of the TAB report until the specified workmanship requirements have been met or written approval of the deviations from the requirements have been received from the Contracting Officer.

3.4.11 Quality Assurance - COTR TAB Field Acceptance Testing

3.4.11.1 TAB Field Acceptance Testing

During the field acceptance testing, verify, in the presence of the COTR, random selections of data (water, air quantities, air motion, sound level readings) recorded in the TAB Report. Points and areas for field acceptance testing are to be selected by the COTR. Measurement and test procedures are the same as approved for TAB work for the TAB Report.

Field acceptance testing includes verification of TAB Report data recorded for the following equipment groups:

Group 1: All chillers, boilers, return fans, computer room units, and air handling units (rooftop and central stations).

Group 2: 25 percent of the VAV terminal boxes and associated diffusers and registers.

Group 3: 25 percent of the supply diffusers, registers, grilles associated with constant volume air handling units.

Group 4: 25 percent of the return grilles, return registers, exhaust grilles and exhaust registers.

Group 5: 25 percent of the supply fans, exhaust fans, and pumps.

Further, if any data on the TAB Report for Groups 2 through 5 is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, additional group data verification is required in the presence of the COTR. Verify TAB Report data for one additional piece of equipment in that group. Continue this additional group data verification until out-of-tolerance data ceases to be found.

3.4.11.2 Additional COTR TAB Field Acceptance Testing

If any of the acceptance testing measurements for a given equipment group is found not to fall within the range of plus 5 to minus 5 percent of the TAB Report data, terminate data verification for all affected data for that group. The affected data for the given group will be disapproved. Make the necessary corrections and prepare a revised TAB Report. Reschedule acceptance testing of the revised report data with the COTR.

Further, if any data on the TAB Report for a given field acceptance test group is out-of-tolerance, then field test data for one additional field test group as specified herein. Continue this increase field test work until out-of-tolerance data ceases to to be found. This additional field testing is up and above the original 25 percent of the of reported data entries to be field tested.

If there are no more similar field test groups from which to choose, additional field testing from another, but different, type of field testing group must be tested.

3.4.11.3 Prerequisite for Approval

Compliance with the field acceptance testing requirements of this section is a prerequisite for the final Contracting Officer approval of the TAB Report submitted.

3.5 MARKING OF SETTINGS

Upon the final TAB work approval, permanently mark the settings of HVAC adjustment devices including valves, gauges, splitters, and dampers so that adjustment can be restored if disturbed at any time. Provide permanent markings clearly indicating the settings on the adjustment devices which result in the data reported on the submitted TAB report.

3.6 MARKING OF TEST PORTS

The TAB team is to permanently and legibly mark and identify the location

points of the duct test ports. If the ducts have exterior insulation, make these markings on the exterior side of the duct insulation. Show the location of test ports on the as-built mechanical drawings with dimensions given where the test port is covered by exterior insulation.

-- End of Section --

SECTION 23 07 00

THERMAL INSULATION FOR MECHANICAL SYSTEMS
02/13, CHG 7: 05/20

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. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 90.1 - SI	(2013) Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE 90.2	(2018) Energy-Efficient Design of Low-Rise Residential Buildings

ASTM INTERNATIONAL (ASTM)

ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A240/A240M	(2020) Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
ASTM A580/A580M	(2018) Standard Specification for Stainless Steel Wire
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM C195	(2007; R 2013) Standard Specification for Mineral Fiber Thermal Insulating Cement
ASTM C450	(2008) Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging
ASTM C533	(2017) Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
ASTM C534/C534M	(2020a) Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

ASTM C547	(2019) Standard Specification for Mineral Fiber Pipe Insulation
ASTM C552	(2017; E 2018) Standard Specification for Cellular Glass Thermal Insulation
ASTM C585	(2010) Standard Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing
ASTM C591	(2020) Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C592	(2016) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM C610	(2015) Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation
ASTM C612	(2014; R 2019) Standard Specification for Mineral Fiber Block and Board Thermal Insulation
ASTM C647	(2008; R 2013) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C755	(2019b) Standard Practice for Selection of Water Vapor Retarders for Thermal Insulation
ASTM C795	(2008; R 2018) Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel
ASTM C916	(2020) Standard Specification for Adhesives for Duct Thermal Insulation
ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM C921	(2010) Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM C1126	(2018) Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM C1136	(2017a) Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C1710	(2011) Standard Guide for Installation of

	Flexible Closed Cell Preformed Insulation in Tube and Sheet Form
ASTM D882	(2012) Tensile Properties of Thin Plastic Sheeting
ASTM D2863	(2019) Standard Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM D5590	(2000; R 2010; E 2012) Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E96/E96M	(2016) Standard Test Methods for Water Vapor Transmission of Materials
ASTM E2231	(2019) Standard Practice for Specimen Preparation and Mounting of Pipe and Duct Insulation Materials to Assess Surface Burning Characteristics
ASTM E2336	(2020) Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

FM GLOBAL (FM)

FM APP GUIDE	(updated on-line) Approval Guide http://www.approvalguide.com/

GREEN SEAL (GS)

GS-36	(2013) Adhesives for Commercial Use

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation

MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds	(8th Ed) National Commercial & Industrial Insulation Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 90B	(2021) Standard for the Installation of Warm Air Heating and Air Conditioning Systems

SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS	SCS Global Services (SCS) Indoor Advantage

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2017) Adhesive and Sealant Applications

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY (TAPPI)

TAPPI T403 OM	(2015) Bursting Strength of Paper

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-A-3316	(1987; Rev C; Am 2 1990) Adhesives, Fire-Resistant, Thermal Insulation
MIL-A-24179	(1969; Rev A; Am 2 1980; Notice 1 1987; Notice 2 2020) Adhesive, Flexible Unicellular-Plastic Thermal Insulation
MIL-PRF-19565	(1988; Rev C) Coating Compounds, Thermal Insulation, Fire- and Water-Resistant, Vapor-Barrier

UNDERWRITERS LABORATORIES (UL)

UL 94	(2013; Reprint Jun 2020) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 723	(2018) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
UL 2818	(2013) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

1.2 SYSTEM DESCRIPTION

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval.. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00

SUBMITTAL PROCEDURES:

Submit the three SD types, SD-02 Shop Drawings, SD-03 Product Data, and SD-08 Manufacturer's Instructions at the same time for each system.

SD-02 Shop Drawings

MICA Plates; G,

Pipe Insulation Systems and Associated Accessories

Duct Insulation Systems and Associated Accessories

Equipment Insulation Systems and Associated Accessories

Recycled content for insulation materials; S

SD-03 Product Data

Pipe Insulation Systems; G,

Duct Insulation Systems; G,

Equipment Insulation Systems; G,

SD-04 Samples

Thermal Insulation; G,

Display Samples; G,

SD-07 Certificates

Indoor air quality for adhesives; S

SD-08 Manufacturer's Instructions

Pipe Insulation Systems; G,

Duct Insulation Systems; G,

Equipment Insulation Systems; G,

1.4 CERTIFICATIONS

1.4.1 Adhesives and Sealants

Provide products certified to meet indoor air quality requirements by UL 2818 (Greenguard) Gold, SCS Global Services Indoor Advantage Gold or provide certification or validation by other third-party programs that products meet the requirements of this Section. Provide current product certification documentation from certification body. When product does not have certification, provide validation that product meets the indoor air quality product requirements cited herein.

1.5 QUALITY ASSURANCE

1.5.1 Installer Qualification

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.6 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. The Contracting Officer may reject insulation material and supplies that become dirty, dusty, wet, or contaminated by some other means. Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material, date codes, and approximate shelf life (if applicable). Insulation packages and containers shall be asbestos free.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide materials which are the standard products of manufacturers regularly engaged in the manufacture of such products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Submit a complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories including adhesives, sealants and jackets for each mechanical system requiring insulation shall be included. The product data must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. Materials furnished under this section shall be submitted together in a booklet and in conjunction with the MICA plates booklet (SD-02). Annotate the product data to indicate which MICA plate is applicable.

2.1.1 Insulation System

Provide insulation systems in accordance with the approved MICA National Insulation Standards plates as supplemented by this specification. Provide field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems and piping systems that are located within, on, under, and adjacent to buildings; and for plumbing systems. Provide CFC and HCFC free insulation.

2.1.2 Surface Burning Characteristics

Unless otherwise specified, insulation must have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flame spread, and smoke developed indexes, shall be determined by ASTM E84 or UL 723. Test insulation in the same density and installed thickness as the material to be used in the actual construction. Prepare and mount test specimens according to ASTM E2231.

2.2 MATERIALS

Provide insulation that meets or exceed the requirements of ASHRAE 90.2. Insulation exterior shall be cleanable, grease resistant, non-flaking and non-peeling. Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C795 requirements. Calcium silicate shall not be used on chilled or cold water systems. Materials shall be asbestos free. Provide product recognized under UL 94 (if containing plastic) and listed in FM APP GUIDE.

2.2.1 Adhesives

Provide non-aerosol adhesive products used on the interior of the building (defined as inside of the weatherproofing system) that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168 (HVAC duct sealants must meet limit requirements of "Other" category within SCAQMD Rule 1168 sealants table). Provide aerosol adhesives used on the interior of the building that meet either emissions requirements of CDPH SECTION 01350 (use the office or classroom requirements, regardless of space type) or VOC content requirements of GS-36. Provide certification or validation of indoor air quality for adhesives.

2.2.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C916, Type I.

2.2.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C195.

2.2.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. Lagging adhesives shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Adhesive shall be MIL-A-3316, Class 1, pigmented red and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bonding glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or Class 2 for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations for pipe and duct insulation.

2.2.1.4 Contact Adhesive

Adhesives may be any of, but not limited to, the neoprene based, rubber based, or elastomeric type that have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any

corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 212 degrees F. The dried adhesive shall be nonflammable and fire resistant. Flexible Elastomeric Adhesive: Comply with MIL-A-24179, Type II, Class I. Provide product listed in FM APP GUIDE.

2.2.2 Caulking

ASTM C920, Type S, Grade NS, Class 25, Use A.

2.2.3 Corner Angles

Nominal 0.016 inch aluminum 1 by 1 inch with factory applied kraft backing. Aluminum shall be ASTM B209, Alloy 3003, 3105, or 5005.

2.2.4 Fittings

Fabricated Fittings are the prefabricated fittings for flexible elastomeric pipe insulation systems in accordance with ASTM C1710. Together with the flexible elastomeric tubes, they provide complete system integrity for retarding heat gain and controlling condensation drip from chilled-water and refrigeration systems. Flexible elastomeric, fabricated fittings provide thermal protection (0.25 k) and condensation resistance (0.05 Water Vapor Transmission factor). For satisfactory performance, properly installed protective vapor retarder/barriers and vapor stops shall be used on high relative humidity and below ambient temperature applications to reduce movement of moisture through or around the insulation to the colder interior surface.

2.2.5 Finishing Cement

ASTM C450: Mineral fiber hydraulic-setting thermal insulating and finishing cement. All cements that may come in contact with Austenitic stainless steel must comply with ASTM C795.

2.2.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth, with 20X20 maximum mesh size, and glass tape shall have maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces/square yard. Elastomeric Foam Tape: Black vapor-retarder foam tape with acrylic adhesive containing an anti-microbial additive.

2.2.7 Staples

Outward clinching type ASTM A167, Type 304 or 316 stainless steel.

2.2.8 Jackets

2.2.8.1 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.016 inch nominal thickness; ASTM B209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.015 inch

thick, 1/2 inch wide for pipe under 12 inch diameter and 3/4 inch wide for pipe over 12 inch and larger diameter. Aluminum jacket circumferential seam bands shall be 2 by 0.016 inch aluminum matching jacket material. Bands for insulation below ground shall be 3/4 by 0.020 inch thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

2.2.8.2 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, ultraviolet (UV) resistant rating or treatment and moderate chemical resistance with minimum thickness 0.030 inch.

2.2.8.3 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive, greater than 3 plies standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive); with 0.0000 permeability when tested in accordance with ASTM E96/E96M, using the water transmission rate test method; heavy duty, white or natural; and UV resistant. Flexible Elastomeric exterior foam with factory applied, UV Jacket made with a cold weather acrylic adhesive. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and excellent Water Vapor Transmission (WVT) rate.

2.2.8.4 Vapor Barrier/Vapor Retarder

Apply the following criteria to determine which system is required.

a. On ducts, piping and equipment located outside shall be equipped with a vapor barrier.

b. Ducts, pipes and equipment that are located inside shall be installed with a vapor retarder where required as stated in paragraph VAPOR RETARDER REQUIRED.

2.2.9 Vapor Retarder Required

ASTM C921, Type I, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 35 pounds/inch width. ASTM C921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 20 pounds/inch width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials that require manufacturer or fabricator applied pipe insulation jackets are cellular glass, when all joints are sealed with a vapor barrier mastic, and mineral fiber. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible elastomerics require (in addition to vapor barrier skin) vapor retarder jacketing for high relative humidity and below ambient temperature applications.

2.2.9.1 White Vapor Retarder All Service Jacket (ASJ)

ASJ is for use on hot/cold pipes, ducts, or equipment indoors or outdoors

if covered by a suitable protective jacket. The product shall meet all physical property and performance requirements of ASTM C1136, Type I, except the burst strength shall be a minimum of 85 psi. ASTM D2863 Limited Oxygen Index (LOI) shall be a minimum of 31.

In addition, neither the outer exposed surface nor the inner-most surface contacting the insulation shall be paper or other moisture-sensitive material. The outer exposed surface shall be white and have an emittance of not less than 0.80. The outer exposed surface shall be paintable.

2.2.9.2 Vapor Retarder/Vapor Barrier Mastic Coatings

2.2.9.2.1 Vapor Barrier

The vapor barrier shall be self adhesive (minimum 2 mils adhesive, 3 mils embossed) greater than 3 plies standard grade, silver, white, black and embossed white jacket for use on hot/cold pipes. Permeability shall be less than 0.02 when tested in accordance with ASTM E96/E96M. Products shall meet UL 723 or ASTM E84 flame and smoke requirements and shall be UV resistant.

2.2.9.2.2 Vapor Retarder

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be in accordance with ASTM C755, Section 7.2.2, Table 2, for insulation type and service conditions. The coating shall be nonflammable, fire resistant type. To resist mold/mildew, coating shall meet ASTM D5590 with 0 growth rating. Coating shall meet MIL-PRF-19565 Type II (if selected for indoor service) and be Qualified Products Database listed. All other application and service properties shall be determined pursuant to ASTM C647.

2.2.9.3 Laminated Film Vapor Retarder

ASTM C1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork; where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable. Vapor retarder shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Flexible Elastomeric exterior foam with factory applied UV Jacket. Construction of laminate designed to provide UV resistance, high puncture, tear resistance and an excellent WVT rate.

2.2.9.4 Polyvinylidene Chloride (PVDC) Film Vapor Retarder

The PVDC film vapor retarder shall have a maximum moisture vapor transmission of 0.02 perms, minimum puncture resistance of 150 Beach units, a minimum tensile strength in any direction of 30 lb/inch when tested in accordance with ASTM D882, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.2.9.5 Polyvinylidene Chloride Vapor Retarder Adhesive Tape

Requirements must meet the same as specified for Laminated Film Vapor Retarder above.

2.2.9.6 Vapor Barrier/Weather Barrier

The vapor barrier shall be greater than 3 ply self adhesive laminate -white vapor barrier jacket- superior performance (less than 0.0000 permeability when tested in accordance with ASTM E96/E96M). Vapor barrier shall meet UL 723 or ASTM E84 25 flame and 50 smoke requirements; and UV resistant. Minimum burst strength 185 psi in accordance with TAPPI T403 OM . Tensile strength 68 lb/inch width (PSTC-1000). Tape shall be as specified for laminated film vapor barrier above.

2.2.10 Vapor Retarder Not Required

ASTM C921, Type II, Class D, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable. Jacket shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.2.11 Wire

Soft annealed ASTM A580/A580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.2.12 Insulation Bands

Insulation bands shall be 1/2 inch wide; 26 gauge stainless steel.

2.2.13 Sealants

Sealants shall be chosen from the butyl polymer type, the styrene-butadiene rubber type, or the butyl type of sealants. Sealants shall have a maximum permeance of 0.02 perms based on Procedure B for ASTM E96/E96M, and a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84.

2.3 PIPE INSULATION SYSTEMS

Conform insulation materials to Table 1 and minimum insulation thickness as listed in Table 2 and meet or exceed the requirements of ASHRAE 90.1 - SI. Limit pipe insulation materials to those listed herein and meeting the following requirements:

2.3.1 Recycled Materials

Provide insulation materials containing the following minimum percentage of recycled material content by weight:

Rock Wool: 75 percent slag of weight
Fiberglass: 20 percent glass cullet
Rigid Foam: 9 percent recovered material
Phenolic Rigid Foam: 9 percent recovered material

Provide data identifying percentage of recycled content for insulation materials.

2.3.2 Aboveground Cold Pipeline (-30 to 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications, shall be as follows:

2.3.2.1 Cellular Glass

ASTM C552, Type II, and Type III. Supply the insulation from the fabricator with (paragraph WHITE VAPOR RETARDER ALL SERVICE JACKET (ASJ)) ASJ vapor retarder and installed with all longitudinal overlaps sealed and all circumferential joints ASJ taped or supply the insulation unfaced from the fabricator and install with all longitudinal and circumferential joints sealed with vapor barrier mastic.

2.3.2.2 Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial additive, complying with ASTM C534/C534M, Grade 1, Type I or II. Type I, Grade 1 for tubular materials. Type II, Grade 1, for sheet materials. Type I and II shall have vapor retarder/vapor barrier skin on one or both sides of the insulation, and require an additional exterior vapor retarder covering for high relative humidity and below ambient temperature applications.

2.3.2.3 Mineral Fiber Insulation with Integral Wicking Material (MFIWM)

ASTM C547. Install in accordance with manufacturer's instructions. Do not use in applications exposed to outdoor ambient conditions in climatic zones 1 through 4.

2.3.2.4 Polyisocyanurate Insulation

ASTM C591, Type I. Supply the insulation with a factory applied vapor retarder/barrier that complies with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. The insulation and all covering must pass the flame spread index of 25 and the smoke developed index of 50 when tested in accordance with ASTM E84.

2.3.3 Aboveground Hot Pipeline (Above 60 deg. F)

Insulation for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

2.3.3.1 Mineral Fiber

ASTM C547, Types I, II or III, supply the insulation with manufacturer's recommended factory-applied jacket.

2.3.3.2 Calcium Silicate

ASTM C533, Type I indoor only, or outdoors above 250 degrees F pipe temperature. Supply insulation with the manufacturer's recommended factory-applied jacket/vapor barrier.

2.3.3.3 Cellular Glass

ASTM C552, Type II and Type III. Supply the insulation with manufacturer's recommended factory-applied jacket.

2.3.3.4 Flexible Elastomeric Cellular Insulation

Closed-cell, foam- or expanded-rubber materials containing anti-microbial

additive, complying with ASTM C534/C534M, Grade 1, Type I or II to 220 degrees F service. Type I for tubular materials. Type II for sheet materials.

2.3.3.5 Phenolic Insulation

ASTM C1126 Type III to 250 degrees F service shall comply with ASTM C795. Supply the insulation with manufacturer's recommended factory-applied jacket/vapor barrier.

2.3.3.6 Perlite Insulation

ASTM C610

2.3.3.7 Polyisocyanurate Insulation

ASTM C591, Type I. Supply the insulation with a factory applied vapor retarder/barrier that complies with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. The insulation and all covering must pass the flame spread index of 25 and the smoke developed index of 50 when tested in accordance with ASTM E84.

2.3.4 Aboveground Dual Temperature Pipeline

Selection of insulation for use over a dual temperature pipeline system (Outdoor, Indoor - Exposed or Concealed) shall be in accordance with the most limiting/restrictive case. Find an allowable material from paragraph PIPE INSULATION MATERIALS and determine the required thickness from the most restrictive case. Use the thickness listed in paragraphs INSULATION THICKNESS for cold & hot pipe applications.

2.3.5 Below-ground Pipeline Insulation

For below-ground pipeline insulation, use cellular glass, ASTM C552, type II.

2.4 DUCT INSULATION SYSTEMS

2.4.1 Factory Applied Insulation

Provide factory-applied ASTM C552, cellular glass thermal .

2.4.1.1 Rigid Insulation

Calculate the minimum thickness in accordance with ASHRAE 90.2.

2.4.1.2 Blanket Insulation

Calculate minimum thickness in accordance with ASHRAE 90.2

2.4.2 Kitchen Exhaust Ductwork Insulation

Insulation thickness shall be a minimum of 2 inches, blocks or boards, either mineral fiber conforming to ASTM C612, Class 5, 20 pcf average or calcium silicate conforming to ASTM C533, Type II. Provide vapor barrier for outside air connection to kitchen exhaust hood. The enclosure materials and the grease duct enclosure systems shall meet testing requirements of ASTM E2336 for noncombustibility, fire resistance, durability, internal fire, and fire-engulfment with a through-penetration

fire stop.

2.4.3 Acoustical Duct Lining

2.4.3.1 General

For ductwork indicated or specified in Section 23 30 00 HVAC AIR DISTRIBUTION to be acoustically lined, provide external insulation in accordance with this specification section and in addition to the acoustical duct lining. Do not use acoustical lining in place of duct wrap or rigid board insulation (insulation on the exterior of the duct).

2.4.3.2 Duct Liner

Flexible Elastomeric Acoustical and Conformable Duct Liner Materials: Flexible Elastomeric Thermal, Acoustical and Conformable Insulation Compliance with ASTM C534/C534M Grade 1, Type II; and NFPA 90A or NFPA 90B as applicable.

2.4.4 Duct Insulation Jackets

2.4.4.1 All-Purpose Jacket

Provide insulation with insulation manufacturer's standard reinforced fire-retardant jacket with or without integral vapor barrier as required by the service. In exposed locations, provide jacket with a white surface suitable for field painting.

2.4.4.2 Metal Jackets

2.4.4.2.1 Aluminum Jackets

ASTM B209, Temper H14, minimum thickness of 27 gauge (0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside dimension 8 inches and larger. Provide corrugated surface jackets for jacket outside dimension 8 inches and larger. Provide stainless steel bands, minimum width of 1/2 inch.

2.4.4.2.2 Stainless Steel Jackets

ASTM A167 or ASTM A240/A240M; Type 304, minimum thickness of 33 gauge (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 1/2 inch.

2.4.4.3 Vapor Barrier/Weatherproofing Jacket

Vapor barrier/weatherproofing jacket shall be laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive), heavy duty white or natural).

2.4.5 Weatherproof Duct Insulation

Provide ASTM C552, cellular glass thermal insulation, and weatherproofing as specified in manufacturer's instruction. Multi-ply, Polymeric Blend Laminate Jacketing: Construction of laminate designed to provide UV

resistance, high puncture, tear resistance and an excellent WVT rate.

2.5 EQUIPMENT INSULATION SYSTEMS

Insulate equipment and accessories as specified in Tables 5 and 6. In outside locations, provide insulation 1/2 inch thicker than specified. Increase the specified insulation thickness for equipment where necessary to equal the thickness of angles or other structural members to make a smooth, exterior surface. Submit a booklet containing manufacturer's published installation instructions for the insulation systems in coordination with the submitted MICA Insulation Stds plates booklet. Annotate their installation instructions to indicate which product data and which MICA plate are applicable. The instructions must be copyrighted, have an identifying or publication number, and shall have been published prior to the issuance date of this solicitation. A booklet is also required by paragraphs titled: Pipe Insulation Systems and Duct Insulation Systems.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after a one hour period; any insulation found to pull apart after one hour, shall be replaced.

3.1.1 Display Samples

Submit and display, after approval of materials, actual sections of installed systems, properly insulated in accordance with the specification requirements. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. The Contracting Officer will inspect display sample sections at the jobsite. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

3.1.1.1 Pipe Insulation Display Sections

Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric waterways and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services.

3.1.1.2 Duct Insulation Display Sections

Display sample sections for rigid and flexible duct insulation used on the job. Use a temporary covering to enclose and protect display sections for duct insulation exposed to weather

3.1.2 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until tests specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Stds plates except where modified herein or on the drawings.

3.1.3 Firestopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING. The protection of ducts at point of passage through firewalls must be in accordance with NFPA 90A and/or NFPA 90B. All other penetrations, such as piping, conduit, and wiring, through firewalls must be protected with a material or system of the same hourly rating that is listed by UL, FM, or a NRTL.

3.1.4 Installation of Flexible Elastomeric Cellular Insulation

Install flexible elastomeric cellular insulation with seams and joints sealed with rubberized contact adhesive. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 220 degrees F. Stagger seams when applying multiple layers of insulation. Protect insulation exposed to weather and not shown to have vapor barrier weatherproof jacketing with two coats of UV resistant finish or PVC or metal jacketing as recommended by the manufacturer after the adhesive is dry and cured.

3.1.4.1 Adhesive Application

Apply a brush coating of adhesive to both butt ends to be joined and to both slit surfaces to be sealed. Allow the adhesive to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

3.1.4.2 Adhesive Safety Precautions

Use natural cross-ventilation, local (mechanical) pickup, and/or general area (mechanical) ventilation to prevent an accumulation of solvent vapors, keeping in mind the ventilation pattern must remove any heavier-than-air solvent vapors from lower levels of the workspaces. Gloves and spectacle-type safety glasses are recommended in accordance

with safe installation practices.

3.1.5 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct.

3.1.6 Pipes/Ducts/Equipment That Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items as specified.

3.2 PIPE INSULATION SYSTEMS INSTALLATION

Install pipe insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder/barrier, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

a. Pipe used solely for fire protection.

b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.

c. Sanitary drain lines.

d. Air chambers.

e. Adjacent insulation.

f. ASME stamps.

g. Access plates of fan housings.

h. Cleanouts or handholes.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

Pipe insulation shall be continuous through the sleeve.

Provide an aluminum jacket or vapor barrier/weatherproofing self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 ply standard grade, silver, white, black and embossed with factory applied moisture retarder over the insulation wherever penetrations require sealing.

3.2.1.2.1 Penetrate Interior Walls

The aluminum jacket or vapor barrier/weatherproofing - self adhesive jacket (minimum 2 mils adhesive, 3 mils embossed) less than 0.0000 permeability, greater than 3 plies standard grade, silver, white, black and embossed shall extend 2 inches beyond either side of the wall and shall be secured on each end with a band.

3.2.1.2.2 Penetrating Floors

Extend the aluminum jacket from a point below the backup material to a point 10 inches above the floor with one band at the floor and one not more than 1 inch from the end of the aluminum jacket.

3.2.1.2.3 Penetrating Waterproofed Floors

Extend the aluminum jacket rom below the backup material to a point 2 inches above the flashing with a band 1 inch from the end of the aluminum jacket.

3.2.1.2.4 Penetrating Exterior Walls

Continue the aluminum jacket required for pipe exposed to weather through the sleeve to a point 2 inches beyond the interior surface of the wall.

3.2.1.2.5 Penetrating Roofs

Insulate pipe as required for interior service to a point flush with the top of the flashing and sealed with flashing sealant. Tightly butt the insulation for exterior application to the top of flashing and interior insulation. Extend the exterior aluminum jacket 2 inches down beyond the end of the insulation to form a counter flashing. Seal the flashing and counter flashing underneath with metal jacketing/flashing sealant.

3.2.1.2.6 Hot Water Pipes Supplying Lavatories or Other Similar Heated Service

Terminate the insulation on the backside of the finished wall. Protect the insulation termination with two coats of vapor barrier coating with a minimum total thickness of 1/16 inch applied with glass tape embedded between coats (if applicable). Extend the coating out onto the insulation 2 inches and seal the end of the insulation. Overlap glass tape seams 1 inch. Caulk the annular space between the pipe and wall penetration with approved fire stop material. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 3/8 inches.

3.2.1.2.7 Domestic Cold Water Pipes Supplying Lavatories or Other Similar Cooling Service

Terminate the insulation on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). Protect the insulation with two coats of weather barrier mastic (breather emulsion type weatherproof mastic impermeable to water and permeable to air) with a minimum total thickness of 1/16 inch. Extend the mastic out onto the insulation 2 inches and shall seal the end of the insulation. The annular space between the outer surface of the pipe insulation and caulk the wall penetration with an approved fire stop material having vapor retarder properties. Cover the pipe and wall penetration with a properly sized

(well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 3/8 inches.

3.2.1.3 Pipes Passing Through Hangers

Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 2 inches and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-58. Whenever insulation shows signs of being compressed, or when the insulation or jacket shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 2 inches shall be installed, or factory insulated hangers (designed with a load bearing core) can be used.

3.2.1.3.1 Horizontal Pipes Larger Than 2 Inches at 60 Degrees F and Above

Supported on hangers in accordance with MSS SP-58, and Section 23 05 15 COMMON PIPING FOR HVAC

3.2.1.3.2 Horizontal Pipes Larger Than 2 Inches and Below 60 Degrees F

Supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-58. An insulation insert of cellular glass, prefabricated insulation pipe hangers, or perlite above 80 degrees F shall be installed above each shield. The insert shall cover not less than the bottom 180-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.

3.2.1.3.3 Vertical Pipes

Supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-58 covering the 360-degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360-degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 2 inches on each end beyond the protection shield. When insulation inserts are required in accordance with the above, and the insulation thickness is less than 1 inch, wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 30 feet, the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe that are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.

3.2.1.3.4 Inserts

Covered with a jacket material of the same appearance and quality as the

adjoining pipe insulation jacket, overlap the adjoining pipe jacket 1-1/2 inches, and seal as required for the pipe jacket. The jacket material used to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 6 inches and less. Grade 1, Type II sheet insulation used on pipes larger than 6 inches shall not be stretched around the pipe. On pipes larger than 12 inches, the insulation shall be adhered directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation. Type II requires an additional exterior vapor retarder/barrier covering for high relative humidity and below ambient temperature applications.

3.2.1.5 Pipes in high abuse areas.

In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, stainless steel, aluminum or flexible laminate cladding (comprised of elastomeric, plastic or metal foil laminate) laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket, - less than 0.0000 permeability; (greater than 3 ply, standard grade, silver, white, black and embossed) aluminum jackets shall be utilized. Pipe insulation to the 6 foot level shall be protected.

3.2.1.6 Pipe Insulation Material and Thickness

Pipe insulation materials must be as listed in Table 1 and must meet or exceed the requirements of ASHRAE 90.2.

TABLE 1

Insulation Material for Piping

Service					
	Material	Specification	Type	Class	VR/VB Req'd
Chilled Water (Supply & Return, Dual Temperature Piping, 40 F nominal)					
	Cellular Glass	ASTM C552	II	2	Yes
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		Yes
	Mineral Fiber with Wicking MaterialDo not use in applications exposed to outdoor ambient conditions in climatic zones 1 through 4.	ASTM C547	I		Yes

TABLE 1					
Insulation Material for Piping					
Service					
	Material	Specification	Type	Class	VR/VB Req'd
Heating Hot Water Supply & Return, Heated Oil (Max 250 F)					
	Mineral Fiber	ASTM C547	I	1	No
	Calcium Silicate	ASTM C533	I		No
	Cellular Glass	ASTM C552	II	2	No
	Faced Phenolic Foam	ASTM C1126	III		Yes
	Perlite	ASTM C610			No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I	2	No
Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping					
	Cellular Glass	ASTM C552	II	2	No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Hot Domestic Water Supply & Recirculating Piping (Max 200 F)					
	Mineral Fiber	ASTM C547	I	1	No
	Cellular Glass	ASTM C552	II	2	No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
	Faced Phenolic Foam	ASTM C1126	III		Yes
Refrigerant Suction Piping (35 degrees F nominal)					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
	Cellular Glass	ASTM C552	II	1	Yes
Compressed Air Discharge, Steam and Condensate Return (201 to 250 Degrees F					
	Cellular Glass	ASTM C552	II		No
	Mineral Fiber	ASTM C547	I	1	No
	Calcium Silicate	ASTM C533	I		No
	Faced Phenolic Foam	ASTM C1126	III		Yes
	Perlite	ASTM C610			No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I	2	No
Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No

TABLE 1

Insulation Material for Piping

Service					
	Material	Specification	Type	Class	VR/VB Req'd
Horizontal Roof Drain Leaders (Including Underside of Roof Drain Fittings)					
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
	Faced Phenolic Foam	ASTM C1126	III		Yes
	Cellular Glass	ASTM C552	III		Yes
Condensate Drain Located Inside Building					
	Cellular Glass	ASTM C552	II	2	No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Medium Temperature Hot Water, Steam and Condensate (251 to 350 Degrees F)					
	Mineral Fiber	ASTM C547	I	1	No
	Calcium Silicate	ASTM C533	I		No
	Cellular Glass	ASTM C552	I or II		No
	Perlite	ASTM C610			No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I	2	No
High Temperature Hot Water & Steam (351 to 700 Degrees F)					
	Mineral Fiber	ASTM C547	I	2	No
	Calcium Silicate	ASTM C533	I		No
	Perlite	ASTM C610			No
	Cellular Glass	ASTM C552			No
Brine Systems Cryogenics (-30 to 0 Degrees F)					
	Cellular Glass	ASTM C552	II	2	No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Brine Systems Cryogenics (0 to 34 Degrees F)					
	Cellular Glass	ASTM C552	II	2	No
	Flexible Elastomeric Cellular	ASTM C534/C534M	I		No
Note: VR/VB = Vapor Retarder/Vapor Barrier					

TABLE 2

Piping Insulation Thickness (inch)
Do not use integral wicking material in Chilled water applications exposed to outdoor ambient conditions in climatic zones 1 through 4.

Service						
	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
Chilled Water (Supply & Return, Dual Temperature Piping, 40 Degrees F nominal)						
	Cellular Glass	1.5	2	2	2.5	3
	Mineral Fiber with Wicking Material	1	1.5	1.5	2	2
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Chilled Water (Supply & Return, Dual Temperature Piping, 40 Degrees F nominal)						
	Cellular Glass	1.5	1.5	1.5	1.5	2
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
	Mineral Fiber with Wicking Material	1	1.5	1.5	2	2
Heating Hot Water Supply & Return, Heated Oil (Max 250 F)						
	Mineral Fiber	1.5	1.5	2	2	2
	Calcium Silicate	2.5	2.5	3	3	3
	Cellular Glass	2	2.5	3	3	3
	Perlite	2.5	2.5	3	3	3
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Cold Domestic Water Piping, Makeup Water & Drinking Fountain Drain Piping						
	Cellular Glass	1.5	1.5	1.5	1.5	1.5
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Hot Domestic Water Supply & Recirculating Piping (Max 200 F)						
	Mineral Fiber	1	1	1	1.5	1.5

TABLE 2

Piping Insulation Thickness (inch)
Do not use integral wicking material in Chilled water applications exposed to outdoor ambient conditions in climatic zones 1 through 4.

Service						
	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
	Cellular Glass	1.5	1.5	1.5	2	2
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Refrigerant Suction Piping (35 degrees F nominal)						
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
	Cellular Glass	1.5	1.5	1.5	1.5	1.5
Compressed Air Discharge, Steam and Condensate Return (201 to 250 Degrees F						
	Mineral Fiber	1.5	1.5	2	2	2
		1.5*	2*	2.5*	3*	3.5*
	Calcium Silicate	2.5	3	4	4	4.5
	Cellular Glass	2	2.5	3	3	3
	Perlite	2.5	3	4	4	4.5
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Exposed Lavatory Drains, Exposed Domestic Water Piping & Drains to Areas for Handicapped Personnel						
	Flexible Elastomeric Cellular	0.5	0.5	0.5	0.5	0.5
Horizontal Roof Drain Leaders (Including Underside of Roof Drain Fittings)						
	Cellular Glass	1.5	1.5	1.5	1.5	1.5
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
	Faced Phenolic Foam	1	1	1	1	1
Condensate Drain Located Inside Building						

TABLE 2

Piping Insulation Thickness (inch)
Do not use integral wicking material in Chilled water applications exposed to outdoor ambient conditions in climatic zones 1 through 4.

Service						
	Material	Tube And Pipe Size (inch)				
		<1	1-<1.5	1.5-<4	4-<8	> or = >8
	Cellular Glass	1.5	1.5	1.5	1.5	1.5
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
Medium Temperature Hot Water, Steam and Condensate (251 to 350 Degrees F)						
	Mineral Fiber	1.5	3	3	4	4
		2.5*	*	3.5*		
	Calcium Silicate	2.5	3.5	4.5	4.5	5
	Perlite	2.5	3.5	4.5	4.5	5
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A
High Temperature Hot Water & Steam (351 to 700 Degrees F)						
	Mineral Fiber	2.5	3	3	4	4
	Calcium Silicate	4	4.5	6	6	6
	Perlite	4	4.5	6	6	6
Brine Systems Cryogenics (-30 to 0 Degrees F)						
	Cellular Glass	2.5	2.5	3	3	3.5
	Flexible Elastomeric Cellular	1	1	N/A	N/A	N/A
Brine Systems Cryogenics (0 to 34 Degrees F)						
	Cellular Glass	2	2	2	2.5	3
	Flexible Elastomeric Cellular	1	1	1	N/A	N/A

3.2.2 Aboveground Cold Pipelines

The following cold pipelines for minus 30 to plus 60 degrees F, shall be insulated in accordance with Table 2 except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted. This includes but is not limited to the following:

a. Make-up water.

b. Horizontal and vertical portions of interior roof drains.

c. Refrigerant suction lines.

d. Chilled water.

e. Dual temperature water, i.e. HVAC hot/chilled water.

f. Air conditioner condensate drains.

g. Brine system cryogenics

h. Exposed lavatory drains and domestic water lines serving plumbing fixtures for handicap persons.

3.2.2.1 Insulation Material and Thickness

Insulation thickness for cold pipelines shall be determined using Table 2.

3.2.2.2 Factory or Field applied Jacket

Insulation shall be covered with a factory applied vapor retarder jacket/vapor barrier or field applied seal welded PVC jacket or greater than 3 ply laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, standard grade, sliver, white, black and embossed for use with Mineral Fiber, Cellular Glass, and Phenolic Foam Insulated Pipe. Insulation inside the building, to be protected with an aluminum jacket or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, Embossed Silver, White & Black, shall have the insulation and vapor retarder jacket installed as specified herein. The aluminum jacket or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, White & Black, shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets or greater than 3ply vapor barrier/weatherproofing self-adhesive (minimum 2 mils adhesive, 3 mils embossed) product, less than 0.0000 permeability, standard grade, embossed silver, white & black, shall be provided for pipe insulation to the 6 ft level.

3.2.2.3 Installing Insulation for Straight Runs Hot and Cold Pipe

Apply insulation to the pipe with tight butt joints. Seal all butted joints and ends with joint sealant and seal with a vapor retarder coating,

greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or PVDC adhesive tape.

3.2.2.3.1 Longitudinal Laps of the Jacket Material

Overlap not less than 1-1/2 inches. Provide butt strips 3 inches wide for circumferential joints.

3.2.2.3.2 Laps and Butt Strips

Secure with adhesive and staple on 4 inch centers if not factory self-sealing. If staples are used, seal in accordance with paragraph STAPLES below. Note that staples are not required with cellular glass systems.

3.2.2.3.3 Factory Self-Sealing Lap Systems

May be used when the ambient temperature is between 40 and 120 degrees F during installation. Install the lap system in accordance with manufacturer's recommendations. Use a stapler only if specifically recommended by the manufacturer. Where gaps occur, replace the section or repair the gap by applying adhesive under the lap and then stapling.

3.2.2.3.4 Staples

Coat all staples, including those used to repair factory self-seal lap systems, with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - 0.0000 perm adhesive tape. Coat all seams, except those on factory self-seal systems, with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

3.2.2.3.5 Breaks and Punctures in the Jacket Material

Patch by wrapping a strip of jacket material around the pipe and secure it with adhesive, staple, and coat with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape. Extend the patch not less than 1-1/2 inches past the break.

3.2.2.3.6 Penetrations Such as Thermometers

Fill the voids in the insulation and seal with vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

3.2.2.3.7 Flexible Elastomeric Cellular Pipe Insulation

Install by slitting the tubular sections and applying them onto the piping or tubing. Alternately, whenever possible slide un-slit sections over the open ends of piping or tubing. Secure all seams and butt joints and seal with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Push insulation on the pipe, never pulled. Stretching of insulation may result in open seams and joints. Clean cut all edges. Rough or jagged edges of the insulation are not be permitted. Use proper tools such as sharp knives. Do not stretch Grade 1, Type II sheet insulation around the pipe when used on pipe larger than 6 inches. On pipes larger than 12 inches, adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

3.2.2.4 Insulation for Fittings and Accessories

a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant and sealed with a vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape.

b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow'. Submit a booklet containing completed MICA Insulation Stds plates detailing each insulating system for each pipe, duct, or equipment insulating system, after approval of materials and prior to applying insulation.

(1) The MICA plates shall detail the materials to be installed and the specific insulation application. Submit all MICA plates required showing the entire insulating system, including plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. The MICA plates shall present all variations of insulation systems including locations, materials, vaporproofing, jackets and insulation accessories.

(2) If the Contractor elects to submit detailed drawings instead of edited MICA Plates, the detail drawings shall be technically equivalent to the edited MICA Plate submittal.

c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with PVDC or greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape or two coats of vapor retarder coating with a minimum total thickness of 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 1 inch. The coating shall extend out onto the adjoining pipe insulation 2 inches. Fabricated insulation with a factory vapor retarder jacket shall be protected with either greater than 3 ply laminate jacket - less than 0.0000 perm adhesive tape, standard grade, silver, white, black and embossed or PVDC adhesive tape or two coats of vapor retarder coating with a minimum thickness of 1/16 inch and with a 2 inch wide glass tape embedded between coats. Where fitting insulation butts to pipe insulation, the joints shall be sealed with a vapor retarder coating and a 4 inch wide ASJ tape which matches the jacket of the pipe insulation.

d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 6 inches from the insulation surface.

e. Insulation shall be marked showing the location of unions, strainers, and check valves.

3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory precut or premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. The covers shall be secured by PVC vapor retarder tape, adhesive, seal welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

3.2.3 Aboveground Hot Pipelines

3.2.3.1 General Requirements

All hot pipe lines above 60 degrees F, except those piping listed in subparagraph Pipe Insulation in PART 3 as to be omitted, shall be insulated in accordance with Table 2. This includes but is not limited to the following:

a. Domestic hot water supply & re-circulating system.

b. Steam.

c. Condensate & compressed air discharge.

d. Hot water heating.

e. Heated oil.

f. Water defrost lines in refrigerated rooms.

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type I jacket or field applied aluminum where required or seal welded PVC.

3.2.3.2 Insulation for Fittings and Accessories

Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be sealed with joint sealant. Insulation shall be marked showing the location of unions, strainers, check valves and other components that would otherwise be hidden from view by the insulation.

3.2.3.2.1 Precut or Preformed

Place precut or preformed insulation around all fittings and accessories. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity.

3.2.3.2.2 Rigid Preformed

Where precut/preformed is unavailable, rigid preformed pipe insulation

sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 2 inches or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, a laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability (greater than 3 ply, standard grade, silver, white, black and embossed aluminum jacket, stainless steel or PVC jacket shall be applied.

PVC jacketing requires no factory-applied jacket beneath it, however an all service jacket shall be applied if factory applied jacketing is not furnished. Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION in PART 3.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 2 inches at longitudinal and circumferential joints and shall be secured with bands at not more than 12 inch centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 60 degrees F and below shall be sealed with metal jacketing/flashing sealant while overlapping to prevent moisture penetration. Where jacketing on piping 60 degrees F and below abuts an un-insulated surface, joints shall be caulked to prevent moisture penetration. Joints on piping above 60 degrees F shall be sealed with a moisture retarder.

3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 1 inch and the adjoining aluminum jacket not less than 2 inches. Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed, and UV resistant.

3.2.4.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.2.4.4 Stainless Steel Jackets

ASTM A167 or ASTM A240/A240M; Type 304, minimum thickness of 33 gauge (

0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 1/2 inch.

3.2.5 Below Ground Pipe Insulation

Below ground pipes shall be insulated in accordance with Table 2, except as precluded in subparagraph Pipe Insulation in PART 3. This includes, but is not limited to the following:

a. Heated oil.

b. Domestic hot water.

c. Heating hot water.

d. Dual temperature water.

e. Steam.

f. Condensate.

3.2.5.1 Type of Insulation

Below ground pipe shall be insulated with Cellular Glass insulation, in accordance with manufacturer's instructions for application with thickness as determined from Table 2 (whichever is the most restrictive).

3.2.5.2 Installation of Below ground Pipe Insulation

a. Bore surfaces of the insulation shall be coated with a thin coat of gypsum cement of a type recommended by the insulation manufacturer. Coating thickness shall be sufficient to fill surface cells of insulation. Mastic type materials shall not be used for this coating. Note that unless this is for a cyclic application (i.e., one that fluctuates between high and low temperature on a daily process basis) there is no need to bore coat the material.

b. Stainless steel bands, 3/4 inch wide by 0.020 inch thick shall be used to secure insulation in place. A minimum of two bands per section of insulation shall be applied. As an alternate, fiberglass reinforced tape may be used to secure insulation on piping up to 12 inches in diameter. A minimum of two bands per section of insulation shall be applied.

c. Insulation shall terminate at anchor blocks but shall be continuous through sleeves and manholes.

d. At point of entry to buildings, underground insulation shall be terminated 2 inches inside the wall or floor, shall butt tightly against the aboveground insulation and the butt joint shall be sealed with high temperature silicone sealant and covered with fibrous glass tape.

e. Provision for expansion and contraction of the insulation system shall be made in accordance with the insulation manufacturer's recommendations.

f. Flanges, couplings, valves, and fittings shall be insulated with

factory pre-molded, prefabricated, or field-fabricated sections of insulation of the same material and thickness as the adjoining pipe insulation. Insulation sections shall be secured as recommended by the manufacturer.

g. Insulation, including fittings, shall be finished with three coats of asphaltic mastic, with 6 by 5.5 mesh synthetic reinforcing fabric embedded between coats. Fabric shall be overlapped a minimum of 2 inches at joints. Total film thickness shall be a minimum of 3/16 inch. As an alternate, a prefabricated bituminous laminated jacket, reinforced with internal reinforcement mesh, shall be applied to the insulation. Jacketing material and application procedures shall match manufacturer's written instructions. Vapor barrier - less than 0.0000 permeability self adhesive (minimum 2 mils adhesive, 3 mils embossed) jacket greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply (minimum 2.9 mils adhesive), heavy duty, white or natural). Application procedures shall match the manufacturer's written instructions.

h. At termination points, other than building entrances, the mastic and cloth or tape shall cover the ends of insulation and extend 2 inches along the bare pipe.

3.3 DUCT INSULATION SYSTEMS INSTALLATION

Install duct insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions. Duct insulation minimum thickness and insulation level must be as listed in Table 3 and must meet or exceed the requirements of ASHRAE 90.2.

Except for oven hood exhaust duct insulation, corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Air conditioned spaces shall be defined as those spaces directly supplied with cooled conditioned air (or provided with a cooling device such as a fan-coil unit) and heated conditioned air (or provided with a heating device such as a unit heater, radiator or convector).

3.3.1 Duct Insulation Minimum Thickness

Duct insulation minimum thickness in accordance with Table 4.

Table 4 - Minimum Duct Insulation (inches)

Cold Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5
Warm Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5

3.3.2 Insulation and Vapor Retarder/Vapor Barrier for Cold Air Duct

Insulation and vapor retarder/vapor barrier shall be provided for the following cold air ducts and associated equipment.

a. Supply ducts.

b. Return air ducts.

c. Relief ducts.

d. Flexible run-outs (field-insulated).

e. Plenums.

f. Duct-mounted coil casings.

g. Coil headers and return bends.

h. Coil casings.

i. Fresh air intake ducts.

j. Filter boxes.

k. Mixing boxes (field-insulated).

l. Supply fans (field-insulated).

m. Site-erected air conditioner casings.

n. Ducts exposed to weather.

o. Combustion air intake ducts.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 3/4 pcf, and rigid type where exposed, minimum density 3 pcf. Insulation for both concealed or exposed round/oval ducts shall be flexible type, minimum density 3/4 pcf or a semi rigid board, minimum density 3 pcf, formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered. Insulation for all exposed ducts shall be provided with either a white, paint-able, factory-applied Type I jacket or a field applied vapor retarder/vapor barrier jacket coating finish as specified, the total field applied dry film thickness shall be approximately 1/16 inch. Insulation on all concealed duct shall be provided with a factory-applied Type I or II vapor retarder/vapor barrier jacket. Duct insulation shall be continuous through sleeves and prepared openings except firewall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder/vapor barrier shall cover the collar, neck, and any un-insulated surfaces of diffusers, registers and grills. Vapor retarder/vapor barrier materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

3.3.2.1 Installation on Concealed Duct

a. For rectangular, oval or round ducts, flexible insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts, 24 inches and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 16 inch centers and not more than 16 inches from duct corners.

d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder/vapor barrier jacket joints overlap 2 inches. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.

e. Where mechanical fasteners are used, self-locking washers shall be installed and the pin trimmed and bent over.

f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 2 inches beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating or PVDC adhesive tape or greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating or PVDC adhesive tape greater than 3 ply laminate (minimum 2 mils adhesive, 3 mils embossed) - less than 0.0000 perm adhesive tape.

i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating.. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.2.2 Installation on Exposed Duct Work

a. For rectangular ducts, rigid insulation shall be secured to the duct

by mechanical fasteners on all four sides of the duct, spaced not more than 12 inches apart and not more than 3 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger. One row shall be provided for each side of duct less than 12 inches. Mechanical fasteners shall be as corrosion resistant as G60 coated galvanized steel, and shall indefinitely sustain a 50 lb tensile dead load test perpendicular to the duct wall.

b. Form duct insulation with minimum jacket seams. Fasten each piece of rigid insulation to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder/barrier jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors.

c. Impale insulation on the fasteners; self-locking washers shall be installed and the pin trimmed and bent over.

d. Seal joints in the insulation jacket with a 4 inch wide strip of tape. Seal taped seams with a brush coat of vapor retarder coating.

e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.

f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a flashing sealant.

g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and un-insulated surface 2 inches. Pin puncture coatings shall extend 2 inches from the puncture in all directions.

h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 3/4 pcf, attached as in accordance with MICA standards.

3.3.3 Insulation for Warm Air Duct

Insulation and vapor barrier shall be provided for the following warm air ducts and associated equipment:.

a. Supply ducts.

b. Return air ducts.

c. Relief air ducts

d. Flexible run-outs (field insulated).

e. Plenums.

f. Duct-mounted coil casings.

g. Coil-headers and return bends.

h. Coil casings.

i. Fresh air intake ducts.

j. Filter boxes.

k. Mixing boxes.

l. Supply fans.

m. Site-erected air conditioner casings.

n. Ducts exposed to weather.

o. Exhaust ducts passing through concealed spaces exhausting conditioned air.

Insulation for rectangular ducts shall be flexible type where concealed, and rigid type where exposed. Insulation on exposed ducts shall be provided with a white, paint-able, factory-applied Type II jacket, or finished with adhesive finish. Flexible type insulation shall be used for round ducts, with a factory-applied Type II jacket. Insulation on concealed duct shall be provided with a factory-applied Type II jacket. Adhesive finish where indicated to be used shall be accomplished by applying two coats of adhesive with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 1/16 inch. Duct insulation shall be continuous through sleeves and prepared openings. Duct insulation shall terminate at fire dampers and flexible connections.

3.3.3.1 Installation on Concealed Duct

a. For rectangular, oval and round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 6 inch wide strips on 12 inch centers.

b. For rectangular and oval ducts 24 inches and larger, insulation shall be secured to the bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corner.

c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 18 inch centers and not more than 18 inches from duct corners.

d. The insulation shall be impaled on the mechanical fasteners where used. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type hangers.

e. Self-locking washers shall be installed where mechanical fasteners are used and the pin trimmed and bent over.

f. Insulation jacket shall overlap not less than 2 inches at joints and the lap shall be secured and stapled on 4 inch centers.

3.3.3.2 Installation on Exposed Duct

a. For rectangular ducts, the rigid insulation shall be secured to the duct by the use of mechanical fasteners on all four sides of the duct, spaced not more than 16 inches apart and not more than 6 inches from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 12 inches and larger and a minimum of one row for each side of duct less than 12 inches.

b. Duct insulation with factory-applied jacket shall be formed with minimum jacket seams, and each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projection is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over the projection. Jacket shall be continuous across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, insulation and jacket shall be carried over the projection.

c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and pin trimmed and bent over.

d. Joints on jacketed insulation shall be sealed with a 4 inch wide strip of tape and brushed with vapor retarder coating.

e. Breaks and penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 2 inches beyond the break or penetration and shall be secured with adhesive and stapled.

f. Insulation terminations and pin punctures shall be sealed with tape and brushed with vapor retarder coating.

g. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation, minimum density of 3/4 pcf attached by staples spaced not more than 16 inches and not more than 6 inches from the degrees of joints. Joints shall be sealed in accordance with item "d." above.

3.3.4 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 60 degrees F, ducts shall be insulated as specified for cold air duct.

3.3.5 Insulation for Evaporative Cooling Duct

Evaporative cooling supply duct located in spaces not evaporatively cooled, shall be insulated. Material and installation requirements shall be as specified for duct insulation for warm air duct.

3.3.6 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be

repaired.

3.3.7 Duct Exposed to Weather

3.3.7.1 Installation

Ducts exposed to weather shall be insulated and finished as specified for the applicable service for exposed duct inside the building. After the above is accomplished, the insulation shall then be further finished as detailed in the following subparagraphs.

3.3.7.2 Round Duct

Laminated self-adhesive (minimum 2 mils adhesive, 3 mils embossed) vapor barrier/weatherproofing jacket - Less than 0.0000 permeability, (greater than 3 ply, standard grade, silver, white, black and embossed or greater than 8 ply, heavy duty, white and natural) membrane shall be applied overlapping material by 3 inches no bands or caulking needed - see manufacturer's recommended installation instructions. Aluminum jacket with factory applied moisture retarder shall be applied with the joints lapped not less than 3 inches and secured with bands located at circumferential laps and at not more than 12 inch intervals throughout. Horizontal joints shall lap down to shed water and located at 4 or 8 o'clock position. Joints shall be sealed with metal jacketing sealant to prevent moisture penetration. Where jacketing abuts an un-insulated surface, joints shall be sealed with metal jacketing sealant.

3.3.7.3 Fittings

Fittings and other irregular shapes shall be finished as specified for rectangular ducts.

3.3.7.4 Rectangular Ducts

Two coats of weather barrier mastic reinforced with fabric or mesh for outdoor application shall be applied to the entire surface. Each coat of weatherproof mastic shall be 1/16 inch minimum thickness. The exterior shall be a metal jacketing applied for mechanical abuse and weather protection, and secured with screws or vapor barrier/weatherproofing jacket less than 0.0000 permeability greater than 3 ply, standard grade, silver, white, black, and embossed or greater than 8 ply, heavy duty white and natural. Membrane shall be applied overlapping material by 3 inches. No bands or caulking needed-see manufacturing recommend installation instructions.

3.4 EQUIPMENT INSULATION SYSTEMS INSTALLATION

Install equipment insulation systems in accordance with the approved MICA Insulation Stds plates as supplemented by the manufacturer's published installation instructions.

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment that must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:

a. Hand-holes.

b. Boiler manholes.

c. Cleanouts.

d. ASME stamps.

e. Manufacturer's nameplates.

f. Duct Test/Balance Test Holes.

3.4.2 Insulation for Cold Equipment

Cold equipment below 60 degrees F: Insulation shall be furnished on equipment handling media below 60 degrees F including the following:

a. Pumps.

b. Refrigeration equipment parts that are not factory insulated.

c. Drip pans under chilled equipment.

d. Cold water storage tanks.

e. Water softeners.

f. Duct mounted coils.

g. Cold and chilled water pumps.

h. Pneumatic water tanks.

i. Roof drain bodies.

j. Air handling equipment parts that are not factory insulated.

k. Expansion and air separation tanks.

3.4.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Material and thicknesses shall be as shown in Table 5:

TABLE 5

Insulation Thickness for Cold Equipment (inches)

Equipment handling media at indicated temperature		
	Material	Thickness (inches)
35 to 60 degrees F		
	Cellular Glass	1.5

TABLE 5		
Insulation Thickness for Cold Equipment (inches)		
Equipment handling media at indicated temperature		
	Material	Thickness (inches)
	Flexible Elastomeric Cellular	1
1 to 34 degrees F		
	Cellular Glass	3
	Flexible Elastomeric Cellular	1.5
Minus 30 to 0 degrees F		
	Cellular Glass	3.5
	Flexible Elastomeric Cellular	1.75

3.4.2.2 Pump Insulation

a. Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Joints between sides and between sides and bottom shall be joined by adhesive with lap strips for rigid mineral fiber and contact adhesive for flexible elastomeric cellular insulation. The box shall conform to the requirements of MICA Insulation Stds plate No. 49 when using flexible elastomeric cellular insulation. Joints between top cover and sides shall fit tightly forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable.

b. Exposed insulation corners shall be protected with corner angles.

c. Upon completion of installation of the insulation, including removable sections, two coats of vapor retarder coating shall be applied with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. Flashing sealant shall be applied to parting line, between equipment and removable section insulation, and at all penetrations.

3.4.2.3 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 12 inch centers except flexible elastomeric cellular which shall be adhered with contact adhesive. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. Cellular glass shall be installed in accordance with manufacturer's instructions. Joints and ends shall be sealed with joint sealant, and sealed with a vapor retarder coating.

d. Insulation on heads of heat exchangers shall be removable. Removable section joints shall be fabricated using a male-female shiplap type joint. The entire surface of the removable section shall be finished by applying two coats of vapor retarder coating with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch.

e. Exposed insulation corners shall be protected with corner angles.

f. Insulation on equipment with ribs shall be applied over 6 by 6 inches by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 by 2 inches washers or shall be securely banded or wired in place on 12 inch centers.

3.4.2.4 Vapor Retarder/Vapor Barrier

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor retarder coating or vapor barrier jacket shall be applied over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Flashing sealant or vapor barrier tape shall be applied to parting line between equipment and removable section insulation.

3.4.3 Insulation for Hot Equipment

Insulation shall be furnished on equipment handling media above 60 degrees F including the following:

a. Converters.

b. Heat exchangers.

c. Hot water generators.

d. Water heaters.

e. Pumps handling media above 130 degrees F.

f. Fuel oil heaters.

g. Hot water storage tanks.

h. Air separation tanks.

i. Surge tanks.

j. Flash tanks.

k. Feed-water heaters.

l. Unjacketed boilers or parts of boilers.

m. Boiler flue gas connection from boiler to stack (if inside).

n. Induced draft fans.

o. Fly ash and soot collectors.

p. Condensate receivers.

3.4.3.1 Insulation

Insulation shall be suitable for the temperature encountered. Shell and tube-type heat exchangers shall be insulated for the temperature of the shell medium.

Insulation thickness for hot equipment shall be determined using Table 6:

TABLE 6

Insulation Thickness for Hot Equipment (inches)

Equipment handling steam or media at indicated pressure or temperature limit		
	Material	Thickness (inches)
15 psig or 250 degrees F		
	Rigid Mineral Fiber	2
	Flexible Mineral Fiber	2
	Calcium Silicate/Perlite	4
	Cellular Glass	3
	Faced Phenolic Foam	1.5
	Flexible Elastomeric Cellular (<200 F)	1
200psig or 400 degrees F		
	Rigid Mineral Fiber	3
	Flexible Mineral Fiber	3
	Calcium Silicate/Perlite	4
	Cellular Glass	4
600 degrees F		
	Rigid Mineral Fiber	5
	Flexible Mineral Fiber	6
	Calcium Silicate/Perlite	6
	Cellular Glass	6

TABLE 6		
Insulation Thickness for Hot Equipment (inches)		
Equipment handling steam or media at indicated pressure or temperature limit		
	Material	Thickness (inches)
600 degrees F: Thickness necessary to limit the external temperature of the insulation to 120 F. Heat transfer calculations shall be submitted to substantiate insulation and thickness selection.		

3.4.3.2 Insulation of Boiler Stack and Diesel Engine Exhaust Pipe

Inside boiler House , bevel insulation neatly around openings and provide sheet metal insulation stop strips around such openings. Apply a skim coat of hydraulic setting cement directly to insulation. Apply a flooding coat of adhesive over hydraulic setting cement, and while still wet, press a layer of glass cloth or tape into adhesive and seal laps and edges with adhesive. Coat glass cloth with adhesive. When dry, apply a finish coat of adhesive at can-consistency so that when dry no glass weave shall be observed. Provide metal jackets for stacks and exhaust pipes that are located above finished floor and spaces outside boiler house . Apply metal jackets directly over insulation and secure with 3/4 inch wide metal bands spaced on 18 inch centers. Do not insulate name plates. Insulation type and thickness shall be in accordance with the following Table 7.

TABLE 7						
Insulation and Thickness for Boiler Stack and Diesel Engine Exhaust Pipe						
Service & Surface Temperature Range (Degrees F)						
	Material	Outside Diameter (Inches)				
		0.25 - 1.25	1 - 1.67	3.5-5	6 - 10	> or = 11 - 36
Boiler Stack (Up to 400 degrees F)						
	Mineral Fiber ASTM C585 Class B-3, ASTM C547 Class 1, or ASTM C612 Class 1	N/A	N/A	3	3.5	4

TABLE 7

Insulation and Thickness for
Boiler Stack and Diesel Engine Exhaust Pipe

	Material	Outside Diameter (Inches)				
		0.25 - 1.25	1 - 1.67	3.5-5	6 - 10	> or = 11 - 36
	Calcium Silicate ASTM C533, Type 1	N/A	N/A	3	3.5	4
	Cellular Glass ASTM C552, Type II	1.5	1.5	1.5	2	2.5
Boiler Stack (401 to 600 degrees F)						
	Mineral Fiber ASTM C547 Class 2, ASTM C592 Class 1, or ASTM C612 Class 3	N/A	N/A	4	4	5
	Calcium Silicate ASTM C533, Type I or II	N/A	N/A	4	4	4
	Mineral Fiber/Cellular Glass Composite:					
	Mineral Fiber ASTM C547 Class 2, ASTM C592 Class 1, or ASTM C612 Class 3	1	1	1	1	2
	Cellular Glass ASTM C552, Type II	2	2	2	2	2
Boiler Stack (601 to 800 degrees F)						
	Mineral Fiber ASTM C547 Class 3, ASTM C592 Class 1, or ASTM C612 Class 3	N/A	N/A	4	4	6

TABLE 7						
Insulation and Thickness for Boiler Stack and Diesel Engine Exhaust Pipe						
Service & Surface Temperature Range (Degrees F)						
	Material	Outside Diameter (Inches)				
		0.25 - 1.25	1 - 1.67	3.5-5	6 - 10	> or = 11 - 36
	Calcium Silicate ASTM C533, Type I or II	N/A	N/A	4	4	6
	Mineral Fiber/Cellular Glass Composite:					
	Mineral Fiber ASTM C547 Class 2, ASTM C592 Class 1, or ASTM C612 Class 3	2	2	2	3	3
	Cellular Glass ASTM C552, Type II	2	2	2	2	2
Diesel Engine Exhaust (Up to 700 degrees F)						
	Calcium Silicate ASTM C533, Type I or II	3	3.5	4	4	4
	Cellular Glass ASTM C552, Type II	2.5	3.5	4	4.5	6

3.4.3.3 Insulation of Pumps

Insulate pumps by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints that do not leave raw ends of insulation exposed. Bottom and sides shall be banded to form a rigid housing that does not rest on the pump. Joints between top cover and sides shall fit tightly. The top cover shall have a joint forming a female shiplap joint on the side pieces and a male joint on the top cover, making the top cover removable. Two coats of Class I adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. The total dry

thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line of the removable sections and penetrations.

3.4.3.4 Other Equipment

a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.

b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not greater than 12 inch centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

c. On high vibration equipment, cellular glass insulation shall be set in a coating of bedding compound as recommended by the manufacturer, and joints shall be sealed with bedding compound. Mineral fiber joints shall be filled with finishing cement.

d. Insulation on heads of heat exchangers shall be removable. The removable section joint shall be fabricated using a male-female shiplap type joint. Entire surface of the removable section shall be finished as specified.

e. Exposed insulation corners shall be protected with corner angles.

f. On equipment with ribs, such as boiler flue gas connection, draft fans, and fly ash or soot collectors, insulation shall be applied over 6 by 6 inch by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 2 by 2 inch washers or shall be securely banded or wired in place on 12 inch (maximum) centers.

g. On equipment handling media above 600 degrees F, insulation shall be applied in two or more layers with joints staggered.

h. Upon completion of installation of insulation, penetrations shall be caulked. Two coats of adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 1/16 inch. Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.4 Equipment Handling Dual Temperature Media

Below and above 60 degrees F: equipment handling dual temperature media shall be insulated as specified for cold equipment.

3.4.5 Equipment Exposed to Weather

3.4.5.1 Installation

Equipment exposed to weather shall be insulated and finished in accordance with the requirements for ducts exposed to weather in paragraph DUCT INSULATION INSTALLATION.

3.4.5.2 Optional Panels

At the option of the Contractor, prefabricated metal insulation panels may be used in lieu of the insulation and finish previously specified. Thermal performance shall be equal to or better than that specified for field applied insulation. Panels shall be the standard catalog product of a manufacturer of metal insulation panels. Fastenings, flashing, and support system shall conform to published recommendations of the manufacturer for weatherproof installation and shall prevent moisture from entering the insulation. Panels shall be designed to accommodate thermal expansion and to support a 250 pound walking load without permanent deformation or permanent damage to the insulation. Exterior metal cover sheet shall be aluminum and exposed fastenings shall be stainless steel or aluminum.

-- End of Section --

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC
02/19, CHG 2: 02/20

PART 1 GENERAL

1.1 SUMMARY

Provide a complete Direct Digital Control (DDC) system, suitable for the control of the heating, ventilating and air conditioning (HVAC) and other building-level systems as indicated and shown and in accordance with Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, other referenced Sections.

1.1.1 Proprietary Systems

1.1.1.1 Proprietary Systems Exempted From Open Protocol Requirements

The following systems are specifically exempted from the open protocol requirements of :

a. A simple split (DX) system consisting of a single indoor unit and a single outdoor unit from the same manufacturer.

b. Systems in Table I (previously approved by the designer in accordance with UFC 3-410-02).

TABLE I: Systems Approved to Use Proprietary Communications

System	Type (Multi-Split/VRF or Chiller/Boiler Plant)	Proprietary Multi-Split Engineering Tool Software Required (for Multi-Split/VRF only)

c. A system (not already shown Table I) of multiple boilers or multiple chillers communicating with a proprietary network for which an approved request has been obtained and for which: all units are from the same manufacturer, they are all co-located in the same room, the network connecting them is fully contained in that room, and the units are operating using a common "plant" sequence of operation which stages the units in a manner that requires operational parameters be shared between them and which cannot be accomplished with a single lead-lag command from a third-party controller.

1.1.1.2 Implementation of Proprietary Systems

For proprietary systems exempted from open protocol requirements, a proprietary network and DDC hardware communicating via proprietary protocol are permitted. For these systems a building control network meeting the requirements of must also be provided, along with a gateway or interface to connect the proprietary system to the open building control network.

The proprietary system gateway or interface must provide the required functionaliality as shown on the points schedule. Scheduling, alarming, trending, overrides, network inputs, network outputs and other protocol related requirements must be met on the open protocol control system as specified in .

1.1.1.3 Proprietary Multi-Split Engineering Tool Software

For each permitted proprietary systems in Table 1 shown as requiring Proprietary Multi-Split Engineering Tool Software, provide the software needed to replace a unit and configure the replacement. Submit hard copies of the software user manuals with the software submittal.

Submit Proprietary Multi-Split Engineering Tool Software on CD-ROM as a Technical Data Package. Submit hard copies of the software user manual for each piece of software.

1.1.2 System Requirements

Provide systems meeting the requirements this Section and other Sections referenced by this Section, and which have the following characteristics:

a. The system implements the control sequences of operation shown in the Contract Drawings using DDC hardware to control mechanical and electrical equipment

b. The system meet the requirements of this specification as a stand-alone system and does not require connection to any other system.

c. Control sequences reside in DDC hardware in the building. The building control network is not dependent upon connection to a Utility Monitoring and Control System (UMCS) Front End or to any other system for performance of control sequences. To the greatest extent practical, the hardware performs control sequences without reliance on the building network.

d. The hardware is installed such that individual control equipment can be replaced by similar control equipment from other equipment manufacturers with no loss of system functionality.

e. All necessary documentation, configuration information, programming tools, programs, drivers, and other software are licensed to and otherwise remain with the Government such that the Government or their agents are able to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the Contractor, Vendor or Manufacturer.

f. Sufficient documentation and data, including rights to documentation and data, are provided such that the Government or their agents can execute work to perform repair, replacement, upgrades, and expansions of the system without subsequent or future dependence on the Contractor, Vendor or Manufacturer.

g. Hardware is installed and configured such that the Government or their agents are able to perform repair, replacement, and upgrades of individual hardware without further interaction with the Contractor, Vendor or Manufacturer.

1.1.3 End to End Accuracy

Select products, install and configure the system such that the maximum error of a measured value as read from the DDC Hardware over the network is less than the maximum allowable error specified for the sensor or instrumentation.

1.1.4 Verification of Dimensions

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 any work.

1.1.5 Drawings

The Government will not indicate all offsets, fittings, and accessories that may be required on the drawings. Carefully investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, arrange such work accordingly, and provide all work necessary to meet such conditions.

1.2 RELATED SECTIONS

Related work specified elsewhere:

a. .

b. Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

c. Section 25 05 11 CYBERSECURITY FOR FACILITY-RELATED CONTROL SYSTEMS

1.3 REFERENCES

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

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE FUN IP	(2017) Fundamentals Handbook, I-P Edition

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41	(1991; R 1995) Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-410-02	(2018; with Change 1, 2020) Direct Digital Control for HVAC and Other Building Control Systems

UNDERWRITERS LABORATORIES (UL)

UL 5085-3	(2006; Reprint Nov 20121) Low Voltage Transformers - Part 3: Class 2 and Class 3 Transformers

1.4 DEFINITIONS

The following list of definitions includes terms used in Sections referenced by this Section and are included here for completeness.The definitions contained in this Section may disagree with how terms are defined or used in other documents, including documents referenced by this Section. The definitions included here are the authoritative definitions for this Section and all Sections referenced by this Section.

After each term the protocol related to that term is included in parenthesis.

1.4.1 Alarm Generation (All protocols)

Alarm Generation is the monitoring of a value, comparison of the value to alarm conditions and the creation of an alarm when the conditions set for the alarm are met. Note that this does NOT include delivery of the alarm to the final destination (such as a user interface) -

1.4.2 Binary (All protocols)

A two-state system where an "ON" condition is represented by a high signal level and an "OFF" condition is represented by a low signal level. 'Digital' is sometimes used interchangeably with 'binary'.

1.4.3 Building Control Network (BCN) (All protocols)

The network connecting all DDC Hardware within a building (or specific group of buildings).

1.4.4 Building Point of Connection (BPOC) (All protocols)

A FPOC for a Building Control System. (This term is being phased out of use in preference for FPOC but is still used in some specifications and criteria. When it was used, it typically referred to a piece of control hardware. The current FPOC definition typically refers instead to IT

hardware.)

1.4.5 Commandable (All protocols)

See Overridable.

1.4.6 Configurable (All protocols)

A property, setting, or value is configurable if it can be changed via hardware settings on the device, via the use of engineering software or over the control network from the front end, and is retained through (after) loss of power.

1.4.7 Control Logic Diagram (All protocols)

A graphical representation of control logic for multiple processes that make up a system.

1.4.8 Digital Controller (All protocols)

An electronic controller, usually with internal programming logic and digital and analog input/output capability, which performs control functions.

1.4.9 Direct Digital Control (DDC) (All protocols)

Digital controllers performing control logic. Usually the controller directly senses physical values, makes control decisions with internal programs, and outputs control signals to directly operate switches, valves, dampers, and motor controllers.

1.4.10 Field Point of Connection (FPOC) (All protocols)

The FPOC is the point of connection between the UMCS IP Network and the field control network (either an IP network, a non-IP network, or a combination of both). The hardware at this location which provides the connection is generally an IT device such as a switch, IP router, or firewall.

In general, the term "FPOC Location" means the place where this connection occurs, and "FPOC Hardware" means the device that provides the connection. Sometimes the term "FPOC" is used to mean either and its actual meaning (i.e. location or hardware) is determined by the context in which it is used.

1.4.11 Gateway (All protocols)

A device that translates from one protocol application data format to another. Devices that change only the transport mechanism of the protocol - "translating" from TP/FT-10 to Ethernet/IP or from BACnet MS/TP to BACnet over IP for example - are not gateways as the underlying data format does not change. Gateways are also called Communications Bridges or Protocol Translators.

1.4.12 IEEE 802.3 Ethernet (All protocols)

A family of local-area-network technologies providing high-speed

networking features over various media, typically Cat 5, 5e or Cat 6 twisted pair copper or fiber optic cable.

1.4.13 Internet Protocol (IP, TCP/IP, UDP/IP) (All protocols)

A communication method, the most common use is the World Wide Web. At the lowest level, it is based on Internet Protocol (IP), a method for conveying and routing packets of information over various LAN media. Two common protocols using IP are User Datagram Protocol (UDP) and Transmission Control Protocol (TCP). UDP conveys information to well-known "sockets" without confirmation of receipt. TCP establishes connections, also known as "sessions", which have end-to-end confirmation and guaranteed sequence of delivery.

1.4.14 Input/Output (I/O) (All protocols)

Physical inputs and outputs to and from a device, although the term sometimes describes network or "virtual" inputs or outputs. See also "Points".

1.4.15 I/O Expansion Unit (All protocols)

An I/O expansion unit provides additional point capacity to a digital controller

1.4.16 IP subnet (All protocols)

A group of devices which share a defined range IP addresses. Devices on a common IP subnet can share data (including broadcasts) directly without the need for the traffic to traverse an IP router.

1.4.17 Local-Area Network (LAN) (All protocols)

A communication network that spans a limited geographic area and uses the same basic communication technology throughout.

1.4.18 Local Display Panels (LDPs) (All protocols)

A DDC Hardware with a display and navigation buttons, and must provide display and adjustment of points as shown on the Points Schedule and as indicated.

1.4.19 MAC Address (All protocols)

Media Access Control address. The physical device address that identifies a device on a Local Area Network.

1.4.20 Monitoring and Control (M&C) Software (All protocols)

The UMCS 'front end' software which performs supervisory functions such as alarm handling, scheduling and data logging and provides a user interface for monitoring the system and configuring these functions.

1.4.21 Operator Configurable (All protocols)

Operator configurable values are values that can be changed from a single common front end user interface across multiple vendor systems.

1.4.22 Override (All protocols)

Changing the value of a point outside of the normal sequence of operation where the change has priority over the sequence and where there is a mechanism for releasing the change such that the point returns to the normal value. Overrides persist until released or overridden at the same or higher priority but are not required to persist through a loss of power. Overrides are often used by operators to change values, and generally originate at a user interface (workstation or local display panel).

1.4.23 Packaged Equipment (All protocols)

Packaged equipment is a single piece of equipment provided by a manufacturer in a substantially complete and operable condition, where the controls (DDC Hardware) are factory installed, and the equipment is sold and shipped from the manufacturer as a single entity. Disassembly and reassembly of a large piece of equipment for shipping does not prevent it from being packaged equipment. Package units may require field installation of remote sensors. Packaged equipment is also called a "packaged unit".

Note industry may use the term "Packaged System" to mean a collection of equipment that is designed to work together where each piece of equipment is packaged equipment and there is a network that connects the equipment together. A "packaged system" of this type is NOT packaged equipment; it is a collection of packaged equipment, and each piece of equipment must individually meet specification requirements.

1.4.24 Packaged Unit (All protocols)

See packaged equipment.

1.4.25 Performance Verification Test (PVT) (All protocols)

The procedure for determining if the installed BAS meets design criteria prior to final acceptance. The PVT is performed after installation, testing, and balancing of mechanical systems. Typically the PVT is performed by the Contractor in the presence of the Government.

1.4.26 Polling (All protocols)

A device periodically requesting data from another device.

1.4.27 Points (All protocols)

Physical and virtual inputs and outputs. See also paragraph INPUT/OUTPUT (I/O).

1.4.28 Proportional, Integral, and Derivative (PID) Control Loop (All protocols)

Three parameters used to control modulating equipment to maintain a setpoint. Derivative control is often not required for HVAC systems

(leaving "PI" control).

1.4.29 Repeater (All protocols)

A device that connects two control network segments and retransmits all information received on one side onto the other.

1.4.30 Router (All protocols)

A device that connects two and controls traffic between the two by retransmitting signals received from one side onto the other based on the signal destination. Routers are used to subdivide a and to limit network traffic.

1.4.31 Segment (All protocols)

A 'single' section of a control network that contains no repeaters or routers. There is generally a limit on the number of devices on a segment, and this limit is dependent on the topology/media and device type.

1.4.32 UMCS (All protocols)

UMCS stands for Utility Monitoring and Control System. The term refers to all components by which a project site monitors, manages, and controls real-time operation of HVAC and other building systems. These components include the UMCS "front-end" and all field building control systems connected to the front-end. The front-end consists of Monitoring and Control Software (user interface software), browser-based user interfaces and network infrastructure.

The network infrastructure (the "UMCS Network"), is an IP network connecting multiple building or facility control networks to the Monitoring and Control Software.

1.4.33 UMCS Network (All protocols)

The UMCS Network connects multiple building or facility control networks to the Monitoring and Control Software.

1.5 PROJECT SEQUENCING

TABLE II: PROJECT SEQUENCING lists the sequencing of submittals as specified in paragraph SUBMITTALS (denoted by an 'S' in the 'TYPE' column) and activities as specified in PART 3 EXECUTION (denoted by an 'E' in the 'TYPE' column). TABLE II does not specify overall project milestone and completion dates.

a. Sequencing for Submittals: The sequencing specified for submittals is the deadline by which the submittal must be initially submitted to the Government. Following submission there will be a Government review period as specified in Section 01 33 00 SUBMITTAL PROCEDURES. If the submittal is not accepted by the Government, revise the submittal and resubmit it to the Government within 14 days of notification that the submittal has been rejected. Upon resubmittal there will be an additional Government review period. If the submittal is not accepted the process repeats until the submittal is accepted by the Government.

b. Sequencing for Activities: The sequencing specified for activities

indicates the earliest the activity may begin.

c. Abbreviations: In TABLE II the abbreviation AAO is used for 'after approval of' and 'ACO' is used for 'after completion of'.

TABLE II. PROJECT SEQUENCING

ITEM #	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY OR DEADLINE FOR SUBMITTAL)
1	S	Existing Conditions Report	
2	S	DDC Contractor Design Drawings	
3	S	Manufacturer's Product Data	
4	S	Pre-construction QC Checklist	
5	E	Install Building Control System	AAO #1 thru #4
6	E	Start-Up and Start-Up Testing	ACO #5
7	S	Post-Construction QC Checklist	days ACO #6
8	S	Programming Software Configuration Software	days ACO #6
9	S	Draft As-Built Drawings	days ACO #6
10	S	Start-Up Testing Report	days ACO #6
11	S	PVT Procedures	days before schedule start of #12 and AAO #10
12	E	Execute PVT	AAO #9 and #11
13	S	PVT Report	days ACO #12

TABLE II. PROJECT SEQUENCING			
ITEM #	TYPE	DESCRIPTION	SEQUENCING (START OF ACTIVITY OR DEADLINE FOR SUBMITTAL)
14	S	Controller Application Programs Controller Configuration Settings	days AAO #13
15	S	Final As-Built Drawings	days AAO #13
16	S	O&M Instructions	AAO #15
17	S	Training Documentation	AAO #10 and days]before scheduled start of #18
18	E	Training	AAO #16 and #17
19	S	Closeout QC Checklist	ACO #18

1.6 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval.. When used, a code following the "G" classification 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

DDC Contractor Design Drawings; G

Draft As-Built Drawings; G

Final As-Built Drawings; G

SD-03 Product Data

Certificate of Networthiness Documentation; G

Programming Software; G

Proprietary Multi-Split Engineering Tool Software; G

Manufacturer's Product Data; G

SD-05 Design Data

Boiler Or Chiller Plant Gateway Request

SD-06 Test Reports

Existing Conditions Report

Start-Up Testing Report; G

PVT Procedures; G

PVT Report; G

Pre-Construction Quality Control (QC) Checklist; G

Post-Construction Quality Control (QC) Checklist; G

SD-10 Operation and Maintenance Data

Operation and Maintenance (O&M) Instructions; G

Training Documentation; G

SD-11 Closeout Submittals

Enclosure Keys; G

Password Summary Report; G

Closeout Quality Control (QC) Checklist; G

1.7 DATA PACKAGE AND SUBMITTAL REQUIREMENTS

Technical data packages consisting of technical data and computer software (meaning technical data which relates to computer software) which are specifically identified in this project and which may be defined/required in other specifications must be delivered strictly in accordance with the CONTRACT CLAUSES and in accordance with the Contract Data Requirements List, DD Form 1423. Data delivered must be identified by reference to the particular specification paragraph against which it is furnished. All submittals not specified as technical data packages are considered 'shop drawings' under the Federal Acquisition Regulation Supplement (FARS) and must contain no proprietary information and be delivered with unrestricted rights.

1.8 PROGRAMMING SOFTWARE

Provide all software related to the programming and configuration of DDC Hardware and Gateways as indicated. License all Software to the project site. The term "controller" as used in these requirements means both DDC Hardware and Gateways.

1.8.1 Certificate of Networthiness Documentation

For all software provided, provide documentation that an Enterprise Certificate of Networthiness exists, that a Limited Certificate of Networthiness for the project site exists, or provide a completed Certificate of Networthiness "Application Checklist". Submit Certificate of Networthiness Documentation in PDF format on CD-ROM.

1.9 BOILER OR CHILLER PLANT GATEWAY REQUEST

If requesting the use of a gateway to a boiler or chiller plant as indicated in paragraph Proprietary Systems Exempted From Open Protocol Requirements, submit a Boiler or Chiller Plant Gateway Request describing the configuration of the boilers or chillers including model numbers for equipment and controllers, the sequence of operation for the units, and a justification for the need to operate the units on a shared network.

1.10 QUALITY CONTROL CHECKLISTS

The QC Representative must verify each item indicated and initial in the space provided to indicate that the requirement has been met. The QC Representative must sign and date the Checklist prior to submission to the Government.

1.10.1 Pre-Construction Quality Control (QC) Checklist

Complete items indicated as Pre-Construction QC Checklist items in the QC Checklist. Submit four copies of the Pre-Construction QC Checklist.

1.10.2 Post-Construction Quality Control (QC) Checklist

Complete items indicated as Post-Construction QC Checklist items in the QC Checklist. Submit four copies of the Post-Construction QC Checklist.

1.10.3 Closeout Quality Control (QC) Checklist

Complete items indicated as Closeout QC Checklist items in the QC Checklist. Submit four copies of the Closeout QC Checklist.

PART 2 PRODUCTS

Provide products meeting the requirements of Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, other referenced Sections, and this Section.

2.1 GENERAL PRODUCT REQUIREMENTS

Units of the same type of equipment must be products of a single manufacturer. Each major component of equipment must have the manufacturer's name and address, and the model and serial number in a conspicuous place. Materials and equipment must be standard products of a manufacturer regularly engaged in the manufacturing of these and similar products. The standard products must have been in a satisfactory commercial or industrial use for two years prior to use on this project. The two year use must include applications of equipment and materials under similar circumstances and of similar size. DDC Hardware not meeting

the two-year field service requirement is acceptable provided it has been successfully used by the Contractor in a minimum of two previous projects. The equipment items must be supported by a service organization. Items of the same type and purpose must be identical, including equipment, assemblies, parts and components.

2.2 PRODUCT DATA

Provide manufacturer's product data sheets documenting compliance with product specifications for each product provided under Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, , or this Section. Provide product data for all products in a single indexed compendium, organized by product type.

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Submit Manufacturer's Product Data on CD-ROM.

2.3 OPERATION ENVIRONMENT

Unless otherwise specified, provide products rated for continuous operation under the following conditions:

a. Pressure: Pressure conditions normally encountered in the installed location.

b. Vibration: Vibration conditions normally encountered in the installed location.

c. Temperature:

(1) Products installed indoors: Ambient temperatures in the range of 32 to 112 degrees F and temperature conditions outside this range normally encountered at the installed location.

(2) Products installed outdoors or in unconditioned indoor spaces: Ambient temperatures in the range of -35 to +151 degrees F and temperature conditions outside this range normally encountered at the installed location.

d. Humidity: 10 to 95 percent relative humidity, noncondensing and humidity conditions outside this range normally encountered at the installed location.

2.4 WIRELESS CAPABILITY

For products incorporating any wireless capability (including but not limited to radio frequency (RF), infrared and optical), provide products for which wireless capability can be permanently disabled at the device. Optical and infrared capabilities may be disabled via a permanently affixed opaque cover plate.

2.5 ENCLOSURES

Enclosures supplied as an integral (pre-packaged) part of another product are acceptable. Provide two Enclosure Keys for each lockable enclosure on a single ring per enclosure with a tag identifying the enclosure the keys operate. Provide enclosures meeting the following minimum requirements:

2.5.1 Outdoors

For enclosures located outdoors, provide enclosures meeting NEMA 250 Type 3 requirements.

2.5.2 Mechanical and Electrical Rooms

For enclosures located in mechanical or electrical rooms, provide enclosures meeting NEMA 250 Type 2 requirements.

2.5.3 Other Locations

For enclosures in other locations including but not limited to occupied spaces, above ceilings, and in plenum returns, provide enclosures meeting NEMA 250 Type 1 requirements.

2.6 WIRE AND CABLE

Provide wire and cable meeting the requirements of NFPA 70 and NFPA 90A in addition to the requirements of this specification and referenced specifications.

2.6.1 Terminal Blocks

For terminal blocks which are not integral to other equipment, provide terminal blocks which are insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, suitable for DIN rail mounting, and which have enclosed sides or end plates and partition plates for separation.

2.6.2 Control Wiring for Binary Signals

For Control Wiring for Binary Signals, provide 18 AWG copper or thicker wire rated for 300-volt service.

2.6.3 Control Wiring for Analog Signals

For Control Wiring for Analog Signals, provide 18 AWG or thicker, copper, single- or multiple-twisted wire meeting the following requirements:

a. minimum 2 inch lay of twist

b. 100 percent shielded pairs

c. at least 300-volt insulation

d. each pair has a 20 AWG tinned-copper drain wire and individual overall pair insulation

e. cables have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

2.6.4 Power Wiring for Control Devices

For 24-volt circuits, provide insulated copper 18 AWG or thicker wire rated for 300 VAC service. For 120-volt circuits, provide 14 AWG or thicker stranded copper wire rated for 600-volt service.

2.6.5 Transformers

Provide UL 5085-3 approved transformers. Select transformers sized so that the connected load is no greater than 80 percent of the transformer rated capacity.

PART 3 EXECUTION

3.1 EXISTING CONDITIONS

3.1.1 Existing Conditions Survey

Perform a field survey, including testing and inspection of the equipment to be controlled and submit an Existing Conditions Report documenting the current status and its impact on the Contractor's ability to meet this specification. For those items considered nonfunctional, document the deficiency in the report including explanation of the deficiencies and estimated costs to correct the deficiencies. As part of the report, define the scheduled need date for connection to existing equipment. Make written requests and obtain Government approval prior to disconnecting any controls and obtaining equipment downtime.

Submit four copies of the Existing Conditions Report.

3.1.2 Existing Equipment Downtime

Make written requests and obtain Government approval prior to disconnecting any controls and obtaining equipment downtime.

3.1.3 Existing Control System Devices

Inspect, calibrate, and adjust as necessary to place in proper working order all existing devices which are to be reused.

3.2 INSTALLATION

Fully install and test the control system in accordance Section 23 09 13 INSTRUMENTATION AND CONTROL DEVICES FOR HVAC, and this Section.

3.2.1 Dielectric Isolation

Provide dielectric isolation where dissimilar metals are used for connection and support. Install control system in a matter that provides clearance for control system maintenance by maintaining access space required to calibrate, remove, repair, or replace control system devices. Install control system such that it does not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.2.2 Penetrations in Building Exterior

Make all penetrations through and mounting holes in the building exterior watertight.

3.2.3 Device Mounting Criteria

Install devices in accordance with the manufacturer's recommendations and as indicated and shown. Provide a weathershield for all devices installed outdoors. Provide clearance for control system maintenance by maintaining access space required to calibrate, remove, repair, or replace control

system devices. Provide clearance for mechanical and electrical system maintenance; do not not interfere with the clearance requirements for mechanical and electrical system maintenance.

3.2.4 Labels and Tags

Key all labels and tags to the unique identifiers shown on the As-Built drawings. For labels exterior to protective enclosures provide engraved plastic labels mechanically attached to the enclosure or DDC Hardware. Labels inside protective enclosures may be attached using adhesive, but must not be hand written. For tags, provide plastic or metal tags mechanically attached directly to each device or attached by a metal chain or wire.

a. Label all Enclosures and DDC Hardware.

b. Tag Airflow measurement arrays (AFMA) with flow rate range for signal output range, duct size, and pitot tube AFMA flow coefficient.

c. Tag duct static pressure taps at the location of the pressure tap

3.2.5 Surge Protection

3.2.5.1 Power-Line Surge Protection

Protect equipment connected to AC circuits to withstand power-line surges in accordance with IEEE C62.41. Do not use fuses for surge protection.

3.2.5.2 Surge Protection for Transmitter and Control Wiring

Protect DDC hardware against or provided DDC hardware capable of withstanding surges induced on control and transmitter wiring installed outdoors and as shown. Protect equipment against the following two waveforms:

a. A waveform with a 10-microsecond rise time, a 1000-microsecond decay time and a peak current of 60 amps.

b. A waveform with an 8-microsecond rise time, a 20-microsecond decay time and a peak current of 500 amperes.

3.2.6 Basic Cybersecurity Requirements

3.2.6.1 Passwords

For all devices with a password, change the password from the default password. Do not use the same password for more than one device. Provide a Password Summary Report documenting the password for each device and describing the procedure to change the password for each device.

Provide two hardcopies of the Password Summary Report, each copy in its own sealed envelope.

3.2.6.2 Wireless Capability

Unless otherwise indicated, disable wireless capability (including but not limited to radio frequency (RF), infrared and optical) for all devices with wireless capability. Optical and infrared capabilities may be disabled via a permanently affixed opaque cover plate. Password

protecting a wireless connections does not meet this requirement; the wireless capability must be disabled.

3.2.6.3 IP Network Physical Security

Install all IP Network media in conduit. Install all IP devices including but not limited to IP-enabled DDC hardware and IP Network Hardware in lockable enclosures.

3.3 DRAWINGS AND CALCULATIONS

Provide drawings in the form and arrangement indicated and shown. Use the same abbreviations, symbols, nomenclature and identifiers shown. Assign a unique identifier as shown to each control system element on a drawing. When packaging drawings, group schedules by system. When space allows, it is permissible to include multiple schedules for the same system on a single sheet. Except for drawings covering all systems, do not put information for different systems on the same sheet.

Submit hardcopy drawings on ISO A1 34 by 22 inchesorA3 17 by 11 inches sheets, and electronic drawings in PDF and in Autodesk Revit 2013 format. In addition, submit electronic drawings in editable Excel format for all drawings that are tabular, including but not limited to the Point Schedule and Equipment Schedule.

a. Submit DDC Contractor Design Drawings consisting of each drawing indicated with pre-construction information depicting the intended control system design and plans. Submit DDC Contractor Design Drawings as a single complete package: hard copies and copies on CD-ROM.

b. Submit Draft As-Built Drawings consisting of each drawing indicated updated with as-built data for the system prior to PVT. Submit Draft As-Built Drawings as a single complete package: hard copies and copies on CD-ROM.

c. Submit Final As-Built Drawings consisting of each drawing indicated updated with all final as-built data. Final As-Built Drawings as a single complete package: hard copies and copies on CD-ROM.

3.3.1 Sample Drawings

Sample drawings in electronic format are available at the Whole Building Design Guide page for this section: http://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-23-09-00 These drawings may prove useful in demonstrating expected drawing formatting and example content and are provided for illustrative purposes only. Note that these drawings do not meet the content requirements of this Section and must be completed to meet project requirements.

3.3.2 Drawing Index and Legend

Provide an HVAC Control System Drawing Index showing the name and number of the building, military site, State or other similar designation, and Country. In the Drawing Index, list all Contractor Design Drawings, including the drawing number, sheet number, drawing title, and computer filename when used. In the Design Drawing Legend, show and describe all symbols, abbreviations and acronyms used on the Design Drawings. Provide a single Index and Legend for the entire drawing package.

3.3.3 Thermostat and Occupancy Sensor Schedule

Provide a thermostat and occupancy sensor schedule containing each thermostat's unique identifier, room identifier and control features and functions as shown. Provide a single thermostat and occupancy sensor schedule for the entire project.

3.3.4 Valve Schedule

Provide a valve schedule containing each valve's unique identifier, size, flow coefficient Kv (Cv), pressure drop at specified flow rate, spring range, positive positioner range, actuator size, close-off pressure to torque data, dimensions, and access and clearance requirements data. In the valve schedule include actuator selection data supported by calculations of the force required to move and seal the valve, access and clearance requirements. Provide a single valve schedule for the entire project.

3.3.5 Damper Schedule

Provide a damper schedule containing each damper's unique identifier, type (opposed or parallel blade), nominal and actual sizes, orientation of axis and frame, direction of blade rotation, actuator size and spring ranges, operation rate, positive positioner range, location of actuators and damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. Include the AMCA 511 maximum leakage rate at the operating static-pressure differential for each damper in the Damper Schedule. Provide a single damper schedule for the entire project.

3.3.6 Project Summary Equipment Schedule

Provide a project summary equipment schedule containing the manufacturer, model number, part number and descriptive name for each control device, hardware and component provided under this specification. Provide a single project equipment schedule for the entire project.

3.3.7 Equipment Schedule

Provide system equipment schedules containing the unique identifier, manufacturer, model number, part number and descriptive name for each control device, hardware and component provided under this specification. Provide a separate equipment schedule for each HVAC system.

3.3.8 Occupancy Schedule

Provide an occupancy schedule drawing containing the same fields as the occupancy schedule Contract Drawing with Contractor updated information. Provide a single occupancy schedule for the entire project.

3.3.9 DDC Hardware Schedule

Provide a single DDC Hardware Schedule for the entire project and including following information for each device.

3.3.9.1 DDC Hardware Identifier

The Unique DDC Hardware Identifier for the device.

3.3.9.2 HVAC System

The system "name" used to identify a specific system (the name used on the system schematic drawing for that system).

3.3.10 Points Schedule

Provide a Points Schedule in tabular form for each HVAC system, with the indicated columns and with each row representing a hardware point, network point or configuration point in the system.

a. When a Points Schedule was included in the Contract Drawing package, use the same fields as the Contract Drawing with updated information in addition to the indicated fields.

b. When Point Schedules are included in the contract package, items requiring contractor verification or input have been shown in angle brackets ("<" and ">"), such as <___> for a required entry or <value> for a value requiring confirmation. Complete all items in brackets as well as any blank cells. Do not modify values which are not in brackets without approval.

Points Schedule Columns must include:

3.3.10.1 Point Name

The abbreviated name for the point using the indicated naming convention.

3.3.10.2 Description

A brief functional description of the point such as "Supply Air Temperature".

3.3.10.3 DDC Hardware Identifier

The Unique DDC Hardware Identifier shown on the DDC Hardware Schedule and used across all drawings for the DDC Hardware containing the point.

3.3.10.4 Settings

The value and units of any setpoints, configured setpoints, configuration parameters, and settings related to each point.

3.3.10.5 Range

The range of values, including units, associated with the point, including but not limited to a zone temperature setpoint adjustment range, a sensor measurement range, occupancy values for an occupancy input, or the status of a safety.

3.3.10.6 Input or Output (I/O) Type

The type of input or output signal associated with the point. Use the following abbreviations for entries in this column:

a. AI: The value comes from a hardware (physical) Analog Input

b. AO: The value is output as a hardware (physical) Analog Output

c. BI: The value comes from a hardware (physical) Binary Input

d. BO: The value is output as a hardware (physical) Binary Output

e. PULSE: The value comes from a hardware (physical) Pulse Accumulator Input

f. NET-IN: The value is provided from the network (generally from another device). Use this entry only when the value is received from another device as part of scheduling or as part of a sequence of operation, not when the value is received on the network for supervisory functions such as trending, alarming, override or display at a user interface.

g. NET-OUT: The value is provided to another controller over the network. Use this entry only when the value is transmitted to another device as part of scheduling or as part of a sequence of operation, not when the value is transmitted on the network for supervisory functions such as trending, alarming, override or display at a user interface.

3.3.10.7 Configuration Information

Indicate the means of configuration associated with each point.

3.3.11 Riser Diagram

The Riser Diagram of the Building Control Network may be in tabular form, and must show all DDC Hardware and all Network Hardware, including network terminators. For each item, provide the unique identifier, common descriptive name, physical sequential order (previous and next device on the network), room identifier and location within room. A single riser diagram must be submitted for the entire system.

3.3.12 Control System Schematics

Provide control system schematics in the same form as the control system schematic Contract Drawing with Contractor updated information. Provide a control system schematic for each HVAC system.

3.3.13 Sequences of Operation

Provide HVAC control system sequence of operation and in the same format as the Contract Drawings. Within these drawings, refer to devices by their unique identifiers. Submit sequences of operation for each HVAC system

3.3.14 Controller, Motor Starter and Relay Wiring Diagram

Provide controller wiring diagrams as functional wiring diagrams which show the interconnection of conductors and cables to each controller and to the identified terminals of input and output devices, starters and package equipment. Show necessary jumpers and ground connections and the labels of all conductors. Identify sources of power required for control systems and for packaged equipment control systems back to the panel board

circuit breaker number, controller enclosures, magnetic starter, or packaged equipment control circuit. Show each power supply and transformer not integral to a controller, starter, or packaged equipment. Show the connected volt-ampere load and the power supply volt-ampere rating. Provide wiring diagrams for each HVAC system.

3.4 CONTROLLER TUNING

Tune each controller in a manner consistent with that described in the ASHRAE FUN IP and in the manufacturer's instruction manual. Tuning must consist of adjustment of the proportional, integral, and where applicable, the derivative (PID) settings to provide stable closed-loop control. Each loop must be tuned while the system or plant is operating at a high gain (worst case) condition, where high gain can generally be defined as a low-flow or low-load condition. Upon final adjustment of the PID settings, in response to a change in controller setpoint, the controlled variable must settle out at the new setpoint with no more than two (2) oscillations above and below setpoint. Upon settling out at the new setpoint the controller output must be steady. With the exception of naturally slow processes such as zone temperature control, the controller must settle out at the new setpoint within five (5) minutes. Set the controller to its correct setpoint and record and submit the final PID configuration settings with the O&M Instructions and on the associated Points Schedule.

3.5 START-UP

3.5.1 Start-Up Test

Perform the following startup tests for each control system to ensure that the described control system components are installed and functioning per this specification.

Adjust, calibrate, measure, program, configure, set the time schedules, and otherwise perform all necessary actions to ensure that the systems function as indicated and shown in the sequence of operation and other contract documents.

3.5.1.1 Systems Check

An item-by-item check must be performed for each HVAC system

3.5.1.1.1 Step 1 - System Inspection

With the system in unoccupied mode and with fan hand-off-auto switches in the OFF position, verify that power and main air are available where required and that all output devices are in their failsafe and normal positions. Inspect each local display panel to verify that all displays indicate shutdown conditions.

3.5.1.1.2 Step 2 - Calibration Accuracy Check

Perform a two-point accuracy check of the calibration of each HVAC control system sensing element and transmitter by comparing the value from the test instrument to the network value provided by the DDC Hardware. Use digital indicating test instruments, such as digital thermometers, motor-driven psychrometers, and tachometers. Use test instruments with accuracy at least twice as accurate as the specified sensor accuracy and with calibration traceable to National Institute of Standards and

Technology standards. Check one the first check point in the bottom one-third of the sensor range, and the second in the top one-third of the sensor range. Verify that the sensing element-to-DDC readout accuracies at two points are within the specified product accuracy tolerances, and if not recalibrate or replace the device and repeat the calibration check.

3.5.1.1.3 Step 3 - Actuator Range Check

With the system running, apply a signal to each actuator through the DDC Hardware controller. Verify proper operation of the actuators and positioners for all actuated devices and record the signal levels for the extreme positions of each device. Vary the signal over its full range, and verify that the actuators travel from zero stroke to full stroke within the signal range. Where applicable, verify that all sequenced actuators move from zero stroke to full stroke in the proper direction, and move the connected device in the proper direction from one extreme position to the other. For valve actuators and damper actuators, perform the actuator range check under normal system pressures.

3.5.1.2 Weather Dependent Test

Perform weather dependent test procedures in the appropriate climatic season.

3.5.2 Start-Up Testing Report

Submit 4 copies of the Start-Up Testing Report. The report may be submitted as a Technical Data Package documenting the results of the tests performed and certifying that the system is installed and functioning per this specification, and is ready for the Performance Verification Test (PVT).

3.6 PERFORMANCE VERIFICATION TEST (PVT)

3.6.1 PVT Procedures

Prepare PVT Procedures explaining step-by-step, the actions and expected results that will demonstrate that the control system performs in accordance with the sequences of operation, and other contract documents. Submit 4 copies of the PVT Procedures. The PVT Procedures may be submitted as a Technical Data Package.

3.6.1.1 Sensor Accuracy Checks

Include a one-point accuracy check of each sensor in the PVT procedures.

3.6.1.2 Endurance Test

Include a one-week endurance test as part of the PVT during which the system is operated continuously.

3.6.1.3 PVT Equipment List

Include in the PVT procedures a control system performance verification test equipment list that lists the equipment to be used during performance verification testing. For each piece of equipment, include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration

3.6.2 PVT Execution

Demonstrate compliance of the control system with the contract documents. Using test plans and procedures approved by the Government, software capable of reading and writing COV Notification Subscriptions, Notification Class Recipient List Properties, event enrollments, demonstrate all physical and functional requirements of the project. Show, step-by-step, the actions and results demonstrating that the control systems perform in accordance with the sequences of operation. Do not start the performance verification test until after receipt of written permission by the Government, based on Government approval of the PVT Plan and Draft As-Builts and completion of balancing. UNLESS GOVERNMENT WITNESSING OF A TEST IS SPECIFICALLY WAIVED BY THE GOVERNMENT, PERFORM ALL TESTS WITH A GOVERNMENT WITNESS. Do not conduct tests during scheduled seasonal off periods of base heating and cooling systems. If the system experiences any failures during the endurance test portion of the PVT, repair the system repeat the endurance test portion of the PVT until the system operates continuously and without failure for the specified endurance test period.

3.6.3 PVT Report

Prepare and submit a PVT report documenting all tests performed during the PVT and their results. Include all tests in the PVT procedures and any additional tests performed during PVT. Document test failures and repairs conducted with the test results.

Submit four copies of the PVT Report. The PVT Report may be submitted as a Technical Data Package.

3.7 OPERATION AND MAINTENANCE (O&M) INSTRUCTIONS

Provide HVAC control System Operation and Maintenance Instructions which include:

a. "Data Package 3" as indicated in Section 01 78 23 OPERATION AND MAINTENANCE DATA for each piece of control equipment.

b. "Data Package 4" as described in Section 01 78 23 OPERATION AND MAINTENANCE DATA for all air compressors.

c. HVAC control system sequences of operation formatted as indicated.

d. Procedures for the HVAC system start-up, operation and shut-down including the manufacturer's supplied procedures for each piece of equipment, and procedures for the overall HVAC system.

e. As-built HVAC control system detail drawings formatted as indicated.

f. Routine maintenance checklist. Provide the routine maintenance

checklist arranged in a columnar format, where the first column lists all installed devices, the second column states the maintenance activity or that no maintenance required, the third column states the frequency of the maintenance activity, and the fourth column is used for additional comments or reference.

g. Qualified service organization list, including at a minimum company name, contact name and phone number.

h. Start-Up Testing Report.

i. Performance Verification Test (PVT) Procedures and Report.

Submit 2 copies of the Operation and Maintenance Instructions, indexed and in booklet form. The Operation and Maintenance Instructions may be submitted as a Technical Data Package.

3.8 MAINTENANCE AND SERVICE

Provide services, materials and equipment as necessary to maintain the entire system in an operational state as indicated for a period of one year after successful completion and acceptance of the Performance Verification Test. Minimize impacts on facility operations.

a. The integration of the system specified in this section into a Utility Monitoring and Control System must not, of itself, void the warranty or otherwise alter the requirement for the one year maintenance and service period. Integration into a UMCS includes but is not limited to establishing communication between devices in the control system and the front end or devices in another system.

b. The changing of configuration properties must not, of itself, void the warranty or otherwise alter the requirement for the one year maintenance and service period.

3.8.1 Description of Work

Provide adjustment and repair of the system including the manufacturer's required sensor and actuator (including transducer) calibration, span and range adjustment.

3.8.2 Personnel

Use only service personnel qualified to accomplish work promptly and satisfactorily. Advise the Government in writing of the name of the designated service representative, and of any changes in personnel.

3.8.3 Scheduled Inspections

Perform two inspections at six-month intervals and provide work required. Perform inspections in June and December. During each inspection perform the indicated tasks:

a. Perform visual checks and operational tests of equipment.

b. Clean control system equipment including interior and exterior surfaces.

c. Check and calibrate each field device. Check and calibrate 50 percent

of the total analog inputs and outputs during the first inspection. Check and calibrate the remaining 50 percent of the analog inputs and outputs during the second major inspection. Certify analog test instrumentation accuracy to be twice the specified accuracy of the device being calibrated. Randomly check at least 25 percent of all binary inputs and outputs for proper operation during the first inspection. Randomly check at least 25 percent of the remaining binary inputs and outputs during the second inspection. If more than 20 percent of checked inputs or outputs failed the calibration check during any inspection, check and recalibrate all inputs and outputs during that inspection.

d. Run system software diagnostics and correct diagnosed problems.

e. Resolve any previous outstanding problems.

3.8.4 Scheduled Work

This work must be performed during regular working hours, Monday through Friday, excluding Federal holidays.

3.8.5 Emergency Service

The Government will initiate service calls when the system is not functioning properly. Qualified personnel must be available to provide service to the system. A telephone number where the service supervisor can be reached at all times must be provided. Service personnel must be at the site within 24 hours after receiving a request for service. The control system must be restored to proper operating condition

3.8.6 Operation

After performing scheduled adjustments and repairs, verify control system operation as demonstrated by the applicable tests of the performance verification test.

3.8.7 Records and Logs

Keep dated records and logs of each task, with cumulative records for each major component, and for the complete system chronologically. Maintain a continuous log for all devices, including initial analog span and zero calibration values and digital points. Keep complete logs and provide logs for inspection onsite, demonstrating that planned and systematic adjustments and repairs have been accomplished for the control system.

3.8.8 Work Requests

Record each service call request as received and include its location, date and time the call was received, nature of trouble, names of the service personnel assigned to the task, instructions describing what has to be done, the amount and nature of the materials to be used, the time and date work started, and the time and date of completion. Submit a record of the work performed within 5 days after work is accomplished.

3.8.9 System Modifications

Submit recommendations for system modification in writing. Do not make system modifications, including operating parameters and control settings, without prior approval of the Government.

3.9 TRAINING

Conduct a training course for operating staff members designated by the Government in the maintenance and operation of the system, including specified hardware and software. Conduct 32hours of training at the project site within 30 days after successful completion of the performance verification test. The Government reserves the right to make audio and visual recordings (using Government supplied equipment)of the training sessions for later use. Provide audiovisual equipment and other training materials and supplies required to conduct training. A training day is defined as 8 hours of classroom instruction, including two 15 minute breaks and excluding lunchtime, Monday through Friday, during the daytime shift in effect at the training facility.

3.9.1 Training Documentation

Prepare training documentation consisting of:

a. Course Attendee List: Develop the list of course attendees in coordination with and signed by the shop supervisor.

b. Training Manuals: Provide training manuals which include an agenda, defined objectives for each lesson, and a detailed description of the subject matter for each lesson. When presenting portions of the course material by audiovisuals, deliver copies of those audiovisuals as a part of the printed training manuals.

3.9.2 Training Course Content

For guidance in planning the required instruction, assume that attendees will have a high school education, and are familiar with HVAC systems. During the training course, cover all of the material contained in the Operating and Maintenance Instructions, the layout and location of each controller enclosure, the layout of one of each type of equipment and the locations of each, the location of each control device external to the panels, the location of the compressed air station, preventive maintenance, troubleshooting, diagnostics, calibration, adjustment, commissioning, tuning, and repair procedures. Typical systems and similar systems may be treated as a group, with instruction on the physical layout of one such system. Present the results of the performance verification test and the Start-Up Testing Report as benchmarks of HVAC control system performance by which to measure operation and maintenance effectiveness.

3.9.3 Training Documentation Submittal Requirements

Submit hardcopy training manuals and all training materials on CD-ROM. Provide one hardcopy manual for each trainee on the Course Attendee List and 2 additional copies for archive at the project site. Provide 2 copies of the Course Attendee List with the archival copies. Training Documentation may be submitted as a Technical Data Package.

APPENDIX A

-- End of Section --

SECTION 23 09 13

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
11/15, CHG 1: 11/20

PART 1 GENERAL

1.1 SUMMARY

This section provides for the instrumentation control system components excluding direct digital controllers, network controllers, gateways etc. that are necessary for a completely functional automatic control system. When combined with a Direct Digital Control (DDC) system, the Instrumentation and Control Devices covered under this section must be a complete system suitable for the control of the heating, ventilating and air conditioning (HVAC) and other building-level systems as specified and indicated.

a. Install hardware to perform the control sequences as specified and indicated and to provide control of the equipment as specified and indicated.

b. Install hardware such that individual control equipment can be replaced by similar control equipment from other equipment manufacturers with no loss of system functionality.

c. Install and configure hardware such that the Government or their agents are able to perform repair, replacement, and upgrades of individual hardware without further interaction with the installing Contractor.

1.1.1 Verification of Dimensions

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 any work.

1.1.2 Drawings

The Government will not indicate all offsets, fittings, and accessories that may be required on the drawings. Carefully investigate the mechanical, electrical, and finish conditions that could affect the work to be performed, arrange such work accordingly, and provide all work necessary to meet such conditions.

1.2 RELATED SECTIONS

Related work specified elsewhere.

Section 01 30 00 ADMINISTRATIVE REQUIREMENTS

Section 23 30 00 HVAC AIR DISTRIBUTION

Section 23 05 15 COMMON PIPING FOR HVAC

Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM

1.3 REFERENCES

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

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 500-D	(2018) Laboratory Methods of Testing Dampers for Rating
AMCA 511	(2010; R 2016) Certified Ratings Program for Air Control Devices

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.1	((2014; Errata 2016) Electric Meters - Code for Electricity Metering

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B16.15	(2018) Cast Copper Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	(2018) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2018) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.34	(2017) Valves - Flanged, Threaded and Welding End
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC VIII D1	(2019) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

ASTM INTERNATIONAL (ASTM)

ASTM A269/A269M	(2015; R 2019) Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B75/B75M	(2020) Standard Specification for Seamless Copper Tube
ASTM B88	(2020) Standard Specification for Seamless

	Copper Water Tube
ASTM D635	(2018) Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
ASTM D638	(2014) Standard Test Method for Tensile Properties of Plastics
ASTM D792	(2013) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D1238	(2013) Melt Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D1693	(2015) Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics

FLUID CONTROLS INSTITUTE (FCI)

FCI 70-2	(2013) Control Valve Seat Leakage

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 142	(2007; Errata 2014) Recommended Practice for Grounding of Industrial and Commercial Power Systems - IEEE Green Book

INTERNATIONAL SOCIETY OF AUTOMATION (ISA)

ISA 7.0.01	(1996) Quality Standard for Instrument Air

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C12.20	(2015; E 2018) Electricity Meters - 0.1, 0.2, and 0.5 Accuracy Classes
NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA/ANSI C12.10	(2011) Physical Aspects of Watthour Meters - Safety Standards

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 94	(2013; Reprint Jun 2020) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and

	Appliances
UL 555	(2006; Reprint Aug 2016) UL Standard for Safety Fire Dampers
UL 555S	(2014; Reprint Oct 2020) UL Standard for Safety Smoke Dampers
UL 1820	(2004; Reprint May 2013) UL Standard for Safety Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics
UL 5085-3	(2006; Reprint Nov 20121) Low Voltage Transformers - Part 3: Class 2 and Class 3 Transformers

1.4 SUBMITTALS

Submittal requirements are specified in Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

1.5 DELIVERY AND STORAGE

Store and protect products from the weather, humidity, and temperature variations, dirt and dust, and other contaminants, within the storage condition limits published by the equipment manufacturer.

1.6 INPUT MEASUREMENT ACCURACY

Select, install and configure sensors, transmitters and DDC Hardware such that the maximum error of the measured value at the input of the DDC hardware is less than the maximum allowable error specified for the sensor or instrumentation.

1.7 SUBCONTRACTOR SPECIAL REQUIREMENTS

Perform all work in this section in accordance with the paragraph entitled CONTRACTOR SPECIAL REQUIREMENTS in Section 01 30 00 ADMINISTRATIVE REQUIREMENTS.

PART 2 PRODUCTS

2.1 EQUIPMENT

2.1.1 General Requirements

All products used to meet this specification must meet the indicated requirements, but not all products specified here will be required by every project. All products must meet the requirements both Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and this Section.

2.1.2 Operation Environment Requirements

Unless otherwise specified, provide products rated for continuous operation under the following conditions:

2.1.2.1 Pressure

Pressure conditions normally encountered in the installed location.

2.1.2.2 Vibration

Vibration conditions normally encountered in the installed location.

2.1.2.3 Temperature

a. Products installed indoors: Ambient temperatures in the range of 32 to 112 degrees F and temperature conditions outside this range normally encountered at the installed location.

b. Products installed outdoors or in unconditioned indoor spaces: Ambient temperatures in the range of -35 to +151 degrees F and temperature conditions outside this range normally encountered at the installed location.

2.1.2.4 Humidity

10 to 95 percent relative humidity, non-condensing and also humidity conditions outside this range normally encountered at the installed location.

2.2 WEATHERSHIELDS

Provide weathershields constructed of galvanized steel painted white, unpainted aluminum, aluminum painted white, or white PVC.

2.3 TUBING

2.3.1 Copper

Provide ASTM B75/B75M or ASTM B88 rated tubing meeting the following requirements:

a. For tubing 0.375 inch outside diameter and larger provide tubing with minimum wall thickness equal to ASTM B88, Type M

b. For tubing less than 0.375 inch outside diameter provide tubing with minimum wall thickness of 0.025 inch

c. For exposed tubing and tubing for working pressures greater than 30 psig provide hard copper tubing.

d. Provide fittings which are ASME B16.18 or ASME B16.22 solder type using ASTM B32 95-5 tin-antimony solder, or which are ASME B16.26 compression type.

2.3.2 Stainless Steel

For stainless steel tubing provide tubing conforming to ASTM A269/A269M

2.3.3 Plastic

Provide plastic tubing with the burning characteristics of linear low-density polyethylene tubing which is self-extinguishing when tested in accordance with ASTM D635, has UL 94 V-2 flammability classification or better, and which withstands stress cracking when tested in accordance with ASTM D1693. Provide plastic-tubing bundles with Mylar barrier and

flame-retardant polyethylene jacket.

2.3.4 Polyethylene Tubing

Provide flame-resistant, multiple polyethylene tubing in flame-resistant protective sheath with mylar barrier, or unsheathed polyethylene tubing in rigid metal, intermediate metal, or electrical metallic tubing conduit for areas where tubing is exposed. Single, unsheathed, flame-resistant polyethylene tubing may be used where concealed in walls or above ceilings and within control panels. Do not provide polyethylene tubing for smoke removal systems, or for systems with working pressures over 30 psig. Provide compression or brass barbed push-on type fittings. Provide extruded seamless polyethylene tubing conforming to the following:

a. Minimum Burst Pressure Requirements: 100 psig at 75 degrees F to 25 psig at 150 degrees F.

b. Stress Crack Resistance: ASTM D1693, 200 hours minimum.

c. Tensile Strength (Minimum): ASTM D638, 1100 psi.

d. Flow Rate (Average): ASTM D1238, 0.30 decigram per minute.

e. Density (Average): ASTM D792, 57.5 pounds per cubic feet.

f. Burn rate: ASTM D635

g. Flame Propagation: UL 1820, less than 5 feet ASTM D635

h. Average Optical Density: UL 1820, less than 0.15 ASTM D635

2.4 WIRE AND CABLE

Provide wire and cable meeting the requirements of NFPA 70 and NFPA 90A in addition to the requirements of this specification and referenced specifications.

2.4.1 Terminal Blocks

For terminal blocks which are not integral to other equipment, provide terminal blocks which are insulated, modular, feed-through, clamp style with recessed captive screw-type clamping mechanism, suitable for DIN rail mounting, and which have enclosed sides or end plates and partition plates for separation.

2.4.2 Control Wiring for Binary Signals

For Control Wiring for Binary Signals, provide 18 AWG copper or thicker wire rated for 300-volt service.

2.4.3 Control Wiring for Analog Signals

For Control Wiring for Analog Signals, provide 18 AWG or thicker, copper, single- or multiple-twisted wire meeting the following requirements:

a. minimum 2 inch lay of twist

b. 100 percent shielded pairs

c. at least 300-volt insulation

d. each pair has a 20 AWG tinned-copper drain wire and individual overall pair insulation

e. cables have an overall aluminum-polyester or tinned-copper cable-shield tape, overall 20 AWG tinned-copper cable drain wire, and overall cable insulation.

2.4.4 Power Wiring for Control Devices

For 24-volt circuits, provide insulated copper 18 AWG or thicker wire rated for 300 VAC service. For 120-volt circuits, provide 14 AWG or thicker stranded copper wire rated for 600-volt service.

2.4.5 Transformers

Provide UL 5085-3 approved transformers. Select transformers sized so that the connected load is no greater than 80 percent of the transformer rated capacity.

2.5 AUTOMATIC CONTROL VALVES

Provide valves with stainless-steel stems and stuffing boxes with extended necks to clear the piping insulation. Provide valves with bodies meeting ASME B16.34 or ASME B16.15 pressure and temperature class ratings based on the design operating temperature and 150 percent of the system design operating pressure. Unless otherwise specified or indicated, provide valves meeting FCI 70-2 Class III leakage rating. Provide valves rated for modulating or two-position service as indicated, which close against a differential pressure indicated as the Close-Off pressure and which are Normally-Open, Normally-Closed, or Fail-In-Last-Position as indicated.

2.5.1 Valve Type

2.5.1.1 Liquid Service 150 Degrees F or Less

Use either globe valves or ball valves except that butterfly valves may be used for sizes 4 inch and larger.

2.5.1.2 Liquid Service Above 150 Degrees F

a. Two-position valves: Use either globe valves or ball valves except that butterfly valves may be used for sizes 4 inch and larger.

b. Modulating valves: Use globe valves except that butterfly valves may be used for sizes 4 inch and larger.

2.5.1.3 Steam Service

Use globe valves except that butterfly valves may be used for sizes 4 inch and larger.

2.5.2 Valve Flow Coefficient and Flow Characteristic

2.5.2.1 Two-Way Modulating Valves

Provide the valve coefficient (Cv) indicated. Provide equal-percentage

flow characteristic for liquid service except for butterfly valves. Provide linear flow characteristic for steam service except for butterfly valves.

2.5.2.2 Three-Way Modulating Valves

Provide the valve coefficient (Cv) indicated. Provide linear flow characteristic with constant total flow throughout full plug travel.

2.5.3 Two-Position Valves

Use full line size full port valves with maximum available (Cv).

2.5.4 Globe Valves

2.5.4.1 Liquid Service Not Exceeding 150 Degrees F

a. Valve body and body connections:

(1) valves 1-1/2 inches and smaller: brass or bronze body, with threaded or union ends

(2) valves from 2 inches to 3 inches inclusive: brass, bronze, or iron bodies. 2 inch valves with threaded connections; 2-1/2 to 3 inches valves with flanged connections

b. Internal valve trim: Brass or bronze.

c. Stems: Stainless steel.

d. Provide valves compatible with a solution of 50 percent ethylene or propylene glycol.

2.5.4.2 Liquid Service Not Exceeding 250 Degrees F

a. Valve body and body connections:

(1) valves 1-1/2 inches and smaller: brass or bronze body, with threaded or union ends

(2) valves from 2 inches to 3 inches inclusive: brass, bronze, or iron bodies. 2 inch valves with threaded connections; 2-1/2 to 3 inches valves with flanged connections

b. Internal trim: Type 316 stainless steel including seats, seat rings, modulation plugs, valve stems, and springs.

c. Provide valves with non-metallic parts suitable for a minimum continuous operating temperature of 250 degrees F or 50 degrees F above the system design temperature, whichever is higher.

d. Provide valves compatible with a solution of 50 percent ethylene or propylene glycol

2.5.4.3 Hot water service 250 Degrees F and above

a. Provide valve bodies conforming to ASME B16.34 Class 300. For valves 1 inch and larger provide valves with bodies which are carbon steel, globe type with welded ends. For valves smaller than 1 inch provide

valves with socket-weld ends. Provide valves with virgin polytetrafluoroethylene (PTFE) packing. Provide valve and actuator combinations which are normally closed.

b. Internal trim: Type 316 stainless steel including seats, seat rings, modulation plugs, valve stems, and springs.

2.5.4.4 Steam Service

For steam service, provide valves meeting the following requirements:

a. Valve body and connections:

(1) valves 1-1/2 inches and smaller: complete body of brass or bronze, with threaded or union ends

(2) valves from 2 inches to 3 inches inclusive: body of brass, bronze, or carbon steel

(3) valves 4 inches and larger: body of carbon steel. 2 inch valves with threaded connections; valves2-1/2 inches and larger with flanged connections.

b. Internal Trim: Type 316 stainless steel including seats, seat rings, modulation plugs, valve stems, and springs.

c. Valve sizing: sized for 15 psig inlet steam pressure with a maximum 12 psi differential through the valve at rated flow, except where indicated otherwise.

2.5.5 Ball Valves

2.5.5.1 Liquid Service Not Exceeding 150 Degrees F

a. Valve body and connections:

(1) valves 1-1/2 inches and smaller: bodies of brass or bronze, with threaded or union ends

(2) valves from 2 inches to 3 inches inclusive: bodies of brass, bronze, or iron. 2 inch valves with threaded connections; valves from 2-1/2 to 3 inches with flanged connections.

b. Ball: Stainless steel or nickel-plated brass or chrome-plated brass.

c. Seals: Reinforced Teflon seals and EPDM O-rings.

d. Stem: Stainless steel, blow-out proof.

e. Provide valves compatible with a solution of 50 percent ethylene or propylene glycol.

2.5.6 Butterfly Valves

Provide butterfly valves which are threaded lug type suitable for dead-end service and modulation to the fully-closed position, with carbon-steel bodies or with ductile iron bodies in accordance with ASTM A536. Provide butterfly valves with non-corrosive discs, stainless steel shafts supported by bearings, and EPDM seats suitable for temperatures from -20

to +250 degrees F. Provide valves with rated Cv of the Cv at 70 percent (60 degrees) open position. Provide valves meeting FCI 70-2 Class VI leakage rating.

2.5.7 Pressure Independent Control Valves (PICV)

Provide pressure independent control valves which include a regulator valve which maintains the differential pressure across a flow control valve. Pressure independent control valves must accurately control the flow from 0-100 percent full rated flow regardless of changes in the piping pressure and not vary the flow more than plus or minus 5 percent at any given flow control valve position when the PICV differential pressure lies between the manufacturer's stated minimum and maximum. The rated minimum differential pressure for steady flow must not exceed 5 psid across the PICV. Provide either globe or ball type valves meeting the indicated requirements for globe and ball valves. Provide valves with a flow tag listing full rated flow and minimum required pressure drop. Provide valves with factory installed Pressure/Temperature ports ("Pete's Plugs") to measure the pressure drop to determine the valve flow rate.

2.5.8 Duct-Coil and Terminal-Unit-Coil Valves

For duct or terminal-unit coils provide control valves with either flare-type or solder-type ends. Provide flare nuts for each flare-type end valve.

2.6 DAMPERS

2.6.1 Damper Assembly

Provide single damper sections with blades no longer than 48 inches and which are no higher than 72 inches and damper blade width of 8 inches or less. When larger sizes are required, combine damper sections. Provide dampers made of steel, or other materials where indicated and with assembly frames constructed of 0.07 inch minimum thickness galvanized steel channels with mitered and welded corners. Steel channel frames constructed of 0.06 inch minimum thickness are acceptable provided the corners are reinforced.

a. Flat blades must be made rigid by folding the edges. Blade-operating linkages must be within the frame so that blade-connecting devices within the same damper section must not be located directly in the air stream.

b. Damper axles must be 1/2 inch minimum, plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically must be supported by thrust bearings.

c. Provide dampers which do not exceed a pressure drop through the damper of 0.04 inches water gauge at 1000 ft/min in the wide-open position. Provide dampers with frames not less than 2 inch in width. Provide dampers which have been tested in accordance with AMCA 500-D.

2.6.2 Operating Linkages

For operating links external to dampers, such as crank arms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers, provide links able to withstand a load equal to at least 300 percent of the maximum required damper-operating force without deforming.

Rod lengths must be adjustable. Links must be brass, bronze, zinc-coated steel, or stainless steel. Working parts of joints and clevises must be brass, bronze, or stainless steel. Adjustments of crank arms must control the open and closed positions of dampers.

2.6.3 Damper Types

2.6.3.1 Flow Control Dampers

Provide parallel-blade or opposed blade type dampers for outside air, return air, relief air, exhaust, face and bypass dampers as indicated on the Damper Schedule. Blades must have interlocking edges. The channel frames of the dampers must be provided with jamb seals to minimize air leakage. Unless otherwise indicated, dampers must meet AMCA 511 Class 1A requirements. Outside air damper seals must be suitable for an operating temperature range of -40 to +167 degrees F. Dampers must be rated at not less than 2000 ft/min air velocity.

2.6.3.2 Mechanical Rooms and Other Utility Space Ventilation Dampers

Provide utility space ventilation dampers as indicated. Unless otherwise indicated provide AMCA 511 class 3 dampers. Provide dampers rated at not less than 1500 ft/min air velocity.

2.6.3.3 Smoke Dampers

Provide smoke-damper and actuator assemblies which meet the current requirements of NFPA 90A, UL 555, and UL 555S. For combination fire and smoke dampers provide dampers rated for 250 degrees F Class II leakage per UL 555S.

2.7 SENSORS AND INSTRUMENTATION

Unless otherwise specified, provide sensors and instrumentation which incorporate an integral transmitter. Sensors and instrumentation, including their transmitters, must meet the specified accuracy and drift requirements at the input of the connected DDC Hardware's analog-to-digital conversion.

2.7.1 Analog and Binary Transmitters

Provide transmitters which match the characteristics of the sensor. Transmitters providing analog values must produce a linear 4-20 mAdc, 0-10 Vdc signal corresponding to the required operating range and must have zero and span adjustment. Transmitters providing binary values must have dry contacts rated at 1A at 24 Volts AC.

2.7.2 Network Transmitters

Sensors and Instrumentation incorporating an integral network connection are considered DDC Hardware and must meet the DDC Hardware requirements of these specifications

2.7.3 Temperature Sensors

Provide the same sensor type throughout the project. Temperature sensors may be provided without transmitters. Where transmitters are used, the range must be the smallest available from the manufacturer and suitable for the application such that the range encompasses the expected range of

temperatures to be measured. The end to end accuracy includes the combined effect of sensitivity, hysteresis, linearity and repeatability between the measured variable and the end user interface (graphic presentation) including transmitters if used.

2.7.3.1 Sensor Accuracy and Stability of Control

2.7.3.1.1 Conditioned Space Temperature

Plus or minus 0.5 degree F over the operating range.

2.7.3.1.2 Unconditioned Space Temperature

a. Plus or minus 1 degree F over the range of 30 to 131 degrees F AND

b. Plus or minus 4 degrees F over the rest of the operating range.

2.7.3.1.3 Duct Temperature

Plus or minus 0.5 degree F

2.7.3.1.4 Outside Air Temperature

a. Plus or minus 2 degrees F over the range of -30 to +130 degrees F AND

b. Plus or minus 1 degree F over the range of 30 to 130 degrees F.

2.7.3.1.5 High Temperature Hot Water

Plus or minus 3.6 degrees F.

2.7.3.1.6 Chilled Water

Plus or minus 0.8 degrees F over the range of 35 to 65 degrees F.

2.7.3.1.7 Dual Temperature Water

Plus or minus 2 degrees F.

2.7.3.1.8 Heating Hot Water

Plus or minus 2 degrees F.

2.7.3.1.9 Condenser Water

Plus or minus 2 degrees F.

2.7.3.2 Transmitter Drift

The maximum allowable transmitter drift: 0.25 degrees F per year.

2.7.3.3 Point Temperature Sensors

Point Sensors must be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper.

2.7.3.4 Temperature Sensor Details

2.7.3.4.1 Room Type

Provide the sensing element components within a decorative protective cover suitable for surrounding decor.

2.7.3.4.2 Duct Probe Type

Ensure the probe is long enough to properly sense the air stream temperature.

2.7.3.4.3 Duct Averaging Type

Continuous averaging sensors must be one foot in length for each 1 square foot of duct cross-sectional area, and a minimum length of 5 feet.

2.7.3.4.4 Pipe Immersion Type

Provide minimum 3 inch immersion. Provide each sensor with a corresponding pipe-mounted sensor well, unless indicated otherwise. Sensor wells must be stainless steel when used in steel piping, and brass when used in copper piping.

2.7.3.4.5 Outside Air Type

Provide the sensing element rated for outdoor use

2.7.4 Relative Humidity Sensor

Relative humidity sensors must use bulk polymer resistive or thin film capacitive type non-saturating sensing elements capable of withstanding a saturated condition without permanently affecting calibration or sustaining damage. The sensors must include removable protective membrane filters. Where required for exterior installation, sensors must be capable of surviving below freezing temperatures and direct contact with moisture without affecting sensor calibration. When used indoors, the sensor must be capable of being exposed to a condensing air stream (100 percent relative humidity) with no adverse effect to the sensor's calibration or other harm to the instrument. The sensor must be of the wall-mounted or duct-mounted type, as required by the application, and must be provided with any required accessories. Sensors used in duct high-limit applications must have a bulk polymer resistive sensing element. Duct-mounted sensors must be provided with a duct probe designed to protect the sensing element from dust accumulation and mechanical damage. Relative humidity (RH) sensors must measure relative humidity over a range of 0 percent to 100 percent with an accuracy of plus or minus 2 percent. RH sensors must function over a temperature range of 40 to 135 degrees F and must not drift more than 1 percent per year.

2.7.5 Carbon Dioxide (CO2) Sensors

Provide photometric type CO2 sensors with integral transducers and linear output. Carbon dioxide (CO2) sensors must measure CO2 concentrations between 0 to 2000 parts per million (ppm) using non-dispersible infrared (NDIR) technology with an accuracy of plus or minus 50 ppm and a maximum response time of 1 minute. The sensor must be rated for operation at ambient air temperatures within the range of 32 to 122 degrees F and relative humidity within the range of 20 to 95 percent (non-condensing).

The sensor must have a maximum drift of 2 percent per year. The sensor chamber must be manufactured with a non-corrosive material that does not affect carbon dioxide sample concentration. Duct mounted sensors must be provided with a duct probe designed to protect the sensing element from dust accumulation and mechanical damage. The sensor must have a calibration interval no less than 5 years.

2.7.6 Differential Pressure Instrumentation

2.7.6.1 Differential Pressure Sensors

Provide Differential Pressure Sensors with ranges as indicated or as required for the application. Pressure sensor ranges must not exceed the high end range indicated on the Points Schedule by more than 50 percent. The over pressure rating must be a minimum of 150 percent of the highest design pressure of either input to the sensor. The accuracy must be plus or minus 1 percent of full scale. The sensor must have a maximum drift of 2 percent per year

2.7.6.2 Differential Pressure Switch

Provide differential pressure switches with a user-adjustable setpoint which are sized for the application such that the setpoint is between 25 percent and 75 percent of the full range. The over pressure rating must be a minimum of 150 percent of the highest design pressure of either input to the sensor. The switch must have two sets of contacts and each contact must have a rating greater than it's connected load. Contacts must open or close upon rise of pressure above the setpoint or drop of pressure below the setpoint as indicated.

2.7.7 Flow Sensors

2.7.7.1 Airflow Measurement Array (AFMA)

2.7.7.1.1 Airflow Straightener

Provide AFMAs which contain an airflow straightener if required by the AFMA manufacturer's published installation instructions. The straightener must be contained inside a flanged sheet metal casing, with the AFMA located as specified according to the published recommendation of the AFMA manufacturer. In the absence of published documentation, provide airflow straighteners if there is any duct obstruction within 5 duct diameters upstream of the AFMA. Air-flow straighteners, where required, must be constructed of 0.125 inch aluminum honeycomb and the depth of the straightener must not be less than 1.5 inches.

2.7.7.1.2 Resistance to Airflow

The resistance to air flow through the AFMA, including the airflow straightener must not exceed 0.085 inch water gauge at an airflow of 2,000 fpm. AFMA construction must be suitable for operation at airflows of up to 5000 fpm over a temperature range of 40 to 120 degrees F.

2.7.7.1.3 Outside Air Temperature

In outside air measurement or in low-temperature air delivery applications, provide an AFMA certified by the manufacturer to be accurate as specified over a temperature range of -20 to +120 degrees F .

2.7.7.1.4 Pitot Tube AFMA

Each Pitot Tube AFMA must contain an array of velocity sensing elements. The velocity sensing elements must be of the multiple pitot tube type with averaging manifolds. The sensing elements must be distributed across the duct cross section in the quantity and pattern specified or recommended by the published installation instructions of the AFMA manufacturer.

a. Pitot Tube AFMAs for use in airflows over 600 fpm must have an accuracy of plus or minus 5 percent over a range of 500 to 2500 fpm.

b. Pitot Tube AFMAs for use in airflows under 600 fpm must have an accuracy of plus or minus 5 percent over a range of 125 to 2500 fpm.

2.7.7.1.5 Electronic AFMA

Each electronic AFMA must consist of an array of velocity sensing elements of the resistance temperature detector (RTD) or thermistor type. The sensing elements must be distributed across the duct cross section in the quantity and pattern specified or recommended by the published application data of the AFMA manufacturer. Electronic AFMAs must have an accuracy of plus or minus 5 percent over a range of 125 to 5,000 fpm and the output must be temperature compensated over a range of 32 to 212 degrees F.

2.7.7.1.6 Fan Inlet Measurement Devices

Fan inlet measurement devices cannot be used unless indicated on the drawings or schedules.

2.7.7.2 Orifice Plate

Orifice plate must be made of an austenitic stainless steel sheet of 0.125 inch nominal thickness with an accuracy of plus or minus 1 percent of full flow. The orifice plate must be flat within 0.002 inches. The orifice surface roughness must not exceed 20 micro-inches. The thickness of the cylindrical face of the orifice must not exceed 2 percent of the pipe inside diameter or 12.5 percent of the orifice diameter, whichever is smaller. The upstream edge of the orifice must be square and sharp. Where orifice plates are used, concentric orifice plates must be used in all applications except steam flow measurement in horizontal pipelines.

2.7.7.3 Flow Nozzle

Flow nozzle must be made of austenitic stainless steel with an accuracy of plus or minus 1 percent of full flow. The inlet nozzle form must be elliptical and the nozzle throat must be the quadrant of an ellipse. The thickness of the nozzle wall and flange must be such that distortion of the nozzle throat from strains caused by the pipeline temperature and pressure, flange bolting, or other methods of installing the nozzle in the pipeline must not cause the accuracy to degrade beyond the specified limit. The outside diameter of the nozzle flange or the design of the flange facing must be such that the nozzle throat must be centered accurately in the pipe.

2.7.7.4 Venturi Tube

Venturi tube must be made of cast iron or cast steel and must have an accuracy of plus or minus 1 percent of full flow. The throat section must be lined with austenitic stainless steel. Thermal expansion

characteristics of the lining must be the same as that of the throat casting material. The surface of the throat lining must be machined to a plus or minus 50 micro inch finish, including the short curvature leading from the converging entrance section into the throat.

2.7.7.5 Annular Pitot Tube

Annular pitot tube must be made of austenitic stainless steel with an accuracy of plus or minus 2 percent of full flow and a repeatability of plus or minus 0.5 percent of measured value. The unit must have at least one static port and no less than four total head pressure ports with an averaging manifold.

2.7.7.6 Insertion Turbine Flowmeter

Provide dual axial turbine flowmeter with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. All parts must meet or exceed the pressure classification of the pipe system it is installed in. Insertion Turbine Flowmeter accuracy must be plus or minus 0.5 percent of rate at calibrated velocity., within plus or minus of rate over a 10:1 turndown and within plus or minus 2 percent of rate over a 50:1 turndown. Repeatability must be plus or minus 0.25 percent of reading. The meter flow sensing element must operate over a range suitable for the installed location with a pressure loss limited to 1 percent of operating pressure at maximum flow rate. The flowmeter ,must include either dry contact pulse outputs, 4-20mA, 0-10Vdc or 0-5Vdc outputs. The turbine rotor assembly must be constructed of Series 300 stainless steel and use Teflon seals.

2.7.7.7 Vortex Shedding Flowmeter

Vortex Shedding Flowmeter accuracy must be within plus or minus 0.8 percent of the actual reading over the range of the meter. Steam meters must contain density compensation by direct measurement of temperature. Mass flow inferred from specified steam pressure are not acceptable. The flow meter body must be made of austenitic stainless steel and include a weather tight NEMA 4X electronics enclosure. The vortex shedding flowmeter body must not require removal from the piping in order to replace the shedding sensor.

2.7.7.8 Ultrasonic Flow Meter

Provide Ultrasonic Flow Meters complete with matched transducers, self aligning installation hardware and transducer cables. Ultrasonic transducers must be optimized for the specific pipe and process conditions for the application. The flow meter accuracy must plus or minus 1 percent of rate from 0 to 40 ft/sec. The flowmeter must include either dry contact pulse outputs, 4-20mA, 0-10Vdc or 0-5Vdc output.

2.7.7.9 Insertion Magnetic Flow Meter

Provide insertion type magnetic flowmeters with all installation hardware necessary to enable insertion and removal of the meter without system shutdown. All parts must meet or exceed the pressure classification of the pipe system it is installed in. Flowmeter accuracy must be no greater than plus or minus 1 percent of rate from 2 to 20 feet/sec. Wetted material parts must be 300 series stainless steel. The flowmeter must include either dry contact pulse outputs, 4-20mA, 0-10Vdc or 0-5Vdc outputs.

2.7.7.10 Positive Displacement Flow Meter

The flow meter must be a direct reading, gerotor, nutating disc or vane type displacement device rated for liquid service as indicated. A counter must be mounted on top of the meter, and must consist of a non-resettable mechanical totalizer for local reading, and a pulse transmitter for remote reading. The totalizer must have a six digit register to indicate the volume passed through the meter in gallons, and a sweep-hand dial to indicate down to 0.25 gallons. The pulse transmitter must have a hermetically sealed reed switch which is activated by magnets fixed on gears of the counter. The meter must have a bronze body with threaded or flanged connections as required for the application. Output accuracy must be plus or minus 2 percent of the flow range. The maximum pressure drop at full flow must be 5 psig.

2.7.7.11 Flow Meters, Paddle Type

Sensor must be non-magnetic, with forward curved impeller blades designed for water containing debris. Sensor accuracy must be plus or minus 1 percent of rate of flow, minimum operating flow velocity must be 1 foot per second. Sensor repeatability and linearity must be plus or minus 1 percent. Materials which will be wetted must be made from non-corrosive materials and must not contaminate water. The sensor must be rated for installation in pipes of 3 to 40 inch diameters. The transmitter housing must be a NEMA 250 Type 4 enclosure.

2.7.7.12 Flow Switch

Flow switch must have a repetitive accuracy of plus or minus 10 percent of actual flow setting. Switch actuation must be adjustable over the operating flow range, and must be sized for the application such that the setpoint is between 25 percent and 75 percent of the full range.. The switch must have Form C snap-action contacts, rated for the application. The flow switch must have non flexible paddle with magnetically actuated contacts and be rated for service at a pressure greater than the installed conditions. Flow switch for use in sewage system must be rated for use in corrosive environments encountered.

2.7.7.13 Gas Flow Meter

Gas flow meter must be diaphragm or bellows type (gas positive displacement meters) for flows up to 2500 SCFH and axial flow turbine type for flows above 2500 SCFH, designed specifically for natural gas supply metering, and rated for the pressure, temperature, and flow rates of the installation. Meter must have a minimum turndown ratio of 10 to 1 with an accuracy of plus or minus 1 percent of actual flow rate. The meter index must include a direct reading mechanical totalizing register and electrical impulse dry contact output for remote monitoring. The electrical impulse dry contact output must not require field adjustment or calibration. The electrical impulse dry contact output must have a minimum resolution of 100 cubic feet of gas per pulse and must not exceed 15 pulses per second at the design flow.

2.7.8 Electrical Instruments

Provide Electrical Instruments with an input range as indicated or sized for the application. Unless otherwise specified, AC instrumentation must be suitable for 60 Hz operation.

2.7.8.1 Current Transducers

Current transducers must accept an AC current input and must have an accuracy of plus or minus 0.5 percent of full scale. The device must have a means for calibration. Current transducers for variable frequency applications must be rated for variable frequency operation.

2.7.8.2 Current Sensing Relays (CSRs)

Current sensing relays (CSRs) must provide a normally-open contact with a voltage and amperage rating greater than its connected load. Current sensing relays must be of split-core design. The CSR must be rated for operation at 200 percent of the connected load. Voltage isolation must be a minimum of 600 volts. The CSR must auto-calibrate to the connected load or be adjustable and field calibrated. Current sensors for variable frequency applications must be rated for variable frequency operation.

2.7.8.3 Voltage Transducers

Voltage transducers must accept an AC voltage input and have an accuracy of plus or minus 0.25 percent of full scale. The device must have a means for calibration. Line side fuses for transducer protection must be provided.

2.7.8.4 Energy Metering

2.7.8.4.1 Watt or Watthour Transducers

Watt transducers must measure voltage and current and must output kW or kWh or both kW and kWh as indicated. kW outputs must have an accuracy of plus or minus 0.5 percent over a power factor range of 0.1 to 1. kWh outputs must have an accuracy of plus or minus 0.5 percent over a power factor range of 0.1 to 1.

2.7.8.4.2 Watthour Revenue Meter (with and without Demand Register)

All Watthour revenue meters must measure voltage and current and must be in accordance with ANSI C12.1 with an ANSI C12.20 Accuracy class of 0.5 and must have pulse initiators for remote monitoring of Watthour consumption. Pulse initiators must consist of form C contacts with a current rating not to exceed two amperes and voltage not to exceed 500 V, with combinations of VA not to exceed 100 VA, and a life rating of one billion operations. Meter sockets must be in accordance with NEMA/ANSI C12.10. Watthour revenue meters with demand registers must output instantaneous demand in addition to the pulse initiators.

2.7.8.4.3 Steam Meters

Steam meters must be the vortex type, with pressure compensation, a minimum turndown ratio of 10 to 1, and an output signal compatible with the DDC system.

2.7.8.4.4 Hydronic BTU Meters

The BTU meter is to be supplied with wall mount hardware and be capable of being installed remote from the flow meter. The BTU meter must include an LCD display for local indication of energy rate and for display of parameters and settings during configuration. Each BTU meter must be

factory configured for its specific application and be completely field configurable by the user via a front panel keypad (no special interface device or computer required). The unit must output Energy Rate, Energy Total, Flow Rate, Supply Temperature, and Return Temperature. An integral transmitter is to provide a linear analog or configurable pulse output signal representing the energy rate; and the signal must be compatible with building automation system DDC Hardware to which the output is connected.

2.7.9 pH Sensor

The sensor must be suitable for applications and chemicals encountered in water treatment systems of boilers, chillers and condenser water systems. Construction, wiring, fittings and accessories must be corrosion and chemical resistant with fittings for tank or suspension installation. Housing must be polyvinylidene fluoride with O-rings made of chemical resistant materials which do not corrode or deteriorate with extended exposure to chemicals. The sensor must be encapsulated. Periodic replacement must not be required for continued sensor operation. Sensors must use a ceramic junction and pH sensitive glass membrane capable of withstanding a pressure of 100 psig at 150 degrees F. The reference cell must be double junction configuration. Sensor range must be 0 to 12 pH, stability 0.05, sensitivity 0.02, and repeatability of plus or minus 0.05 pH value, response of 90 percent of full scale in one second and a linearity of 99 percent of theoretical electrode output measured at 76 degrees F.

2.7.10 Oxygen Analyzer

Oxygen analyzer must consist of a zirconium oxide sensor for continuous sampling and an air-powered aspirator to draw flue gas samples. The analyzer must be equipped with filters to remove flue air particles. Sensor probe temperature rating must be 815 degrees F. The sensor assembly must be equipped for flue flange mounting.

2.7.11 Carbon Monoxide Analyzer

Carbon monoxide analyzer must consist of an infrared light source in a weather proof steel enclosure for duct or stack mounting. An optical detector/analyzer in a similar enclosure, suitable for duct or stack mounting must be provided. Both assemblies must include internal blower systems to keep optical windows free of dust and ash at all times. The third component of the analyzer must be the electronics cabinet. Automatic flue gas temperature compensation and manual/automatic zeroing devices must be provided. Unit must read parts per million (ppm) of carbon monoxide and the response time must be less than 3 seconds to 90 percent value. Unit measurement range must not exceed specified range by more that 50 percent. Repeatability must be plus or minus 1 percent of full scale with an accuracy of plus or minus 1 percent of full scale.

2.7.12 Occupancy Sensors

Occupancy sensors must have occupancy-sensing sensitivity adjustment and an adjustable off-delay timer with a setpoint of 15 minutes. Adjustments accessible from the face of the unit are preferred. Occupancy sensors must be rated for operation in ambient air temperatures ranging from 40 to 95 degrees F or temperatures normally encountered in the installed location. Sensors integral to wall mount on-off light switches must have an auto-off switch. Wall switch sensors must be decorator style and must

fit behind a standard decorator type wall plate. All occupancy sensors, power packs, and slave packs must be UL listed. In addition to any outputs required for lighting control, the occupancy sensor must provide an output for the HVAC control system.

2.7.12.1 Passive Infrared (PIR) Occupancy Sensors

PIR occupancy sensors must have a multi-level, multi-segmented viewing lens and a conical field of view with a viewing angle of 180 degrees and a detection of at least 20 feet unless otherwise indicated or specified. PIR Sensors must provide field-adjustable background light-level adjustment with an adjustment range suitable to the light level in the sensed area, room or space. PIR sensors must be immune to false triggering from RFI and EMI.

2.7.12.2 Ultrasonic Occupancy Sensors

Ultrasonic sensors must operate at a minimum frequency 32 kHz and must be designed to not interfere with hearing aids.

2.7.12.3 Dual-Technology Occupancy Sensor (PIR and Ultrasonic)

Dual-Technology Occupancy Sensors must meet the requirements of both PIR and Ultrasonic Occupancy Sensors.

2.7.13 Vibration Switch

Vibration switch must be solid state, enclosed in a NEMA 250 Type 4 or Type 4X housing with sealed wire entry. Unit must have two independent sets of Form C switch contacts with one set to shutdown equipment upon excessive vibration and a second set for monitoring alarm level vibration. The vibration sensing range must be a true rms reading, suitable for the application. The unit must include either displacement response for low speed or velocity response for high speed application. The frequency range must be at least 3 Hz to 500 Hz. Contact time delay must be 3 seconds. The unit must have independent start-up and running delay on each switch contact. Alarm limits must be adjustable and setpoint accuracy must be plus or minus 10 percent of setting with repeatability of plus or minus 2 percent.

2.7.14 Conductivity Sensor

Sensor must include local indicating meter and must be suitable for measurement of conductivity of water in boilers, chilled water systems, condenser water systems, distillation systems, or potable water systems as indicated. Sensor must sense from 0 to 10 microSeimens per centimeter (µS/cm) for distillation systems, 0 to 100 µS/cm for boiler, chilled water, and potable water systems and 0 to 1000 µS/cm for condenser water systems. Contractor must field verify the ranges for particular applications and adjust the range as required. The output must be temperature compensated over a range of 32 to 212 degrees F. The accuracy must be plus or minus 2 percent of the full scale reading. Sensor must have automatic zeroing and must require no periodic maintenance or recalibration.

2.7.15 Compressed Air Dew Point Sensor

Sensor must be suitable for measurement of dew point from -40 +80 degrees F over a pressure range of 0 to 150 psig. The transmitter must provide

both dry bulb and dew point temperatures on separate outputs. The end to end accuracy of the dew point must be plus or minus 5 degrees F and the dry bulb must be plus or minus 1 degree F. Sensor must be automatic zeroing and must require no normal maintenance or periodic recalibration.

2.7.16 NOx Monitor

Monitor must continuously monitor and give local indication of boiler stack gas for NOx content. It must be a complete system designed to verify compliance with the Clean Air Act standards for NOx normalized to a 3 percent oxygen basis and must have a range of from 0 to 100 ppm. Sensor must be accurate to plus or minus 5 ppm. Sensor must output NOx and oxygen levels and binary output that changes state when the NOx level is above a locally adjustable NOx setpoint. Sensor must have normal, trouble and alarm lights. Sensor must have heat traced lines if the stack pickup is remote from the sensor. Sensor must be complete with automatic zero and span calibration using a timed calibration gas system, and must not require periodic maintenance or recalibration.

2.7.17 Turbidity Sensor

Sensor must include a local indicating meter and must be suitable for measurement of turbidity of water. Sensor must sense from 0 to 1000 Nephelometric Turbidity Units (NTU). Range must be field-verified for the particular application and adjusted as required. The output must be temperature compensated over a range of 32 to 212 degrees F. The accuracy must be plus or minus 5 percent of full scale reading. Sensor must have automatic zeroing and must not require periodic maintenance or recalibration.

2.7.18 Chlorine Detector

The detector must measure concentrations of chlorine in water in the range 0 to 20 ppm with a repeatability of plus or minus 1 percent of full scale and an accuracy of plus or minus 2 percent of full scale. The Chlorine Detector transmitter must be housed in a non-corrosive NEMA 250 Type 4X enclosure. Detector must include a local panel with adjustable alarm trip level, local audio and visual alarm with silence function.

2.7.19 Floor Mounted Leak Detector

Leak detectors must use electrodes mounted at slab level with a minimum built-in-vertical adjustment of 0.125 inches. Detector must have a binary output. The indicator must be manual reset type.

2.7.20 Temperature Switch

2.7.20.1 Duct Mount Temperature Low Limit Safety Switch (Freezestat)

Duct mount temperature low limit switches (Freezestats) must be manual reset, low temperature safety switches at least 1 foot long per square foot of coverage which must respond to the coldest 18 inch segment with an accuracy of plus or minus 3.6 degrees F. The switch must have a field-adjustable setpoint with a range of at least 30 to 50 degrees F. The switch must have two sets of contacts, and each contact must have a rating greater than its connected load. Contacts must open or close upon drop of temperature below setpoint as indicated and must remain in this state until reset.

2.7.20.2 Pipe Mount Temperature Limit Switch (Aquastat)

Pipe mount temperature limit switches (aquastats) must have a field adjustable setpoint between 60 and 90 degrees F, an accuracy of plus or minus 3.6 degrees F and a 10 degrees F fixed deadband. The switch must have two sets of contacts, and each contact must have a rating greater than its connected load. Contacts must open or close upon change of temperature above or below setpoint as indicated.

2.7.21 Damper End Switches

Each end switch must be a hermetically sealed switch with a trip lever and over-travel mechanism. The switch enclosure must be suitable for mounting on the duct exterior and must permit setting the position of the trip lever that actuates the switch. The trip lever must be aligned with the damper blade.

End switches integral to an electric damper actuator are allowed as long as at least one is adjustable over the travel of the actuator.

2.7.22 Air Quality Sensors

Provide full spectrum air quality sensors using a hot wire element based on the Taguchi principle. The sensor must monitor a wide range of gaseous volatile organic components common in indoor air contaminants like paint fumes, solvents, cigarette smoke, and vehicle exhaust. The sensor must automatically compensate for temperature and humidity, have span and calibration potentiometers, operate on 24 VDC power with output of 0-10 VDC, and have a service rating of 32 to 140 degrees F and 5 to 95 percent relative humidity.

2.8 INDICATING DEVICES

All indicating devices must display readings in English (inch-pound) units.

2.8.1 Thermometers

Provide bi-metal type thermometers at locations indicated. Thermometers must have either 9 inch long scales or 3.5 inch diameter dials, with insertion, immersion, or averaging elements. Provide matching thermowells for pipe-mounted installations. Select scale ranges suitable for the intended service, with the normal operating temperature near the scale's midpoint. The thermometer's accuracy must be plus or minus 2 percent of the scale range.

2.8.1.1 Piping System Thermometers

Piping system thermometers must have brass, malleable iron or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 9 inch scale. Piping system thermometers must have an accuracy of plus or minus 1 percent of scale range. Thermometers for piping systems must have rigid stems with straight, angular, or inclined pattern. Thermometer stems must have expansion heads as required to prevent breakage at extreme temperatures. On rigid-stem thermometers, the space between bulb and stem must be filled with a heat-transfer medium.

2.8.1.2 Air-Duct Thermometers

Air-duct thermometers must have perforated stem guards and 45-degree adjustable duct flanges with locking mechanism.

2.8.2 Pressure Gauges

Provide pipe-mounted pressure gauges at the locations indicated. Gauges must conform to ASME B40.100 and have a 4 inch diameter dial and shutoff cock. Select scale ranges suitable for the intended service, with the normal operating pressure near the scale's midpoint. The gauge's accuracy must be plus or minus 2 percent of the scale range.

Gauges must be suitable for field or panel mounting as required, must have black legend on white background, and must have a pointer traveling through a 270-degree arc. Gauge range must be suitable for the application with an upper end of the range not to exceed 150 percent of the design upper limit. Accuracy must be plus or minus 3 percent of scale range. Gauges must meet requirements of ASME B40.100.

2.8.3 Low Differential Pressure Gauges

Gauges for low differential pressure measurements must be a minimum of 3.5 inch (nominal) size with two sets of pressure taps, and must have a diaphragm-actuated pointer, white dial with black figures, and pointer zero adjustment. Gauge range must be suitable for the application with an upper end of the range not to exceed 150 percent of the design upper limit. Accuracy must be plus or minus two percent of scale range.

2.8.4 Pressure Gauges for Pneumatic Controls

Gauges must have a 0 to 30 psi scale with 1 psi graduations.

2.9 OUTPUT DEVICES

2.9.1 Actuators

Actuators must be electric (electronic) . All actuators must be normally open (NO), normally closed (NC) or fail-in-last-position (FILP) as indicated. Normally open and normally closed actuators must be of mechanical spring return type. Electric actuators must have an electronic cut off or other means to provide burnout protection if stalled. Actuators must have a visible position indicator. Actuators must smoothly and fully open or close the devices to which they are applied. Electric actuators must have a full stroke response time in both directions of 90 seconds or less at rated load. Electric actuators must be of the foot-mounted type with an oil-immersed gear train or the direct-coupled type. Where multiple electric actuators operate from a common signal, the actuators must provide an output signal identical to its input signal to the additional devices. All actuators must be rated for their operating environment. Actuators used outdoors must be designed and rated for outdoor use. Actuators under continuous exposure to water, such as those used in sumps, must be submersible.

Actuators incorporating an integral network connection are considered DDC Hardware and must meet the DDC Hardware requirements of Section .

2.9.1.1 Valve Actuators

Valve actuators must provide shutoff pressures and torques as indicated on the Valve Schedule.

2.9.1.2 Damper Actuators

Damper actuators must provide the torque necessary per damper manufacturer's instructions to modulate the dampers smoothly over its full range of operation and torque must be at least 6 inch-pounds/1 square foot of damper area for opposed blade dampers and 9 inch-pounds/1 square foot of damper area for parallel blade dampers.

2.9.1.3 Positive Positioners

Positive positioners must be a pneumatic relay with a mechanical position feedback mechanism and an adjustable operating range and starting point.

2.9.1.4 Electric Actuators

Each actuator must have distinct markings indicating the full-open and full-closed position Each actuator must deliver the torque required for continuous uniform motion and must have internal end switches to limit the travel, or be capable of withstanding continuous stalling without damage. Actuators must function properly within 85 to 110 percent of rated line voltage. Provide actuators with hardened steel running shafts and gears of steel or copper alloy. Fiber or reinforced nylon gears may be used for torques less than 16 inch-pounds..

a. Two-position actuators must be single direction, spring return, or reversing type. Two position actuator signals may either be the control power voltage or line voltage as needed for torque or appropriate interlock circuits.

b. Modulating actuators must be capable of stopping at any point in the cycle, and starting in either direction from any point. Actuators must be equipped with a switch for reversing direction, and a button to disengage the clutch to allow manual adjustments. Provide the actuator with a hand crank for manual adjustments, as applicable. Modulating actuator input signals can either be a 4 to 20 mAdc or a 0-10 VDC signal.

c. Floating or pulse width modulation actuators are acceptable for non-fail safe applications unless indicated otherwise provided that the floating point control (timed actuation) must have a scheduled re-calibration of span and position no more than once a day and no less than once a week. The schedule for the re-calibration should not affect occupied conditions and be staggered between equipment to prevent falsely loading or unloading central plant equipment.

2.9.1.5 Pneumatic Actuators

Provide piston or diaphragm type actuators with replaceable diaphragm/piston.

2.9.2 Solenoid-Operated Electric to Pneumatic Switch (EPS)

Solenoid-Operated Electric to Pneumatic Switches (EPS) must accept a voltage input to actuate its air valve. Each valve must have three-port

operation: common, normally open, and normally closed. Each valve must have an outer cast aluminum body and internal parts of brass, bronze, or stainless steel. The air connection must be a 0.38 inch NPT threaded connection. Valves must be rated for 50 psig.

2.9.3 Electric to Pneumatic Transducers (EP)

Electric to Pneumatic Transducers (EPs) must convert either a 4-20 mAdc input signal, a 0-10 Vdc input signal to a proportional 0 to 20 psig pneumatic output. The EP must withstand pressures at least 150 percent of the system supply air pressure (main air). EPs must include independent offset and span adjustment. Steady state air consumption must not be greater than 0.05 scfm. EPs must have a manual adjustable override for the EP pneumatic output. EPs must have sufficient output capacity to provide full range stroke of the actuated device in both directions within 90 seconds.

2.9.4 Relays

Relays must have contacts rated for the intended application, indicator light, and dust proof enclosure. The indicator light must be lit when the coil is energized and off when coil is not energized.

Control relay contacts must have utilization category and ratings selected for the application. Each set of contacts must incorporate a normally open (NO), normally closed (NC) and common contact. Relays must be rated for a minimum life of one million operations.

2.10 USER INPUT DEVICES

User Input Devices, including potentiometers, switches and momentary contact push-buttons. Potentiometers must be of the thumb wheel or sliding bar type. Momentary Contact Push-Buttons may include an adjustable timer for their output. User input devices must be labeled for their function.

2.11 MULTIFUNCTION DEVICES

Multifunction devices are products which combine the functions of multiple sensor, user input or output devices into a single product. Unless otherwise specified, the multifunction device must meet all requirements of each component device. Where the requirements for the component devices conflict, the multifunction device must meet the most stringent of the requirements.

2.11.1 Current Sensing Relay Command Switch

The Current Sensing Relay portion must meet all requirements of the Current Sensing Relay input device. The Command Switch portion must meet all requirements of the Relay output device except that it must have at least one normally-open (NO) contact.

Current Sensing Relays used for Variable Frequency Drives must be rated for Variable Frequency applications unless installed on the source side of the drive. If used in this situation, the threshold for showing status must be set to allow for the VFD's control power when the drive is not enabled and provide indication of operation when the drive is enabled at minimum speed.

2.11.2 Space Sensor Module

Space Sensor Modules must be multifunction devices incorporating a temperature sensor and one or more of the following as specified and indicated on the Space Sensor Module Schedule:

a. A temperature indicating device.

b. A User Input Device which must adjust a temperature setpoint output.

c. A User Input Momentary Contact Button and an output to the control system indicating zone occupancy.

d. A three position User Input Switch labeled to indicate heating, cooling and off positions ('HEAT-COOL-OFF' switch) and providing corresponding outputs to the control system.

e. A two position User Input Switch labeled with 'AUTO' and 'ON' positions and providing corresponding output to the control system..

f. A multi-position User Input Switch with 'OFF' and at least two fan speed positions and providing corresponding outputs to the control system.

Space Sensor Modules cannot contain mercury (Hg).

2.12 COMPRESSED AIR STATIONS

2.12.1 Air Compressor Assembly

Air compressors for pneumatic control systems must be the tank-mounted, electric motor driven, air cooled, reciprocating type with integral duplex motors and compressors, tank, controller, pressure switch, belt guard, pressure relief valve, automatic moisture drain valve and must be supported by a steel base mounted on an air storage tank. Compressor piston speeds must not exceed 450 fpm. Provide compressors with a dry-type combination intake air filter and silencer with baked enamel steel housing. The filter must be 99 percent efficient at 10 microns. The pressure switch must start the compressor at 70 psig and stop the compressor at 90 psig. The relief valve must be set for 10 to 25 psig above the control switch cut-off pressure. Provide compressor capacity suitable for not more than a 33 percent run time, at full system control load. Compressors must have a combination type magnetic starter with undervoltage protection and thermal-overload protection for each phase and must automatically restart after a power outage. Motors 0.5 hp and larger must be three-phase.

2.12.2 Compressed Air Station Specialties

2.12.2.1 Refrigerated Air Dryers

Provide each air compressor tank with a refrigerant air dryer sized for continuous operation at full delivery capacity of the compressor. The air must be dried at a pressure of not less than 70 psi to a temperature not greater than 35 degrees F and an ambient air temperature between 55 and 95 degrees F. The dryer must be provided with an automatic condensate drain trap with manual override feature with an adjustable cycle and drain time. Locate each dryer in the air piping between the tank and the pressure-reducing station. The refrigerant used in the dryer must be one

of the fluorocarbon gases and have an Ozone Depletion Potential of not more than 0.05. A five micron pre-filter and coalescing-type 0.03 micron oil removal filter with shut-off valves must be provided in the dryer discharge.

2.12.2.2 Compressed Air Discharge Filters

Provide a disposable type in-line filter in the incoming pneumatic main at each pneumatic control panel. The filter must be capable of eliminating 99.99 percent of all liquid or solid contaminants 0.1 micron or larger. Provide the filter with fittings that allow easy removal/replacement. Each filter bowl must be rated for 150 psi maximum working pressure. A pressure regulator, with high side and low side pressure gauges, and a safety valve must be provided downstream of the filter.

2.12.2.3 Air Pressure-Reducing Stations

Provide air compressors with a pressure-reducing valve (PRV) with a field adjustable range of 0 to 50 psig discharge pressure, at an inlet pressure of 70 to 90 psig. Provide a factory-set pressure relief valve downstream of the PRV to relieve over-pressure. Provide a pressure gage upstream of the PRV with range of 0 to 100 psig and downstream of the PRV with range of. For two-pressure control systems, provide an additional PRV and downstream pressure gage. Pressure regulators of the relieving type must not be used.

2.12.2.4 Flexible Pipe Connections

The flexible pipe connections must be designed for 150 psi and 250 degrees F service, and must be constructed of rubber or tetrafluoroethylene resin tubing with a reinforcing protective cover of braided corrosion-resistant steel, bronze, monel, or galvanized steel. The connectors must be suitable for the service intended and must have threaded or soldered ends. The length of the connectors must be as recommended by the manufacturer for the service intended.

2.12.2.5 Vibration Isolation Units

The vibration isolation units must be standard products with published loading ratings, and must be single rubber-in-shear, double rubber-in-shear, or spring type.

2.12.3 Compressed Air Tanks

The air storage tank must be fabricated for a working pressure of not less than 200 psi and constructed and certified in accordance with ASME BPVC SEC VIII D1. The tank must be of sufficient volume so that no more than six compressor starts per hour are required with the starting pressure switch differential set at 20 psi. The tank must be provided with an automatic condensate drain trap with manual override feature. Provide drain valve and piping routing the drainage to a floor sink or other safe and visible drainage location.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General Installation Requirements

Perform the installation under the supervision of competent technicians

regularly employed in the installation of DDC systems.

3.1.1.1 Device Mounting Criteria

All devices must be installed in accordance with manufacturer's recommendations and as specified and indicated. Control devices to be installed in piping and ductwork must be provided with required gaskets, flanges, thermal compounds, insulation, piping, fittings, and manual valves for shutoff, equalization, purging, and calibration. Strap-on temperature sensing elements must not be used except as specified. Spare thermowells must be installed adjacent to each thermowell containing a sensor and as indicated. Devices located outdoors must have a weathershield.

3.1.1.2 Labels and Tags

Match labels and tags to the unique identifiers indicated on the As-Built drawings. Label all enclosures and instrumentation. Tag all sensors and actuators in mechanical rooms. Tag airflow measurement arrays to show flow rate range for signal output range, duct size, and pitot tube AFMA flow coefficient. Tag duct static pressure taps at the location of the pressure tap. Provide plastic or metal tags, mechanically attached directly to each device or attached by a metal chain or wire. Labels exterior to protective enclosures must be engraved plastic and mechanically attached to the enclosure or instrumentation. Labels inside protective enclosures may attached using adhesive, but must not be hand written.

3.1.2 Weathershield

Provide weathershields for sensors located outdoors. Install weathershields such that they prevent the sun from directly striking the sensor and prevent rain from directly striking or dripping onto the sensor. Install weather shields with adequate ventilation so that the sensing element responds to the ambient conditions of the surroundings. When installing weathershields near outside air intake ducts, install them such that normal outside air flow does not cause rainwater to strike the sensor.

3.1.3 Room Instrument Mounting

Mount room instruments, including but not limited to wall mounted non-adjustable space sensor modules and sensors located in occupied spaces, 60 inches above the floor unless otherwise indicated. Install adjustable devices to be ADA compliant unless otherwise indicated on the Room Sensor Schedule:

a. Space Sensor Modules for Fan Coil Units may be either unit or wall mounted but not mounted on an exterior wall.

b. Wall mount all other Space Sensor Modules.

3.1.4 Indication Devices Installed in Piping and Liquid Systems

Provide snubbers for gauges in piping systems subject to pulsation. For gauges for steam service use pigtail fittings with cock. Install thermometers and temperature sensing elements in liquid systems in thermowells. Provide spare Pressure/Temperature Ports (Pete's Plug) for all temperature and pressure sensing elements installed in liquid systems

for calibration/testing.

3.1.5 Occupancy Sensors

Provide a sufficient quantity of occupancy sensors to provide complete coverage of the area (room or space). Occupancy sensors are to be ceiling mounted. Install occupancy sensors in accordance with NFPA 70 requirements and the manufacturer's instructions. Do not locate occupancy sensors within 6 feet of HVAC outlets or heating ducts, or where they can "see" beyond any doorway. Installation above doorway(s) is preferred. Do not use ultrasonic sensors in spaces containing ceiling fans. Install sensors to detect motion to within 2 feet of all room entrances and to not trigger due to motion outside the room. Set the off-delay timer to 15 minutes unless otherwise indicated. Adjust sensors prior to beneficial occupancy, but after installation of furniture systems, shelving, partitions, etc. For each controlled area, provide one hundred percent coverage capable of detecting small hand-motion movements, accommodating all occupancy habits of single or multiple occupants at any location within the controlled room.

3.1.6 Switches

3.1.6.1 Temperature Limit Switch

Provide a temperature limit switch (freezestat) to sense the temperature at the location indicated. Provide a sufficient number of temperature limit switches (freezestats) to provide complete coverage of the duct section but no less than 1 foot in length per square foot of cross sectional area. Install manual reset limit switches in approved, accessible locations where they can be reset easily. Install temperature limit switch (freezestat) sensing elements in a side-to-side (not top-to-bottom) serpentine pattern with the relay section at the highest point and in accordance with the manufacturer's installation instructions.

3.1.6.2 Hand-Off Auto Switches

Wire safety controls such as smoke detectors and freeze protection thermostats to protect the equipment during both hand and auto operation.

3.1.7 Temperature Sensors

Install temperature sensors in locations that are accessible and provide a good representation of sensed media. Installations in dead spaces are not acceptable. Calibrate and install sensors according to manufacturer’s instructions. Select sensors only for intended application as designated or recommended by manufacturer.

3.1.7.1 Room Temperature Sensors

Mount the sensors on interior walls to sense the average room temperature at the locations indicated. Avoid locations near heat sources such as copy machines or locations by supply air outlet drafts. Mount the center of all user-adjustable sensors 5 feet above the finished floor. Non user-adjustable sensors can be mounted as indicated in paragraph ROOM INSTRUMENT MOUNTING.

3.1.7.2 Duct Temperature Sensors

3.1.7.2.1 Probe Type

Place tip of the sensor in the middle of the airstream or in accordance with manufacturer's recommendations or instructions.Provide a gasket between the sensor housing and the duct wall. Seal the duct penetration air tight. When installed in insulated duct, provide enclosure or stand off fitting to accommodate the thickness of duct insulation to allow for maintenance or replacement of the sensor and wiring terminations. Seal the duct insulation penetration vapor tight.

3.1.7.2.2 Averaging Type

Weave the sensing element in a serpentine fashion from side to side perpendicular to the flow, across the duct or air handler cross-section, using durable non-metal supports in accordance with manufacturer's installation instructions. Avoid tight radius bends or kinking of the sensing element. Prevent contact between the sensing element and the duct or air handler internals. Provide a duct access door at the sensor location. The access door must be hinged on the side, factory insulated, have cam type locks, and be as large as the duct will permit, maximum 18 by 18 inches. For sensors inside air handlers, the sensors must be fully accessible through the air handler's access doors without removing any of the air handler's internals.

3.1.7.3 Immersion Temperature Sensors

Provide thermowells for sensors measuring piping, tank, or pressure vessel temperatures. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. When installed on insulated piping, provide stand enclosure or stand off fitting to accommodate the thickness of the pipe insulation and allow for maintenance or replacement of the sensor or wiring terminations. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to sense flow across entire area of well. Wells must not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide the sensor well with a heat-sensitive transfer agent between the sensor and the well interior ensuring contact between the sensor and the well.

3.1.7.4 Outside Air Temperature Sensors

Provide outside air temperature sensors on the building's north side with a protective weather shade that does not inhibit free air flow across the sensing element, and protects the sensor from snow, ice, and rain. Location must not be near exhaust hoods and other areas such that it is not influenced by radiation or convection sources which may affect the reading. Provide a shield to shade the sensor from direct sunlight.

3.1.8 Air Flow Measurement Arrays (AFMA)

Locate Outside Air AFMAs downstream from the Outside Air filters.

Install AFMAs with the manufacturer's recommended minimum distances between upstream and downstream disturbances. Airflow straighteners may be used to reduce minimum distances as recommended by the AFMA manufacturer.

3.1.9 Duct Static Pressure Sensors

Locate the duct static pressure sensing tap at 75 percent of the distance between the first and last air terminal units . If the transmitter output is a 0-10Vdc signal, locate the transmitter in the same enclosure as the air handling unit (AHU) controller for the AHU serving the terminal units. If a remote duct static pressure sensor is to be used, run the signal wire back to the controller for the air handling unit.

3.1.10 Relative Humidity Sensors

Install relative humidity sensors in supply air ducts at least 10 feet downstream of humidity injection elements.

3.1.11 Meters

3.1.11.1 Flowmeters

Install flowmeters to ensure minimum straight unobstructed piping for at least 10 pipe diameters upstream and at least 5 pipe diameters downstream of the flowmeter, and in accordance with the manufacturer's installation instructions.

3.1.11.2 Energy Meters

Locate energy meters as indicated. Connect each meter output to the DDC system, to measure both instantaneous demand/energy and other variables as indicated.

3.1.12 Dampers

3.1.12.1 Damper Actuators

Provide spring return actuators which fail to a position that protects the served equipment and space on all control dampers related to freeze protection or force protection. For all outside, makeup and relief dampers provide dampers which fail closed. Terminal fan coil units, terminal VAV units, convectors, and unit heaters nay be non-spring return unless indicated otherwise. Do not mount actuators in the air stream. Do not connect multiple actuators to a common drive shaft. Install actuators so that their action seal the damper to the extent required to maintain leakage at or below the specified rate and so that they move the blades smoothly throughout the full range of motion.

3.1.12.2 Damper Installation

Install dampers straight and true, level in all planes, and square in all dimensions. Dampers must move freely without undue stress due to twisting, racking (parallelogramming), bowing, or other installation error. External linkages must operate smoothly over the entire range of motion, without deformation or slipping of any connecting rods, joints or brackets that will prevent a return to it's normal position. Blades must close completely and leakage must not exceed that specified at the rated static pressure. Provide structural support for multi-section dampers. Acceptable methods of structural support include but are not limited to U-channel, angle iron, corner angles and bolts, bent galvanized steel stiffeners, sleeve attachments, braces, and building structure. Where multi-section dampers are installed in ducts or sleeves, they must not sag due to lack of support. Do not use jackshafts to link more than three

damper sections. Do not use blade to blade linkages. Install outside and return air dampers such that their blades direct their respective air streams towards each other to provide for maximum mixing of air streams.

3.1.13 Valves

Install the valves in accordance with the manufacturer's instructions.

3.1.13.1 Valve Actuators

Provide spring return actuators on all control valves where freeze protection is required. Spring return actuators for terminal fan coil units, terminal VAV units, convectors, and unit heaters are not required unless indicated otherwise.

3.1.14 Thermometers and Gauges

3.1.14.1 Local Gauges for Actuators

Provide a pressure gauge at each pneumatic control input and output. Pneumatic actuators must have an accessible and visible pressure gauge installed in the tubing lines at the actuator as indicated.

3.1.14.2 Thermometers

Mount devices to allow reading while standing on the floor or ground, as applicable.

3.1.15 Wire and Cable

Provide complete electrical wiring for the Control System, including wiring to transformer primaries. Wire and Cable must be installed without splices between control devices and in accordance with NFPA 70 and NFPA 90A. Instrumentation grounding must be installed per the device manufacturer's instructions and as necessary to prevent ground loops, noise, and surges from adversely affecting operation of the system. Test installed ground rods as specified in IEEE 142. Cables and conductor wires must be tagged at both ends, with the identifier indicated on the shop drawings. Electrical work must be as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM and as indicated. Wiring external to enclosures must be run in raceways

Install control circuit wiring not in raceways in a neat and safe manner. Wiring must not use the suspended ceiling system (including tiles, frames or hangers) for support. Where conduit or raceways are required, control circuit wiring must not run in the same conduit/raceway as power wiring over 50 volts. Run all circuits over 50 volts in conduit, metallic tubing, covered metal raceways, or armored cable.

3.1.16 Copper Tubing

Provide hard-drawn copper tubing in exposed areas and either hard-drawn or annealed copper tubing in concealed areas. Use only tool-made bends. Use only brass or copper solder joint type fittings, except for connections to apparatus. For connections to apparatus use brass compression type fittings.

3.1.17 Plastic Tubing

Install plastic tubing within covered raceways or conduit except when otherwise specified. Do not use plastic tubing for applications where the tubing could be subjected to a temperature exceeding 130 degrees F. For fittings, use brass or acetal resin of the compression or barbed push-on type for instrument service. Except in walls and exposed locations, plastic multitube instrument tubing bundle without conduit or raceway protection may be used where a number of air lines run to the same points, provided the multitube bundle is enclosed in a protective sheath, is run parallel to the building lines and is adequately supported as specified.

3.1.18 Pneumatic Lines

Run tubing concealed in finished areas, run tubing exposed in unfinished areas like mechanical rooms. For tubing enclosed in concrete, provide rigid metal conduit. Run tubing parallel and perpendicular to building walls. Use 5 foot maximum spacing between tubing supports. With the compressor turned off, test each tubing system pneumatically at 1.5 times the working pressure and prove it air tight, locating and correcting leaks as applicable. Caulking joints is not permitted. Do not run tubing and electrical power conductors in the same conduit.

a. Install pneumatic lines must such that they are not exposed to outside air temperatures. Conceal pneumatic lines except in mechanical rooms and other areas where other tubing and piping is exposed.

b. Install all tubes and tube bundles exposed to view in lines parallel to the lines of the building. Route tubing in mechanical/electrical so that the lines are easily traceable.

c. Purge air lines of dirt, impurities and moisture before connecting to the control equipment. Number-code or color-code air lines and key the coding in the As-Built Drawings for future identification and servicing the control system.

3.1.18.1 Pneumatic Lines In Mechanical/Electrical Spaces

In mechanical/electrical spaces, use plastic or copper tubing for pneumatic lines. Install horizontal and vertical runs of plastic tubing or soft copper tubing min raceways or rigid conduit dedicated to tubing. Support dedicated raceways, conduit, and hard copper tubing not installed in raceways every 6 feet for horizontal runs and every 8 feet for vertical runs.

3.1.18.2 Pneumatic Lines External to Mechanical/Electrical Spaces

External to mechanical/electrical spaces, use plastic tubing in raceways not containing power wiring or copper tubing with sweat fittings. Support raceways and tubing not in raceways every 8 feet. For pneumatic lines concealed in walls use hard-drawn copper tubing or plastic tubing in rigid conduit. Plastic tubing in a protective sheath, run parallel to the building lines and supported as specified, may be used above accessible ceilings and in other concealed but accessible locations.

3.1.18.3 Terminal Single Lines

For terminal single lines use hard-drawn copper tubing, except when the run is less than 12 inches in length, flexible polyethylene may be used.

3.1.18.4 Connection to Liquid and Steam Lines

Use copper with brass compression fittings for connection of sensing elements and transmitters to liquid and steam lines.

3.1.18.5 Connection to Ductwork

Use plastic tubing for connections to sensing elements in ductwork.

3.1.18.6 Tubing in Concrete

Install tubing in concrete in rigid conduit. Install tubing in walls containing insulation, fill, or other packing materials in raceways dedicated to tubing.

3.1.18.7 Tubing Connection to Actuators

For final connections to actuators use plastic tubing no more than 12 inches long and unsupported at the actuator.

3.1.19 Compressed Air Stations

Mount the air compressor assembly on vibration eliminators, in accordance with ASME BPVC SEC VIII D1 for tank clearance. Connect the air line to the tank with a flexible pipe connector. Provide compressed air station specialties with required tubing, including condensate tubing to a floor drain. Compressed air stations must deliver control air meeting the requirements of ISA 7.0.01. Provide foundations and housekeeping pads for the HVAC control system air compressors in accordance with the air compressor manufacturer's instructions.

-- End of Section --

SECTION 23 21 23

HYDRONIC PUMPS
08/17

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 OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 189.1	(2014) Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.1	(2003; R 2018) Unified Inch Screw Threads (UN and UNR Thread Form)
ASME B4.1	(1967; R 1994; R 2004; R 2009; R 2020) Preferred Limits and Fits for Cylindrical Parts
ASME B16.1	(2020) Gray Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA E103	(2015) Horizontal and Vertical Line-Shaft Pumps

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M	(2003; R 2016) Standard Specification for Gray Iron Castings
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A159	(1983; R 2020) Standard Specification for Automotive Gray Iron Castings
ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength

ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM A582/A582M	(2012; R 2017) Standard Specification for Free-Machining Stainless Steel Bars
ASTM B584	(2014) Standard Specification for Copper Alloy Sand Castings for General Applications

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.2	(2014) Rotodynamic (Centrifugal) Pump for Nomenclature and Definitions
HI 1.3	(2013) Rotodynamic (Centrifugal) Pump Applications
HI 9.6.4	(2009) Rotodynamic Pumps for Vibration Analysis and Allowable Values
HI ANSI/HI 2.1-2.2	(2014) Rotodynamic Vertical Pumps of Radial, Mixed, and Axial Flow Types for Nomenclature and Definitions
HI ANSI/HI 9.6.3	(2017) Rotodynamic Pumps - Guideline for Operating Regions - B120
HI ANSI/HI 14.6	(2011) Rotodynamic Pumps for Hydraulic Performance Acceptance Tests - A136

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators
NEMA Z535.4	(2011; R 2017) Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

NSF INTERNATIONAL (NSF)

NSF 372	(2016) Drinking Water System Components - Lead Content

SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 21	(1982; E 2004) White or Colored Silicone Alkyd Paint (Type I, High Gloss and Type II, Medium Gloss)
SSPC Paint 25	(1997; E 2004) Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel, Type I and Type II

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

29 CFR 1910.219 Mechanical Power Transmission Apparatus

UNDERWRITERS LABORATORIES (UL)

UL 778 (2016; Reprint Jun 2020) UL Standard for Safety Motor-Operated Water Pumps

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control Approval. When used, a code following the "G" classification 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

System Coordination; G AE

SD-03 Product Data

Instructions; G AE

Equipment Data; G AE

Training Period; G AE

SD-06 Test Reports

Factory Tests

Field Quality Control

SD-07 Certificates

Manufacturer's Representative

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G AE

Training; G AE

1.3 QUALITY ASSURANCE

1.3.1 Manufacturer Services

Provide the services of a manufacturer's representative experienced in the installation, adjustment, and operation of the equipment specified. The representative must supervise the installation, adjustment, testing of the equipment, and conduct training.

Submit the names and qualifications of the manufacturer's representative and training engineers and written certification from the manufacturer that the representative and trainers are technically qualified.

1.3.2 Standard Products

Provide material and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate equipment that has been in satisfactory HVAC operation at least 2 years prior to issuance of this solicitation. Support equipment with a service organization that is reasonably convenient to the jobsite. Pumps of the same types must each be the product of one manufacturer.

1.3.3 Conformance with Agency Requirements

Where materials or equipment are specified to be an approved type, attach the seal or label of approval from a nationally recognized testing agency, adequately equipped and competent to perform such services. A written certificate from the testing agency must accompany the materials or equipment and be submitted stating that the items have been tested and that they conform to the applicable requirements of the specifications and to the standards listed herein. The certificate must indicate the methods of testing used by the testing agency. In lieu of a certificate from a testing agency, published catalog specification data, accompanied by the manufacturer's certified statement to the effect that the items are in accordance with the applicable requirements of the specifications and the referenced standards, will be considered and may be acceptable as evidence that the items conform with agency requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect equipment, delivered and designated for storage, from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Hydronic pumps used for heating and air conditioning applications are defined by the type of impeller, number of impellers, type of casing, method of connection to the driver, and mounting position. Provide centrifugal water pumps of the types indicated and specified. Use an electric motor driving unit for each pump as indicated and specified.

2.1.1 Selection Criteria

Select pumps at a point within the maximum efficiency for a given impeller casing combination. Deviations within 3 percent of maximum efficiency are permissible, provided the lesser efficiency is not less than the scheduled efficiency in the construction design documents. Pumps having impeller diameters larger or smaller than manufacturer's published maximum and minimum impeller diameters for a given impeller casing combination will be rejected. Pump performance data, as shown in performance curves, must be based on factory tests using precision instrumentation and exacting procedures as detailed in HI ANSI/HI 14.6.

2.1.2 System Coordination

Submit drawings containing complete wiring and piping schematic diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Show the proposed layout and anchorage of equipment and appurtenances, and equipment

relationship to other parts of the work including clearances for maintenance and operation. Provide a complete listing of equipment, materials and miscellaneous components including mechanical seals, bearings, and couplings.

2.1.3 Safety Requirements

Fully enclose or guard couplings, projecting set-screws, keys, and other rotating parts, that pose an entangling hazards..

2.2 MATERIALS AND EQUIPMENT

2.2.1 Nameplates

Securely affix a standard nameplate to pumps and motors in a conspicuous place showing the manufacturer's name, address, type or style, model, serial number, and catalog number. In addition, for each pump show the capacity in gpm at rated speed in rpm and total head in feet of water. For each electric motor show at least the minimum information required by NEMA MG 1. Show such other information as the manufacturer may consider necessary to complete identification on the nameplate. Pumps must be listed and labeled by UL, and comply with UL 778 for pumps not using universal motors rated more than 250 volts such as circulating pumps.

2.2.2 Framed Instructions

Submit proposed diagrams, instructions, and other sheets, prior to posting. Post approved wiring and control diagrams showing the complete layout of the entire system, including equipment, piping valves, and control sequence, framed under glass or in approved laminated plastic, where directed. Provide 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, framed as specified above for the wiring and control diagrams, and posted beside the diagrams. Post the framed instructions before acceptance testing of the systems.

2.2.3 Pump Characteristic

Construct hydronic water pumps in accordance with HI 1.1-1.2 and HI ANSI/HI 2.1-2.2. The pumps must be capable of discharging quantities at total discharge heads measured at the discharge flange, between the following limits:

Operate pumps at optimum efficiencies to produce the most economical pumping system under the conditions encountered and size to make optimum match with the system head curve as shown. Pumps must furnish not less than 150 percent of rated capacity at a total discharge head of not less than 65 percent of total rated head. Operate pumps at specified system fluid temperatures without vapor binding and cavitation. Operate pumps to HI ANSI/HI 9.6.3 standard for Preferred Operationg Region (POR).

2.2.4 Pump Drivers

Provide electric motors as indicated for each pump and in compliance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM .

2.2.5 Equipment Data

Submit manufacturer's descriptive data and technical literature, performance charts and curves for all impeller sizes for a given casing, catalog cuts, and installation instructions. Provide spare parts data for each different item of material and equipment specified, after approval of the detail drawings and not later than months prior to the date of beneficial occupancy. Include a complete list of parts and supplies, with current unit prices and local source of supply with contact information.

Submit catalog information, certified pumps curves, rated capacities, final impeller dimensions, and accessories provided for the product indicated. Indicate operating point of each pump on curves. Furnish pump curves for each pump and combination of pumps designed to operate in parallel. The pump curve must show as a minimum; bhp, flow, total dynamic head, efficiency, NPSH, impeller diameter and system curve (individually and in combination for each pump operating in a parallel application). Select pumps operating in parallel operation to cross the system curve when operating individually.

2.3 HYDRONIC PUMPS

Provide centrifugal, single-stage type, designed for HVAC service in the following configurations:

Configuration	Pump No.
Circulator	
Small In-Line	
Large In-Line	
Base-Mounted, Flexible Coupled, End Suction	
Base-Mounted, Close Coupled, End Suction	
Base-Mounted, Flexible Coupled, Double Suction, Horizontally and Vertically Split	
Vertical Lineshaft Turbine	
Automatic Cooling Coil Condensate Pump Units	

2.3.1 Circulator

Provide pumps with capacities as indicated of a horizontal, wet rotor circulator type specifically designed for quiet operation. Suitable for 225 degrees F operation at 125 psig working pressure. The pump must be single stage with flanged piping connections. The pump internals must be capable of being serviced without disturbing piping connections.

a. The three piece pump must be composed of three separable components a

motor, bearing assembly, and cast iron

b. Wet rotor circulator for potable water service must be lead content certified in accordance with NSF 372.

2.3.1.1 Seal Assembly

Pump must be equipped with an internally flushed mechanical seal assembly. Seal assembly must have a brass housing, Buna bellows and seat gasket, stainless steel spring, and be of a carbon ceramic design with the carbon face rotating against a stationary ceramic face.

2.3.1.2 Motor Mount

To ensure alignment, mount the motor to the bearing assembly via a bolted motor bracket assembly. Use a replaceable resilient rubber motor mount to assist in aligning the motor shaft with the pump shaft.

2.3.1.3 Motors

Motors must meet scheduled horsepower, speed, voltage, and enclosure design. Motors must be drip proof, maintenance free, premium efficiency and meet NEMA MG 1 specifications.

Pump must be driven by an electrically commutated electrical motor (ECM) with permanent magnet rotor. The rotor magnets must be time stable, non-toxic ceramic magnets. Drive the electrically commuted electrical motor by a frequency converter with an integrated PFC filter.

2.3.2 Small In-Line

Provide pumps with capacities as indicated,suitable for 225 degrees F operation at 175 psig working pressure. The pump must be single stage, in-line design, in cast iron bronze fitted construction. The pump internals must be capable of being serviced without disturbing piping connections.

2.3.2.1 Pump Shaft

The pump must have a solid steel shaft with a coupler between the pump and motor shafts. For non-stainless steel shafts, employ a non-ferrous shaft sleeve to completely cover the wetted area under the seal.

2.3.2.2 Bearing

The bearing assembly must house maintenance-free permanently lubricated bearings.

2.3.2.3 Seal Assembly

Equip the pump with an internal self-flushing mechanical seal assembly. Seal assembly must have Buna bellows and seat gasket, stainless steel spring, and be of a carbon ceramic design with the carbon face rotating against a stationary ceramic face.

2.3.2.4 Impeller

Provide impeller of cast bronze or brass material. Impeller must be hydraulically and dynamically balanced to HI 9.6.4 balance grade G6.3,

keyed to the shaft and secured by a locking capscrew or nut.

2.3.2.5 Volute

Pump volute must be of cast iron. The connection style on cast iron pumps must be flanged.

2.3.2.6 Motor Mount

To ensure alignment, mount the motor to the bearing assembly via a bolted motor bracket assembly. Use a replaceable resilient rubber motor mount to assist in aligning the motor shaft with the pump shaft.

2.3.2.7 Motors

NEMA MG 1; premium efficiency; non-overloading at any point on the pump curve; maintenance free with permanently lubricated bearings; and resilient mounted for smaller sizes, rigid mounted otherwise.

2.3.3 Large In-Line

Provide pumps with capacities as indicated; split-coupled , in-line, single stage, for installation in position, and. suitable for 225 degrees F operation at 175 psig working pressure. The pump internals must be capable of being serviced without disturbing piping connections.

2.3.3.1 Casing

Provide pump casing complying with ASTM A48/A48M Class 30 cast iron, suitable for 175 psig working pressure with integral cast iron flanges drilled for ASME B16.1 ANSI Class 125 .

2.3.3.2 Pump Shaft

Provide carbon or stainless steel pump shaft, guided by a carbon graphite lower throttle bushing. Carbon steel pump shaft must have a bronze shaft sleeve that completely covers the wetted area under the seal.

2.3.3.3 Seal Assembly

Equip the pump with a mechanical seal assembly consisting of a carbon seal rotating ring, stainless steel spring, ceramic seat and flexible bellows and gasket. The liquid cavity must have a tapped flush line with manual valve to remove air from the seal chamber to allow fast initial start-up and insure mechanical seal cooling.

2.3.3.4 Spacer Coupling

The axially split spacer coupling must be of high tensile aluminum, split to allow the servicing of the seal without disturbing the pump or motor. Pump coupler must be aligned by the manufacturer before shipment. The motor bracket must contain a carbon steel coupler guard conforming to 29 CFR 1910.219 standards for safety.

2.3.3.5 Impeller

Hydraulically and dynamically balance the impeller to HI 9.6.4 balance grade G6.3, closed, single suction, fabricated from cast bronze, keyed to the shaft and secured by a locking capscrew.

2.3.3.6 Motor

Electric motors must meet NEMA MG 1 and the horsepower, speed, voltage, indicated. Motor enclosure must be open drip proof, with heavy duty grease lubricated ball bearings completely adequate for the maximum load for which the motor is designed. Motor must be non-overloading at any point on the pump curve and premium efficiency. Provide open drip proof motor efficiencies as shown in ASHRAE 189.1. Totally enclosed fan cooled motor efficiencies must be as shown in NEMA MG 1.

Include one-piece combination motor bracket and volute coverplate in the assembly to ensure concentric alignment of the motor to the pump casing.

2.3.4 Base-Mounted, Flexible Coupled, End suction

Provide pumps with capacities as indicated; base mounted, separately-coupled, end suction designed with volute housing mounted to the frame to allow for pump service without relocating the motor or disturbing piping connections. Bearings and seals must be serviceable without disturbing piping. Pump must be factory hydrostatically tested in accordance with Hydraulic Institute standards and thoroughly cleaned.

2.3.4.1 Casing

Provide radially split pump casing ASTM A48/A48M Class 30 cast iron suitable for 175 psig working pressure with integral cast iron flanges drilled for ASME B16.1 ANSI Class 125 flanges, with an integrally-cast pedestal support foot. The pump volute must include gauge tappings at suction and discharge nozzles along with vent and drain tappings at top and bottom.

2.3.4.2 Pump Shaft

Carbon steel pump shaft with a replaceable bronze shaft sleeve completely covering the wetted area of the shaft under the seal.

2.3.4.3 Bearing

Incorporate maintenance free, permanently lubricated and sealed bearings in the pump bearing frame.

2.3.4.4 Seal Assembly

Equip with an integrally flushed mechanical seal assembly or a positive pressure external seal flushing line. Provide a mechanical seal with ceramic seal seat and carbon seal ring. Seal assembly must be rated up to 225 degrees F.

2.3.4.5 Baseplate

Baseplate must be of steel construction fully enclosed at sides and ends with welded cross members and fully open grouting area for field grouting. Minimum base plate stiffness must conform to HI 1.3 for horizontal baseplate design standards.

2.3.4.6 Coupler

Provide a flexible-type coupler between the pump and motor, capable of

absorbing torsional vibration and variable speed operation between the pump and motor. The coupler must allow replacement with no need to move the hubs. Coupler must have natural rubber or neoprene type element materials with a maximum misalignment capability of 4 degrees angular and 0.125 inches parallel. Provide donut shaped elastomer element with preassembled flanges mechanically clamped to reinforced element and preassembled spacer center assembly. Secure flexible donut shaped element of coupler in place with radial clamp ring screws. Couplers must be rated for required maximum rpm, horsepower and torque. The coupler must be shielded by a coupler guard securely fastened to the base. Provide coupler guard in compliance with current national safety standards including 29 CFR 1910.219 and NEMA Z535.4. Guards cannot have gaps greater than 0.250 inches, must be safety orange in color, and have an NEMA Z535.4 compliant warning label.

2.3.4.7 Impeller

Hydraulically and dynamically balance to HI 9.6.4 balance grade G6.3, closed, overhung, single suction, fabricate from cast bronze, key to shaft and secured by a locking capscrew.

2.3.4.8 Motor

Electric Motors must meet NEMA MG 1 and be the horsepower, speed, and voltage indicated. Motor enclosure must be open drip proof . Motor must have heavy duty grease lubricated ball bearings completely adequate for the maximum load for which the motor is designed. Motor must be non-overloading at any point on the pump curve and premium efficiency. Open drip proof motor efficiencies must comply with ASHRAE 189.1.

2.3.5 Base-Mounted, Close Coupled, End Suction

Provide pumps with capacities as indicated. Pump must be base mounted, close coupled, single stage, end suction design capable of being serviced without disturbing piping connections.

2.3.5.1 Casing

Provide pump volute of Class 30 cast iron suitable for 175 psig working pressure. Include vent, drain and gauge tappings.

2.3.5.2 Seal Assembly

Seal off the liquid cavity at the motor shaft by an internally flushed mechanical seal or a positive pressure external seal flushing line with ceramic seal seat and carbon seal ring, suitable for continuous operation at 225 degrees F. A replaceable shaft sleeve of bronze alloy must completely cover the wetted area under the seal.

2.3.5.3 Impeller

Provide cast bronze or 304 stainless steel impeller, enclosed type, hydraulically and dynamically balanced to HI 9.6.4 balance grade G6.3, keyed to shaft and secured by a locking capscrew.

2.3.5.4 Motor

Electric Motors must comply with NEMA MG 1 and be the horsepower, and voltage indicated. Motor enclosure must be open drip proof . provide with heavy duty grease lubricated ball bearings completely adequate for

the maximum load for which the motor and pump impeller is designed. Motor must be non-overloading at any point on the pump curve and premium efficiency. Provide open drip proof motor efficiencies in compliance with ASHRAE 189.1. Totally enclosed fan cooled motor efficiencies must be as shown in NEMA MG 1.

2.3.6 Base-Mounted, Flexible Coupled, Double Suction

Provide pumps with capacities as indicated; base mounted, flexible coupled, double-suction, horizontal and vertical split case design, single stage centrifugal pump. Construction must be cast iron - bronze fitted, equipped with mechanical seals. Bearings and seals must be serviceable without disturbing piping or motor. Factory hydrostatically test the pump in accordance with Hydraulic Institute standards and thoroughly clean.

2.3.6.1 Casing

Provide ASTM A48/A48M Class 30 or ASTM A159 cast iron pump casing, suitable for 175 psig working pressure, with integral cast iron flanges drilled for ASME B16.1 ANSI Class 125 flanges. Supply the pump volute with plugged vent, drain, and gauge tappings.

2.3.6.2 Bearings

Incorporate maintenance free, permanently lubricated and sealed bearings with an L10 life of 60,000 hours minimum in the pump bearing frame.

Incorporate regreasable ball bearing type pump bearing frame with provision for purging or flushing through the bearing surface and greased while running after start-up.

2.3.6.3 Seal Assembly

Seal off liquid cavity by an internally-flushed seal assembly. Seal assembly must have a brass housing, Buna bellows and seat gasket, stainless steel spring, and be of a carbon face rotating against a stationary silicon carbide seat. Provide replaceable mechanical seals without disturbing the upper casing half and system piping. Seals must be suitable for continuous operation at 225 degrees F. Arrange to assure that seal leakage cannot enter the bearing housings.

2.3.6.4 Coupler

Provide a flexible-type coupler between the pump and motor capable of absorbing torsional vibration and variable speed operation. The coupler must allow replacement with no need to move the hubs. Coupler must have natural rubber or neoprene type element materials with a maximum misalignment capability of 4 degrees angular and 0.125 inches parallel. Provide donut shaped elastomer element and with preassembled flanges mechanically clamped to reinforced element and preassembled spacer center assembly. Secure flexible donut shaped element of coupler in place with radial clamp ring screws. Couplers must be rated for required maximum rpm, horsepower and torque. Shield the coupler by a coupler guard securely fastened to the base. Coupler guard must comply with current national safety standards including 29 CFR 1910.219, and NEMA Z535.4. Provide guards with gaps no greater than 0.250 inches, of safety orange in color, and have an NEMA Z535.4 compliant warning label.

2.3.6.5 Base Plate

Provide baseplate of steel construction fully enclosed at sides and ends with welded cross members and fully open grouting area for field grouting. Minimum base plate stiffness must conform to HI 1.3 for horizontal baseplate design standards.

2.3.6.6 Impeller

Bronze or brass enclosed double suction type, both hydraulically and dynamically balanced to HI 9.6.4 grade G6.3, keyed to shaft and fixed in an axial position. Hub must have sufficient metal thickness to allow machining for installation of impeller rings.

2.3.6.7 Motor

Provide electric motor conforming to NEMA MG 1 and of the horsepower, and voltage indicated. Motor enclosure must be open drip proof ; with heavy duty grease lubricated ball bearings completely adequate for the maximum load for which the motor is designed. Motor must be non-overloading at any point on the pump curve and premium efficiency. Open drip proof motor efficiencies must be as shown in ASHRAE 189.1. Totally enclosed fan cooled motor efficiencies must be as shown in NEMA MG 1.

2.3.6.8 Pump Shaft

Provide pump shaft of solid 416 stainless steel shaft or solid carbon steel shaft with replaceable bronze or 304 stainless steel shaft sleeve covering wetted area of shaft.

2.3.7 Vertical Lineshaft Turbine

Provide pumps with capacities as indicated. Pump must be vertical lineshaft turbine manufactured for lubrication of the line-shaft bearings by the water being pumped. Design and manufacture the pumping unit in accordance with HI ANSI/HI 2.1-2.2 standards AWWA E103.

2.3.7.1 Bowl Assembly

Flange type construct the intermediate bowls, discharge cases and suction bowls from ASTM A48/A48M Class 30 close grain cast iron. They must be free of defects and accurately machined and fitted to ASME B4.1 close tolerances. Epoxy enamel coat the intermediate bowls waterways for maximum efficiency. Thread all threaded discharge cases for water lubricated column assembly. All assembly bolting must be stainless steel. Provide intermediate bowl bearings.

2.3.7.2 Pump Shaft

Construct the bowl shaft from ASTM A582/A582M type 416 stainless steel, precision ground and polished with surface finish better than 40 RMS.

2.3.7.3 Lineshaft

Vertical pump lineshaft must be open and constructed from ASTM A582/A582M type 416 stainless steel. Straighten lineshaft sections to 0.0005inch/foot total runout. Lineshaft sections must not exceed 10 feet in length and must be coupled with threaded stainless steel couplings. Design the diameter of the lineshaft and coupling in accordance with AWWA E103.

2.3.7.4 Impeller

Provide impellers of ASTM B584 silicon bronze or stainless steel, the enclosed type. They must be free from defects, machined, and balanced to HI 9.6.4 balance grade G6.3 for optimum efficiency and performance. Securely fasten to the bowl shaft with stainless steel taper lock collets. The impellers must be adjustable by means of a top shaft adjusting nut or adjustable solid shaft coupling.

2.3.7.5 Discharge Head

Construct the discharge head, sized for pump capacity, of ASTM A48/A48M Class 30 high grade ductile iron or fabricated steel of the high profile type with an integral motor base which allows the head shaft to be coupled to the top shaft above the stuffing box. A separate motor stand is not acceptable. The discharge head must have an ASME B16.1 (for cast iron) or Class 150 (for steel) discharge flange supplied with dual 1/4 inch NPT ports at the top. Thread the head to accept the column pipe.

2.3.7.6 Stuffing Box

Provide stuffing box of cast or ductile iron, ASTM A536 class 65, and containing a minimum of five rings of packing; with an available fitting for pressure relief. The packing follower gland must be stainless steel and secured in place by stainless steel studs and nuts. The packing box bearing must be bronze. Provide a water slinger to operate on the top shaft, above the packing gland.

2.3.7.7 Mechanical Seal

Provide a mechanical seal.

2.3.7.8 Column Pipe

Provide column pipe of ASTM A53/A53M grade B steel pipe not less than Schedule 30. Machine the column ends with threads and faced parallel to the threads to ensure proper alignment. Connect the pipe with threaded sleeve type ductile iron couplings or flanges that will accept 3/4 inch stainless steel or bonze bearing retainers. Lineshaft bearings must be fluted rubber retained in a centering spider retainer.

2.3.7.9 Basket Strainer

Provide and attach a stainless steel basket strainer of a suitable size to the pump suction with stainless steel fasteners. Strainer must have a net inlet area equal to at least three times the impeller inlet area. The maximum opening must not be more than 75 percent of the maximum opening of the water passage through the bowl or impeller.

2.3.7.10 Motor

Electric motor must meet NEMA MG 1 and be the size and voltage indicated. Provide 1800RPM motor with NEMA Class B or Class F insulation. The motor must have a vertical hollow (or solid) shaft motor with space heaters and a non-reverse ratchet (or self-release coupling) to prevent reverse rotation. The motor must have an angular contact thrust bearing to meet the designed pump's hydraulic thrust load plus the weight of the rotating parts under operating conditions. Provide high efficiency motor with a

weather protected WP-1 enclosure, 230/460 volt, 3 phase, 60HZ, and a 1.15 service factor. Motor must be non-overloading at any point on the pump curve and premium efficiency. Provide motor with efficiencies in compliance with NEMA MG 1.

2.3.8 Cooling Coil Condensate Pump Units

Provide pumps with capacities as indicated. Cooling Coil Condensate Pump Unit must be a packaged unit including a corrosion-resistant pump, plastic tank with cover, and automatic controls. Include factory installed check valve and a 72 inch minimum, electrical power cord with plug for 120V/1PH/60HZ electrical service.

2.3.8.1 Motor

Electric motor must comply with NEMA MG 1 and be the size, voltage and enclosure indicated. Provide heavy duty grease lubricated ball bearings completely adequate for the maximum load for which the motor is designed.

2.4 ELECTRICAL WORK

Provide electrical motor driven equipment specified herein complete with motors, motor starters, and controls. Provide electric equipment and wiring in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical characteristics must be as indicated. Provide motor starters complete with properly sized thermal overload protection in each phase and other appurtenances necessary for the motor control specified. Each motor must be of sufficient capacity to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor when operating at proper electrical system voltage and frequency. Manual or automatic control and protective or signal devices required for the operation herein specified and any control wiring required for controls and devices but not indicated must be provided under this section of the specifications.

2.5 ELECTRICAL EQUIPMENT

Provide electrical equipment in conformance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide electrical motor driven equipment herein specified complete with motors, motor starters, and controls. Motor controls, equipment, and wiring must be in accordance with NFPA 70.

2.5.1 Electric Motors

Drive each electric motor-driven pump by a continuous-duty electric motor with enclosure type for specific service as defined in paragraph HYDRONIC PUMPS. Motor must have a 1.5 service factor. Provide synchronous motors having normal-starting-torque and low-starting-current characteristics, and of sufficient size so that the nameplate horsepower rating will not be exceeded throughout the entire published pump characteristic curve. Integral size motors must be the premium efficiency type in accordance with NEMA MG 1. Pump electric motor efficiencies must meet or exceed the requirements of ASHRAE 189.1, Table C-13. Motor bearings must provide smooth operations under the conditions encountered for the life of the motor. Provide adequate thrust bearing in the motor to carry the weight of all rotating parts plus the hydraulic thrust and be capable of withstanding upthrust imposed during pump starting and under variable pumping head conditions specified. Motors must be rated 60 Hz and such rating must be stamped on the nameplate. Provide motors in conformance

with NEMA MG 1.

2.5.2 Control Equipment

Manually controlled pumps must have START-STOP pushbutton in cover. Automatically controlled pumps must have three-position "MANUAL-OFF-AUTOMATIC" selector switch in cover. Provide additional controls or protective devices as indicated.

2.5.3 Variable Speed Control

The variable speed motor controllers must meet the requirements of UFGS 26 29 23 ADJUSTABLE SPEED DRIVE SYSTEMS UNDER 600 VOLTS.

2.6 EQUIPMENT APPURTENANCES

2.6.1 Attachments

Furnish all necessary bolts, nuts, washers, bolt sleeves, and other types of attachments with the equipment for the installation of the equipment. Bolts conform to the requirements of ASTM A307 and hexagonal nuts of the same quality as the bolts used. Threads must be clean-cut and conform to ASME B1.1. Bolts, nuts, and washers specified to be galvanized or not otherwise indicated or specified, must be zinc coated after being threaded, by the hot-dip process conforming to ASTM A123/A123M as appropriate. Bolts, nuts, and washers specified or indicated to be stainless steel must be Type 316.

2.6.2 Equipment Guards

Provide equipment driven by open shafts, belts, chains, or gears with all-metal guards enclosing the drive mechanism. Secure guards in position with steel braces or straps that permit easy removal for servicing the equipment. Coupler guards must comply with current national safety standards including 29 CFR 1910.219 and NEMA Z535.4. Provide guards with gaps no greater than 0.250 inches, safety orange in color, and have an NEMA Z535.4 compliant warning label.

2.6.3 Tools

Furnish a complete set of all special tools which may be necessary for the adjustment, operation, maintenance, and disassembly of all equipment. Special tools are considered to be those tools which because of their limited use are not normally available, but which are necessary for the particular equipment. Special tools must be high-grade, smooth, forged, alloy, tool steel. Furnish one pressure grease gun for each type of grease required. Deliver all tools at the same time as the equipment to which they pertain. Properly store and safeguard such tools until completion of the work, at which time deliver them to the Contracting Officer.

2.7 FINISHES

All motors, pump casings, and similar parts of equipment must be thoroughly cleaned, primed, and given two finish coats of paint at the factory in accordance with the recommendations of the manufacturer. Give ferrous surfaces not to be painted a shop coat of grease or other suitable rust-resistant coating.

2.8 FACTORY TESTS

Pumps must be tested by the manufacturer or a nationally recognized testing agency in compliance with HI 1.3. Submit certified test results.

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

Install each pump and motor in accordance with the written instructions of the manufacturer. Provide access space around the device for servicing no less than the minimum recommended by the manufacturer.

3.2.1 Base Mounted, Long-Coupled Pumps

Set the pump baseplate as follows.

a. Place two sets of shims or wedges for each foundation bolt. Lower baseplate onto foundation bolts and level baseplate both lengthwise and across by adding or removing shims or mount wedges. A maximum difference of 0.125 inches lengthwise and 0.059 inches across is allowable.

b. Mount pump and driver on baseplate if not already mounted at factory. Pump and driver shafts must have initial cold (pump and driver at ambient temperature) alignment check and final hot (pump and driver at operating temperature) alignment check. Perform cold alignment check before baseplate is grouted, after baseplate is grouted, and after piping is connected. Perform final alignment check when pump and driver are at operating temperature. Move or shim only the driver to make adjustments to prevent strain on the piping installations. Initial alignment may be performed with scales, straight edges and calipers. Final alignment must be done with dial gauges or laser alignment devices. Final alignment misalignment may not exceed coupling manufacturer's maximum parallel and angular misalignment values. When using variable frequency drives, reduce the manufacturer's misalignment values by 50 percent. Remove flexible coupling when performing alignment.

c. Support the connecting piping to ensure that there are no piping loads at the pump flange connections and connecting piping is not forced into position.

3.3 FIELD QUALITY CONTROL

After installation of the pumping units and appurtenances, including coupling guard, is complete, carry out operating tests to assure that the pumping installation operates properly. Give each pumping unit a running field test in the presence of the Contracting Officer for a minimum of 2 hours. Operate each pumping unit at its rated capacity or such other point on its head-capacity curve selected by the Contracting Officer. Provide an accurate and acceptable method of measuring the discharge flow. Tests must assure that the units and appurtenances have been

installed correctly, that there is no objectionable heating, vibration, or noise from any parts, and that all manual and automatic controls function properly. If any deficiencies are revealed during any tests, correct such deficiencies and reconduct the tests.

Submit test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report must indicate the final position of controls.

3.4 FIELD PAINTING

Do not paint stainless steel, galvanized steel, and nonferrous surfaces.

3.4.1 Touch-up painting

Factory painted items requiring touching up in the field must be thoroughly cleaned of all foreign material, and primed and topcoated with the manufacturer's standard factory finish.

3.4.2 Exposed Ferrous Surfaces

Paint exposed ferrous surfaces with two coats of enamel paint conforming to SSPC Paint 21. Solvent clean factory primed surfaces before painting. Surfaces that have not been factory primed must be prepared and primed with one coat of SSPC Paint 25 or in accordance with the enamel paint manufacturer's recommendations.

3.5 CLOSEOUT ACTIVITIES

3.5.1 Operation and Maintenance Manuals

Submit one complete set at the time the tests procedure is submitted; remaining sets before the contract is completed. Permanently bind each in a hard cover. Inscribe the following identification on the covers: the words "OPERATING AND MAINTENANCE INSTRUCTIONS," name and location of the building, name of the Contractor, and contract number. Place flysheets before instructions covering each subject. Use 8-1/2 by 11 inches paper for instruction sheets, with large sheets of drawings folded in.

Include, but do not limit to, the following in the Instructions:

a. System layout showing piping, valves, and controls.

b. Approved wiring and control diagrams including variable frequency drives.

c. A control sequence describing startup, operation, and shutdown.

d. Operating and maintenance instructions for each piece of equipment, including task list for routine maintenance, routine inspections, intermediate inspections, and annual inspections; lubrication instructions; and troubleshooting guide.

e. Manufacturer's bulletins, cuts, and descriptive data; and parts list and recommended spare parts.

3.5.2 Training

Upon completion of the work, and at a time designated by the Contracting Officer, provide the services of one or more competent engineers for a training period of not less than 4 hours to instruct a representative of the Government in the contents of the operation and maintenance manuals for the equipment furnished under these specifications. These field instructions must cover all the items contained in the bound instructions. Submit the training course curriculum and training instructions 14 days prior to the start of training.

-- End of Section --

SECTION 23 25 00

CHEMICAL TREATMENT OF WATER FOR MECHANICAL SYSTEMS
11/08

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 OF MECHANICAL ENGINEERS (ASME)

ASME B40.100	(2013) Pressure Gauges and Gauge Attachments

ASTM INTERNATIONAL (ASTM)

ASTM D596	(2001; R 2018) Standard Guide for Reporting Results of Analysis of Water
ASTM D1384	(2005; R 2019) Corrosion Test for Engine Coolants in Glassware
ASTM D2688	(2015; E 2016) Standard Test Method for Corrosivity of Water in the Absence of Heat Transfer (Weight Loss Methods)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA MG 1	(2018) Motors and Generators

U.S. ARMY CORPS OF ENGINEERS (USACE)

PWTB 420-49-5	(1998) Industrial Water Treatment Procedures

U.S. DEPARTMENT OF DEFENSE (DOD)

UFC 3-230-03	(2012; with Change 2, 2020) Water Treatment

1.2 SUMMARY

This section covers the provisions and installation procedures necessary for a complete and totally functional water system(s) chemical treatment. Provide and install the system with all necessary System Components, Accessories, Piping Components, and Supplemental Components/Services.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for

Contractor Quality Control Approval. for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Water Treatment System; G
Water Analysis; G
Spare Parts
Field Instructions
Tests; G
Training Course; G

SD-06 Test Reports

Condenser Water QA Tests
Steam Boiler Water QA Tests

SD-10 Operation and Maintenance Data

Water Treatment System

1.4 QUALITY CONTROL

1.4.1 Safety

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. Install safety devices so that proper operation of equipment is not impaired.

1.4.2 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. Carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.6 MAINTENANCE

Submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings, not later than months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with source of supply

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

a. Provide materials and equipment which are standard products of a

manufacturer regularly engaged in the manufacturing of such products, that are of a similar material, design and workmanship and that have been in satisfactory commercial or industrial use for two years prior to bid opening.

b. The two-year use shall include applications of equipment and materials under similar circumstances and of similar size. The two years experience shall have been satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a two-year field service record will 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.

c. All products shall be supported by a service organization. Submit a certified list of qualified permanent service organizations for support of the equipment, including their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and shall be able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

d. The selected service organization shall provide the chemicals required, the concentrations required, and the water treatment equipment sizes and flow rates required. The company shall provide all chemicals required for the condenser and chilled water systems and fill the systems with chemicals to the levels specified. The chemical shall meet the requirements of this specification as well as the recommendations from the manufacturers of the condenser and cooling tower. Acid treatment chemicals shall not be used.

2.2 NAMEPLATES

Each major component of equipment shall have the manufacturer's name, address, type or style, and catalog or serial number on a plate securely attached to the item of equipment. Nameplates shall be provided for:

a. Pump(s)

b. Pump Motor(s)

2.3 ELECTRICAL WORK

Electrical equipment, motors, motor efficiencies, and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide electrical motor driven equipment specified complete with motors, motor starters, and controls. Electrical characteristics and enclosure type shall be as shown, and unless otherwise indicated, all motors of 1 horsepower and above with open, dripproof, or totally enclosed fan cooled enclosures, shall be high efficiency type. Field wiring shall be in accordance with manufacturer's instructions. Each motor shall conform to NEMA MG 1 and be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. All motors shall be continuous duty with the enclosure specified. Provide motor starters complete with thermal overload protection and other appurtenances necessary for the motor control indicated. Furnish motors with a magnetic across-the-line or reduced voltage type starter as required by the manufacturer. Motor starter shall be provided with NEMA 1 enclosures. 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.

2.4 GAUGES

Gauges shall conform to ASME B40.100, Class 1, 2, or 3, Style X, Type I or III as required, 4-1/2 inches in diameter with phenolic or metal case.

2.5 WATER ANALYSIS

Conditions of make-up water to be supplied to the boilers, cooling towers and chilled water systems reported in accordance with ASTM D596 are as follows:

Date of Sample	
Temperature	degrees C
Silica (SiO 2)	ppm (mg/L)
Insoluble	ppm (mg/L)
Iron, total (Fe)	ppm (mg/L)
Aluminum (Al)	ppm (mg/L)
Calcium (Ca)	ppm (mg/L)
Magnesium (Mg)	ppm (mg/L)
Carbonate (HCO 3)	ppm (mg/L)
Sulfate (SO 4)	ppm (mg/L)
Chloride (Cl)	ppm (mg/L)
Nitrate (NO 3)	ppm (mg/L)
Turbidity	ntu
pH	
Residual Chlorine	ppm (mg/L)
Total Alkalinity	ppm (mg/L)
Non-Carbonate Hardness	ppm (mg/L)
Total Hardness	ppm (mg/L)
Dissolved Solids	ppm (mg/L)
Conductivity	micromho/cm

2.6 CONDENSER WATER TREATMENT SYSTEMS

The use of chemical-treatment products containing hexavalent chromium (Cr) is prohibited. Treat the water to be used in the condenser water systems to maintain the conditions recommended by this specification as well as the recommendations from the manufacturers of the condenser and evaporator coils. Chemicals shall meet all required federal, state, and local environmental regulations for the treatment of condenser-side heat exchangers, cooling towers and direct discharge to the sanitary sewer.

2.6.1 Condenser Water Limits

The condenser water limits shall be as follows, unless dictated differently by the cooling tower or chiller manufacturer's recommendations:

Treatment type	Phosphonate/Polymer
Puckorius Index	4 minimum
Langelier Index	4 maximum
Total Dissolved Solids	5000 ppm maximum
Calcium Hardness	1200 ppm maximum
Silica	150 ppm maximum
pH	7.5 - 8.5

For treated condenser/cooling tower water, blowdown must be minimized until the first of one of the top 5 limits is reached. Specific requirements for treatment chemicals and levels are listed below in paragraphs dealing with small and large systems.

2.6.2 Glycol Solution

Provide for the system a percent concentration by volume of industrial grade ethylene glycol, and corrosion inhibitors. Test the glycol in accordance with ASTM D1384 with less than 0.5 mils penetration per year for all system metals. The glycol shall contain corrosion inhibitors. Silicate based inhibitors are not acceptable. The solution shall be compatible with pump seals, other elements of the system, and water treatment chemicals used within the system.

2.6.3 Chemical Treatment for Small Systems

For cooling systems with a capacity of 50 tons or less, provide the following chemical treatment. For corrosion control provide 15 to 20 pounds polyphosphate in nylon mesh bag in cooling tower sump. If biocide is needed, use either 1-bromo-3-chloro-5.5-dimethylhydantoin or gluteraldehyde as recommended by manufacturer.

2.6.4 Chemical Treatment for Large Systems

For cooling systems with capacities greater than 50 tons provide one of the three following chemical treatments with the limits indicated. The

zinc and molybdate in the last two treatments help to meet the maximum corrosion requirements in waters that tend to be more corrosive. Biocides must be maintained to control bacteria below 10,000 colony forming units per milliliter.

a. Phosphonate Type Treatment

Phosphate	3-5 ppm
Polymer	3-4 ppm
TT	1-2 ppm
Biocides	as required

b. Zinc-Phosphonate Type Treatment

Phosphate	3-5 ppm
Polymer	3-4 ppm
Zinc	1-2 ppm
TT	1-2 ppm
Biocides	as required

c. Zinc-Molybdate Type Treatment

Phosphate	3-5 ppm
Polymer	3-4 ppm
Molybdate	10-15 ppm
Zinc	2-3 ppm
TT	1-2 ppm
Biocides	as required

2.6.4.1 General Requirements

Provide a water treatment system capable of automatically feeding chemicals and bleeding the system to prevent corrosion, scale, and biological formations. Submit 6 complete copies, at least 5 weeks prior to the purchase of the water treatment system, of the proposed water treatment plan including a layout; control scheme; a list of existing make-up water chemistry, including the items listed in paragraph Water Analysis; a list of treatment chemicals to be added; the proportion of chemicals to be added; the final treated water control levels; and a

description of health, safety and environmental concerns for handling the chemicals plus any special ventilation requirements. Automatic chemical feed systems shall automatically feed chemicals into the condenser water based on makeup water rate. Electrical signals from a water meter on the makeup water line shall be used to control the output of chemical feed pumps. The system shall be initially set manually based on the water analysis of the make-up water. Submit 6 complete copies of operating and maintenance manuals for the step-by-step water treatment procedures. The manuals shall include testing procedures used in determining water quality.

2.6.4.2 Chemical Feed Pumps and Tanks

a. Furnish chemical feed pumps and tanks as a package with the pumps mounted on and piping connected to the tank. The chemical feed pumps shall be positive displacement diaphragm type. The pump's cylinders, plungers, ball check valves, and check valve bodies shall be of corrosion resistant materials suitable for the chemicals being pumped. Cylinders shall be replaceable for increased or reduced pressure or capacity ranges.

b. The flow rate of the pumps shall be adjustable from 0 to 100 percent while in operation. Volumetric accuracy of the pumps shall be within one percent over the range indicated. Pump capacities shall be adjustable by positioning crank pin with micrometer setscrews. Stroke length scale shall be divided in percentage graduations engraved on scale. The discharge pressure of pumps shall not be less than 1.5 times the line pressure at the point of connection. The pumps shall be provided with a pressure relief valve and a check valve mounted in the pump discharge. The pumps shall be controlled by an external controller/timer receiving signals from the makeup water meter.

c. Drive motors shall be 110 volt, single phase and shall have drip-proof enclosures. Provide two chemical tanks. The tanks shall be constructed of materials compatible with the chemicals to be stored in the tank with a hinged cover and mounted on legs. Tanks shall have filling and drain connections and gauge glass. Each tank shall be furnished with one pump, mounted and piped with black iron pipe and fittings, with suction strainer and stainless steel screen, and with 1/2 inch relief valve with steel body and stainless steel trim. Tank bottom shall be dished concave to a radius equal to the diameter of the tank. Motor-driven agitator shall be provided. The tanks shall have sufficient capacity to require recharging only once per 7 days during normal operation.

2.6.4.3 Chemical Injection Assembly

Provide an injection assembly at each chemical feed point. Locate the injection assembly downstream of recirculating pumps and upstream of the condenser. The injection assemblies shall be constructed of stainless steel. The discharge of the assemblies shall extend to the centerline of the condenser water piping. Each assembly shall include a shutoff valve and check valve at the point of entrance into the condenser water line.

2.6.4.4 Water Meter

Provide water meters with an electric contacting register and remote accumulative counter. Install the meter within the make-up water line, as indicated.

2.6.4.5 Timers

Timers shall be of the automatic reset, adjustable type, and electrically operated. The timers shall be designed to work with the contacting head water meters. The timer should include the water meter cable. The timers will control operation of the chemical feed pumps. The timers shall be suitable for a 120 volt current. The timers shall be located within the water treatment control panel.

2.6.4.6 Bleed (Blowdown) Line

Control the flow through the bleed line by a conductivity meter and probe installed to measure the conductivity of the condenser water. The conductivity meter shall have a high and low set point above which the conductivity meter shall open a solenoid valve on the bleed line. The bleed line attachment to the condenser water piping shall be located downstream of the recirculating pumps and upstream of the chemical injection point. The bleed line shall be extended to the nearest drain for continuous discharge.

2.6.4.7 Control Panel

The control panel shall be a NEMA 12 enclosure suitable for surface mounting. The panel shall be constructed of stainless steel with a hinged door and lock. The panel shall contain a laminated plastic nameplate identifying each of the following functions:

(1) Main power switch and indicating light
(2) MAN-OFF-AUTO selector switch
(3) Indicating lamp for bleed-off valve
(4) Indicating lamp for each chemical feed pump
(5) Set point reading for each timer

2.6.4.8 Chemical Piping

The piping and fittings shall be constructed of schedule 80 PVC suitable for the water treatment chemicals.

2.6.4.9 Sequence of Operation

The chemicals shall be added based upon sensing the make-up water flow rate and activating appropriate timers. A separate timer shall be provided for each chemical. The blow down shall be controlled based upon the conductivity of the condenser water. The injection of the chemical required for biological control shall be controlled by a timer that can be manually set for proper chemical feed. All timer set points, blow down rates, and chemical pump flow rates shall be determined and set by the water treatment company.

2.6.4.10 Test Kits

One test kit of each type required to determine the water quality as outlined within the operation and maintenance manuals shall be provided.

2.7 CHILLED WATER SYSTEM

A 2 gallon shot feeder shall be provided on the chilled water piping as indicated. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping.

2.7.1 Requirements for Glycol Solution

Provide a percent concentration by volume of industrial grade ethylene glycol, and corrosion inhibitors, for the system. Test the glycol in accordance with ASTM D1384 with less than 0.5 mils penetration per year for all system metals. The glycol shall contain corrosion inhibitors. Silicate based inhibitors shall not be used. The solution shall be compatible with pump seals, other elements of the system, and water treatment chemicals used within the system.

2.7.2 Chilled Water Treatment

Treat chilled water with either a borax/nitrite type treatment or a molybdate type treatment. Both types of treatment can be used with glycol. Borax/nitrite treatment shall be maintained at the limits of 600 to 1000 ppm nitrite, 40 - 50 ppm copper corrosion inhibitor (TT or MBT), and pH of 8.5 to 9.5. Molybdate treatment shall be maintained at the limits of 100 to 125 ppm molybdate, 40 - 50 ppm copper corrosion inhibitor (TT or MBT), and pH of 8.0 to 9.0.

2.7.3 Dual Temperature Systems

Dual hot/chilled water systems treated with borax/nitrite shall also be treated with a biocide.

2.7.4 Chilled Water Test Kits

One test kit of each type required to determine the water quality as outlined within the operation and maintenance manuals shall be provided (e.g. pH and nitrite or molybdate).

2.8 LOW AND MEDIUM TEMPERATURE HOT WATER BOILERS AND HEAT EXCHANGERS

Low and medium temperature hot water boilers are defined as those operating below 350 degrees F, (250 degrees F for Low Temperature).

2.8.1 Chemical Feeder

A 2 gallon shot feeder shall be provided on the hot water piping as indicated. Size and capacity of feeder shall be based on local requirements and water analysis. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping.

2.8.2 Low and Medium Temperature Hot Water Treatment

Hot water shall be treated with either a borax/nitrite type treatment or a molybdate type treatment. Both types of treatment can be used with glycol. Borax/nitrite treatment shall be maintained at the limits of 600 to 1000 ppm nitrite, 40 - 50 ppm copper corrosion inhibitor (TT or MBT) and pH of 8.5 to 9.5. Molybdate treatment shall be maintained at the limits of 100 to 125 ppm molybdate, 40 - 50 ppm copper corrosion inhibitor (TT or MBT) and pH of 8.0 to 9.0.

2.8.3 Dual Temperature Systems

Dual hot/chilled water systems treated with borax/nitrite shall also be treated with a biocide.

2.8.4 Test Kit Requirements

One test kit of each type required to determine the water quality as outlined within the operation and maintenance manuals shall be provided (e.g. pH and nitrite or molybdate).

2.9 HIGH TEMPERATURE HOT WATER BOILERS

2.9.1 Chemical Feeder Unit

A feeder unit shall be provided for each boiler. Chemical feeder shall be automatic proportioning, shot type, or pump type. All appurtenances necessary for satisfactory operation shall be provided. Size and capacity of feeder shall be based upon local requirements and water analysis.

2.9.2 Pumps and Tanks

a. Furnish chemical feed pumps and tanks as a package with the pumps mounted on and piping connected to the tank. The chemical feed pumps shall be positive displacement diaphragm type. The pump cylinders, plungers, ball check valves, and check valve bodies shall be of corrosion resistant materials suitable for the chemicals being pumped. Cylinders shall be replaceable for increased or reduced pressure or capacity ranges.

b. The flow rate of the pumps shall be adjustable from 0 to 100 percent while in operation. Volumetric accuracy of the pumps shall be within one percent over the range indicated. Pump capacities shall be adjustable by positioning crank pin with micrometer setscrews. Stroke length scale shall be divided in percentage graduations engraved on scale. The discharge pressure of pumps shall not be less than 1.5 times the line pressure at the point of connection. The pump shall be designed to feed the chemical solutions into the HTW return line to the system circulating pumps and shall have capacity to feed a maximum of 5 gph. The pumps shall be provided with a pressure relief valve and a check valve mounted in the pump discharge. The pumps shall be controlled by an external controller/timer receiving signals from the makeup water meter.

c. Drive motors shall be 110 volt, single phase and shall have drip-proof enclosures. The tanks shall be constructed of materials compatible with the chemicals to be stored in the tank with a hinged cover and mounted on legs. Tanks shall have filling and drain connections and gauge glass. Each tank shall be furnished with one pump, mounted and piped with black iron pipe and fittings, with suction strainer and stainless steel screen, and with 1/2 inch relief valve with steel body and stainless steel trim. Tank bottom shall be dished concave to a radius equal to the diameter of the tank. Units shall be for phosphate, caustic feed and sulfite feeding. Sulfite tank shall have a floating cover to completely cover the surface of the solution. Motor-driven agitator shall be provided. The tanks shall have sufficient capacity to require recharging only once per 7 days during normal operation.

2.9.3 Treated Water Limits

The boiler manufacturer shall be consulted for the determination of the boiler water chemical composition limits. The recirculating hot water chemical limits shall be as follows unless dictated differently by the

boiler manufacturer's recommendations:

pH	9.3-9.9
Sulfite	30-60 ppm
Hardness	Less than 2.0 ppm

2.10 Test Kit

One test kit of each type required to determine the water quality as outlined within the operation and maintenance manuals shall be provided (e.g. pH, hardness and sulfite).

2.11 STEAM BOILER WATER TREATMENT

Provide a water treatment system capable of feeding chemicals and blowdown of the system to prevent corrosion and scale within the boiler and piping distribution system. Treat the water to maintain the conditions recommended by the boiler manufacturer or UFC 3-230-03 (Central Boiler Plants) and PWTB 420-49-5 (Industrial Water Treatment Procedures). Chemicals shall meet required federal, state, and local environmental regulations for the treatment of boilers and discharge to the sanitary sewer. The services of a company regularly engaged in the treatment of boilers shall be used to determine the correct concentrations required for water treatment. The company shall maintain the chemical treatment and provide all chemicals required for a period of 1 year from the date of occupancy. Filming amines, hydrazine and chelants shall not be used. The water treatment chemicals shall remain stable throughout the operating temperature range of the system and shall be compatible with pump seals and other elements of the system.

2.11.1 Boiler Water Limits

The boiler water limits shall be as follows unless dictated differently by the boiler manufacturer's recommendations:

Causticity (OH)	20-200 ppm
Total Alkalinity (CaCO3)	200-800 ppm
Phosphate (PO4)	30-60 ppm
Polymer (dispersant) or Tannin	5-10 ppm or medium color, respectively
Dissolved Solids (water tube boilers)	3000-3500 ppm
Dissolved Solids (fire tube boilers)	3500-5000 ppm
Suspended Solids	15 ppm Maximum
Sodium Sulfite	20-40 ppm

Silica	Less than 200 ppm
Dissolved Oxygen	Less than 7 ppb
Iron	Less than 10 ppm
pH (Condensate)	7.5 - 8
Conductivity (Condensate)	Less than 35 micromhos
Hardness (Condensate and makeup)	Less than 2 ppm

The above limits apply to boilers operating above 15 psi up 300 psi. Above 300 psi these limits decrease. Use ABMA or chemical vendor recommended limits above 300 psi.

2.11.2 Boiler Water Treatment System

The water treatment system shall be capable of automatically feeding chemicals to prevent corrosion and scale within the boiler and condensate system. Automatic chemical feed systems shall feed chemicals into the boiler based on makeup water rate. Electrical signals from a water meter on the makeup water line shall be used to control the output of chemical feed pumps.

2.11.3 Steam Boiler Chemical Feed Pumps and Tanks

a. Furnish chemical feed pumps and tanks as a package with the pumps mounted on and piping connected to the tank. The chemical feed pumps shall be positive displacement diaphragm type. The pump cylinders, plungers, ball check valves, and check valve bodies shall be of corrosion resistant materials suitable for the chemicals being pumped. Cylinders shall be replaceable for increased or reduced pressure or capacity ranges. The flow rate of the pumps shall be adjustable from 0 to 100 percent while in operation. Volumetric accuracy of the pumps shall be within one percent over the range indicated. Pump capacities shall be adjustable by positioning crank pin with micrometer setscrews. Stroke length scale shall be divided in percentage graduations engraved on scale.

b. The discharge pressure of pumps shall not be less than 1.5 times the line pressure at the point of connection. The pumps shall be provided with a pressure relief valve and a check valve mounted in the pump discharge. The pumps shall be controlled by an external controller/timer receiving signals from the makeup water meter.

c. Drive motors shall be 110 volt, single phase and shall have drip-proof enclosures. The tanks shall be constructed of materials compatible with the chemicals to be stored in the tank with a hinged cover and mounted on legs. Tanks shall have filling and drain connections and gauge glass. Each tank shall be furnished with one pump, mounted and piped with black iron pipe and fittings, with suction strainer and stainless steel screen, and with 1/2 inch relief valve with steel body and stainless steel trim. Tank bottom shall be dished concave to a radius equal to the diameter of the tank. The tank for sodium sulfite will have a floating cover to minimize contact with air. Motor-driven

agitator shall be provided. The tanks shall have sufficient capacity to require recharging only once per 7 days during normal operation.

2.11.4 Steam Boiler Chemical Injection Assemblies

Provide an injection assembly at each chemical injection point located along the boiler piping as indicated. The injection assemblies shall be constructed of stainless steel. The discharge of the assemblies shall extend to the centerline of the piping. Each assembly shall include a shutoff valve and check valve at the point of entrance into the water line.

2.11.5 Steam Boiler Water Meter

Provide the water meter with an electric contacting register and remote accumulative counter. Install the meter within the makeup water line, as indicated.

2.11.6 Steam Boiler Timers

Timers shall be of the automatic reset, adjustable type, and electrically operated. The timers shall be designed to work with the contacting head water meters. The timer should include the water meter cable. The timers will control operation of the chemical feed pumps. The timers shall be suitable for a 120 volt current. The timers shall be used to control the electrical signals from the water meters to the chemical feed pumps.

2.11.7 Steam Boiler Control Panel

The control panel shall be a NEMA 12, single door, wall-mounted box conforming with NEMA 250. The panel shall be constructed of coated steel with a hinged door and lock. The panel shall contain, as a minimum, the following functions identified with a laminated plastic nameplate:

a. Main power switch and indicating light
b. MAN-OFF-AUTO selector switch
c. Indicating lamp for each chemical feed pump
d. Indicating lamp for the water softener

2.11.8 Boiler Blowdown

Provide the boiler with continuous blowdown . Bottom blowdown connection and valve shall also be present to allow removal of solids and water from the bottom of the boiler.

2.11.9 Boiler Chemical Piping

The piping and fittings shall be constructed of steel .

2.11.10 Boiler Test Kits

One test kit of each type required to determine the water quality as outlined in paragraph Boiler Water Limits above and within the operation and maintenance manuals.

2.12 SUPPLEMENTAL COMPONENTS/SERVICES

Drain and makeup water piping shall comply with the documents. Drains which connect to sanitary sewer systems shall be connected by means of an indirect waste.

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 any work.

3.2 INSTALLATION

Provide all chemicals, equipment and labor necessary to bring all system waters in conformance with the specified requirements. Perform all work in accordance with the manufacturer's published diagrams, recommendations, and equipment warranty requirements.

3.3 PIPING

Connections between dissimilar metals shall be made with a dielectric union.

3.4 TRAINING COURSE

Submit a schedule, at least 2 weeks prior to the date of the proposed training course, that identifies the date, time, and location for the training. Conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total hours of normal working time and start after the system is functionally completed but prior to final acceptance tests. Submit field instructions, at least 2 weeks prior to construction completion, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions shall include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions shall be framed under glass or laminated plastic and posted where indicated by the Contracting Officer. The field instructions shall cover all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations.

3.5 TESTS

If the waters of the mechanical systems are not in conformance with the specified requirements or in accordance with manufacturer's recommendations, the water treatment company shall take corrective action to enable compliance. Daily operational tests shall be performed in the directed frequencies to maintain required control to prevent corrosion, scaling and damage to equipment during operation Submit test schedules, at least 2 weeks prior to the start of related testing, for the condenser/chilled/boiler/condensate/feedwater water quality tests. The schedules shall identify the date, time, frequency and collection location for each test.

3.5.1 Condenser Water Quality Tests

3.5.1.1 Small Systems (weekly)

Once a week, for cooling systems with a capacity of 50 tons or less, the following items shall be recorded.

pH	
Total Alkalinity (as CaCO3)	ppm (mg/L)
Conductivity	micromho/cm

3.5.1.2 Tests for Large Systems (daily)

Daily, for cooling systems with a capacity larger than 50 tons, the following items shall be recorded.

pH	
Total Alkalinity (as CaCO3)	ppm (mg/L)
Conductivity	micromho/cm
Phosphate	ppm (mg/L)
Zinc, if used (Zn)	ppm (mg/L)
Molybdate, if used (Mo)	ppm (mg/L)

3.5.2 Chilled Water Testing (monthly)

Once a month, the following tests will be performed on chilled water.

pH	
Nitrite or Molybdate	ppm (mg/L)
Conductivity	micromho/cm

3.5.3 Hot Water Boiler Water Quality Testing

3.5.3.1 Low and Medium Temperature Systems (monthly)

Monthly testing shall be completed and recorded for the following parameters.

pH	
Nitrite or Molybdate	ppm (mg/L)

3.5.3.2 High Temperature Hot Water Systems (daily)

Daily testing shall be completed and recorded for the following parameters.

pH	
Sulfite	ppm (mg/L)
Hardness	ppm (mg/L)

3.5.4 Steam Boiler Water Testing

3.5.4.1 Small Steam Systems

The type of treatment required for small steam systems (below 25 hp) varies greatly depending on local water and system conditions. The type of treatment and frequency of testing shall be determined by the water treatment chemical vendor.

3.5.4.2 Medium Steam Systems (twice weekly)

Twice a week for steam boiler systems operating between 25 hp and 100 hp the following items will be recorded and utilized for operation purposes.

pH	
P Alkalinity (as CaCO3)	ppm (mg/L)
Total Dissolved Solids	ppm (mg/L)
Phosphate (PO4)	ppm (mg/L)
Sulfite (NaSO3)	ppm (mg/L)

3.5.4.3 Large Steam Systems (daily)

Daily, for steam boiler systems operating above 15 psi and 100 hp, the following items will be recorded and utilized for operational purposes.

Sulfite (NaSO3)	ppm (mg/L)
P Alkalinity (as CaCO3)	ppm (mg/L)
Conductivity	micromho/cm
Neutralized Conductivity	micromho/cm
Total Dissolved Solids	ppm (mg/L)
Phosphate (PO4)	ppm (mg/L)
Condensate pH	
Condensate Conductivity	micromho/cm

Condensate Hardness (as CaCO3)	ppm (mg/L)
Makeup Water Hardness (as CaCO3)	ppm (mg/L)

3.5.5 Quality Assurance Testing

Conduct QA testing periodically by an independent water treatment lab/consultant to verify to managers that the mechanical and water treatment systems are being maintained properly. Provide the QA evaluation reports to the government COR.

3.5.5.1 Condenser Water QA Tests

Submit test reports in bound 8-1/2 by 11 inch booklets. The reports shall identify the chemical composition of the condenser water. The reports shall also include a comparison of the manufacturer's or chemical vendor's recommended operating conditions for the cooling tower and condenser in relation to the actual condition of the condenser water. Any required corrective action shall be documented within the report.

a. For cooling systems with a capacity of 50 ton or less, the following tests shall be performed

Presence of scale/corrosion	
Polyphosphate	ppm (mg/L)
Biocide	ppm (mg/L)
pH	
Total Alkalinity (as CaCO3)	ppm (mg/L)
Calcium Hardness (as CaCO3)	ppm (mg/L)
Conductivity	micromho/cm
Written evaluation summary	

b. For cooling systems with capacities greater than 50 ton), the condenser water shall be analyzed a minimum of once a month for a period of one year by the water treatment company. The analysis shall include the following information recorded in accordance with ASTM D596.

Date of Sample	
Temperatures (before & after condenser)	& degrees C
pH	

Silica (SiO2)	ppm (mg/L)
Iron (total, as Fe(2)O(3))	ppm (mg/L)
Copper (Cu)	ppm (mg/L)
Calcium Hardness(CaCO3)	ppm (mg/L)
Total Hardness (as CaCO3)	ppm (mg/L)
Chloride (Cl)	ppm (mg/L)
Total Alkalinity (as CaCO3)	ppm (mg/L)
Conductivity	micromho/cm
Total Dissolved Solids	ppm (mg/L)
Phosphonate (as PO4)	ppm (mg/L)
Zinc (if used) (Zn)	ppm (mg/L)
Molybdate (if used) (Mo)	ppm (mg/L)
Tolyltriazole (TT)	ppm (mg/L)
Biocide	ppm (mg/L)
Bacteria colony count	colonies/mL
Makeup water pH	ppm (mg/L)
Makeup water Iron	ppm (mg/L)
Makeup water Silica	ppm (mg/L)
Makeup water Calcium Hardness	ppm (mg/L)
Makeup water Total Hardness	ppm (mg/L)
Makeup water Total Alkalinity	ppm (mg/L)
Makeup water Chloride (Cl)	ppm (mg/L)
Makeup water Conductivity	micromho/cm
Written evaluation summary	

3.5.5.2 Chilled Water Quality Assurance Testing (quarterly)

Quarterly, the following tests shall be performed on chilled water.

pH	
Nitrite or Molybdate	ppm (mg/L)
Conductivity	micromho/cm
Iron (total, as Fe(2)O(3))	ppm (mg/L)
Written evaluation summary	

3.5.5.3 Hot Water Boiler Water Quality Assurance Testing

a. Quarterly testing of Low and Medium Temperature Systems shall be completed and recorded for the following parameters.

pH	
Nitrite or Molybdate	ppm (mg/L)
Iron (total, as Fe(2)O(3))	ppm (mg/L)
Written evaluation summary	

b. The hot water boiler water shall be analyzed once a month for a period of 1 year by an independent consultant. The analysis shall include the following information recorded in accordance with ASTM D596.

pH	
Sulfite (Na2SO3)	ppm (mg/L)
Hardness(as CaCO3)	ppm (mg/L)
Iron (total, as Fe(2)O(3))	ppm (mg/L)
Written evaluation summary	

3.5.5.4 Steam Boiler Water QA Tests

Submit the water quality test report identifying the chemical composition of the boiler, feedwater and condensate water. The report shall include a comparison of the condition of the boiler water with the manufacturer's or chemical vendor's recommended conditions. Any required corrective action shall be documented within the report.

a. Small and Medium Steam Boiler Systems (quarterly)are systems operating between 25 hp and 100 hp. The following tests shall be performed quarterly.

pH	
Sulfite, if used, (NaSO3)	ppm (mg/L)
P Alkalinity (as CaCO3)	ppm (mg/L)
Total Dissolved Solids	ppm (mg/L)
Phosphate, if used, (PO4)	ppm (mg/L)
Polymer, if used	ppm (mg/L)
Iron (total, as Fe(2)O(3))	ppm (mg/L)
Condensate pH	
Condensate Conductivity	micromho/cm
Condensate Hardness (as CaCO3)	ppm (mg/L)
Condensate Iron (total, as Fe(2)O(3))	ppm (mg/L)
Makeup Water Hardness (as CaCO3)	ppm (mg/L)
Written evaluation summary	

b. Large steam boilers are those operating above 15 psi and 100 hp. The boiler water shall be analyzed a minimum of once a month for a period of 1 year by an independent consultant. The analysis shall include the following information recorded in accordance with ASTM D596.

Date of Sample	
pH	
Sulfite (NaSO3)	ppm (mg/L)
P Alkalinity (as CaCO3)	ppm (mg/L)
Conductivity	micromho/cm
Neutralized Conductivity	micromho/cm
Total Dissolved Solids	ppm (mg/L)
Phosphate (PO4)	ppm (mg/L)
Polymer, if used	ppm (mg/L)
Silica (SiO2)	ppm (mg/L)

Iron (total, as Fe(2)O(3))	ppm (mg/L)
Condensate pH	
Condensate Conductivity	micromho/cm
Condensate Hardness (as CaCO3)	ppm (mg/L)
Condensate Iron (total, as Fe(2)O(3))	ppm (mg/L)
Makeup Water Hardness (as CaCO3)	ppm (mg/L)
Written evaluation summary	

3.5.6 Corrosion Testers

Install corrosion coupon and rack systems to verify corrosion control in the systems. Testers or coupons are installed in flowing system water through a sidestream or rack system. Both mild steel and copper metal samples are to be tested in the corrosion testers in accordance with ASTM D2688. Samples are to be replaced and analyzed every 3 months. Rates of corrosion less than 3 mpy for steel and 0.2 mpy for copper are acceptable. Corrosion testers shall be installed on the piping systems of the following systems.

Condenser loop
Chilled water system
Hot water loop
Condensate

3.6 INSPECTIONS

3.6.1 Inspection General Requirements

Thirty days after project completion, inspect the cooling tower and condenser for problems due to corrosion, scale, and biological growth. If the cooling tower and condenser are found not to conform to the manufacturer's recommended conditions, and the water treatment company recommendations have been followed; the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations.

3.6.2 Boiler/Piping Test

Thirty day after project completion, inspect the boiler and condensate piping for problems due to corrosion and scale. If the boiler is found not to conform to the manufacturer's recommendations, and the water treatment company recommendations have been followed, the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations. If corrosion is found within the condensate piping, proper repairs shall be made by the water treatment company.

-- End of Section --

SECTION 23 30 00

HVAC AIR DISTRIBUTION
05/20

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 S12.51	(2012; R 2017) American National Standard Acoustics - Determination of Sound Power Levels and Sound Energy Levels of Noise Sources using Sound Pressure - Precision Methods for Reverberation Test Rooms

AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)

ACCA Manual 4	(2001) Installation Techniques for Perimeter Heating and Cooling; 11th Edition

AIR MOVEMENT AND CONTROL ASSOCIATION INTERNATIONAL, INC. (AMCA)

AMCA 201	(2002; R 2011) Fans and Systems
AMCA 210	(2016) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
AMCA 220	(2005;R 2012) Test Methods for Air Curtain Units
AMCA 300	(2014) Reverberant Room Method for Sound Testing of Fans
AMCA 301	(2014) Methods for Calculating Fan Sound Ratings from Laboratory Test Data
AMCA 500-D	(2018) Laboratory Methods of Testing Dampers for Rating

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 260 I-P	(2012) Sound Rating of Ducted Air Moving and Conditioning Equipment
AHRI 350	(2015) Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment
AHRI 410	(2001; Addendum 1 2002; Addendum 2 2005; Addendum 3 2011) Forced-Circulation Air-Cooling and Air-Heating Coils

AHRI 430	(2009) Central-Station Air-Handling Units
AHRI 440	(2008) Performance Rating of Room Fan-Coils
AHRI 880 I-P	(2011) Performance Rating of Air Terminals
AHRI 885	(2008; Addendum 2011) Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets
AHRI DCAACP	(Online) Directory of Certified Applied Air-Conditioning Products
AHRI Guideline D	(1996) Application and Installation of Central Station Air-Handling Units

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 9	(2015) Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	(2014) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 15 & 34	(2013) ASHRAE Standard 34-2016 Safety Standard for Refrigeration Systems/ASHRAE Standard 34-2016 Designation and Safety Classification of Refrigerants-ASHRAE Standard 34-2016
ASHRAE 52.2	(2012) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE 62.1	(2010) Ventilation for Acceptable Indoor Air Quality
ASHRAE 68	(1997) Laboratory Method of Testing to Determine the Sound Power In a Duct
ASHRAE 70	(2006; R 2011) Method of Testing for Rating the Performance of Air Outlets and Inlets
ASHRAE 84	(2020) Method of Testing Air-to-Air Heat Exchangers
ASHRAE 90.1 - IP	(2013) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A13.1	(2020) Scheme for the Identification of Piping Systems

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A123/A123M	(2017) Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A924/A924M	(2020) Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B75/B75M	(2020) Standard Specification for Seamless Copper Tube
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM B152/B152M	(2019) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B209	(2014) Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B280	(2020) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B766	(1986; R 2015) Standard Specification for Electrodeposited Coatings of Cadmium
ASTM C553	(2013; R 2019) Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C916	(2020) Standard Specification for Adhesives for Duct Thermal Insulation
ASTM C1071	(2019) Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM D520	(2000; R 2011) Zinc Dust Pigment
ASTM D1654	(2008; R 2016; E 2017) Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D1785	(2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120

ASTM D2466	(2017) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2564	(2012) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D2855	(2015) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D3359	(2017) Standard Test Methods for Rating Adhesion by Tape Test
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM E2016	(2020) Standard Specification for Industrial Woven Wire Cloth

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH (CDPH)

CDPH SECTION 01350	(2010; Version 1.1) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers

GERMAN INSTITUTE FOR STANDARDIZATION (DIN)

DIN EN 14037	(2016) Free Hanging Heating and Cooling Surfaces for Water with a Temperature Below 120 Degrees C - Part 1: Pre-Fabricated Ceiling Mounted Radiant Panels for Space Heating
DIN EN 14240	(2004) Ventilation for Buildings

INSTITUTE OF ENVIRONMENTAL SCIENCES AND TECHNOLOGY (IEST)

IEST RP-CC-001	(2016; Rev 6) HEPA and ULPA Filters

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA MG 1	(2018) Motors and Generators
NEMA MG 10	(2017) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 96	(2021) Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
NFPA 701	(2019) Standard Methods of Fire Tests for Flame Propagation of Textiles and Films

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA 1403	(2008) Accepted Industry Practice for Industrial Duct Construction, 2nd Edition
SMACNA 1819	(2002) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems, 5th Edition
SMACNA 1966	(2005) HVAC Duct Construction Standards Metal and Flexible, 3rd Edition
SMACNA 1972 CD	(2012) HVAC Air Duct Leakage Test Manual - 2nd Edition
SMACNA 1981	(2008) Seismic Restraint Manual Guidelines for Mechanical Systems, 3rd Edition

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

SCAQMD Rule 1168	(2017) Adhesive and Sealant Applications

U.S. DEPARTMENT OF ENERGY FEDERAL ENERGY MANAGEMENT PROGRAM (FEMP)

PL-109-58	(1992; R 2005) Energy Efiicient Procument Requirements

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

40 CFR 82	Protection of Stratospheric Ozone

UNDERWRITERS LABORATORIES (UL)

UL 6	(2007; Reprint Sep 2019) UL Standard for Safety Electrical Rigid Metal Conduit-Steel
UL 94	(2013; Reprint Jun 2020) UL Standard for Safety Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 181	(2013; Reprint Apr 2017) UL Standard for

	Safety Factory-Made Air Ducts and Air Connectors
UL 555	(2006; Reprint Aug 2016) UL Standard for Safety Fire Dampers
UL 586	(2009; Reprint Dec 2017) UL Standard for Safety High-Efficiency Particulate, Air Filter Units
UL 705	(2017; Reprint Oct 2018) UL Standard for Safety Power Ventilators
UL 723	(2018) UL Standard for Safety Test for Surface Burning Characteristics of Building Materials
UL 900	(2015) Standard for Air Filter Units
UL 1995	(2015) UL Standard for Safety Heating and Cooling Equipment
UL 2021	(2015; Reprint Dec 2016) UL Standard for Safety Fixed and Location-Dedicated Electric Room Heaters
UL Bld Mat Dir	(updated continuously online) Building Materials Directory
UL Electrical Construction	(2012) Electrical Construction Equipment Directory
UL Fire Resistance	(2014) Fire Resistance Directory

1.2 SYSTEM DESCRIPTION

Furnish ductwork, piping offsets, fittings, and accessories as required to provide a complete installation. Coordinate the work of the different trades to avoid interference between piping, equipment, structural, and electrical work. Provide complete, in place, all necessary offsets in piping and ductwork, and all fittings, and other components, required to install the work as indicated and specified.

1.2.1 Mechanical Equipment Identification

The number of charts and diagrams must be equal to or greater than the number of mechanical equipment rooms. Where more than one chart or diagram per space is required, mount these in edge pivoted, swinging leaf, extruded aluminum frame holders which open to 170 degrees.

1.2.1.1 Charts

Provide chart listing of equipment by designation numbers and capacities such as flow rates, pressure and temperature differences, heating and cooling capacities, horsepower, pipe sizes, and voltage and current characteristics.

1.2.1.2 Diagrams

Submit proposed diagrams, at least 2 weeks prior to start of related testing. provide neat mechanical drawings provided with extruded aluminum frame under 1/8-inch glass or laminated plastic, system diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system. After approval, post these items where directed.

1.2.2 Service Labeling

Label equipment, including fans, air handlers, terminal units, etc. with labels made of self-sticking, plastic film designed for permanent installation. Provide labels in accordance with the typical examples below:

SERVICE	LABEL AND TAG DESIGNATION
Air handling unit Number	AHU -
Control and instrument air	CONTROL AND INSTR.
Exhaust Fan Number	EF -
VAV Box Number	VAV -
Fan Coil Unit Number	FC -
Terminal Box Number	TB -
Unit Ventilator Number	UV -

Identify similar services with different temperatures or pressures. Where pressures could exceed 125 pounds per square inch, gage, include the maximum system pressure in the label. Label and arrow piping in accordance with the following:

a. Each point of entry and exit of pipe passing through walls.

b. Each change in direction, i.e., elbows, tees.

c. In congested or hidden areas and at all 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 not to exceed 75 feet. All labels must be visible and legible from the primary service and operating area.

For Bare or Insulated Pipes	
for Outside Diameters of	Lettering
1/2 thru 1-3/8 inch	1/2 inch
1-1/2 thru 2-3/8 inch	3/4 inch
2-1/2 inch and larger	1-1/4 inch

1.2.3 Color Coding

Color coding of all piping systems must be in accordance with ASME A13.1 .

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control. When used, a code following the "G" classification 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

Detail Drawings; G

SD-03 Product Data

Metallic Flexible Duct

Insulated Nonmetallic Flexible Duct Runouts

Duct Connectors

Duct Access Doors; G

Fire Dampers

Manual Balancing Dampers; G

Sound Attenuation Equipment

Acoustical Duct Liner

Diffusers

Registers and Grilles

Louvers

Air Vents, Penthouses, and Goosenecks

Centrifugal Fans

In-Line Centrifugal Fans

Axial Flow Fans

Panel Type Power Wall Ventilators

Centrifugal Type Power Wall Ventilators

Centrifugal Type Power Roof Ventilators

Propeller Type Power Roof Ventilators

Air-Curtain Fans

Ceiling Exhaust Fans

PL-109-58 label for ceiling exhaust fan product; S

Air Handling Units; G

Room Fan-Coil Units; G

Coil Induction Units; G

Constant Volume, Single Duct Terminal Units; G

Variable Volume, Single Duct Terminal Units; G

Variable Volume, Single Duct, Fan-Powered Terminal Units; G

Dual Duct Terminal Units; G

Ceiling Induction Terminal Units; G

Reheat Units; G

Unit Ventilators

Energy Recovery Devices; G

Hydronic Modular Panels; G

Prefabricated Radiant-Heating Electric Panels; G

Test Procedures

Diagrams; G

Indoor Air Quality for Duct Sealants; S

SD-06 Test Reports

Performance Tests; G

Damper Acceptance Test; G

SD-07 Certificates

Ozone Depleting Substances Technician Certification

SD-08 Manufacturer's Instructions

Manufacturer's Installation Instructions

Operation and Maintenance Training

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals; G

Fire Dampers; G

Manual Balancing Dampers; G

Centrifugal Fans; G

In-Line Centrifugal Fans; G

Axial Flow Fans; G

Panel Type Power Wall Ventilators; G

Centrifugal Type Power Wall Ventilators; G

Centrifugal Type Power Roof Ventilators; G

Propeller Type Power Roof Ventilators; G

Air-Curtain Fans; G

Ceiling Exhaust Fans; G

Air Handling Units; G

Room Fan-Coil Units; G

Coil Induction Units; G

Constant Volume, Single Duct Terminal Units; G

Variable Volume, Single Duct Terminal Units; G

Variable Volume, Single Duct, Fan-Powered Terminal Units; G

Dual Duct Terminal Units; G

Ceiling Induction Terminal Units; G

Reheat Units; G

Unit Ventilators; G

Energy Recovery Devices; G

Hydronic Modular Panels; G

Prefabricated Radiant-Heating Electric Panels; G

SD-11 Closeout Submittals

Indoor Air Quality During Construction; S

1.4 QUALITY ASSURANCE

Except as otherwise specified, approval of materials and equipment is based on manufacturer's published data.

a. Where materials and equipment are specified to conform to the standards of the Underwriters Laboratories, the label of or listing with reexamination in UL Bld Mat Dir, and UL 6 is acceptable as sufficient evidence that the items conform to Underwriters Laboratories requirements. In lieu of such label or listing, submit a written certificate from any nationally recognized testing agency, adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the specified requirements. Outline methods of testing used by the specified agencies.

b. Where materials or equipment are specified to be constructed or tested, or both, in accordance with the standards of the ASTM International (ASTM), the ASME International (ASME), or other standards, a manufacturer's certificate of compliance of each item is acceptable as proof of compliance.

c. Conformance to such agency requirements does not relieve the item from compliance with other requirements of these specifications.

d. Where products are specified to meet or exceed the specified energy efficiency requirement of FEMP-designated or ENERGY STAR covered product categories, equipment selected must have as a minimum the efficiency rating identified under "Energy-Efficient Products" at http://femp.energy.gov/procurement.

1.4.1 Prevention of Corrosion

Protect metallic materials against corrosion. Provide rust-inhibiting treatment and standard finish for the equipment enclosures. Do not use aluminum in contact with earth, and where connected to dissimilar metal. Protect aluminum by approved fittings, barrier material, or treatment. Provide hot-dip galvanized ferrous parts such as anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous parts not of corrosion-resistant steel or nonferrous materials in accordance with ASTM A123/A123M for exterior locations and cadmium-plated in conformance with ASTM B766 for interior locations.

1.4.2 Asbestos Prohibition

Do not use asbestos and asbestos-containing products.

1.4.3 Ozone Depleting Substances Technician Certification

All technicians working on equipment that contain ozone depleting

refrigerants must be certified as a Section 608 Technician to meet requirements in 40 CFR 82, Subpart F. Provide copies of technician certifications to the Contracting Officer at least 14 calendar days prior to work on any equipment containing these refrigerants.

1.4.4 Detail Drawings

Submit detail drawings showing equipment layout, including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications. Include any information required to demonstrate that the system has been coordinated and functions properly as a unit on the drawings and show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Submit drawings showing bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Submit function designation of the equipment and any other requirements specified throughout this Section with the shop drawings.

1.4.5 Test Procedures

Conduct performance tests as required in Section 23 05 93 Testing, Adjusting and Balancing for HVAC and Section 23 09 00 Instrumentation and Control for HVAC.

1.5 DELIVERY, STORAGE, AND HANDLING

Protect stored equipment at the jobsite from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, cap or plug all pipes until installed.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Provide components and equipment that are "standard products" of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. "Standard products" is defined as being in satisfactory commercial or industrial use for 2 years before bid opening, including applications of components and equipment under similar circumstances and of similar size, satisfactorily completed by a product that is sold on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record are acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. Provide equipment items that are supported by a service organization. In product categories covered by ENERGY STAR or the Federal Energy Management Program, provide equipment that is listed on the ENERGY STAR Qualified Products List or that meets or exceeds the FEMP-designated Efficiency Requirements.

2.2 IDENTIFICATION PLATES

In addition to standard manufacturer's identification plates, provide engraved laminated phenolic identification plates for each piece of mechanical equipment. Identification plates are to designate the function of the equipment. Submit designation with the shop drawings. Provide

identification plates that are layers, black-white-black, engraved to show white letters on black background. Letters must be upper case. Identification plates that are 1-1/2-inches high and smaller must be 1/16-inch thick, with engraved lettering 1/8-inch high; identification plates larger than 1-1/2-inches high must be 1/8-inch thick, with engraved lettering of suitable height. Identification plates 1-1/2-inches high and larger must have beveled edges. Install identification plates using a compatible adhesive.

2.3 EQUIPMENT GUARDS AND ACCESS

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact according to OSHA requirements. Properly guard or cover with insulation of a type specified, high temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard.

2.4 ELECTRICAL WORK

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00INTERIOR DISTRIBUTION SYSTEM. Provide manual or automatic control and protective or signal devices required for the operation specified and control wiring required for controls and devices specified, but not shown. For packaged equipment, include manufacturer provided controllers with the required monitors and timed restart.

b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11. Provide premium efficiency type integral size motors in accordance with NEMA MG 1.

c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system , and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1. Select premium efficiency polyphase motors in accordance with NEMA MG 10.

d. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Provide motors rated for continuous duty with the enclosure specified. Provide motor duty that allows for maximum frequency start-stop operation and minimum encountered interval between start and stop. Provide motor torque capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Provide motor starters complete with thermal overload protection and other necessary appurtenances. Fit motor bearings with grease supply fittings and grease relief to outside of the enclosure.

e. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers are allowed to accomplish the same function. Use solid-state variable-speed controllers for motors rated 10 hp or less and adjustable frequency drives for larger motors.

Provide variable frequency drives for motors as specified in Section 26 29 23 ADJUSTABLE SPEED DRIVE SYSTEMS UNDER 600 VOLTS.

2.5 ANCHOR BOLTS

Provide anchor bolts for equipment placed on concrete equipment pads or on concrete slabs. Bolts to be of the size and number recommended by the equipment manufacturer and located by means of suitable templates. Installation of anchor bolts must not degrade the surrounding concrete.

2.6 SEISMIC ANCHORAGE

Anchor equipment in accordance with applicable seismic criteria for the area and as defined in SMACNA 1981

2.7 PAINTING

Paint equipment units in accordance with approved equipment manufacturer's standards unless specified otherwise. Field retouch only if approved. Otherwise, return equipment to the factory for refinishing.

2.8 INDOOR AIR QUALITY

Provide equipment and components that comply with the requirements of ASHRAE 62.1 unless more stringent requirements are specified herein.

2.9 DUCT SYSTEMS

2.9.1 Metal Ductwork

Provide metal ductwork construction, including all fittings and components, that complies with SMACNA 1966, as supplemented and modified by this specification .

b. Provide radius type elbows with a centerline radius of 1.5 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes are allowed.

c. Provide ductwork that meets the requirements of Seal Class A. Provide ductwork in VAV systems upstream of the VAV boxes that meets the requirements of Seal Class A.

e. Provide sealants that conform to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS and are suitable for the range of air distribution and ambient temperatures to which it is exposed. Do not use pressure sensitive tape as a sealant. Provide duct sealant products that meet either emissions requirements of CDPH SECTION 01350 (limit requirements for either office or classroom spaces regardless of space type) or VOC content requirements of SCAQMD Rule 1168 (HVAC duct sealants are classified as "Other" within the SCAQMD Rule 1168 sealants table). Provide validation of indoor air quality for duct sealants.

f. Make spiral lock seam duct, and flat oval with duct sealant and lock

with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA 1966. Apply the sealant to the exposed male part of the fitting collar so that the sealer is on the inside of the joint and fully protected by the metal of the duct fitting. Apply one brush coat of the sealant over the outside of the joint to at least 2 inch band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar are not acceptable.

g. Fabricate outdoor air intake ducts and plenums with watertight soldered or brazed joints and seams.

2.9.1.1 Metallic Flexible Duct

a. Provide duct that conforms to UL 181 and NFPA 90A with factory-applied insulation, vapor barrier, and end connections. Provide duct assembly that does not exceed 25 for flame spread and 50 for smoke developed. Provide ducts designed for working pressures of 2 inches water gauge positive and 1.5 inches water gauge negative. Provide flexible round duct length that does not exceed 5 feet. Secure connections by applying adhesive for 2 inches over rigid duct, apply flexible duct 2 inches over rigid duct, apply metal clamp, and provide minimum of three No. 8 sheet metal screws through clamp and rigid duct.

b. Inner duct core: Provide interlocking spiral or helically corrugated flexible core constructed of zinc-coated steel, aluminum, or stainless steel; or constructed of inner liner of continuous galvanized spring steel wire helix fused to continuous, fire-retardant, flexible vapor barrier film, inner duct core.

c. Insulation: Provide inner duct core that is insulated with mineral fiber blanket type flexible insulation, minimum of 1 inch thick. Provide insulation covered on exterior with manufacturer's standard fire retardant vapor barrier jacket for flexible round duct.

2.9.1.2 Insulated Nonmetallic Flexible Duct Runouts

Use flexible duct runouts only where indicated. Runout length is indicated on the drawings, and is not to exceed 5 feet. Provide runouts that are preinsulated, factory fabricated, and that comply with NFPA 90A and UL 181. Provide either field or factory applied vapor barrier. Provide not less than 20 ounce glass fabric duct connectors coated on both sides with neoprene. Where coil induction or high velocity units are supplied with vertical air inlets, use a streamlined, vaned and mitered elbow transition piece for connection to the flexible duct or hose. Provide a die-stamped elbow and not a flexible connector as the last elbow to these units other than the vertical air inlet type. Insulated flexible connectors are allowed as runouts. Provide insulated material and vapor barrier that conform to the requirements of Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Do not expose the insulation material surface to the air stream.

2.9.1.3 General Service Duct Connectors

Provide a flexible duct connector approximately 6 inches in width where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, secure the flexible material by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, install the flexible material locked to metal collars using normal duct construction methods. Provide a composite connector

system that complies with NFPA 701 and is classified as "flame-retardent fabrics" in UL Bld Mat Dir.

2.9.1.4 High Temperature Service Duct Connections

Provide material that is approximately 3/32 inch thick, 35 to 40-ounce per square yard weight, plain weave fibrous glass cloth with, nickel/chrome wire reinforcement for service in excess of 1200 degrees F.

2.9.1.5 Aluminum Ducts

ASTM B209, alloy 3003-H14 for aluminum sheet and alloy 6061-T6 or equivalent strength for aluminum connectors and bar stock.

2.9.1.6 Copper Sheets

ASTM B152/B152M, light cold rolled temper.

2.9.1.7 Corrosion Resisting (Stainless) Steel Sheets

ASTM A167

2.9.2 Duct Access Doors

Provide hinged access doors conforming to SMACNA 1966 in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system. Provide access doors upstream and downstream of air flow measuring primaries and heating and cooling coils. Provide doors that are a minimum 15 by 18 inches, unless otherwise shown. Where duct size does not accommodate this size door, make the doors as large as practicable. Equip doors 24 by 24 inches or larger with fasteners operable from inside and outside the duct. Use insulated type doors in insulated ducts.

2.9.3 Fire Dampers

Use 1.5 hour rated fire dampers unless otherwise indicated. Provide fire dampers that conform to the requirements of NFPA 90A and UL 555. Perform the fire damper test as outlined in NFPA 90A. Provide a pressure relief door upstream of the fire damper. If the ductwork connected to the fire damper is to be insulated then provide a factory installed pressure relief damper. Provide automatic operating fire dampers with a dynamic rating suitable for the maximum air velocity and pressure differential to which it is subjected. Provide fire dampers approved for the specific application, and install according to their listing. Equip fire dampers with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, does not impair the operation of the damper. Equip sleeves or frames with perimeter mounting angles attached on both sides of the wall or floor opening. Construct ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies in conformance with UL Fire Resistance. Provide curtain type with damper blades or single blade type or multi-blade type fire dampers. Install dampers that do not reduce the duct or the air transfer opening cross-sectional area. Install dampers so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, comply with the installation details given in SMACNA 1819 and in manufacturer's instructions for fire

dampers. Perform acceptance testing of fire dampers according to paragraph Fire Damper Acceptance Test and NFPA 90A.

2.9.4 Manual Balancing Dampers

Furnish manual balancing dampers with accessible operating mechanisms. Use chromium plated operators (with all exposed edges rounded) in finished portions of the building. Provide manual volume control dampers that are operated by locking-type quadrant operators. Install dampers that are 2 gauges heavier than the duct in which installed. Unless otherwise indicated, provide opposed blade type multileaf dampers with maximum blade width of 12 inches. Provide access doors or panels for all concealed damper operators and locking setscrews. Provide stand-off mounting brackets, bases, or adapters not less than the thickness of the insulation when the locking-type quadrant operators for dampers are installed on ducts to be thermally insulated, to provide clearance between the duct surface and the operator. Provide stand-off mounting items that are integral with the operator or standard accessory of the damper manufacturer.

2.9.5 Air Supply And Exhaust Air Dampers

Provide outdoor air supply and exhaust air dampers that have a maximum leakage rate when tested in accordance with AMCA 500-D as required by ASHRAE 90.1 - IP, including maximum Damper Leakage for:

a. Climate Zones 1,2,6,7,8 the maximum damper leakage at 1.0 inch w.g. for motorized dampers is 4 cfm per square foot of damper area and non-motorized dampers are not allowed.

b. All other Climate Zones the maximum damper leakage at 1.0 inch w.g. is 10 cfm per square foot and for non-motorized dampers is 20 cfm per square foot of damper area.

Dampers smaller than 24 inches in either direction may have leakage of 40 cfm per square foot.

2.9.6 Air Deflectors (Volume Extractors) and Branch Connections

Provide air deflectors (volume extractors) at all duct mounted supply outlets, at takeoff or extension collars to supply outlets, at duct branch takeoff connections, and at 90 degree elbows, as well as at locations as indicated on the drawings or otherwise specified. Conical branch connections or 45 degree entry connections are allowed in lieu of deflectors for branch connections. Furnish all air deflectors (volume extractors), except those installed in 90 degree elbows, with an approved means of adjustment. Provide easily accessible means for adjustment inside the duct or from an adjustment with sturdy lock on the face of the duct. When installed on ducts to be thermally insulated, provide external adjustments with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Provide factory-fabricated air deflectors consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Provide factory or field assembled air deflectors (volume extractors). Make adjustment from the face of the diffuser or by position adjustment and lock external to the duct. Provide stand-off brackets on insulated ducts as described herein. Provide fixed air deflectors (volume extractors), also called

turning vanes, in 90 degree elbows.

2.9.7 Plenums and Casings for Field-Fabricated Units

2.9.7.1 Plenum and Casings

Fabricate and erect plenums and casings as shown in SMACNA 1966, as applicable. Construct system casing of not less than 16 gauge galvanized sheet steel. Furnish cooling coil drain pans with 1 inch threaded outlet to collect condensation from the cooling coils. Fabricate drain pans from not lighter than 16 gauge steel, galvanized after fabrication or of 18 gauge corrosion-resisting sheet steel conforming to ASTM A167, Type 304, welded and stiffened. Thermally insulate drain pans exposed to the atmosphere to prevent condensation. Coat insulation with a flame resistant waterproofing material. Provide separate drain pans for each vertical coil section, and a separate drain line for each pan. Size pans to ensure capture of entrained moisture on the downstream-air side of the coil. Seal openings in the casing, such as for piping connections, to prevent air leakage. Size the water seal for the drain to maintain a pressure of at least 2 inch water gauge greater than the maximum negative pressure in the coil space.

2.9.7.2 Casing

Terminate casings at the curb line and bolt each to the curb using galvanized angle, as indicated in SMACNA 1966.

2.9.7.3 Access Doors

Provide access doors in each section of the casing. Weld doorframes in place, gasket each door with neoprene, hinge with minimum of two brass hinges, and fasten with a minimum of two brass tension fasteners operable from inside and outside of the casing. Where possible, make doors 36 by 18 inches and locate them 18 inches above the floor. Where the space available does not accommodate doors of this size, use doors as large as the space accommodates. Swing doors so that fan suction or pressure holds doors in closed position, airtight. Provide a push-button station, located inside the casing, to stop the supply.

2.9.7.4 Factory-Fabricated Insulated Sheet Metal Panels

Factory-fabricated components are allowed for field-assembled units, provided all requirements specified for field-fabricated plenums and casings are met. Provide panels of modular design, pretested for structural strength, thermal control, condensation control, and acoustical control. Seal and insulate panel joints. Provide and gasket access doors to prevent air leakage. Provide panel construction that is not less than 20 gauge galvanized sheet steel, assembled with fasteners treated against corrosion. Provide standard length panels that deflect not more than 1/2 inch under operation. Construct details, including joint sealing, not specifically covered, as indicated in SMACNA 1966. Construct the plenums and casings to withstand the specified internal pressure of the air systems.

2.9.7.5 Duct Liner

Unless otherwise specified, duct liner is not permitted.

2.9.8 Sound Attenuation Equipment

2.9.8.1 Systems with total pressure above 4 Inches Water Gauge

Provide sound attenuators on the discharge duct of each fan operating at a total pressure above 4 inch water gauge, and, when indicated, at the intake of each fan system. Provide sound attenuators elsewhere as indicated. Provide factory fabricated sound attenuators, tested by an independent laboratory for sound and performance characteristics. Provide a net sound reduction as indicated. Maximum permissible pressure drop is not to exceed 0.63 inch water gauge. Construct traps to be airtight when operating under an internal static pressure of 10 inch water gauge. Provide air-side surface capable of withstanding air velocity of 10,000 fpm. Certify that the equipment can obtain the sound reduction values specified after the equipment is installed in the system and coordinated with the sound information of the system fan to be provided. Provide sound absorbing material conforming to ASTM C1071, Type I or II. Provide sound absorbing material that meets the fire hazard rating requirements for insulation specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. For connection to ductwork, provide a duct transition section. Factory fabricated double-walled internally insulated spiral lock seam and round duct and fittings designed for high pressure air system can be provided if complying with requirements specified for factory fabricated sound attenuators, in lieu of factory fabricated sound attenuators. Construct the double-walled duct and fittings from an outer metal pressure shell of zinc-coated steel sheet, 1 inch thick acoustical blanket insulation, and an internal perforated zinc-coated metal liner. Provide a sufficient length of run to obtain the noise reduction coefficient specified. Certify that the sound reduction value specified can be obtained within the length of duct run provided. Provide welded or spiral lock seams on the outer sheet metal of the double-walled duct to prevent water vapor penetration. Provide duct and fittings with an outer sheet that conforms to the metal thickness of high-pressure spiral and round ducts and fittings shown in SMACNA 1966. Provide acoustical insulation with a thermal conductivity "k" of not more than 0.27 Btu/inch/square foot/hour/degree F at 75 degrees F mean temperature. Provide an internal perforated zinc-coated metal liner that is not less than 24 gauge with perforations not larger than 1/4 inch in diameter providing a net open area not less than 10 percent of the surface.

2.9.8.2 System with total pressure of 4 Inch Water Gauge and Lower

Use sound attenuators only where indicated. Provide factory fabricated sound attenuators that are constructed of galvanized steel sheets. Provide attenuator with outer casing that is not less than 22 gauge. Provide fibrous glass acoustical fill. Provide net sound reduction indicated. Obtain values on a test unit not less than 24 by 24 inches outside dimensions made by a certified nationally recognized independent acoustical laboratory. Provide air flow capacity as indicated or required. Provide pressure drop through the attenuator that does not exceed the value indicated, or that is not in excess of 15 percent of the total external static pressure of the air handling system, whichever is less. Acoustically test attenuators with metal duct inlet and outlet sections while under the rated air flow conditions. Include with the noise reduction data the effects of flanking paths and vibration transmission. Construct sound attenuators to be airtight when operating at the internal static pressure indicated or specified for the duct system, but in no case less than 2 inch water gauge.

2.9.8.3 Acoustical Duct Liner

Use fibrous glass designed or flexible elastomeric duct liner for lining ductwork and conforming to the requirements of ASTM C1071, Type I and II. Provide uniform density, graduated density, or dual density liner composition, as standard with the manufacturer. Provide not less than 1 inch thick coated lining. Where acoustical duct liner is used, provide the thermal equivalent of the insulation specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS for liner or combination of liner and insulation applied to the exterior of the ductwork. Increase duct sizes shown to compensate for the thickness of the lining used. In lieu of sheet metal duct with field-applied acoustical lining, provide acoustically equivalent lengths of fibrous glass duct, elastomeric duct liner or factory fabricated double-walled internally insulated duct with perforated liner.

2.9.9 Diffusers, Registers, and Grilles

Provide factory-fabricated units of steel that distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 50 fpm in occupied zone, or dead spots anywhere in the conditioned area. Provide outlets for diffusion, spread, throw, and noise level as required for specified performance. Certify performance according to ASHRAE 70. Provide sound rated and certified inlets and outlets according to ASHRAE 70. Provide sound power level as indicated. Provide diffusers and registers with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device is acceptable. Provide opposed blade type volume dampers for all diffusers and registers, except linear slot diffusers. Provide linear slot diffusers with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 7 feet above the floor, protect them by a grille or screen according to NFPA 90A.

2.9.9.1 Diffusers

Provide diffuser types indicated. Furnish ceiling mounted units with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Provide diffusers with air deflectors of the type indicated. Provide air handling troffers or combination light and ceiling diffusers conforming to the requirements of UL Electrical Construction for the interchangeable use as cooled or heated air supply diffusers or return air units. Install ceiling mounted units with rims tight against ceiling. Provide sponge rubber gaskets between ceiling and surface mounted diffusers for air leakage control. Provide suitable trim for flush mounted diffusers. For connecting the duct to diffuser, provide duct collar that is airtight and does not interfere with volume controller. Provide return or exhaust units that are similar to supply diffusers.

2.9.9.2 Registers and Grilles

Provide units that are four-way directional-control type, except provide return and exhaust registers that are fixed horizontal or vertical louver type similar in appearance to the supply register face. Furnish registers with sponge-rubber gasket between flanges and wall or ceiling. Install wall supply registers at least 6 inches below the ceiling unless otherwise indicated. Locate return and exhaust registers 6 inches above the floor unless otherwise indicated. Achieve four-way directional control by a

grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Provide grilles as specified for registers, without volume control damper.

2.9.10 Louvers

Provide louvers for installation in exterior walls that are associated with the air supply and distribution system as specified in Section 07 60 00 FLASHING AND SHEET METAL .

2.9.11 Air Vents, Penthouses, and Goosenecks

Fabricate air vents, penthouses, and goosenecks from galvanized steel or aluminum sheets with galvanized or aluminum structural shapes. Provide sheet metal thickness, reinforcement, and fabrication that conform to SMACNA 1966. Accurately fit and secure louver blades to frames. Fold or bead edges of louver blades for rigidity and baffle these edges to exclude driving rain. Provide air vents, penthouses, and goosenecks with bird screen.

2.9.12 Bird Screens and Frames

Provide bird screens that conform to ASTM E2016, No. 2 mesh, aluminum or stainless steel. Provide "medium-light" rated aluminum screens. Provide "light" rated stainless steel screens. Provide removable type frames fabricated from either stainless steel or extruded aluminum.

2.9.13 Radon Exhaust Ductwork

Fabricate radon exhaust ductwork installed in or beneath slabs from Schedule 40 PVC pipe that conforms to ASTM D1785. Provide fittings that conform to ASTM D2466. Use solvent cement conforming to ASTM D2564 to make joints. Otherwise provide metal radon exhaust ductwork as specified herein.

2.10 AIR SYSTEMS EQUIPMENT

2.10.1 Fans

Test and rate fans according to AMCA 210. Calculate system effect on air moving devices in accordance with AMCA 201 where installed ductwork differs from that indicated on drawings. Install air moving devices to minimize fan system effect. Where system effect is unavoidable, determine the most effective way to accommodate the inefficiencies caused by system effect on the installed air moving device. The sound power level of the fans must not exceed 85 dBA when tested according to AMCA 300 and rated in accordance with AMCA 301. Provide all fans with an AMCA seal. Connect fans to the motors either directly or indirectly with V-belt drive. Use V-belt drives designed for not less than 150 percent of the connected driving capacity. Provide variable pitch motor sheaves for 15 hp and below, and fixed pitch as defined by AHRI Guideline D (A fixed-pitch sheave is provided on both the fan shaft and the motor shaft. This is a non-adjustable speed drive.). Select variable pitch sheaves to drive the fan at a speed which can produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, provide a replaceable sheave when needed to achieve system air balance. Provide motors for V-belt drives with adjustable rails or bases. Provide removable metal guards for all exposed V-belt drives, and provide speed-test openings at the center of all rotating shafts. Provide

fans with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Provide fan and motor assemblies with vibration-isolation supports or mountings as indicated. Use vibration-isolation units that are standard products with published loading ratings. Select each fan to produce the capacity required at the fan static pressure indicated. Provide sound power level as indicated. Obtain the sound power level values according to AMCA 300. Provide standard AMCA arrangement, rotation, and discharge as indicated. Provide power ventilators that conform to UL 705 and have a UL label.

2.10.1.1 Centrifugal Fans

Provide fully enclosed, single-width single-inlet, or double-width double-inlet centrifugal fans, with AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Provide impeller wheels that are rigidly constructed and accurately balanced both statically and dynamically. . Provide fan wheels over 36 inches in diameter with overhung pulleys and a bearing on each side of the wheel. Provide fan wheels 36 inches or less in diameter that have one or more extra long bearings between the fan wheel and the drive. Provide sleeve type, self-aligning and self-oiling bearings with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Connect grease fittings to tubing for serviceability from a single accessible point. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide steel, accurately finished fan shafts, with key seats and keys for impeller hubs and fan pulleys. Provide fan outlets of ample proportions, designed for the attachment of angles and bolts for attaching flexible connections. Provide automatically operated inlet vanes on suction inlets. Provide automatically operated outlet dampers. Unless otherwise indicated, provide motors that do not exceed 1800 rpm and have open enclosures.

2.10.1.2 In-Line Centrifugal Fans

Provide in-line fans with centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Mount fans in a welded tubular casing. Provide a fan that axially flows the air in and out. Streamline inlets with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Enclose and isolate fan bearings and drive shafts from the air stream. Provide precision, self aligning ball or roller type fan bearings that are sealed against dust and dirt and are permanently lubricated. Provide L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11.

2.10.1.3 Axial Flow Fans

Provide axial flow fans complete with drive components and belt guard, with steel housing, cast fan wheel, cast or welded steel diffusers, fan shaft, bearings, and mounting frame as a factory-assembled unit. Provide fan wheels that are dynamically balanced and keyed to the fan shaft, with radially projecting blades of airfoil cross-section. Enclose and isolate fan bearings and drive shafts from the air stream. Permanently lubricate fan bearings or provide them with accessible grease fittings. Provide precision self-aligning ball or roller type fan bearings that are sealed against dust and dirt. Provide fan bearings that have a L50 rated bearing life at not less than 200,000 hours of operation as defined by ABMA 9 and

ABMA 11. Provide fan inlets with an aerodynamically shaped bell and an inlet cone. Install diffuser or straightening vanes at the fan discharge to minimize turbulence and provide smooth discharge air flow. Furnish fan unit with inlet and outlet flanges, inlet screen, duct equalizer section, and automatic operation adjustable inlet vanes.

2.10.1.4 Panel Type Power Wall Ventilators

Provide propeller type fans, assembled on a reinforced metal panel with venturi opening spun into panel. Provide direct or V-belt driven fans with wheels less than 24 inches in diameter and provide V-belt driven fans with wheels 24 inches in diameter and larger. Provide fans with wall mounting collar. Provide lubricated bearings. Equip fans with wheel and motor side metal or wire guards which have a corrosion-resistant finish. Provide dripproof type motor enclosure. Install motor operated backdraft dampers where indicated.

2.10.1.5 Centrifugal Type Power Wall Ventilators

Provide direct or V-belt driven centrifugal type fans with backward inclined, non-overloading wheel. Provide removable and weatherproof motor housing. Provide unit housing that is designed for sealing to building surface and for discharge and condensate drippage away from building surface. Construct housing of heavy gauge aluminum. Equip unit with an aluminum or plated steel wire discharge bird screen, disconnect switch, anodized aluminum wall grille, manufacturer's standard motor-operated damper, an airtight and liquid-tight metallic wall sleeve. Provide totally enclosed fan cooled type motor enclosure. Use only lubricated bearings.

2.10.1.6 Centrifugal Type Power Roof Ventilators

Provide direct or V-belt driven centrifugal type fans with backward inclined, non-overloading wheel. Provide hinged or removable and weatherproof motor compartment housing, constructed of heavy gauge aluminum. Provide fans with birdscreen, disconnect switch, motorized dampers, and . Provide dripproof type motor enclosure. Provide centrifugal type kitchen exhaust fans according to UL 705, fitted with V-belt drive, round hood, and windband upblast discharge configuration, integral residue trough and collection device, with motor and power transmission components located in outside positively air ventilated compartment. Use only lubricated bearings.

2.10.1.7 Propeller Type Power Roof Ventilators

Provide direct or V-belt driven fans. Provide hinged or removable weathertight fan housing, fitted with framed rectangular base constructed of aluminum or galvanized steel. Provide totally enclosed fan cooled type motors. Furnish motors with nonfusible, horsepower rated, manual disconnect mount on unit. Furnish fans with motor operated dampers, birdscreen. Use only lubricated bearings.

2.10.1.8 Air-Curtain Fans

Provide fans that conform to AMCA 220 with AMCA seal. Furnish air curtains with a weatherproof housing constructed of high impact plastic or minimum 18 gauge rigid welded steel. Provide backward curved, non-overloading, centrifugal type fan wheels, accurately balanced statically and dynamically. Provide motors with totally enclosed fan

cooled enclosures. Provide remote manual type motor starters with weather-resistant enclosure actuated when the doorway served is open. Provide air curtains that attain the air velocities specified within 2 seconds following activation. Provide bird screens at air intake and discharge openings. Provide air curtain unit or a multiple unit installation that is at least as wide as the opening to be protected. Provide the air discharge openings to permit outward adjustment of the discharge air. Place installation and adjust according to the manufacturer's written recommendation. Furnish directional controls on air curtains for service windows for easy clean or convenient removal. Design air curtains to prevent the adjustment of the air velocities specified. Make the interior surfaces of the air curtain units accessible for cleaning. Provide certified test data indicating that the fan can provide the air velocities required when fan is mounted as indicated. Provide air curtains designed as fly fans unless otherwise indicated.

2.10.1.9 Ceiling Exhaust Fans

Provide centrifugal type, direct driven suspended cabinet-type ceiling exhaust fans. Provide fans with acoustically insulated housing. Provide chatter-proof backdraft damper. Provide egg-crate design or louver design integral face grille. Mount fan motors on vibration isolators. Furnish unit with mounting flange for hanging unit from above. Provide U.L. listed fans. Provide PL-109-58 labeled ceiling exhaust fan product. Provide proof of PL-109-58 label for ceiling exhaust fan product.

2.10.2 Coils

Provide fin-and-tube type coils constructed of seamless copper tubes and aluminum or copper fins mechanically bonded or soldered to the tubes... Provide casing and tube support sheets that are not lighter than 16 gauge galvanized steel, formed to provide structural strength. When required, provide multiple tube supports to prevent tube sag. Mount coils for counterflow service. Rate and certify coils to meet the requirements of AHRI 410.

2.10.2.1 Direct-Expansion Coils

Provide suitable direct-expansion coils for the refrigerant involved. Provide refrigerant piping that conforms to ASTM B280 and clean, dehydrate and seal. Provide seamless copper tubing suction headers or seamless or resistance welded steel tube suction headers with copper connections. Provide supply headers that consist of a distributor which distributes the refrigerant through seamless copper tubing equally to all circuits in the coil. Provide circuited tubes to ensure minimum pressure drop and maximum heat transfer. Provide circuiting that permits refrigerant flow from inlet to suction outlet without causing oil slugging or restricting refrigerant flow in coil. Provide field installed coils which are completely dehydrated and sealed at the factory upon completion of pressure tests. Pressure test coils in accordance with UL 1995.

2.10.2.2 Water Coils

Install water coils with a pitch of not less than 1/8 inch/foot of the tube length toward the drain end. Use headers constructed of cast iron, welded steel or copper. Furnish each coil with a plugged vent and drain connection extending through the unit casing. Provide removable water coils with drain pans. Pressure test coils in accordance with UL 1995.

2.10.2.3 Steam Heating Coils

Construct steam coils from cast semisteel, welded steel or copper headers, and copper tubes. Construct headers from cast iron, welded steel or copper. Provide fin tube and header section that float within the casing to allow free expansion of tubing for coils subject to high pressure steam service. Provide each coil with a field or factory installed vacuum breaker. Provide single-tube type coils with tubes not less than 1/2 inch outside diameter, except for steam preheat coils. Provide supply headers that distribute steam evenly to all tubes at the indicated steam pressure. Factory test coils to ensure that, when supplied with a uniform face velocity, temperature across the leaving side is uniform with a maximum variation of no more than 5 percent. Pressure testcoils in accordance with UL 1995.

2.10.2.4 Steam Preheat (Nonfreeze) Coils

Provide steam-distribution-tube type steam (nonfreeze) coils with condensing tubes not less than 1 inch outside diameter for tube lengths 60 inches and over and 1/2 inch outside diameter for tube lengths under 60 inches. Construct headers from cast iron, welded steel, or copper. Provide distribution tubes that are not less than 5/8 inch outside diameter for tube lengths 60 inches and over and 3/8 inch outside diameter for tube lengths under 60 inches with orifices to discharge steam to condensing tubes. Install distribution tubes concentric inside of condensing tubes and hold securely in alignment. Limit maximum length of a single coil to 144 inches. Factory test coils to ensure that, when supplied with a uniform face velocity, temperature across the leaving side is uniform with a maximum variation of no more than 5 percent. Pressure test coils in accordance with UL 1995.

2.10.3 Air Filters

List air filters according to requirements of UL 900, except list high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method under the Label Service to meet the requirements of UL 586.

2.10.3.1 Extended Surface Pleated Panel Filters

Provide 2 inch depth, sectional, disposable type filters of the size indicated with a MERV of 8 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.36 inches water gauge. Provide UL Class 2 filters, and nonwoven cotton and synthetic fiber mat media. Attach a wire support grid bonded to the media to a moisture resistant fiberboard frame. Bond all four edges of the filter media to the inside of the frame to prevent air bypass and increase rigidity.

2.10.3.2 Extended Surface Nonsupported Pocket Filters

Provide 30 inch depth, sectional, replaceable dry media type filters of the size indicated with a MERV of 13 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.45 inches water gauge. Provide UL Class 1 filters. Provide fibrous glass media, supported in the air stream by a wire or non-woven synthetic backing and secured to a galvanized steel metal header. Provide pockets that do not sag or flap at anticipated air flows. Install each filter in a factory preassembled, side access housing or a factory-made sectional frame bank, as indicated.

2.10.3.3 Cartridge Type Filters

Provide 12 inch depth, sectional, replaceable dry media type filters of the size indicated with a MERV of 13 when tested according to ASHRAE 52.2. Provide initial resistance at 500 fpm that does not exceed 0.56 inches, water gauge. Provide UL class 1 filters, and pleated microglass paper media with corrugated aluminum separators, sealed inside the filter cell to form a totally rigid filter assembly. Fluctuations in filter face velocity or turbulent airflow have no effect on filter integrity or performance. Install each filter in a factory preassembled side access housing, or a factory-made sectional frame bank, as indicated.

2.10.3.4 Sectional Cleanable Filters

Provide 1 inch thick cleanable filters. Provide viscous adhesive in 5 gallon containers in sufficient quantity for 12 cleaning operations and not less than one quart for each filter section. Provide one washing and charging tank for every 100 filter sections or fraction thereof; with each washing and charging unit consisting of a tank and single drain rack mounted on legs and drain rack with dividers and partitions to properly support the filters in the draining position.

2.10.3.5 Replaceable Media Filters

Provide the dry-media type replaceable media filters, of the size required to suit the application. Provide filtering media that is not less than 2 inches thick fibrous glass media pad supported by a structural wire grid or woven wire mesh. Enclose pad in a holding frame of not less than 16 gauge galvanized steel, equipped with quick-opening mechanism for changing filter media. Base the air flow capacity of the filter on net filter face velocity not exceeding 300 fpm, with initial resistance of 0.13 inches water gauge. Provide MERV that is not less than when tested according to ASHRAE 52.2.

2.10.3.6 Automatic Renewable Media Filters

Provide the following:

a. Automatic, renewable media filters consisting of a horizontal or vertical traveling curtain of adhesive-coated bonded fibrous glass supplied in convenient roll form, and filter that does not require water supply, sewer connections, adhesive reservoir, or sprinkler equipment as part of the operation and maintenance requirements.

b. Basic frame that is fabricated of not less than 14 gauge galvanized steel, and sectional design filters with each section of each filter fully factory assembled, requiring no field assembly other than setting in place next to any adjacent sections and the installation of media in roll form.

c. Each filter complete with initial loading of filter media drive motor adequate to handle the number of sections involved, and stainless steel control box containing a warning light to indicate media runout, a runout switch, and a Hand-Off-Auto selector switch.

d. Media feed across the filter face in full-face increments automatically controlled as determined by filter pressure differential to provide substantially constant operating resistance to airflow and varying not more than plus or minus 10 percent. Roll or enclose media

in such a way that collected particulates can not re-entrain.

e. Rolls of clean media, no less than 65 feet long, rerolled on disposable spools in the rewind section of the filter after the media has accumulated its design dirt load. Equip rewind section with a compression panel to tightly rewind used media for ease of handling. Provide media made of continuous, bonded fibrous glass material, UL Class 2, that does not compress more than 1/4 inch when subjected to air flow at 500 fpm. Factory charge media with an odorless and flame retardant adhesive which does not flow while in storage nor when subjected to temperatures up to 175 degrees F. Support media on both the leaving and entering air faces. Clean media must have initial resistance that does not exceed 0.18 inch water gauge at its rated velocity of 500 fpm. Set control so that the resistance to air flow is between 0.40-and 0.50 inch water gauge unless otherwise indicated.

f. Dust holding capacity, of 80 percent average arrestance under these operating conditions, when operating at a steady state with an upper operating resistance of 0.50 inch water gauge, that is at least 592 (55) grams of ASHRAE Standard Test Dust per square foot of media area, when tested according to the dynamic testing provisions of ASHRAE 52.2.

g. The horizontal type automatic renewable media filters, when used in conjunction with factory fabricated air handling units, that are dimensionally compatible with the connecting air handling units, and horizontal type filter housings with all exposed surfaces factory insulated internally with 1 inch, 1-1/2 pound density neoprene coated fibrous glass with thermal conductivity not greater than 0.27 Btu/hour/degree F/square foot/inch of thickness.

h. Access doors for horizontal filters with double wall construction as specified for plenums and casings for field-fabricated units in paragraph DUCT SYSTEMS.

2.10.3.7 Electrostatic Filters

Provide the following:

a. The combination dry agglomerator/extended surface, nonsupported pocket electrostatic filters or the combination dry agglomerator/automatic renewable, media (roll) type electrostatic filters, as indicated (except as modified). Supply each dry agglomerator electrostatic air filter with the correct quantity of fully housed power packs and equip with silicon rectifiers, manual reset circuit breakers, low voltage safety cutout, relays for field wiring to remote indication of primary and secondary voltages, with lamps mounted in the cover to indicate these functions locally. Equip power pack enclosure with external mounting brackets, and low and high voltage terminals fully exposed with access cover removed for ease of installation. Furnish interlock safety switches for each access door and access panel that permits access to either side of the filter, so that the filter is de-energized in the event that a door or panel is opened.

b. Ozone generation within the filter that does not exceed five parts per one hundred million parts of air. Locate high voltage insulators in a serviceable location outside the moving air stream or on the clean air side of the unit. Fully expose ionizer wire supports and furnish ionizer wires precut to size and with formed loops at each end to facilitate ionizer wire replacement.

c. Agglomerator cell plates that allow proper air stream entrainment of agglomerates and prevent excessive residual dust build-up, with cells that are open at the top and bottom to prevent accumulation of agglomerates which settle by gravity. Where the dry agglomerator electrostatic filter is indicated to be the automatic renewable media type, provide a storage section that utilizes a horizontal or vertical traveling curtain of adhesive-coated bonded fibrous glass for dry agglomerator storage section service supplied in 65 foot lengths in convenient roll form. Otherwise, provide section construction and roll media characteristics as specified for automatic renewable media filters. Also a dry agglomerator/renewable media combination with an initial air flow resistance, after installation of clean media, that does not exceed 0.25 inch water gauge at 500 fpm face velocity.

d. A MERV of the combination that is not less than 15 when tested according to ASHRAE 52.2 at an average operating resistance of 0.50 inch water gauge. Where the dry agglomerator electrostatic filter is indicated to be of the extended surface nonsupported pocket filter type, provide a storage section as specified for extended surface non-supported pocket filters, with sectional holding frames or side access housings as indicated.

e. A dry agglomerator/extended surface nonsupported pocket filter section combination with initial air flow resistance, after installation of clean filters, that does not exceed 0.65 inch water gauge at 500 fpm face velocity, with a MERV of the combination not less than 16 when tested according to ASHRAE 52.2. Furnish front access filters with full height air distribution baffles and upper and lower mounting tracks to permit the baffles to be moved for agglomerator cell inspection and service. When used in conjunction with factory fabricated air handling units, supply side access housings which have dimensional compatibility.

2.10.3.8 High-Efficiency Particulate Air (HEPA) Filters

Provide HEPA filters that meet the requirements of IEST RP-CC-001 and are individually tested and certified to have an efficiency of not less than 95 percent, and an initial resistance at fpm that does not exceed inches water gauge. Provide filters that are constructed by pleating a continuous sheet of filter medium into closely spaced pleats separated by corrugated aluminum or mineral-fiber inserts, strips of filter medium, or by honeycomb construction of the pleated filter medium. Provide interlocking, dovetailed, molded neoprene rubber gaskets of 5-10 durometer that are cemented to the perimeter of the upstream face of the filter cell sides. Provide self-extinguishing rubber-base type adhesive or other materials conforming to fire hazard classification specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Provide filter cell sides that are 3/4 inch thick exterior grade fire-retardant plywood assembled in a rigid manner. Provide overall cell side dimensions that are correct to 1/16 inch, and squareness that is maintained to within 1/8 inch. Provide holding frames that use spring loaded fasteners or other devices to seal the filter tightly within it and that prevent any bypass leakage around the filter during its installed life. Provide air capacity and the nominal depth of the filter as indicated. Install each filter in a factory preassembled side access housing or a factory-made sectional supporting frame as indicated. Provide prefilters of the type, construction and efficiency indicated.

2.10.3.9 Holding Frames

Fabricate frames from not lighter than 16 gauge sheet steel with rust-inhibitor coating. Equip each holding frame with suitable filter holding devices. Provide gasketed holding frame seats. Make all joints airtight.

2.10.3.10 Filter Gauges

Provide dial type filter gauges, diaphragm actuated draft for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Provide gauges that are at least 3-7/8 inches in diameter, with white dials with black figures, and graduations with a minimum range of 1 inch of water beyond the specified final resistance for the filter bank on which each gauge is applied. Provide each gauge with a screw operated zero adjustment and two static pressure tips with integral compression fittings, two molded plastic vent valves, two 5 foot minimum lengths of 1/4 inch diameter aluminum tubing, and all hardware and accessories for gauge mounting.

2.11 AIR HANDLING UNITS

2.11.1 Field-Fabricated Air Handling Units

Provide built-up units as specified in paragraph DUCT SYSTEMS. Provide fans, coils spray-coil dehumidifiers, and air filters as specified in paragraph AIR SYSTEMS EQUIPMENT for types indicated.

2.11.2 Factory-Fabricated Air Handling Units

Provide single-zone draw-through type or single-zone blow-through type or multizone blow-through type units as indicated. Units must include fans, coils, airtight insulated casing, vibration-isolators, and appurtenances required for specified operation. Provide vibration isolators as indicated. Physical dimensions of each air handling unit must be suitable to fit space allotted to the unit with the capacity indicated. Provide air handling unit that is rated in accordance with AHRI 430 and AHRI certified for cooling.

2.11.2.1 Casings

Provide the following:

a. Design and construct casing with an integral insulated structural galvanized steel frame such that exterior panels are non-load bearing.

b. Individually removable exterior panels with standard tools. Removal must not affect the structural integrity of the unit. Furnish casings with access sections, according to paragraph AIR HANDLING UNITS, inspection doors, and access doors, all capable of opening a minimum of 90 degrees, as indicated.

c. Insulated, fully gasketed, double-wall type inspection and access doors, of a minimum 18 gauge outer and 20 gauge inner panels made of either galvanized steel or corrosion-resisting sheet steel conforming to ASTM A167, Type 304. Provide rigid doors with heavy duty hinges and latches. Inspection doors must be a minimum 12 inches wide by 12 inches high. Access doors must be a minimum 24 inches wide, the full height of the unit casing or a minimum of 6 foot, whichever is less.

Install a minimum 8 by 8 inches sealed glass window suitable for the intended application, in all access doors.

d. Double-wall insulated type drain pan (thickness equal to exterior casing) constructed of 16 gauge galvanized steel , conforming to ASHRAE 62.1. Construct drain pans water tight, treated to prevent corrosion, and designed for positive condensate drainage. When 2 or more cooling coils are used, with one stacked above the other, condensate from the upper coils must not flow across the face of lower coils. Provide intermediate drain pans or condensate collection channels and downspouts, as required to carry condensate to the unit drain pan out of the air stream and without moisture carryover. Construct drain pan to allow for easy visual inspection, including underneath the coil without removal of the coil and to allow complete and easy physical cleaning of the pan underneath the coil without removal of the coil. Provide coils that are individually removable from the casing.

e. Casing insulation that conforms to NFPA 90A. Insulate single-wall casing sections handling conditioned air with not less than 1 inch thick, 1-1/2 pound density coated fibrous glass material having a thermal conductivity not greater than 0.23 Btu/hr-sf-F. Insulate double-wall casing sections handling conditioned air with not less than 2 inches of the same insulation specified for single-wall casings. Foil-faced insulation is not an acceptable substitute for use with double wall casing. Seal double wall insulation completely by inner and outer panels.

f. Factory applied fibrous glass insulation that conforms to ASTM C1071, except that the minimum thickness and density requirements do not apply, and that meets the requirements of NFPA 90A. Make air handling unit casing insulation uniform over the entire casing. Foil-faced insulation is not an acceptable substitute for use on double-wall access doors and inspections doors .

g. Duct liner material, coating, and adhesive that conforms to fire-hazard requirements specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Protect exposed insulation edges and joints where insulation panels are butted with a metal nosing strip or coat to meet erosion resistance requirements of ASTM C1071.

h. A latched and hinged inspection door, in the fan and coil sections. Plus additional inspection doors, access doors and access sections where indicated.

2.11.2.2 Heating and Cooling Coils

Provide coils as specified in paragraph AIR SYSTEMS EQUIPMENT.

2.11.2.3 Air Filters

Provide air filters as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.11.2.4 Fans

Provide the following:

a. Fans that are double-inlet, centrifugal type with each fan in a

separate scroll. Dynamically balance fans and shafts prior to installation into air handling unit, then after it has been installed in the air handling unit, statically and dynamically balance the entire fan assembly. Mount fans on steel shafts, accurately ground and finished.

b. Fan bearings that are sealed against dust and dirt and are precision self-aligning ball or roller type, with L50 rated bearing life at not less than 200,000 hours as defined by ABMA 9 and ABMA 11. Provide bearings that are permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Support bearings by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Do not fasten bearings directly to the unit sheet metal casing. Furnish fans and scrolls with coating indicated.

c. Fans that are driven by a unit-mounted, or a floor-mounted motor connected to fans by V-belt drive complete with belt guard for externally mounted motors. Furnish belt guards that are the three-sided enclosed type with solid or expanded metal face. Design belt drives for not less than a 1.3 service factor based on motor nameplate rating.

d. Where fixed sheaves are required, the use of variable pitch sheaves is allowed during air balance, but replace them with an appropriate fixed sheave after air balance is completed. Select variable pitch sheaves to drive the fan at a speed that produces the specified capacity when set at the approximate midpoint of the sheave adjustment. Furnish motors for V-belt drives with adjustable bases, and with enclosures.

e. Motor starters of type with general-purpose enclosure. Select unit fan or fans to produce the required capacity at the fan static pressure with sound power level as indicated. Obtain the sound power level values according to AMCA 300, ASHRAE 68, or AHRI 260 I-P.

2.11.2.5 Access Sections and Filter/Mixing Boxes

Provide access sections where indicated and furnish with access doors as shown. Construct access sections and filter/mixing boxes in a manner identical to the remainder of the unit casing and equip with access doors. Design mixing boxes to minimize air stratification and to promote thorough mixing of the air streams.

2.11.2.6 Diffuser Sections

Furnish diffuser sections between the discharge of all housed supply fans . Provide diffuser sections that are fabricated by the unit manufacturer in a manner identical to the remainder of the unit casing, designed to be airtight under positive static pressures up to 8 inches water gauge and with an access door on each side for inspection purposes. Provide a diffuser section that contains a perforated diffusion plate, fabricated of galvanized steel, Type 316 stainless steel, aluminum, or steel treated for corrosion with manufacturer's standard corrosion-resisting finish, and designed to accomplish uniform air flow across the down-stream coil while reducing the higher fan outlet velocity to within plus or minus 5 percent of the required face velocity of the downstream component.

2.12 TERMINAL UNITS

2.12.1 Room Fan-Coil Units

Provide base units that include galvanized coil casing, coil assembly drain pan air filter, fans, motor, fan drive, motor switch, an enclosure for cabinet models and casing for concealed models, leveling devices integral with the unit for vertical type units, and sound power levels as indicated. Obtain sound power level data or values for these units according to test procedures based on AHRI 350. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles. Values obtained for the standard cabinet models are acceptable for concealed models without separate test provided there is no variation between models as to the coil configuration, blowers, motor speeds, or relative arrangement of parts. Provide automatic valves and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Fasten each unit securely to the building structure. Provide units with capacity indicated. Provide room fan-coil units that are certified as complying with AHRI 440, and meet the requirements of UL 1995.

2.12.1.1 Enclosures

Fabricate enclosures from not lighter than 18 gauge steel, reinforced and braced. Provide enclosures with front panels that are removable and have 1/4 inch closed cell insulation or 1/2 inch thick dual density foil faced fibrous glass insulation. Make the exposed side of a high density, erosion-proof material suitable for use in air streams with velocities up to 4,500 fpm. Provide a discharge grille that is adjustable and that is of such design as to properly distribute air throughout the conditioned space. Plastic discharge and return grilles are acceptable provided the plastic material is certified by the manufacturer to be classified as flame resistant according to UL 94 and the material complies with the heat deflection criteria specified in UL 1995. Provide galvanized or factory finished ferrous metal surfaces with corrosion resistant enamel, and access doors or removable panels for piping and control compartments, plus easy access for filter replacement. Provide duct discharge collar for concealed models.

2.12.1.2 Fans

Provide steel or aluminum, multiblade, centrifugal type fans. In lieu of metal, fans and scrolls could be of non-metallic materials of suitably reinforced compounds with smooth surfaces. Dynamically and statically balance the fans. Provide accessible assemblies for maintenance. Disassemble and re-assemble by means of mechanical fastening devices and not by epoxies or cements.

2.12.1.3 Coils

Fabricate coils from not less than 3/8 inch outside diameter seamless copper tubing, with copper or aluminum fins mechanically bonded or soldered to the tubes. Provide coils with not less than 1/2 inch outside diameter flare or sweat connectors, accessory piping package with thermal connections suitable for connection to the type of control valve supplied, and manual air vent. Test coils hydrostatically at 300 psi or under water at 250 psi air pressure. Provide coils suitable for 200 psi working pressure. Make provisions for coil removal.

2.12.1.4 Drain Pans

Size and locate drain and drip pans to collect all water condensed on and dripping from any item within the unit enclosure or casing. Provide condensate drain pans designed for self-drainage to preclude the buildup of microbial slime and thermally insulated to prevent condensation and constructed of not lighter than 21 gauge type 304 stainless steel or noncorrosive ABS plastic. Provide insulation with a flame spread rating not over 25 without evidence of continued progressive combustion, a smoke developed rating no higher than 50, and of a waterproof type or coated with a waterproofing material. Design drain pans so as to allow no standing water and pitch to drain. Provide minimum 3/4 inch NPT or 5/8 inch OD drain connection in drain pan. Provide plastic or metal auxiliary drain pans to catch drips from control and piping packages, eliminating insulation of the packages; if metal, provide auxiliary pans that comply with the requirements specified above. Extend insulation at control and piping connections 1 inch minimum over the auxiliary drain pan.

2.12.1.5 Manually Operated Outside Air Dampers

Provide manually operated outside air dampers according to the arrangement indicated, and parallel airfoil type dampers of galvanized construction. Provide blades that rotate on stainless steel or nylon sleeve bearings.

2.12.1.6 Filters

Provide disposable type filter that complies with ASHRAE 52.2. Provide filters in each unit that are removable without the use of tools.

2.12.1.7 Motors

Provide motors of the permanent split-capacitor type with built-in thermal overload protection, directly connected to unit fans. Provide motor switch with two or three speeds and off, manually operated, and mounted on an identified plate inside the unit below or behind an access door. In lieu of the above fan speed control, a solid-state variable-speed controller having a minimum speed reduction of 50 percent is allowed. Provide motors with permanently-lubricated or oilable sleeve-type or combination ball and sleeve-type bearings with vibration isolating mountings suitable for continuous duty. Provide a motor power consumption, shown in watts, at the fan operating speed selected to meet the specified capacity that does not exceed the following values:

Free Discharge Motors			
Unit Capacity (cfm)	Maximum Power Consumption (Watts)		
	115V	230V	277V
200	70	110	90
300	100	110	110
400	170	150	150

Free Discharge Motors			
Unit Capacity (cfm)	Maximum Power Consumption (Watts)		
	115V	230V	277V
600	180	210	220
800	240	240	230
1000	310	250	270
1200	440	400	440

High Static Motors	
Unit Capacity (cfm)	Maximum Power Consumption (Watts)
200	145
300	145
400	210
600	320
800	320
1000	530
1200	530

2.12.2 Coil Induction Units

Provide base unit that includes air plenums, air-discharge nozzles, air discharge grilles, recirculation grilles, water coil assembly, valve and piping package, condensate drain pan, and adjustable air-balancing dampers, plus an enclosure for cabinet models and casing for concealed models. Make each unit capable of producing not less than the capacity indicated without exceeding the indicated static pressure. Provide a sound power level as indicated with power level data or values for these units based on tests conducted according to ASA S12.51. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles. The values obtained for the standard cabinet models are acceptable for concealed models without separate tests, provided there is no variation between models as to coil configuration, air discharge nozzles, air balancing dampers, or relative arrangement of parts. Provide automatic valves and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Secure each unit to the building structure. Provide units with capacity indicated.

2.12.2.1 Enclosures

Fabricate enclosures from not lighter than 18 gauge steel, reinforced and braced. Provide a removable front panel of enclosure and insulate when required acoustically and to prevent condensation. Provide discharge grilles that are adjustable and properly distribute air throughout the conditioned space. Plastic discharge and return grilles are not acceptable. Provide access doors for all piping and control compartments.

2.12.2.2 Air Plenums

Fabricate plenums from galvanized steel with interior acoustically baffled and lined with sound absorbing material to attenuate the sound power from the primary air supply to the room. Provide heat-resistant nozzles that are integral with or attached airtight to the plenum. Where coil induction units are supplied with vertical runouts, furnish a streamlined, vaned, mitered elbow transition piece for connection between the unit and ductwork. Provide an adjustable air-balancing damper in each unit.

2.12.2.3 Coils

Fabricate coils from not less than 3/8 inch outside diameter seamless copper tubing, with copper or aluminum fins, mechanically bonded or soldered to the tubes. Furnish coil connections with not less than 1/2 inch outside diameter flare or sweat connectors, accessory piping package with terminal connections suitable for connection to the type of control valve supplied, and manual air vent. Test coils hydrostatically at 300 psi or under water at 250 psi air pressure and provide coils suitable for 200 psi working pressure.

2.12.2.4 Screens

Provide easily accessible lint screens or throwaway filters for each unit.

2.12.2.5 Drain Pan

Size and locate drain and drip pans to collect condensed water dripping from any item within the unit enclosure. Provide drain pans constructed of not lighter than 21 gauge steel, galvanized after fabrication, and thermally insulated to prevent condensation. Provide insulation that has a flame spread rating not over 25 without evidence of continued progressive combustion, a smoke developed rating no higher than 50, and that is a waterproof type or coated with a waterproofing material. In lieu of the above, drain pans constructed of die-formed 22 gauge steel are allowed, formed from a single sheet and galvanized after fabrication and insulated and coated as for the 21 gauge steel material or of die-formed 21 gauge type 304 stainless steel insulated as specified above. Pitch drain pans to drain. Provide drain connection when a condensate drain system is indicated. Make connection a minimum 3/4 inch NPT or 5/8 inch OD.

2.12.3 Variable Air Volume (VAV) and Dual Duct Terminal Units

a. Provide VAV and dual duct terminal units that are the type, size, and capacity shown, mounted in the ceiling or wall cavity, plus units that are suitable for single or dual duct system applications. Provide actuators and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS.

b. Provide unit enclosures that are constructed of galvanized steel not lighter than 22 gauge or aluminum sheet not lighter than 18 gauge. Provide single or multiple discharge outlets as required. Units with flow limiters are not acceptable. Provide unit air volume that is factory preset and readily field adjustable without special tools. Provide reheat coils as indicated.

c. Attach a flow chart to each unit. Base acoustic performance of the terminal units upon units tested according to AHRI 880 I-P with the calculations prepared in accordance with AHRI 885. Provide sound power level as indicated. Show discharge sound power for minimum and 1-1/2 inches water gauge inlet static pressure. Provide acoustical lining according to NFPA 90A.

2.12.3.1 Constant Volume, Single Duct Terminal Units

Provide constant volume, single duct, terminal units that contain within the casing, a constant volume regulator. Provide volume regulators that control air delivery to within plus or minus 5 percent of specified air flow subjected to inlet pressure from 3/4 to 6 inch water gauge.

2.12.3.2 Variable Volume, Single Duct Terminal Units

Provide variable volume, single duct, terminal units with a calibrated air volume sensing device, air valve or damper, actuator, and accessory relays. Provide units that control air volume to within plus or minus 5 percent of each air set point volume as determined by the thermostat with variations in inlet pressures from 3/4 to 6 inch water gauge. Provide units with an internal resistance not exceeding 0.4 inch water gauge at maximum flow range. Provide external differential pressure taps separate from the control pressure taps for air flow measurement with a 0 to 1 inch water gauge range.

2.12.3.3 Variable Volume, Single Duct, Fan-Powered Terminal Units

Provide variable volume, single duct, fan-powered terminal units with a calibrated air volume sensing device, air valve or damper, actuator, fan and motor, and accessory relays. Provide units that control primary air volume to within plus or minus 5 percent of each air set point as determined by the thermostat with variations in inlet pressure from 3/4 to 6 inch water gauge. Provide unit fan that is centrifugal, direct-driven, double-inlet type with forward curved blades. Provide either single speed with speed controller or three-speed, permanently lubricated, permanent split-capacitor type fan motor. Isolate fan/motor assembly from the casing to minimize vibration transmission. Provide factory furnished fan control that is wired into the unit control system. Provide a factory-mounted pressure switch to operate the unit fan whenever pressure exists at the unit primary air inlet or when the control system fan operates.

2.12.3.4 Dual Duct Terminal Units

Provide dual duct terminal units with hot and cold inlet valve or dampers that are controlled in unison by single or dual actuators. Provide actuator as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Provide unit that controls delivered air volumes within plus or minus 5 percent with inlet air variations from 1 to 8 inch water gauge in either duct. Include mixing baffles with the unit casing. Provide cabinet and closed duct leakage that does not exceed 2 percent of

maximum rated air volume. Provide units with an internal resistance that does not exceed inch water gauge at maximum flow range.

2.12.3.5 Ceiling Induction Terminal Units

Provide ceiling induction unit with a calibrated primary air volume sensing device, primary air valve, induced air damper, and insulated induction tube. Arrange unit to induce air from the ceiling plenum to maintain a maximum total flow circulated to the conditioned space. Vary primary air upon demand of the room thermostat. Upon a demand for maximum cooling, provide a unit that delivers 100 percent primary air and, at minimum cooling, delivers 50 percent primary air. Provide a terminal unit capable of closing to full shut off without additional actuators or linkage changes. Provide terminals that reset primary air volume within plus or minus 5 percent determined by the thermostat regardless of upstream changes in the static pressure. Provide a minimum inlet static pressure that does not exceed 1 inch water gauge, including a maximum of 0.3 inch water gauge downstream static pressure. Provide external differential pressure taps separate from control pressure taps for primary air flow measurement with 0 to 1 inch water gauge range. Make each unit normally open upon loss of pneumatic pressure. Factory pipe actuator and accuracy controls requiring only field installation of 20 psi pneumatic main air and room thermostat.

2.12.3.6 Series Fan Powered Variable Air Volume (VAV) Terminals

Provide units factory assembled, designed, tested, rated in accordance with AHRI 880 I-P, that are AHRI certified, listed in the AHRI DCAACP and that produce a supply air discharge mix by modulation of conditioned primary air and recirculating of return air. Provide units that include casing, centrifugal fan and motor, primary VAV damper or valve, electronic volume regulator, discharge air damper, primary air inlet cone with high and low pressure flow sensors, recirculating air filter frames, filter, and electrical disconnect.

2.12.3.6.1 Casing

Provide removable full bottom access panels for servicing internal components without disturbing duct connections. Insulate inside of casing with manufacturer's standard insulation. Provide units that have recirculating air inlet equipped with filter frame, round primary damper or valve, and unit mounting brackets.

2.12.3.6.2 Fans and Motors

Provide centrifugal, forward curved, multiblade, fan wheels with direct-drive motors. Provide motors that are the high efficiency permanent-split capacitor type with thermal overload protection, permanently lubricated bearings, and have three speeds or are equipped with solid state speed controllers. Provide isolation between fan motor assembly and unit casing. Provide fan and motor that is removable through casing access panel.

2.12.3.6.3 Flow Sensor

Provide ring or cross type sensor with minimum of two pickup points which average the velocity across the inlet. Obtain flow measurement within plus or minus 5 percent of rated airflow with 1.5 diameters of straight duct upstream of unit and inlet static variation of 0.5 to 5.0 inches

water gauge. Supply flow measuring taps and calibration flowchart with each unit for field balancing airflows.

2.12.3.6.4 Primary VAV Damper or Valve

Provide galvanized steel damper blade that closes against gasket inside unit. Connect damper to operating shaft with a positive mechanical connection. Provide nylon bearing for damper shaft. Cylindrical die cast aluminum valve inlet tapered to fit round flexible ducts with integral flow diffuser and beveled self-centering disc. Provide damper or valve leakage at shutoff that does not exceed 2 percent of capacity at 1 inch water gauge pressure.

2.12.3.6.5 Regulator

Provide electronic volume regulator. Electronic controls contained in NEMA ICS 6, Type 1 enclosure sealed from airflow. Provide unit with controls mounted on side or on air valve. System powered regulators are not permitted. Provide volume regulator that resets primary air volume as determined by thermostat, within upstream static pressure variation noted in paragraph titled "Flow Sensor." Provide volume regulators that are field adjustable, factory set and calibrated to indicated maximum and minimum primary airflows, direct acting and normally open upon loss of pneumatic pressure.

2.12.3.6.6 Electrical

Provide unit that incorporates single point electrical connection with electrical disconnect. Provide electrical components that are UL or ETL listed, installed in accordance with NFPA 70 and mounted in control box. Units UL or ETL listed as an assembly do not require airflow switch interlock with electric heating coil, when factory assembled.

2.12.3.6.7 Filters

Provide UL listed throwaway one inch thick fiberglass filters, standard dust-holding capacity.

2.12.3.7 Reheat Units

2.12.3.7.1 Hot Water Coils

Provide fin-and-tube type hot-water coils constructed of seamless copper tubes and copper or aluminum fins mechanically bonded or soldered to the tubes. Provide headers that are constructed of cast iron, welded steel or copper. Provide casing and tube support sheets that are 16 gauge, galvanized steel, formed to provide structural strength. Provide tubes that are correctly circuited for proper water velocity without excessive pressure drop and are drainable where required or indicated. At the factory, test each coil at not less than 250 psi air pressure and provide coils suitable for 200 psi working pressure. Install drainable coils in the air handling units with a pitch of not less than 1/8 inch per foot of tube length toward the drain end. Coils must conform to the provisions of AHRI 410.

2.12.3.7.2 Steam Coils

Provide steam coils constructed of cast semisteel, welded steel, or copper headers, red-brass or copper tubes, and copper or aluminum fins

mechanically bonded or soldered to the tubes. Roll and bush, braze or weld tubes into headers. Provide coil casings and tube support sheets, with collars of ample width, that are not lighter than 16 gauge galvanized steel formed to provide structural strength. When required, furnish multiple tube supports to prevent tube sag. Float the fin tube and header section within the casing to allow free expansion of tubing for coils subject to high pressure steam service. Provide coils that are factory pressure tested and capable of withstanding 250 psi hydrostatic test pressure or 250 psi air pressure, and are for 100 psi steam working pressure. Provide steam-distribution tube type preheat coils with condensing tubes having not less than 5/8 inch outside diameters. Provide distribution tubes that have not less than 3/8 inch outside diameter, with orifices to discharge steam to condensing tubes. Install distribution tubes concentric inside of condensing tubes held securely in alignment. Limit the maximum length of a single coil to 120 times the diameter of the outside tube. Other heating coils must be single tube type with an outside diameter not less than 1/2 inch. Provide supply headers that distribute steam evenly to all tubes at the indicated steam pressure. Provide coils that conform to the provisions of AHRI 410.

2.12.3.7.3 Electric Resistance Heaters

Provide the duct-mounting type electric resistance heaters consisting of a nickel-chromium resistor mounted on refractory material and a steel or aluminum frame for attachment to ductwork. Provide electric duct heater that meets the requirement of Underwriters Laboratories and NFPA 70 and is provided with a built-in or surface-mounted high-limit thermostat. Interlock electric duct heaters electrically so that they cannot be energized unless the fan is running.

2.12.4 Unit Ventilators

Provide unit ventilators that include an enclosure, coil assembly, drain pan, air filters, fan assembly, fan drive, motor, motor controller, dampers, damper operators, and sound power level as indicated. Obtain sound power level data or values for these units according to test procedures based on AHRI 350. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles, when handling standard flow for which the unit air capacity is rated. Secure each unit to the building structure. Provide the unit ventilators with capacity indicated. Provide the year-round classroom type unit ventilator with automatic controls arranged to properly heat, cool, and ventilate the room. Provide automatic valves and controls as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS. Make the sequence of control any one of the standard ANSI cycles specified in paragraph CONTROLS.

2.12.4.1 Enclosures

Fabricate enclosures from not lighter than 16 gauge galvanized steel, reinforced and braced, or all welded framework with panels to provide equivalent strength. Provide casing that is acoustically and thermally insulated internally with not less than 1/2 inch thick dual density fibrous glass insulation. Make the exposed side a high density, erosion-proof material suitable for use in air streams with velocities up to 4500 fpm. Fasten the insulation with waterproof, fire-resistant adhesive. Design front panel for easy removal by one person. Provide discharge grilles that properly distribute air throughout the conditioned space. Provide return grilles that are removable where front panel does

not provide access to interior components. Plastic discharge or return grilles are not acceptable. Furnish removable panels or access doors for all piping and control compartments. Provide fan switch that is key operated or accessible through a locked access panel. Install gaskets at the back and bottom of the unit for effective air seal, as required.

2.12.4.2 Electric Resistance Heating Elements

Provide electric resistance heating elements that are of the sheathed, finned, tubular type, or of the open resistance type designed for direct exposure to the air stream. Provide heating element electrical characteristics as indicated. Where fan motor or control voltage is lower than required for the electric-resistance heating element, install a fused factory mounted and wired transformer.

2.12.4.3 Fans

Provide fans that meet the requirements as specified in paragraph AIR SYSTEMS EQUIPMENT. Provide galvanized steel or aluminum, multiblade, centrifugal type fans, dynamically and statically balanced. Equip fan housings with resilient mounted, self-aligning permanently lubricated ball bearings, sleeve bearings, or combination ball and sleeve bearings, capable of not less than 2000 hours of operation on one oiling. Provide direct-connected fans.

2.12.4.4 Coils

Provide coils that are circuited for a maximum water velocity of 8 fps without excessive pressure drop and are otherwise as specified for hot water coils in paragraph TERMINAL UNITS.

2.12.4.5 Drain Pans

Size and locate drain and drip pans to collect all condensed water dripping from any item within the unit enclosure. Provide drain pans constructed of not lighter than 18 gauge steel, galvanized after fabrication, and thermally insulated to prevent condensation. Provide insulation that is coated with a fire-resistant waterproofing material. In lieu of the above, drain pans constructed of die-formed 20 gauge steel is allowed, formed from a single sheet and galvanized after fabrication and insulated and coated as for the 18 gauge steel material, or of die-formed 18 gauge type 304 stainless steel insulated as specified above. Pitch drain pans to drain. Furnish drain connection unless otherwise indicated. Make the minimum connection 3/4 inch NDT or 5/8 inch OD.

2.12.4.6 Filters

Disposable type rated in accordance with ASHRAE 52.2, installed upstream of coil.

2.12.4.7 Dampers

Provide an outside air proportioning damper on each unit. In addition, provide a vane to prevent excessive outside air from entering unit and to prevent blow-through of outside air through the return air grille under high wind pressures. Where outside air and recirculated air proportioning dampers are provided on the unit, an additional vane is not required. Provide face and bypass dampers for each unit to ensure constant air

volume at all positions of the dampers. Furnish each unit with a factory installed control cam assembly, pneumatic motor, or electric motor to operate the face and bypass dampers and outside air damper or outside air and recirculated air dampers in the sequence as specified in paragraph SUPPLEMENTAL COMPONENTS/SERVICES, subparagraph CONTROLS.

2.12.4.8 Motors

Provide permanent split-capacitor type motors with built-in thermal overload protection and automatic reset. Mount motor on a resilient mounting, isolated from the casing and suitable for operation on electric service available. Provide a manually operated motor switch that provides for 2 or 3 speeds and off, mounted on an identified plate . In lieu of speed control, provide a solid state variable speed controller having minimum speed reduction of 50 percent.

2.12.4.9 Outside Air Intakes

Provide the manufacturer's standard design outside air intakes furnished with 1/2 inch mesh bird screen or louvers on 1/2 inch centers.

2.13 ENERGY RECOVERY DEVICES

2.13.1 Rotary Wheel

Provide unit that is a factory fabricated and tested assembly for air-to-air energy recovery by transfer of sensible heat from exhaust air to supply air stream, with device performance according to ASHRAE 84 and that delivers an energy transfer effectiveness of not less than 70 percent with cross-contamination not in excess of 0.1 percent of exhaust airflow rate at system design differential pressure, including purging sector if provided with wheel. Provide exchange media that is chemically inert, moisture-resistant, fire-retardant, laminated, nonmetallic material which complies with NFPA 90A. Isolate exhaust and supply streams by seals which are static, field adjustable, and replaceable. Equip chain drive mechanisms with ratcheting torque limiter or slip-clutch protective device. Fabricate enclosure from galvanized steel and include provisions for maintenance access. Provide recovery control and rotation failure provisions as indicated.

2.13.2 Run-Around-Coil

Provide assembly that is factory fabricated and tested air-to-liquid-to-air energy recovery system for transfer of sensible heat from exhaust air to supply air stream and that delivers an energy transfer effectiveness not less than that indicated without cross-contamination with maximum energy recovery at minimum life cycle cost. Computer optimize components for capacity, effectiveness, number of coil fins per inch, number of coil rows, flow rate, heat transfer rate of percent by volume of ethylene glycol solution, and frost control. Provide coils that conform to paragraph AIR HANDLING UNITS. Provide related pumps, and piping specialties that conform to requirements of .

2.13.3 Heat Pipe

Provide a device that is a factory fabricated, assembled and tested, counterflow arrangement, air-to-air heat exchanger for transfer of sensible heat between exhaust and supply streams and that delivers an energy transfer effectiveness not less than that indicated without

cross-contamination. Provide heat exchanger tube core that is 1/2 inch nominal diameter, seamless aluminum or copper tube with extended surfaces, utilizing wrought aluminum Alloy 3003 or Alloy 5052, temper to suit. Provide maximum fins per unit length and number of tube rows as indicated. Provide tubes that are fitted with internal capillary wick, filled with a refrigerant complying with ASHRAE 15 & 34, selected for system design temperature range, and hermetically sealed. Refrigerants containing chlorofluorocarbons (CFC) are prohibited. Provide heat exchanger frame that is constructed of not less than 16 gauge galvanized steel and fitted with intermediate tube supports, and flange connections. Provide tube end-covers and a partition of galvanized steel to separate exhaust and supply air streams without cross-contamination and in required area ratio. Provide heat recovery regulation by system face and bypass dampers and related control system as indicated. Coil must be fitted with pleated flexible connectors.

2.13.4 Desiccant Wheel

Provide counterflow supply, regeneration airstreams, a rotary type dehumidifier designed for continuous operation, and extended surface type wheel structure in the axial flow direction with a geometry that allows for laminar flow over the operating range for minimum air pressure differentials. Provide the dehumidifier complete with a drive system utilizing a fractional-horsepower electric motor and speed reducer assembly driving the rotor. Include a slack-side tensioner for automatic take-up for belt-driven wheels. Provide an adsorbing type desiccant material. Apply the desiccant material to the wheel such that the entire surface is active as a desiccant and the desiccant material does not degrade or detach from the surface of the wheel which is fitted with full-face, low-friction contact seals on both sides to prevent cross leakage. Provide rotary structure that has underheat, overheat and rotation fault circuitry. Provide wheel assembly with a warranty for a minimum of five years.

2.13.5 Plate Heat Exchanger

Provide energy recovery ventilator unit that is factory-fabricated for indoor installation, consisting of a flat plate cross-flow heat exchanger, cooling coil, supply air fan and motor and exhaust air fan and motor. The casing must be 20 gauge G90, galvanized steel, double wall construction with one inch insulation. Provide fibrous desiccant cross-flow type heat exchanger core capable of easy removal from the unit.

2.14 FACTORY PAINTING

Factory paint new equipment, which are not of galvanized construction. Paint with a corrosion resisting paint finish according to ASTM A123/A123M or ASTM A924/A924M. Clean, phosphatize and coat internal and external ferrous metal surfaces with a paint finish which has been tested according to ASTM B117, ASTM D1654, and ASTM D3359. Submit evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors. Provide rating of failure at the scribe mark that is not less than 6, average creepage not greater than 1/8 inch. Provide rating of the inscribed area that is not less than 10, no failure. On units constructed of galvanized steel that have been welded, provide a final shop docket of zinc-rich protective paint on exterior surfaces of welds or welds that have burned through from the interior according to ASTM D520 Type I.

Field paint factory painting that has been damaged prior to acceptance by the Contracting Officer in compliance with the requirements of paragraph FIELD PAINTING OF MECHANICAL EQUIPMENT.

2.15 SUPPLEMENTAL COMPONENTS/SERVICES

2.15.1 Condensate Drain Lines

Provide and install condensate drainage for each item of equipment that generates condensate except as modified herein.

2.15.2 Backflow Preventers

The requirements for backflow preventers are specified in Section 22 00 00 PLUMBING, GENERAL PURPOSE.

2.15.3 Insulation

The requirements for shop and field applied insulation are specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.15.4 Controls

The requirements for controls are specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS.

2.16 RADIANT PANELS

2.16.1 Hydronic Modular Panels

2.16.1.1 Panels

Modular radiant panels will fit into a standard 24 inch x 24 inch or 24 inch x 48 inch suspended T-Bar ceiling grid or flush mounted on a drywall ceiling. For flush mounted ceiling applications, the manufacturer will provide a one piece extruded aluminum frame. Panels must be supported from the T-bar assembly. Panels must be 14 gauge or 16 gauge extruded aluminum or sheet steel.

2.16.1.2 Heat Sink

The modular panels must use extruded aluminum with integrated heat sinks on the back to transfer heat between copper tubes and the panel face.

2.16.1.3 Water Tubes

Tubes must consist of ASTM B75/B75M 1/2 inch O.D. nominal copper tubing. Water connections will be suitable for solder or compression fittings. Heat pads will be used between the soldered fitting and the panel to protect the panel surface. The manufacturer will provide water pressure drop data as well as heating and cooling output data derived from tests in accordance with DIN EN 14037 (heating) and DIN EN 14240 (cooling). The panels will have the capacity to have multiple passes with connections either on the same end or opposite ends, dependent on the number of passes.

2.16.1.4 Finish

All visible components must be powder coated with highly emissive powder

coat polyester paint for optimal radiative properties as well as durability and easy cleaning. Standard finish color must be white.

2.16.1.5 Performance

Manufacturer will provide water pressure drop data as well as heat and cool output data derived from tests in accordance with DIN EN 14037 (heating) and DIN EN 14240 (cooling).

2.16.1.6 Capacity

Modular radiant panel capacity will be tested and certified by manufacturer in accordance with DIN EN 14037 (heating) and DIN EN 14240 (cooling) to meet the required performance. Should any performance rating, chilled or hot water supply temperature, water pressure drop, etc. deviate from the schedule, the manufacturer will submit the updated capacity.

2.16.1.7 Water Connections

Connections will be shipped sealed to limit the introduction of dust and dirt during shipping and construction.

2.16.1.8 Installation

Panels will be installed as recommended by the manufacturer.

2.16.1.9 Accessories

Stainless steel braded hoses, 12 inches or 18 inches long will be supplied with the panels.

The top of the heating and cooling panels must be covered with1-1/2 inches thick 1 lb/cu ft formaldehyde-free fiber glass insulation with a minimum R = 4.5 (hr ft2 deg F)/BTU. The insulation must be covered with a foil scrim kraft vapor barrier facing.

2.16.2 Hydronic Linear Panels

2.16.2.1 Panels

Linear radiant panels must use extruded aluminum with integrated heat sinks on the back to transfer heat between copper tubes and the panel face. The linear radiant panel is to radiate or absorb heat from or to the zone below. Panels must be 14 gauge or 16 gauge extruded aluminum.

2.16.2.2 Heat Sink

The modular panels must use extruded aluminum with integrated heat sinks on the back to transfer heat between copper tubes and the panel face.

2.16.2.3 Water Tubes

Tubes must consist of ASTM B75/B75M 1/2 inch or 5/8 inch O.D. nominal copper tubing. Water connections will be suitable for solder or compression fittings. The manufacturer will provide water pressure drop data as well as heating and cooling output data derived from tests in accordance with DIN EN 14037 (heating) and DIN EN 14240 (cooling).

2.16.2.4 Mounting

Units must be provided with mounting hardware as required for mounting in T-Bar applications or ceiling flush mounting. The manufacturer's standard hardware for mounting panels abutting each other must be submitted for approval.

2.16.2.5 Finish

All visible components must be powder coated with highly emissive powder coat polyester paint for optimal radiative properties as well as durability and easy cleaning. Standard finish color must be white.

2.16.2.6 Performance

Manufacturer must provide water pressure drop data as well as heat and cool output data derived from tests in accordance with DIN EN 14037 (heating) and DIN EN 14240 (cooling).

2.16.2.7 Capacity

Modular radiant panel capacity must be tested and certified by manufacturer in accordance with DIN EN 14037 (heating) and DIN EN 14240 (cooling) to meet the required performance. Should any performance rating, chilled or hot water supply temperature, water pressure drop, etc. deviate from the schedule, the manufacturer must submit the updated capacity.

2.16.2.8 Water Connections

Connections will be shipped sealed to limit the introduction of dust and dirt during shipping and construction.

2.16.2.9 Accessories

Stainless steel braded hoses, 12 inches or 18 inches long will be supplied with the panels.

The top of the heating and cooling panels must be covered with 1-1/2 inches thick 1 lb/cu ft formaldehyde-free fiber glass insulation with a minimum R = 4.5 (hr ft2 deg F)/BTU. The insulation must be covered with a foil scrim kraft vapor barrier facing.

2.16.3 Prefabricated Radiant-Heating Electric Panels

2.16.3.1 Description

Sheet metal enclosed panel with heating element suitable for lay-in installation flush with T-bar ceiling grid. Comply with UL 2021

2.16.3.2 Panel

Minimum 0.027 inch thick, galvanized steel sheet back panel riveted to minimum 0.040 inch thick, galvanized steel sheet front panel with fused-on crystalline surface.

2.16.3.3 Heating Element

Powdered graphite sandwiched between sheets of electric insulation.

2.16.3.4 Electrical Connections

Nonheating, high-temperature, insulated-copper leads, factory connected to heating element.

2.16.3.5 Exposed-Side Panel Finish

Apply silk-screened finish to match appearance of Architect selected acoustical ceiling tiles.

2.16.3.6 Surface-Mounting Trim

Sheet metal with baked-enamel finish in color as selected by Architect.

2.16.3.7 Wall Thermostat

Bimetal, sensing elements; with contacts suitable for -voltage circuit, and manually operated on-off switch with contactors, relays, and control transformers.

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

a. Install materials and equipment in accordance with the requirements of the contract drawings and approved manufacturer's installation instructions. Accomplish installation by workers skilled in this type of work. Perform installation so that there is no degradation of the designed fire ratings of walls, partitions, ceilings, and floors.

b. No installation is permitted to block or otherwise impede access to any existing machine or system. Install all hinged doors to swing open a minimum of 120 degrees. Provide an area in front of all access doors that clears a minimum of 3 feet. In front of all access doors to electrical circuits, clear the area 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, install emergency switches and alarms in conspicuous locations. Mount all indicators, to include gauges, meters, and alarms in order to be easily visible by people in the area.

3.2.1 Condensate Drain Lines

Provide water seals in the condensate drain from all units . Provide a depth of each seal of 2 inches plus the number of inches, measured in water gauge, of the total static pressure rating of the unit to which the drain is connected. Provide water seals that are constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Provide pipe cap or plug cleanouts where indicated. Connect drains indicated to connect to the sanitary waste system using an indirect waste fitting. Insulate air conditioner drain lines as specified in Section 23 07 00

THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.2.2 Equipment and Installation

Provide frames and supports for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Floor mount or ceiling hang air handling units as indicated. Anchor and fasten as detailed. Set floor-mounted equipment on not less than 6 inch concrete pads or curbs doweled in place unless otherwise indicated. Make concrete foundations heavy enough to minimize the intensity of the vibrations transmitted to the piping, duct work and the surrounding structure, as recommended in writing by the equipment manufacturer. In lieu of a concrete pad foundation, build a concrete pedestal block with isolators placed between the pedestal block and the floor. Make the concrete foundation or concrete pedestal block a mass not less than three times the weight of the components to be supported. Provide the lines connected to the pump mounted on pedestal blocks with flexible connectors.

3.2.3 Access Panels

Install access panels for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance of sufficient size, and locate them so that the concealed items are easily serviced and maintained or completely removed and replaced.

3.2.4 Flexible Duct

Install pre-insulated flexible duct in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Provide hangers, when required to suspend the duct, of the type recommended by the duct manufacturer and set at the intervals recommended.

3.2.5 Metal Ductwork

Install according to SMACNA 1966 unless otherwise indicated. Install duct supports for sheet metal ductwork according to SMACNA 1966, unless otherwise specified. Do not use friction beam clamps indicated in SMACNA 1966. Anchor risers on high velocity ducts in the center of the vertical run to allow ends of riser to move due to thermal expansion. Erect supports on the risers that allow free vertical movement of the duct. Attach supports only to structural framing members and concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C-clamps are used, provide retainer clips.

3.2.5.1 Underground Ductwork

Provide PVC plastisol coated galvanized steel underground ductwork with coating on interior and exterior surfaces and watertight joints. Install ductwork as indicated, according to ACCA Manual 4 and manufacturer's instructions. Maximum burial depth is 6 feet.

3.2.5.2 Radon Exhaust Ductwork

Perforate subslab suction piping where indicated. Install PVC joints as specified in ASTM D2855.

3.2.5.3 Light Duty Corrosive Exhaust Ductwork

For light duty corrosive exhaust ductwork, use PVC plastisol coated galvanized steel with PVC coating on interior surfaces.

3.2.6 FRP Ductwork

Provide fibrous glass reinforced plastic ducting and related structures that conform to SMACNA 1403. Provide flanged joints where indicated. Crevice-free butt lay-up joints are acceptable where flanged joints are not indicated. When ambient temperatures are lower than 50 degrees F, heat cure joints by exothermic reaction heat packs.

3.2.7 Kitchen Exhaust Ductwork

3.2.7.1 Ducts Conveying Smoke and Grease Laden Vapors

Provide ducts conveying smoke and grease laden vapors that conform to requirements of NFPA 96. Make seams, joints, penetrations, and duct-to-hood collar connections with a liquid tight continuous external weld. Provide duct material that is a minimum 18 gauge, Type 304L or 316L, stainless steel . Include with duct construction an external perimeter angle sized in accordance with SMACNA 1966, except place welded joint reinforcement on maximum of 24 inch centers; continuously welded companion angle bolted flanged joints with flexible ceramic cloth gaskets where indicated; pitched to drain at low points; welded pipe coupling-plug drains at low points; welded fire protection and detergent cleaning penetration; steel framed, stud bolted, and flexible ceramic cloth gasketed cleaning access provisions where indicated. Make angles, pipe couplings, frames, bolts, etc., the same material as that specified for the duct unless indicated otherwise.

3.2.7.2 Exposed Ductwork

Provide exposed ductwork that is fabricated from minimum 18 gauge, Type 304L or 316L, stainless steel with continuously welded joints and seams. Pitch ducts to drain at hoods and low points indicated. Match surface finish to hoods.

3.2.7.3 Concealed Ducts Conveying Moisture Laden Air

Fabricate concealed ducts conveying moisture laden air from minimum 16 gauge, galvanized steel . Continuously weld, braze, or solder joints to be liquid tight. Pitch ducts to drain at points indicated. Make transitions to other metals liquid tight, companion angle bolted and gasketed.

3.2.8 Acoustical Duct Lining

Apply lining in cut-to-size pieces attached to the interior of the duct with nonflammable fire resistant adhesive conforming to ASTM C916, Type I, NFPA 90A, UL 723, and ASTM E84. Provide top and bottom pieces that lap the side pieces and are secured with welded pins, adhered clips of metal, nylon, or high impact plastic, and speed washers or welding cup-head pins installed according to SMACNA 1966. Provide welded pins, cup-head pins, or adhered clips that do not distort the duct, burn through, nor mar the finish or the surface of the duct. Make pins and washers flush with the surfaces of the duct liner and seal all breaks and punctures of the duct liner coating with the nonflammable, fire resistant adhesive. Coat

exposed edges of the liner at the duct ends and at other joints where the lining is subject to erosion with a heavy brush coat of the nonflammable, fire resistant adhesive, to prevent delamination of glass fibers. Apply duct liner to flat sheet metal prior to forming duct through the sheet metal brake. Additionally secure lining at the top and bottom surfaces of the duct by welded pins or adhered clips as specified for cut-to-size pieces. Other methods indicated in SMACNA 1966 to obtain proper installation of duct liners in sheet metal ducts, including adhesives and fasteners, are acceptable.

3.2.9 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, perform temporary dust control protection. Protect the distribution system (supply and return) with temporary seal-offs at all inlets and outlets at the end of each day's work. Keep temporary protection in place until system is ready for startup.

3.2.10 Insulation

Provide thickness and application of insulation materials for ductwork, piping, and equipment according to Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Externally insulate outdoor air intake ducts and plenums .

3.2.11 Duct Test Holes

Provide holes with closures or threaded holes with plugs in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Plug insulated duct at the duct surface, patched over with insulation and then marked to indicate location of test hole if needed for future use.

3.2.12 Power Roof Ventilator Mounting

Provide foamed 1/2 inch thick, closed-cell, flexible elastomer insulation to cover width of roof curb mounting flange. Where wood nailers are used, predrill holes for fasteners.

3.2.13 Power Transmission Components Adjustment

Test V-belts and sheaves for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Uniformly load belts on drive side to prevent bouncing. Make alignment of direct driven couplings to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.3 EQUIPMENT PADS

Provide equipment pads to the dimensions shown or, if not shown, to conform to the shape of each piece of equipment served with a minimum 3-inch margin around the equipment and supports. Allow equipment bases and foundations, when constructed of concrete or grout, to cure a minimum of 28 calendar days before being loaded.

3.4 CUTTING AND PATCHING

Install work in such a manner and at such time that a minimum of cutting and patching of the building structure is required. Make holes in exposed

locations, in or through existing floors, by drilling and smooth by sanding. Use of a jackhammer is permitted only where specifically approved. Make holes through masonry walls to accommodate sleeves with an iron pipe masonry core saw.

3.5 CLEANING

Thoroughly clean surfaces of piping and equipment that have become covered with dirt, plaster, or other material during handling and construction before such surfaces are prepared for final finish painting or are enclosed within the building structure. Before final acceptance, clean mechanical equipment, including piping, ducting, and fixtures, and free from dirt, grease, and finger marks. When the work area is in an occupied space such as office, laboratory or warehouse protect all furniture and equipment from dirt and debris. Incorporate housekeeping for field construction work which leaves all furniture and equipment in the affected area free of construction generated dust and debris; and, all floor surfaces vacuum-swept clean.

3.6 PENETRATIONS

Provide sleeves and prepared openings for duct mains, branches, and other penetrating items, and install during the construction of the surface to be penetrated. Cut sleeves flush with each surface. Place sleeves for round duct 15 inches and smaller. Build framed, prepared openings for round duct larger than 15 inches and square, rectangular or oval ducts. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Provide one inch clearance between penetrating and penetrated surfaces except at grilles, registers, and diffusers. Pack spaces between sleeve or opening and duct or duct insulation with mineral fiber conforming with ASTM C553, Type 1, Class B-2.

3.6.1 Sleeves

Fabricate sleeves, except as otherwise specified or indicated, from 20 gauge thick mill galvanized sheet metal. Where sleeves are installed in bearing walls or partitions, provide black steel pipe conforming with ASTM A53/A53M, Schedule 20.

3.6.2 Framed Prepared Openings

Fabricate framed prepared openings from 20 gauge galvanized steel, unless otherwise indicated.

3.6.3 Insulation

Provide duct insulation in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS continuous through sleeves and prepared openings except firewall penetrations. Terminate duct insulation at fire dampers and flexible connections. For duct handling air at or below 60 degrees F, provide insulation continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air.

3.6.4 Closure Collars

Provide closure collars of a minimum 4 inches wide, unless otherwise indicated, for exposed ducts and items on each side of penetrated surface, except where equipment is installed. Install collar tight against the surface and fit snugly around the duct or insulation. Grind sharp edges

smooth to prevent damage to penetrating surface. Fabricate collars for round ducts 15 inches in diameter or less from 20 gauge galvanized steel. Fabricate collars for square and rectangular ducts, or round ducts with minimum dimension over 15 inches from 18 gauge galvanized steel. Fabricate collars for square and rectangular ducts with a maximum side of 15 inches or less from 20 gauge galvanized steel. Install collars with fasteners a maximum of 6 inches on center. Attach to collars a minimum of 4 fasteners where the opening is 12 inches in diameter or less, and a minimum of 8 fasteners where the opening is 20 inches in diameter or less.

3.6.5 Firestopping

Where ducts pass through fire-rated walls, fire partitions, and fire rated chase walls, seal the penetration with fire stopping materials as specified in Section 07 84 00 FIRESTOPPING.

3.7 FIELD PAINTING OF MECHANICAL EQUIPMENT

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except clean to bare metal on metal surfaces subject to temperatures in excess of 120 degrees F. Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Provide aluminum or light gray finish coat.

3.7.1 Temperatures less than 120 degrees F

Immediately after cleaning, apply one coat of pretreatment primer applied to a minimum dry film thickness of 0.3 mil, one coat of primer applied to a minimum dry film thickness of one mil; and two coats of enamel applied to a minimum dry film thickness of one mil per coat to metal surfaces subject to temperatures less than 120 degrees F.

3.7.2 Temperatures between 120 and 400 degrees F

Apply two coats of 400 degrees F heat-resisting enamel applied to a total minimum thickness of two mils to metal surfaces subject to temperatures between 120 and 400 degrees F.

3.7.3 Temperatures greater than 400 degrees F

Apply two coats of 315 degrees C 600 degrees F heat-resisting paint applied to a total minimum dry film thickness of two mils to metal surfaces subject to temperatures greater than 400 degrees F.

3.7.4 Color Coding Scheme for Locating Hidden Utility Components

Use scheme in buildings having suspended grid ceilings. Provide color coding scheme that identifies points of access for maintenance and operation of components and equipment that are not visible from the finished space and are accessible from the ceiling grid, consisting of a color code board and colored metal disks. Make each colored metal disk approximately 3/8 inch diameter and secure to removable ceiling panels with fasteners. Insert each fastener into the ceiling panel so as to be concealed from view. Provide fasteners that are manually removable without the use of tools and that do not separate from the ceiling panels

when the panels are dropped from ceiling height. Make installation of colored metal disks follow completion of the finished surface on which the disks are to be fastened. Provide color code board that is approximately 3 foot wide, 30 inches high, and 1/2 inches thick. Make the board of wood fiberboard and frame under glass or 1/16 inch transparent plastic cover. Make the color code symbols approximately 3/4 inch in diameter and the related lettering in 1/2 inch high capital letters. Mount the color code board in the mechanical or equipment room. Make the color code system as indicated below:

Color	System	Item	Location

3.8 IDENTIFICATION SYSTEMS

Provide identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and item number on all valves and dampers. Provide tags that are 1-3/8 inch minimum diameter with stamped or engraved markings. Make indentations black for reading clarity. Attach tags to valves with No. 12 AWG 0.0808-inch diameter corrosion-resistant steel wire, copper wire, chrome-plated beaded chain or plastic straps designed for that purpose.

3.9 DUCTWORK LEAK TEST

Perform ductwork leak test for the entire air distribution and exhaust system, including fans, coils, Provide test procedure, apparatus, and report that conform to SMACNA 1972 CD. The maximum allowable leakage rate is cfm. Complete ductwork leak test with satisfactory results prior to applying insulation to ductwork exterior or concealing ductwork.

3.10 DAMPER ACCEPTANCE TEST

Submit the proposed schedule, at least 2 weeks prior to the start of test. Operate all fire dampers and smoke dampers under normal operating conditions, prior to the occupancy of a building to determine that they function properly. Test each fire damper equipped with fusible link by having the fusible link cut in place. Test dynamic fire dampers with the air handling and distribution system running. Reset all fire dampers with the fusible links replaced after acceptance testing. To ensure optimum operation and performance, install the damper so it is square and free from racking.

3.11 TESTING, ADJUSTING, AND BALANCING

The requirements for testing, adjusting, and balancing are specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC. Begin testing, adjusting, and balancing only when the air supply and distribution, including controls, has been completed, with the exception of performance tests.

3.12 PERFORMANCE TESTS

Conduct performance tests as required in Section 23 05 93 Testing, Adjusting and Balancing for HVAC and Section 23 09 00 Instrumentation and Control for HVAC.

3.13 CLEANING AND ADJUSTING

Provide a temporary bypass for water coils to prevent flushing water from passing through coils. Inside of room fan-coil units thoroughly clean ducts, plenums, and casing of debris and blow free of small particles of rubbish and dust and then vacuum clean before installing outlet faces. Wipe equipment clean, with no traces of oil, dust, dirt, or paint spots. Provide temporary filters prior to startup of all fans that are operated during construction, and provide new filters after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. Perform and document that proper "Indoor Air Quality During Construction" procedures have been followed; provide documentation showing that after construction ends, and prior to occupancy, new filters were provided and installed. Maintain system in this clean condition until final acceptance. Properly lubricate bearings with oil or grease as recommended by the manufacturer. Tighten belts to proper tension. Adjust control valves and other miscellaneous equipment requiring adjustment to setting indicated or directed. Adjust fans to the speed indicated by the manufacturer to meet specified conditions. Maintain all equipment installed under the contract until close out documentation is received, the project is completed and the building has been documented as beneficially occupied.

3.14 RADIANT PANELS

3.14.1 Installation

Install radiant panels level and plumb, maintaining sufficient clearance for normal services and maintenance.

3.14.2 Soldering

When soldering copper fittings at the panel, a heat pad will be used to protect the panel finish.

3.14.3 Connections

Install piping adjacent to radiant panels to allow for service and maintenance.

3.15 OPERATION AND MAINTENANCE

3.15.1 Operation and Maintenance Manuals

Submit six manuals at least 2 weeks prior to field training. Submit data complying with the requirements specified in Section 01 78 23 OPERATION AND MAINTENANCE DATA. Submit Data Package 3 for the items/units listed under SD-10 Operation and Maintenance Data

3.15.2 Operation And Maintenance Training

Conduct a training course for the members of the operating staff as designated by the Contracting Officer. Make the training period consist of a total of hours of normal working time and start it after all work specified herein is functionally completed and the Performance Tests have been approved. Conduct field instruction that covers all of the items contained in the Operation and Maintenance Manuals as well as demonstrations of routine maintenance operations. Submit the proposed

On-site Training schedule concurrently with the Operation and Maintenance Manuals and at least 14 days prior to conducting the training course.

-- End of Section --

SECTION 23 36 00.00 40

AIR TERMINAL UNITS
05/16

PART 1 GENERAL

Section 23 30 00 HVAC AIR DISTRIBUTION applies to work specified in this section.

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 DUCT COUNCIL (ADC)

ADC Standards Manual	(2008; 5th Edition) Flexible Duct Performance Installation Standards

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 880 I-P	(2011) Performance Rating of Air Terminals

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 130	(2008) Method of Testing for Rating Ducted Air Terminal Units

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C1071	(2019) Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 90A	(2021) Standard for the Installation of

UNDERWRITERS LABORATORIES (UL)

UL 181	(2013; Reprint Apr 2017) UL Standard for Safety Factory-Made Air Ducts and Air Connectors
UL 486A-486B	(2018) UL Standard for Safety Wire Connectors

1.2 ADMINISTRATIVE REQUIREMENTS

Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, communication and security systems,and partition assemblies.

1.2.1 Pre-Installation Meetings

Submit itemized lists for all materials, equipment, and fixtures to be incorporated in the work 30 days prior to commencement of work. Ensure list includes manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information. Submit product data for each type of air terminal unit indicated, including rated capacities, furnished specialties, sound-power ratings, and accessories:

a. Bypass Single-Duct Air Terminal Units

b. Dual-Duct Air Terminal Units

c. Fan-Powered Air Terminal Units

d. Induction Air Terminal Units

e. Shutoff Single-Duct Air Terminal Units

f. Integral-Diffuser Air Terminal Units

g. High-Pressure Dual-Duct Mixing Boxes

h. Low-Pressure Dual-Duct Mixing Boxes

Submit records of existing conditions consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work constitutes acceptance of existing conditions.

Submit shop drawings which detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished. Include wiring diagrams to show power, signal, and control wiring.

Provide units with the configuration, capacity, and static-pressure characteristics indicated.

Ensure dimensional data stated constitutes nominal sizing, which has been adjusted by the manufacturer when necessary to accommodate acoustic material thickness.

Ensure units proposed are identical to units having at least 2 years of proven satisfactory field service.

Provide certification that units and the list of spare parts are ADC Standards Manual tested and rated.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. When used, a code following the "G" classification 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

Records of Existing Conditions

SD-02 Shop Drawings

Bypass Single-Duct Air Terminal Units; G,

Dual-Duct Air Terminal Units; G

Fan-Powered Air Terminal Units; G

Induction Air Terminal Units; G

Shutoff Single-Duct Air Terminal Units; G

Integral-Diffuser Air Terminal Units; G

High-Pressure Dual-Duct Mixing Boxes; G

Low-Pressure Dual-Duct Mixing Boxes; G

SD-03 Product Data

Bypass Single-Duct Air Terminal Units; G

Dual-Duct Air Terminal Units; G

Fan-Powered Air Terminal Units; G

Induction Air Terminal Units; G

Shutoff Single-Duct Air Terminal Units; G

Integral-Diffuser Air Terminal Units; G

High-Pressure Dual-Duct Mixing Boxes; G

Low-Pressure Dual-Duct Mixing Boxes; G

SD-06 Test Reports

Test Report

SD-07 Certificates

List of Spare Parts

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

SD-11 Closeout Submittals

Record Drawings

1.4 QUALITY CONTROL

Indicate on drawings the size, profiles, and dimensional requirements of air terminal units that are based on the specific system indicated.

Conform to NFPA 70, Article 100 for electrical components, devices, and accessories. List and label items as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

Ensure Air Terminals are certified under the AHRI 880 I-P Certification Program and carry the ARI Seal.

PART 2 PRODUCTS

2.1 EQUIPMENT

2.1.1 Verification of Performance

Rate air terminal units according to AHRI 880 I-P.

2.1.2 Bypass Single-Duct Air Terminal Units

2.1.2.1 Configuration

Provide diverting-damper assembly inside unit casing with control components located inside a protective metal shroud.

2.1.2.2 Casing

Provide 0.034-inch steel casing. Provide 1/2-inch thick, coated, fibrous-glass duct casing lining complying with ASTM C1071. Secure with adhesive. For the air inlet, provide round stub connection for duct attachment. For the air outlet, provide s-slip and drive connections. Provide removable panels, with airtight gaskets, for access to diverter and other parts requiring service, adjustment, or maintenance.

2.1.2.3 Diverter Assembly

Provide galvanized-steel gate, with polyethylene linear bearings diverter assembly.

2.1.2.4 Multi-Outlet Attenuator Section

Provide two, 6-inch diameter collars, each with locking butterfly balancing damper.

2.1.2.5 Hot-Water Heating Coil

Provide a copper tube heating coil, mechanically expanded into aluminum-plate fins. Verify heating coil passes underwater leak test to 200 psig.

2.1.2.6 Electric Heating Coil

Provide a factory installed and wired slip-in-type, open-coil design with integral control box. Include the following features:

a. Primary and secondary over temperature protection

b. Nickel chrome 80/20 heating elements

c. Airflow switch

d. Non-interlocking disconnect switch

e. Fuses (for coils more than 48 A)

f. Mercury contactors

g. Pneumatic-electric switches and relays.

h. Magnetic contactor for each step of control (for three-phase coils)

2.1.2.7 Electric Controls

Provide a 24 V damper actuator that is powered closed and powered open with a microswitch to energize heating control circuit.

Provide a wall-mounting electric type thermostat with temperature display in Celsius and Fahrenheit, and with a space temperature set point.

Provide a changeover thermostat of duct-mounting, electric type that reverses action of controls when the duct temperature rises 70 degrees F.

2.1.2.8 Electronic Controls

Provide a 24 V damper actuator that is powered closed and powered open.

2.1.2.9 Pneumatic Controls

Provide a pneumatic damper operator with a 8 to 13 psig spring range.

Provide a factory calibrated and field adjustable velocity controller capable of handling minimum and maximum air volumes. Ensure controllers maintain a constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inches wg when tested in accordance with ASHRAE 130. Provide controller with a multipoint velocity sensor. Locate velocity sensors in cold-deck air inlets and air outlets.

2.1.2.10 Thermostat

Provide a wall-mounting electronic type thermostat with integral control of room temperature. Ensure thermostat is time-proportional type with a reheat-coil control feature. Display temperature set-points in Celsius and Fahrenheit. Ensure the auxiliary switch energizes the heating control circuit, and changeover thermistor has a reverse action feature.

2.1.3 Dual-Duct Air Terminal Units

2.1.3.1 Configuration

Provide two volume dampers inside the unit casing with mixing attenuator section and control components located inside a protective metal shroud.

2.1.3.2 Casing

Provide 0.034-inch-inch casing. Include with casing an integral mixing baffle to efficiently mix the hot and cold airstream.

a. Casing Lining

Provide 0.034-inch casing. Provide 1/2-inch thick, coated, fibrous-glass duct casing lining complying with ASTM C1071. Secure with adhesive. Cover liner with nonporous foil.Cover liner with nonporous foil and perforated metal.

Attach a 3/4-inch thick adhesive of polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25, and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E84. Coat any cut edges of fiberglass exposed to the airstream with a NFPA 90A approved seal.

For the air inlet, provide round stub connection for duct attachment. For the air outlet, provide s-slip and drive connections. Provide removable panels with an airtight gasket for access to the diverter and other parts requiring service, adjustment, or maintenance.

2.1.3.3 Volume Damper

Provide a galvanized steel volume damper with peripheral gasket and self-lubricating bearings.

Perform a Maximum Damper Leakage Test (MDLT) in conformance to AHRI 880 I-P, for 3 percent of nominal airflow at 3-inch wginlet static pressure.

Select either Damper Position, Hot Deck: normally open or Damper Position, Cold Deck: normally closed.

2.1.3.4 Attenuator Section

Provide 0.034-inch sheet metal. Provide 1/2-inch thick, coated, fibrous-glass duct casing lining complying with ASTM C1071. Secure with adhesive. Cover liner with nonporous foil.

Attach a 3/4-inch thick adhesive of polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25, and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E84. Coat any cut edges of

fiberglass exposed to the airstream with NFPA 90A approved seal.

2.1.3.5 Multi-Outlet Attenuator Section

Provide two, 6 inch diameter collars; each with locking butterfly balancing damper.

2.1.3.6 Pneumatic Controls

a. Pneumatic Damper Operator

Provide a pneumatic damper operator with a 8 to 13 psig spring range.

b. Velocity Controllers

Provide a factory calibrated velocity controller, field adjustable to minimum and maximum air volumes. Ensure controllers maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg when tested in accordance with ASHRAE 130. Provide controller with a multipoint velocity sensor. Locate velocity sensors in cold-deck air inlet and air outlet.

c. Thermostat

Provide a wall-mounting pneumatic type thermostat with appropriate mounting hardware.

2.1.3.7 Electronic Controls

a. Damper Actuator

Provide a 24 V, powered closed, spring return open damper actuator.

b. Velocity Control

Provide a factory calibrated controller, with settings for minimum and maximum air volumes, and field adjustable at thermostat. Ensure controller maintains constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg, when tested in accordance with ASHRAE 130. Provide controller with a multipoint velocity sensor. Locate velocity sensors in cold-deck air inlet and air outlet.

c. Thermostat

Provide a wall-mounting electronic type thermostat with integral control of room temperature, time-proportional with reheat-coil control feature. Provide a temperature set-point display in Celsius and Fahrenheit.

2.1.3.8 DDC Controls

a. Damper Actuators

Provide a 24 V, powered closed, powered open damper actuator.

b. Velocity Sensors

Provide a multipoint array with velocity sensors in cold-deck and hot-deck

air inlet and air outlet.

c. Terminal Unit Controller

Provide a pressure independent, variable-air volume controller with electronic airflow transducers factory calibrated to minimum and maximum air volumes. Include the following features:

(1) Proportional, plus integral control of room temperature

(2) Time-proportional reheat-coil control

(3) Occupied and unoccupied operating mode

(4) Remote reset of airflow or temperature set points

(5) Adjusting and monitoring with portable terminal

d. Room Sensor

Provide a wall mounting room sensor, with temperature set-point adjustment and access for connection of portable operator terminal.

2.1.3.9 Control Sequence

Modulate cold-air damper to maintain room temperature. Modulate warm-air damper to maintain constant airflow.

2.1.4 Fan-Powered Air Terminal Units

2.1.4.1 Configuration

Provide volume-damper assembly and fan in series arrangement inside unit casing with control components inside a protective metal shroud.

2.1.4.2 Casing

Provide 0.034-inch casing. Include with casing an integral mixing baffle to efficiently mix the hot and cold airstream.

a. Casing Lining

Provide 1/2-inch thick with 1.5 pounds per cubic foot density, coated, fibrous-glass duct casing lining complying with ASTM C1071. Secure with adhesive.

Attach a 3/4-inch thick adhesive of polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25, and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E84. Coat any cut edges of fiberglass exposed to the airstream with NFPA 90A approved seal.

Provide a round stub connection for the air inlet duct attachment. For the air outlet provide s-slip and drive connections. Provide removable panels for access to diverter and other parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn gaskets.

2.1.4.3 Volume Damper

Provide a galvanized steel volume damper with peripheral gasket and self-lubricating bearings.

Perform a Maximum Damper Leakage Test (MDLT) in conformance to AHRI 880 I-P, for 2 percent of nominal airflow at 3-inch wg inlet static pressure, when tested in accordance with ASHRAE 130.

Select damper position: Normally open.

2.1.4.4 Fan Section

Provide a galvanized-steel plenum, with direct-drive, forward-curved fan with air filter and backdraft damper.

a. Lining

Provide 1/2-inch thick, coated, fibrous-glass duct liner complying with ASTM C1071; secured with adhesive.

b. Motor

Comply with requirements in Section 26 60 13.00 40 LOW-VOLTAGE MOTORS for Multi-speed motors. Provide motor which includes a speed control feature that is infinitely adjustable with pneumatic-electric and electronic controls. Provide rubber isolators with fan-motor assembly.

c. Air Filter

Provide 2-inchthick, fiberglass throwaway air-filter.

2.1.4.5 Attenuator Section

Provide 0.034-inch sheet metal. Provide 1/2-inch, coated, fibrous-glass duct casing lining complying with ASTM C1071. Secure with adhesive.

Attach a 3/4-inch thick adhesive of polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25, and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E84. Coat any cut edges of fiberglass exposed to the airstream with NFPA 90A approved seal.

2.1.4.6 Hot-Water Heating Coil

Provide a copper tube mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig; and factory installed.

2.1.4.7 Electric Heating Coil

Provide a slip-in-type, open-coil design with integral control box factory wired and installed. Include the following features:

a. Primary and secondary over-temperature protection

b. Nickel chrome 80/20 heating elements

c. Fan interlock contacts

d. Non-interlocking disconnect switch

e. Fuses (for coils more than 48 A)

f. Mercury contactors

g. Pneumatic-electric switches and relay

h. Magnetic contactor for each step of control (for three-phase coils)

2.1.4.8 Factory-Mounted and -Wired Controls

Mount electrical components in control box with removable cover. Incorporate single-point electrical connection to power source.

Provide factory mounted control transformer for control voltage on electric and electronic control units with terminal strip in control box for field wiring of thermostat and power source.

Provide fan and controls to terminal strip, with terminal lugs which match quantities, sizes, and materials of branch-circuit conductors for wiring terminations. Enclose terminal lugs in terminal box that is sized according to NFPA 70.

Factory-mount a fused type disconnect switch.

2.1.4.9 Control Panel Enclosure

Provide control panel enclosure conforming to NEMA 250, Type 1, with access panel sealed from airflow and mounted on side of unit.

2.1.4.10 Electric Controls

Provide a 24 V damper actuator with wall-mounting electric thermostat and appropriate mounting hardware.

2.1.4.11 Pneumatic Controls

a. Pneumatic Damper Operator

Provide a pneumatic damper operator with a 8 to 13 psig spring range.

b. Velocity Controllers

Provide a factory calibrated velocity controller, field adjustable to minimum and maximum air volumes. Ensure controllers maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg when tested in accordance with ASHRAE 130. Provide controller with a multipoint velocity sensor. Locate velocity sensors in cold-deck air inlet and air outlet.

c. Thermostat

Provide a wall-mounting pneumatic type thermostat with appropriate mounting hardware.

2.1.4.12 Electronic Controls

Provide a bi-directional damper operator and microprocessor-based controller with integral airflow transducer and room sensor compatible with temperature controls, having the following features:

a. Proportional, plus integral control of room temperature

b. Time-proportional reheat-coil control

c. Occupied and unoccupied operating mode

d. Remote reset of airflow or temperature set points

e. Adjusting and monitoring with portable terminal

f. Communication with temperature-control system

2.1.5 Induction Air Terminal Units

2.1.5.1 Configuration

Provide a volume-damper assembly inside the unit casing with a mechanical induction damper mounted on the casing with control components located inside a protective metal shroud.

2.1.5.2 Casing

Provide 0.034-inch casing. Ensure the casing includes an integral mixing baffle to efficiently mix the hot and cold airstream.

a. Casing Lining

Provide 1/2-inch thick, coated, fibrous-glass duct casing lining complying with ASTM C1071. Secure with adhesive.

For the air inlet provide round stub connection for duct attachment. For the air outlet provide s-slip and drive connections . Provide removable panels with an airtight gasket, for access to diverter and other parts requiring service, adjustment, or maintenance.

2.1.5.3 Volume Damper

Provide a galvanized steel volume damper with peripheral gasket and self-lubricating bearing.

Perform a Maximum Damper Leakage Test (MDLT) in conformance to AHRI 880 I-P, for 2 percent of nominal airflow at 3-inch wg inlet static pressure, when tested in accordance with ASHRAE 130.

Select Damper Position, normally openclosed.

2.1.5.4 Induction Damper

Provide galvanized-steel, multi-blade assembly with self-lubricating bearings.

2.1.5.5 Hot-Water Heating Coil

Provide a with a factory installed copper tube mechanically expanded into aluminum-plate fins and leak tested underwater to 200 psig.

2.1.5.6 Electric Heating Coil

Provide a slip-in-type, open-coil design with integral control box factory wired and installed. Include the following features:

a. Primary and secondary over-temperature protection

b. Nickel chrome 80/20 heating elements

c. Airflow switch

d. Non-interlocking disconnect switch

e. Fuses (for coils more than 48 A)

f. Mercury contactors

g. Pneumatic-electric switches and relays

h. Magnetic contactor for each step of control (for three-phase coils)

2.1.5.7 Pneumatic Controls

a. Damper Operator

Provide a pneumatic, 5 to 10 psig spring range damper operator.

b. Velocity Controller

Provide a factory calibrated velocity controller; field adjustable to minimum and maximum air volumes. Ensure controller is capable of maintaining constant airflow dictated by a thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4 inch wg when tested in accordance with ASHRAE 130. Ensure controller has a multipoint velocity sensor at air inlet.

c. Induction Damper Operator

Provide a pneumatic, spring range induction damper operator matching reset range of controller.

d. Thermostat

Provide a wall-mounting pneumatic type thermostat with appropriate mounting hardware.

2.1.5.8 Electronic Controls

a. Damper Actuator

Provide a pneumatic, 5 to 10 psig spring range damper operator.

b. Velocity Controller

Provide a factory calibrated velocity controller; field adjustable to minimum and maximum air volumes. Ensure controller is capable of maintaining constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg when tested in accordance with ASHRAE 130. Ensure controller has a multipoint velocity sensor at air inlet.

c. Induction Damper Operator

Provide a pneumatic, spring range induction damper operator matching reset range of controller.

d. Thermostat

Provide a wall-mounting pneumatic type thermostat with appropriate mounting hardware with the following features:

(1) Proportional, plus integral control of room temperature

(2) Time-proportional reheat-coil control

(3) Temperature set-point display in Celsius and Fahrenheit

2.1.6 Shutoff Single-Duct Air Terminal Units

2.1.6.1 Configuration

Provide a volume-damper assembly inside unit casing with control components located inside a protective metal shroud.

2.1.6.2 Casing

Provide 0.034-inch casing. Ensure the casing includes an integral mixing baffle to efficiently mix the hot and cold airstream.

a. Casing Lining

Provide 1/2-inch thick, coated, fibrous-glass duct casing lining complying with ASTM C1071. Secure with adhesive.

Attach a 3/4-inch adhesive of polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25, and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E84. Coat any cut edges of fiberglass exposed to the airstream with NFPA 90A approved seal.

For the air inlet provide round stub connection for duct attachment. For the air outlet provide s-slip and drive connections. Provide removable panels for access to diverter and other parts requiring service, adjustment, or maintenance; with airtight gasket.

2.1.6.3 Regulator Assembly

Provide galvanized-steel components with key damper blades onto shaft with nylon-fitted pivot points located inside unit casing.

a. Automatic Flow-Control Assembly

Match combined spring rates for each volume-regulator size with machined

dashpot for stable operation. Provide factory-calibrated and field-adjustable assembly with shaft extension for connection to externally mounted control actuator.

2.1.6.4 Regulator Assembly

Provide system-air-powered bellows section incorporating polypropylene bellows for volume regulation and thermostatic control. Ensure the bellows operate at temperatures from 0 to 140 degrees F; are impervious to moisture and fungus; are suitable for 10-inch wg static pressure when tested in accordance with ASHRAE 130, and are factory tested for leaks.

2.1.6.5 Volume Damper

Provide a galvanized steel volume damper with peripheral gasket and self-lubricating bearings.

Perform a Maximum Damper Leakage Test (MDLT)in conformance to AHRI 880 I-P, for 2 percent of nominal airflow at 3-inch wg inlet static pressure when tested in accordance with ASHRAE 130.

Select Damper Position, normally open.

2.1.6.6 Attenuator Section

Provide 0.034-inch sheet metal attenuator section.

Provide 1/2-inch thick, coated, fibrous-glass duct casing lining complying with ASTM C1071. Secure with adhesive. Cover liner with nonporous foil.

Attach a 3/4-inch thick adhesive of polyurethane foam insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25, and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E84. Coat any cut edges of fiberglass exposed to the airstream with NFPA 90A approved seal.

2.1.6.7 Multi-Outlet Attenuator Section

Provide two, 6-inch diameter collars; each with locking butterfly balancing damper.

2.1.6.8 Hot-Water Heating Coil

Provide a copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig; and factory installed.

2.1.6.9 Electric Heating Coil

Provide a slip-in-type, open-coil design with integral control box factory wired and installed. Include the following features:

a. Primary and secondary over-temperature protection

b. Nickel chrome 80/20 heating elements

c. Airflow switch

d. Non-interlocking disconnect switch

e. Fuses (for coils more than 48 A)

f. Mercury contactors

g. Pneumatic-electric switches and relays

h. Magnetic contactor for each step of control (for three-phase coils)

2.1.6.10 Electric Controls

a. Damper Actuator

Provide a 24 V, powered closed, powered open damper actuator.

b. Thermostat

Provide a wall-mounting electronic type thermostat with clock display, temperature display in Celsius and Fahrenheit, and space temperature set point.

2.1.6.11 Pneumatic Controls

a. Pneumatic Damper Operator

Provide a* 8 to 13 psig spring range.

b. Velocity Controllers

Provide a factory calibrated controller, field adjustable to minimum and maximum air volumes. Ensure controllers maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg, when tested in accordance with ASHRAE 130. Ensure controller has a multipoint velocity sensor. Locate velocity sensors in cold-deck air inlet and air outlet.

c. Thermostat

Provide a wall-mounting pneumatic type thermostat with appropriate mounting hardware.

2.1.6.12 Electronic Controls

Provide bidirectional damper operator and microprocessor-based thermostat with integral airflow transducer. Ensure room sensor is compatible with temperature controls specified.

a. Damper Actuator

Provide a 24 V, powered closed, spring return open damper actuator.

b. Velocity Controller

Provide a factory calibrated controller set to minimum and maximum air volumes, field adjustable at thermostat. Ensure controller maintains constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg, when tested in accordance with ASHRAE 130. Ensure controller has a multipoint velocity sensor. Locate velocity sensors in cold-deck air inlet and air outlet.

c. Thermostat

Provide a wall-mounting electronic type thermostat with integral control of room temperature, time-proportional with reheat-coil control feature, and displaying a temperature set-point in Celsius and Fahrenheit.

2.1.6.13 DDC Controls

Provide bidirectional damper operators and microprocessor-based controller. Provide with room sensor that is compatible with temperature controls specified.

a. Damper Actuators

Provide a 24 V, powered closed, spring return open damper actuator.

b. Terminal Unit Controller

Provide a pressure independent, variable-air volume controller with electronic airflow transducers factory calibrated to minimum and maximum air volumes. Include the following features:

(1) Proportional, plus integral control of room temperature

(2) Time-proportional reheat-coil control

(3) Occupied and unoccupied operating mode

(4) Remote reset of airflow or temperature set points

(5) Adjusting and monitoring with portable terminal

(6) Room Sensor

Provide a wall mounting room sensor, with temperature set-point adjustment and access for connection of portable operator terminal.

2.1.6.14 Control Sequence

Make suitable for operation with duct pressures between 0.25 and 3.0-inch wg inlet static pressure. Provide a factory-mounted and -piped, 5-micron filter; velocity-resetting, adjustable, high-limit control, with amplifying relay. Provide a system-powered, wall-mounting thermostat.

2.1.7 Integral-Diffuser Air Terminal Units

2.1.7.1 Configuration

Provide a volume-damper assembly inside unit casing with integral diffuser.

2.1.7.2 Casing

Provide 0.034-inch steel casing, including an integral mixing baffle to efficiently mix the hot and cold airstream.

a. Casing Lining

Provide 0.034-inch steel casing. Provide 1/2-inch thick, coated, fibrous-glass duct casing lining complying with ASTM C1071. Secure with adhesive. For the air inlet provide round stub connection for duct attachment.

2.1.7.3 Volume Damper

Provide galvanized steel with peripheral gasket and self-lubricating bearings.

Damper Position: Normally open.

2.1.7.4 Diffuser

Provide a galvanized-steel insulated plenum with extruded-aluminum or sheet-steel diffuser, having fixed or variable geometry designed to operate from 100 percent to minimum airflow, manual adjustment of airflow direction.

2.1.7.5 Electric Controls

a. Damper Actuator

Provide a 24 V, powered closed, spring return open.

b. Thermostat

Provide a wall-mounting electronic type thermostat with clock display, temperature display in Celsius and Fahrenheit, and space temperature set point.

2.1.7.6 Pneumatic Controls

Provide damper operator and thermostat compatible with temperature controls specified.

a. Pneumatic Damper Operator

Provide a 8 to 13 psig spring range.

b. Velocity Controller

Provide a factory calibrated velocity controller, which is field adjustable to minimum and maximum air volumes capable of maintaining constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg when tested in accordance with ASHRAE 130. Ensure controller has a multipoint velocity sensor at air inlet.

c. Thermostat

Provide a wall-mounting pneumatic type thermostat with appropriate mounting hardware.

2.1.7.7 Electronic Controls

Provide bidirectional damper operator and microprocessor-based thermostat with integral airflow transducer. Provide with room sensor that is compatible with temperature controls specified.

a. Damper Actuator

Provide a 24 V, powered closed, spring return open.

b. Velocity Controller

Provide a factory calibrated velocity controller, field adjustable to minimum and maximum air volumes. Ensure controller is capable of maintaining constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg when tested in accordance with ASHRAE 130. Provide controller with a multipoint velocity sensor at air inlet.

c. Thermostat

Provide a wall-mounting electronic type thermostat with integral control of room temperature. Ensure thermostat is time-proportional with reheat-coil control feature, and displays a temperature set-point in Celsius and Fahrenheit.

2.1.7.8 Control Sequence

Make suitable for operation with duct pressures between 0.25 and 3.0-inch wg inlet static pressure. Provide factory-mounted and -piped, 5-micron filter; velocity-resetting, adjustable, high-limit control; and amplifying relay with a system-powered, wall-mounting thermostat.

2.1.8 High-Pressure Dual-Duct Mixing Boxes

Provide mechanical constant-volume control type units with a mechanical controller that is operated by the entering mixed-airstream and maintains a constant airflow through the unit.

Provide factory preset units to deliver air volumes indicated.

2.1.8.1 Construction

Provide factory assembled units, complete with casing, air mixing valve assembly, single air mixing valve operator, and mechanical constant-volume control, ready for field mounting and connection to control.

Verify casing exterior is not less than 0.040-inch thick aluminum, or 20 gage mill-galvanized steel with not less than 1.25 ounces of zinc per square foot of two-sided surface, conforming to ASTM A653/A653M.

Ensure casing interior is acoustically baffled and lined with fibrous glass thick enough to attain required sound power level performance and preclude condensation on any exterior surface, but in no case less than 1-inch. Verify air side of fibrous glass is chloroprene-impregnated and manufactured to resist delamination or surface erosion at air velocities to 4,000-feet per minute. Ensure liner edges exposed to airstream are protected by metal turnovers. Verify liner and fibrous-glass baffle material conforms to NFPA 90A.

Ensure inlet valves and connecting linkage are constructed for modulation by a single operator. Verify hot inlet valve is normally open, and the cold inlet valve is normally closed. Ensure hot and cold inlet ports are field reversible.

Verify mechanical constant-volume control is externally adjustable and has a cubic feet-per-minute graduated capacity scale, which also indicates minimum/maximum range of the unit.

Ensure mechanical constant-volume control is externally adjustable. Provide a calibration chart with each unit indicating capacity per revolution of mechanical constant-volume device. Clearly label each unit with minimum/maximum volume range to facilitate field adjustment.

Ensure components subject to friction have oil-impregnated bronze bearings, graphite-impregnated nylon bearings, and lubricant-impregnated elastomers, corrosion-resistant steel, and similar materials.

Ensure casing is fitted with rigid, airtight access panels, easily removable and of ample size to give free access to interior parts. Verify closure is achieved by spring-retained, quarter-turn, slotted-cam captive devices, or similar operating fasteners.

Verify that all caulking compounds are chloroprene, polyurethane polysulfides, or silicone elastomers, with chloroprene, polyurethane, or vinyl gaskets.

2.1.8.2 Casing Leakage

Verify casing joints are sealed to prevent leakage of more than 2 percent of rated capacity with all connections sealed and with an internal static pressure of 1-inch wg.

2.1.8.3 Inlet Valve Leakage

Verify leakage in fully closed valve position does not exceed 2 percent of unit rated capacity against inlet pressure of 8-inches wg.

2.1.8.4 Mixed-Air Temperature Requirements

Verify that a thermometer traverse of all unit outlets shows variation of not more than 5 percent of the difference, at the time, between the temperatures of equal quantities of cold and warm airstreams entering the unit.

2.1.8.5 Volume Control Requirements

Verify mechanical constant-volume control maintains design volume within plus or minus 5 percent, regardless of the modulation position of inlet valves or the fluctuation of inlet or outlet pressure, within limits of indicated minimum pressure.

2.1.8.6 Sound Level Requirements

When determining equipment sound-power level performance and when no space-attenuation criteria are given, assume 18 dB space attenuation in all octave bands. Verify manufacturer's design incorporates sound correction factors for equipment.

Verify the scheduled airborne and radiated sound-power level (PWL) requirements, to attain the specified NC levels. Assume an 18 dB space attenuation in all octave bands with consideration given to downstream duct construction and configuration in determining airborne NC levels.

Assume the following ceiling sound-transmission loss (TL) characteristics, based on 1-inch acoustic lay-in panels and T-bar suspension, in computing resultant space radiated NC levels:

OCTAVE BAND	2ND	3RD	4TH	5TH	6TH	7TH
PWL-TL	-2	-4	-9	-10	-13	-15

NC40 is the limiting factor.

2.1.8.7 Control Requirements

Ensure operating-control power source is dry, compressed air of instrument quality at 15 psig, unless otherwise approved.

Provide for an air mixing valve operator from the automatic temperature control manufacturer, and installation by the unit manufacturer, unless field installation for specific construction is pre-approved by the Contracting Officer. Ensure operator is controlled by a direct-acting thermostat.

Provide copper pneumatic control tubing brought to the exterior of the casing for connection to automatic temperature control system.

2.1.9 Low-Pressure Dual-Duct Mixing Boxes

Provide manual-damper volume control type units. Provide a calibration chart with each unit. Label each unit with capacity minimum/maximum range to facilitate field adjustment.

Verify volume control damper is externally adjustable over an inlet pressure range of 0.05 to 1-inch wg.

Ensure components subject to friction have oil-impregnated bronze bearings, graphite-impregnated nylon bearings, and lubricant-impregnated elastomers, corrosion-resistant steel, and similar materials.

Ensure casings are fitted with rigid, airtight access panels, easily removable, and of ample size to give free access to interior parts. Provide closure mechanism which is achieved by spring-retained, quarter-turn, slotted-cam captive devices or similar operating fasteners.

Provide caulking compounds which are chloroprene, polyurethane polysulfides, or silicone elastomers. Provide chloroprene, polyurethane, or vinyl gaskets.

2.1.9.1 Casing Leakage

Seal all casing joints to prevent leakage of more than 2 percent of rated capacity, with all connections sealed and with an internal static pressure of 1-inch wg.

2.1.9.2 Inlet Valve Leakage

Leakage in fully closed valve position is not to exceed 2 percent of unit rated capacity against inlet pressure of 1 inch wg.

2.1.9.3 Mixed-Air Temperature Requirements

Ensure a thermometer traverse of all unit outlets shows variation of not more than 5 percent of the difference, at the time, between the temperatures of equal quantities of cold and warm airstreams entering the unit.

2.1.9.4 Sound Level Requirements

When determining equipment sound power level performance when no space-attenuation criteria are given, assume 18 dB space attenuation in all octave bands. Verify manufacturer designs incorporates sound correction factors for equipment.

2.1.9.5 Control Requirements

Ensure operating-control power source is dry, compressed air of instrument quality at 15 psig, unless otherwise approved.

Provide an air mixing valve operator from the automatic temperature control manufacturer and install using the unit manufacturer, unless field installation for specific construction is pre-approved by the Contracting Officer. Ensure operator is controlled by a direct-acting thermostat.

Provide copper pneumatic control tubing brought to the exterior of the casing for connection to the automatic temperature control system.

PART 3 EXECUTION

3.1 INSTALLATION

Install air terminal units level and plumb, and in accordance with NFPA 90A. Maintain sufficient clearance for normal service and maintenance.

3.1.1 Identification

Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

3.1.2 Connections

Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified in piping systems.

Install piping adjacent to air terminal units to allow service and maintenance.

3.1.2.1 Hot-Water Piping

Connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

Connect ducts to air terminal units.

Ground units with electric heating coils.

Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are

not indicated, use those specified in UL 486A-486B.

3.2 FIELD QUALITY CONTROL

Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections, and to assist in field testing.

Perform the following field tests and inspections and prepare a test report.

After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.

3.2.1 Leak Test

After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.

3.2.2 Operational Test

After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment. Remove and replace malfunctioning units and retest.

3.3 SYSTEM STARTUP

Engage a factory-authorized service representative to perform startup service.

Complete installation and startup checks according to manufacturer's written instructions and do the following:

a. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.

b. Verify that controls and control enclosure are accessible.

c. Verify that control connections are complete.

d. Verify that nameplate and identification tag are visible.

e. Verify that controls respond to inputs as specified.

3.4 CLOSEOUT ACTIVITIES

3.4.1 Operation and Maintenance

Submit 6 copies of the operation and maintenance manuals 30 calendar days prior to testing the following items. Update and re-submit data for final approval no later than 30 calendar days prior to contract completion. Concurrently, submit record drawings providing current factual information, including deviations and amendments to the drawings, and concealed and visible changes in the work.

3.4.2 Demonstration

Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

-- End of Section --

SECTION 23 37 13.00 40

DIFFUSERS, REGISTERS, AND GRILLES
05/15

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 OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 113	(2013) Method of Testing for Room Air Diffusion
ASHRAE EQUIP IP HDBK	(2012) Handbook, HVAC Systems and Equipment (IP Edition)
ASHRAE FUN IP	(2017) Fundamentals Handbook, I-P Edition

1.2 ADMINISTRATIVE REQUIREMENTS

Section 23 30 00 HVAC AIR DISTRIBUTION applies to work specified in this section.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. When used, a code following the "G" classification 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

Material, Equipment, and Fixture Lists; G

Records of Existing Conditions; G

SD-02 Shop Drawings

Fabrication Drawings; G

Installation Drawings; G

SD-03 Product Data

Equipment and Performance Data; G

SD-04 Samples

Manufacturer's Standard Color Chart; G

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

Certify air diffusion devices having been tested and rated in accordance with Chapter 19-ASHRAE EQUIP IP HDBK, Chapter 16-ASHRAE FUN IP, and ASHRAE 113, where such certification is required.

Submit equipment and performance data for air-diffusion devices consisting of sound data in terms of Noise Criteria (NC) index for the capacity range of the device.

2.2 COMPONENTS

2.2.1 Air Diffusion Device Construction

Preclude flutter, rattle, or vibration on air-diffusion device construction and mounting. Modify devices and provide accessories necessary for mounting in indicated surface construction.

Select color from manufacturer's standard color chart which indicates the manufacturer's standard color selections and finishes for air-diffusion devices.

Match color with architectural background.

Provide color as indicated on drawings.

Provide supply diffusers with combination damper and equalizing grid. Ensure dampers are extracting-splitter type, except as otherwise indicated.

Ensure air-diffusion device volume and pattern adjustments can be made from the face of the device. Make volume adjustments by removable key.

Provide gaskets for supply-terminal air devices mounted in finished surfaces.

Include within the material, equipment, and fixture lists the manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site information.

Submit records of existing conditions consisting of the results of Contractor's survey of work area conditions and features of existing structures and facilities within and adjacent to the jobsite. Commencement of work constitutes acceptance of existing conditions.

Submit fabrication drawings for air-diffusion devices consisting of fabrication and assembly details to be performed in the factory.

2.2.2 Types of Air Diffusion Devices

2.2.2.1 Type DRA

Provide type DRA supply diffuser, round with five or more expanding cones with beaded edges to provide hemispherically diffused discharge air. Arrange cones to provide a minimum of four air paths which simultaneously diffuse air at 20 to 50 feet per minute (fpm) and aspirate room air at 25 to 35 percent of discharge volume.

Provide aluminum diffuser with baked enamel finish.

Provide antismudge rings and extended cones.

2.2.2.2 Type DRB

Provide type DRB supply diffuser, round with four more expanding cones to provide hemispherically diffused discharge air. Arrange cones to provide a minimum of three air paths which simultaneously diffuse air at 20 to 50 fpm. Provide a pattern adjustment range from horizontal to downward projection, and any intermediate point, when mounted on exposed ductwork.

Provide aluminum diffuser with baked enamel finish.

Provide Integral antismudge rings and extended cones.

2.2.2.3 Type DRC

Provide type DRC combination supply and return diffuser, round with four expanding cones. Arrange cones to provide one return air path and two supply air paths. Provide a butterfly supply-air damper and an annular return-air damper. Provide aluminum construction.

Provide antismudge rings.

2.2.2.4 Type DRE

Provide type DRE supply diffuser, round with three expanding cones to provide discharge air paths, minimally, two-position adjustable for horizontal or vertical discharge.

Provide antismudge rings.

2.2.2.5 Type DRH

Provide type DRH supply diffuser, half-round with four semiconical expanding members to discharge diffused air in a 180-degree pattern. Arrange cones to provide a minimum of three air paths which simultaneously diffuse air at 20 to 50 fpm. Provide opposed-blade volume control.

Provide a baked enamel finish.

Provide antismudge rings.

2.2.2.6 Type DP Series

Provide type DP series supply diffuser with a square, perforated, hinged, face plate with opposed blade volume control, white baked enamel exterior finish, and black matte finish on exposed-to-view interior surface.

Provide one-way deflection.

Provide two-way opposed deflection.

Provide two-way diagonal deflection.

Provide three-way deflection.

Provide four-way deflection.

2.2.2.7 Type DLB

Provide type DLB supply diffuser, linear bar type, frame mounted, with extruded-aluminum bar and frame.

For floor- and sill-mounted diffusers provide heavy-duty reinforced construction to carry loads of not less than pounds per square foot.

Provide continuous length diffuser with hairline butt joints.

Provide mitered end caps where diffuser run terminates.

Provide opposed-blade type dampers.

Provide an integral, pivoted, bar-type access door where indicated.

Provide straightening grids where indicated.

2.2.2.8 Type DLS

Provide type DLS supply diffuser, linear slot type, extruded aluminum construction, with fully adjustable integral air pattern and volume control vanes that deflect air pattern from horizontal along ceiling to straight down. Ensure any intermediate setting and a pattern control element that permits complete blanking-off of slot.

Slot width: 3/4 inch.

Provide number of slots per unit run as indicated.

Align butts in continuous runs for hairline joints.

Butt ends of diffuser against walls without mitered end caps. Provide end caps where slot terminates.

Provide exposed-to-view part of frame with anodized aluminum, and all interior exposed-to-view components with a black matte finish.

2.2.2.9 Type DSA

Provide type DSA supply diffuser, square with four expanding flared members to provide radially diffused discharge air. Arrange flared members to provide a minimum of four air paths which simultaneously diffuse air at 20 to 50 fpm. Include pattern adjustments horizontal, vertical projection, and an intermediate position or range.

Provide a baked enamel finish.

Provide aluminum construction.

Provide antismudge rings.

Provide integral extended surface to fit into module of lay-in ceiling.

2.2.2.10 Type GS

Provide type GS supply grilles double deflection type with adjustable face bars parallel to short dimension and adjustable rear bars parallel to long dimension.

Provide a baked enamel finish.

Provide aluminum construction.

Provide antismudge rings.

Provide integral extended surface to fit into module of lay-in ceiling.

2.2.2.11 Type GR

Provide type GR return grilles, single deflection type with fixed face bars.

Provide grilles installed in vertical surfaces with horizontal face bars set downward at 35 degrees from vertical.

Provide grilles installed in horizontal surfaces with face bars straight and parallel to short dimension.

Provide a baked enamel finish.

Provide aluminum construction.

Provide antismudge rings.

Provide integral extended surface to fit into module of lay-in ceiling.

2.2.2.12 Type GCA

Provide type GCA with an individually adjustable, horizontal, curved-blade grilles and a one-way pattern.

Provide a baked enamel finish.

Provide aluminum construction.

2.2.2.13 Type GCB

Provide type GCB with an individually adjustable, vertical, curved-blade grilles and a one-way pattern.

Provide a baked enamel finish.

Provide aluminum construction.

2.2.2.14 Type GCD

Provide type GCD with an individually adjustable, vertical, curved-blade grilles and a two-way pattern.

Provide a baked enamel finish.

Provide aluminum construction.

2.2.2.15 Type GCE

Provide type GCE with an individually adjustable, vertical and horizontal, curved-blade grilles and a three-way pattern.

Provide a baked enamel finish.

Provide aluminum construction.

2.2.2.16 Type GCF

Provide type GCF with an individually adjustable, vertical and horizontal, curved-blade grilles and a four-way pattern.

Provide a baked enamel finish.

Provide aluminum construction.

2.2.2.17 Type RS

Provide type RS supply register, double-deflection type, with adjustable face bars parallel to short dimension and adjustable rear bars parallel to long dimension with opposed-blade type dampers.

Provide a baked enamel finish.

Provide aluminum construction.

Provide integral extended surface to fit into module of lay-in ceiling.

2.2.2.18 Type RR

Provide type RR return register, single-deflection type with fixed face bars with opposed-blade dampers.

Provide registers installed in vertical surfaces with horizontal face bars set downward at approximately 35 degrees from vertical.

Provide registers installed in horizontal surfaces with face bars set straight and parallel to short dimension.

Provide a baked enamel finish.

2.2.2.19 Type RCA

Provide type RCA with an individually adjustable, horizontal, curved-blade register and a one-way pattern with opposed-blade damper.

Provide a baked enamel finish.

Provide aluminum construction.

2.2.2.20 Type RCB

Provide type RCB with individually adjustable, vertical, curved-blade register and a one-way pattern with opposed blade damper.

Provide a baked enamel finish.

Provide aluminum construction.

2.2.2.21 Type RCC

Provide type RCC with an individually adjustable, horizontal, curved-blade register and a two-way pattern with opposed blade damper.

Provide a baked enamel finish.

Provide aluminum construction.

2.2.2.22 Type RCD

Provide type RCD with an individually adjustable, vertical, curved-blade register and a two-way pattern with opposed blade damper.

Provide a baked enamel finish.

Provide aluminum construction.

2.2.2.23 Type RCE

Provide type RCE with an individually adjustable, vertical and horizontal, curved-blade register and a three-way pattern with opposed-blade damper.

Provide a baked enamel finish.

Provide aluminum construction.

2.2.2.24 Type RCF

Provide type RCF with an individually adjustable, vertical and horizontal, curved-blade register and a four-way pattern with opposed-blade damper.

Provide a baked enamel finish.

Provide aluminum construction.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment as indicated and specified and in accordance with manufacturer's recommendations.

Mount wall-mounted supply registers 6 inches below ceiling.

Mount wall-mounted return registers 6 inches above the finished floor.

Submit installation drawings for air-diffusion devices. Indicate on drawings overall physical features, dimensions, ratings, service requirements, and equipment weights.

3.1.1 Operations and Maintenance Manuals

Provide operation and maintenance manuals consistent with manufacturer's standard brochures, schematics, printed instructions, general operating procedures and safety precautions.

-- End of Section --

SECTION 23 52 00

HEATING BOILERS
04/08, CHG 5: 11/19

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, INC. (AMCA)

AMCA 801	(2001; R 2008) Industrial Process/Power Generation Fans: Specification Guidelines

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 52.2	(2012) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(2013; R 2018) Pipe Threads, General Purpose (Inch)
ASME B16.3	(2016) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.4	(2016) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.5	(2017) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard
ASME B16.9	(2018) Factory-Made Wrought Buttwelding Fittings
ASME B16.11	(2016) Forged Fittings, Socket-Welding and Threaded
ASME B16.15	(2018) Cast Copper Alloy Threaded Fittings Classes 125 and 250
ASME B16.18	(2018) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.20	(2017) Metallic Gaskets for Pipe Flanges
ASME B16.22	(2018) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(2018) Standard for Cast Copper Alloy

	Fittings for Flared Copper Tubes
ASME B16.34	(2017) Valves - Flanged, Threaded and Welding End
ASME B16.39	(2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B31.1	(2020) Power Piping
ASME B31.5	(2020) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2013) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IV	(2017) BPVC Section IV-Rules for Construction of Heating Boilers
ASME BPVC SEC IX	(2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications
ASME BPVC SEC VIII D1	(2019) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1
ASME CSD-1	(2016) Control and Safety Devices for Automatically Fired Boilers

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	(2015) Grooved and Shouldered Joints

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2019) Specification for Filler Metals for Brazing and Braze Welding
AWS B2.2/B2.2M	(2016) Specification for Brazing Procedure and Performance Qualification

ASTM INTERNATIONAL (ASTM)

ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A105/A105M	(2018) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A167	(2011) Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A183	(2014; R 2020) Standard Specification for Carbon Steel Track Bolts and Nuts

ASTM A193/A193M	(2020) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service and Other Special Purpose Applications
ASTM A234/A234M	(2019) Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A515/A515M	(2017) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A516/A516M	(2017) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B32	(2020) Standard Specification for Solder Metal
ASTM B62	(2017) Standard Specification for Composition Bronze or Ounce Metal Castings
ASTM B75/B75M	(2020) Standard Specification for Seamless Copper Tube
ASTM B88	(2020) Standard Specification for Seamless Copper Water Tube
ASTM B813	(2016) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B828	(2016) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM C27	(1998; R 2008) Fireclay and High-Alumina Refractory Brick
ASTM C34	(2017) Standard Specification for Structural Clay Loadbearing Wall Tile
ASTM C155	(1997; R 2013) Standard Specification for Insulating Firebrick
ASTM C401	(2012) Alumina and Alumina-Silicate Castable Refractories

ASTM D596	(2001; R 2018) Standard Guide for Reporting Results of Analysis of Water
ASTM D1784	(2020) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D2000	(2018) Standard Classification System for Rubber Products in Automotive Applications
ASTM F1097	(2017) Standard Specification for Mortar, Refractory (High-Temperature, Air-Setting)
ASTM F1139	(1988; R 2019) Steam Traps and Drains

COMPRESSED AIR AND GAS INSTITUTE (CAGI)

CAGI B19.1	(2010) Safety Standard for Compressor Systems

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015	(2016; 14/17) Copper Tube Handbook

EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA Stds	(2015) (10th Ed) EJMA Standards

HYDRONICS INSTITUTE DIVISION OF AHRI (HYI)

HYI-005	(2008) I=B=R Ratings for Boilers, Baseboard Radiation and Finned Tube (Commercial)

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(2018) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation
MSS SP-70	(2011) Gray Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-78	(2011) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(2019) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(2011) Gray Iron Globe & Angle Valves Flanged and Threaded Ends

MSS SP-110	(2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA MG 1	(2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(2020) Standard for the Installation of Oil-Burning Equipment
NFPA 54	(2021) National Fuel Gas Code

U.S. DEPARTMENT OF ENERGY (DOE)

Energy Star	(1992; R 2006) Energy Star Energy Efficiency Labeling System (FEMP)

UNDERWRITERS LABORATORIES (UL)

UL 726	(1995; Reprint Oct 2013) Oil-Fired Boiler Assemblies
UL 1738	(2010; Reprint Feb 2020) Venting Systems for Gas-Burning Appliances, Categories II, III and IV
UL FLAMMABLE & COMBUSTIBLE	(2012) Flammable and Combustible Liquids and Gases Equipment Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings

SD-03 Product Data

Materials and Equipment; G

Spare Parts

Water Treatment System

Boiler Water Treatment
Heating System Tests

Fuel System Tests

Welding

Qualifications

Field Instructions

Tests

SD-06 Test Reports

Heating System Tests; G.

Fuel System Tests;G

SD-07 Certificates

Bolts

SD-10 Operation and Maintenance Data

Operation and Maintenance Instructions; G

Water Treatment System; G

SD-11 Closeout Submittals

Indoor Air Quality During Construction; S

1.3 QUALITY ASSURANCE

Submit a copy of qualified welding procedures and a list of names and identification symbols of qualified welders and welding operators, at least 2 weeks prior to the start of welding operations. Boilers and piping shall be welded and brazed 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 B31.1. Notify the Contracting Officer 24 hours in advance of tests, and the tests shall be performed at the work site if practical. The welder or welding operator shall apply the personally assigned symbol near each weld made as a permanent record.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect equipment delivered and placed in storage from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

1.5 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings and no later than 2 months prior to the date of beneficial occupancy. Submit Detail Drawings consisting of equipment layout including installation details and

electrical connection diagrams; combustion and safety control diagrams; ductwork layout showing the location of supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of guides and anchors, the load imposed on each support or anchor (not required for radiant floor tubing), and typical support details. Include on the drawings any information required to demonstrate that the system has been coordinated and will properly function as a unit and to show equipment relationship to other parts of the work, including clearances required for operation and maintenance. Include in the data a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 years of service.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Submit manufacturer's catalog data included with the detail drawings for the following:

a. Radiant floor heating system including tubing, joints, and manifold for radiant floor heating systems.

b. Data showing model, size, options, etc., that are intended for consideration. Data submitted shall be adequate to demonstrate compliance with contract requirements. Data shall include manufacturer's written installation instructions and manufacturer's recommendations for operation and maintenance clearances for the following:

(1) Boilers
(2) Unit Heaters
(3) Fuel Burning Equipment
(4) Combustion Control Equipment
(5) Pumps
(6) Fittings and Accessories
(7) Fuel Oil Storage System
(8) Water Treatment System

2.1.2 Asbestos Prohibition

Asbestos and asbestos-containing products will not be allowed.

2.1.3 Nameplates

Secure a plate to each major component of equipment containing the manufacturer's name, address, type or style, model or serial number, and catalog number. Also, display an Energy Star label as applicable. Each pressure vessel shall have an approved ASME stamp.

2.1.4 Equipment Guards

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded in accordance with OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified. Catwalks, operating platforms, ladders, and guardrails shall be provided where shown and shall be constructed in accordance with Section .

2.2 BOILERS

Each boiler shall have the output capacity in British thermal units per hour (Btuh) as indicated when fired with the specified fuels. The boiler shall be furnished complete with the gas burning equipment, boiler fittings and trim, automatic controls, forced draft fan, electrical wiring, insulation, piping connections, and protective jacket. The boiler shall be completely assembled and tested at the manufacturer's plant. Boiler auxiliaries including fans, motors, drives, and similar equipment shall be provided with at least 10 percent excess capacity to allow for field variations in settings and to compensate for any unforeseen increases in pressure losses in appurtenant piping and ductwork. However, the boiler safety devices shall not be sized for a 10 percent excess capacity. The boiler and its accessories shall be designed and installed to permit ready accessibility for operation, maintenance, and service. Boilers shall be designed, constructed, and equipped in accordance with ASME BPVC SEC IV. Each boiler shall be of the condensing type and designed for water service as specified herein. The boiler capacity shall be based on the ratings shown in HYI-005 or as certified by the American Boiler Manufacturers Association, or American Gas Association.

2.2.1 Firetube Boiler

Boiler shall be self-contained, multipass, packaged type, complete with all accessories, mounted on a structural steel base. When the boilers are operating at maximum output, the heat input rates shall not be greater than 6,700 Btuh per square ft of fireside heating surface.

2.2.2 Watertube Boiler

The boiler shall be a standard type of water tube boiler. Boiler shall be self-contained, packaged type, complete with all accessories, mounted on a structural steel base. The boiler heating surface area for bent or flexible tube boilers shall be at least 4 square feet/boiler horse power. Bent or flexible tube boilers shall be provided with single or multiple downcomers for circulation without the need for exterior pumping. The tubes for bent or flexible tube boilers shall be designed for replacement without requiring welding or rolling of tubes. Any special tools required for bent or flexible tube removal or installation shall be provided with the boiler.

2.2.3 Condensing Boiler

Each boiler shall be a self-contained packaged type, complete with accessories, mounted on a structural steel base or a steel base which is integral to the boiler shell. Each boiler shall conform to the commercial design used by the manufacturer and shall permit free thermal expansion without placing undue stress on any part of the boiler. Each boiler which

experiences the formation of condensate within the flue gas shall be specifically designed for condensing application. Each boiler shall withstand the corrosive effects of condensate for each part which may be in contact with the condensate at all possible operating conditions. Each boiler shall be provided with a separate air intake, exhaust, and condensate drain. Each boiler shall be designed to withstand the water temperature differentials anticipated at the required operating conditions without experiencing any damage due to thermal shock.

2.2.4 Modular Configuration

Modular boilers shall be of the condensing type. Modular boilers shall have the capability of independent operation. Upon failure of any module, the remaining modules shall be capable of operating at their designed capacity. The size of the individual modules shall be as indicated.

2.2.5 Hot Water Heating Boilers

The hot water heating boiler shall be capable of operating at the specified maximum continuous capacity without damage or deterioration to the boiler, its setting, firing equipment, or auxiliaries. The rated capacity shall be the capacity at which the boiler will operate continuously while maintaining at least the specified minimum efficiency.

2.3 FUEL BURNING EQUIPMENT

Boiler shall be designed to burn gas . Each boiler shall comply with Federal, state, and local emission regulations.

2.3.1 Burners

2.3.1.1 Gas and Combination Gas-Oil Fired Burners and Controls

Burners shall be UL approved

2.3.1.2 Oil-Fired Burners and Controls

Oil-fired burners and controls for oil-fired units firing oil shall be atomizing, forced-draft type in conformance with UL 726. Oil-fired units less than 12,500,000 Btuh input shall conform to ASME CSD-1.

2.3.2 Draft Fans

Fans conforming to AMCA 801 forced-draft shall be furnished as an integral part of boiler design. Fans shall be centrifugal with backward-curved blades or axial flow type. Each fan shall be sized for output volume and static pressure rating sufficient for pressure losses, excess air requirements at the burner, leakages, temperature, and elevation corrections for worst ambient conditions, all at full combustion to meet net-rated output at normal firing conditions, plus an overall excess air volume of 10 percent against a 20 percent static overpressure. Noise levels for fans shall not exceed 85 decibels in any octave band at a 3 foot station. Forced draft fan bearings shall be air cooled.

2.3.2.1 Draft Fan Control

Forced-draft centrifugal fans shall have inlet vane controls or shall have variable speed control where indicated. Inlet vanes shall be suitable for use with combustion control equipment. Axial propeller fans shall have

variable propeller pitch control.

2.3.2.2 Draft Fan Drives

Fans shall be driven by electric motors. Electric motor shall be drip proof . Motor starter shall be magnetic across-the-line type with general purpose enclosure and shall be furnished with four auxiliary interlock contacts.

2.3.3 Draft Damper

Boilers shall be provided with manual dampers, draft hoods, or barometric dampers as recommended by the boiler manufacturer to maintain proper draft in the boiler. Draft damper shall be provided in a convenient and accessible location in the flue gas outlet from the boiler. Automatic damper shall be arranged for automatic operation by means of a damper regulator .

2.3.4 Ductwork

Air ducts connecting the forced-draft fan units with the plenum chamber shall be designed to convey air with a minimum of pressure loss due to friction. Ductwork shall be galvanized sheet metal conforming to ASTM A653/A653M. Ducts shall be straight and smooth on the inside with laps made in direction of air flow. Ducts shall have cross-break with enough center height to assure rigidity in the duct section, shall be angle iron braced, and shall be completely free of vibration. Access and inspection doors shall be provided as indicated and required, with a minimum of one in each section between dampers or items of equipment. Ducts shall be constructed with long radius elbows having a centerline radius 1-1/2 times the duct width, or where the space does not permit the use of long radius elbows, short radius or square elbows with factory-fabricated turning vanes may be used. Duct joints shall be substantially airtight and shall have adequate strength for the service, with 1-1/2 x 1-1/2 x 1/8 inch angles used where required for strength or rigidity. Duct wall thickness shall be 16 gauge (0.0598 inch) for ducts 60 inches or less and 12 gauge (0.1046 inch) for ducts larger than 60 inches in maximum dimension. Additional ductwork shall be in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

2.4 COMBUSTION CONTROL EQUIPMENT

Combustion control equipment shall be provided as a system by a single manufacturer. Field installed automatic combustion control system shall be installed in accordance with the manufacturer's recommendations and under the direct supervision of a representative of the control manufacturer. The boiler water temperature shall be controlled by a water temperature controller. The equipment shall operate electronically . On multiple boiler installations, each boiler unit shall have a completely independent system of controls responding to the load and to a plant master controller. If recording instruments are provided, a 1 year supply of ink and 400 blank charts for each recorder shall be furnished.

2.4.1 Pneumatic Controls

If pneumatic operation is provided, a regenerant desiccant air dryer unit shall be provided. Boiler shall shut down on loss of control air pressure. Pneumatic control systems shall conform to CAGI B19.1. Air filter regulator sets shall be installed at each control valve and

transmitter in the system. The master air filter regulator set on the control panel shall be the dual type where one side can be cleaned and repaired while the other is operating. Exterior control air piping and devices shall be protected from freezing.

2.4.1.1 Air Compressor Unit

The air compressor unit shall be electric-motor driven, polytetrafluoroethylene or carbon ring type automatic air compressor. The compressor unit shall be sized to run not more than 60 percent of the time when all controls are in service. The air compressor unit shall be complete with necessary accessories including automatic pressure control equipment, relief valves, check valves, air filters, moisture traps, and a receiver with ample capacity for emergency operation of the controls for 15 minutes after compressor shutdown. Compressor speed shall not exceed 900 rpm. Motor speed shall not exceed 1750 rpm. The compressor air intake shall be provided with a low drop type air suction filter/silencer suitable for outdoor installation.

2.4.1.2 Air Receiver

The air receiver shall be constructed in accordance with ASME BPVC SEC VIII D1for unfired pressure vessels for 200 psi working pressure, and shall be equipped with inlet and outlet connections, valved drain connection, minimum 6 inch dial pressure gauge, pop safety valves, and regulator connections.

2.4.2 Electrical controls

Electrical control devices shall be rated at 120 volts and shall be connected as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.4.3 Water Temperature Controller

The controller shall be of sturdy construction and shall be protected against dust and dampness. The thermostatic element shall be inserted in a separable socket installed in the upper part of the boiler near the water outlet . Modulating controllers shall control the fuel burning equipment to maintain set boiler water temperature within 2 percent.

2.5 PUMPS

2.5.1 Hot Water and Boiler Circulating Pumps

Circulating pumps for hot water shall be electrically driven single-stage centrifugal type and have a capacity not less than indicated. Boiler circulating pumps shall be supported on a concrete foundation with a cast iron or structural steel base and shall be closed-coupled shaft . The boiler circulating pumps shall be vertical split case type. Hot water circulating pumps shall be supported by the piping on which installed and shall have a flexible-coupled shaft. The hot water circulating pumps shall be vertical split case type. The pump shaft shall be constructed of corrosion-resistant alloy steel, sleeve bearings and glands of bronze designed to accommodate a mechanical seal, and the housing of close-grained cast iron. Pump seals shall be capable of withstanding 240 degrees F temperature without external cooling. The motor shall have sufficient power for the service required, shall be of a type approved by the manufacturer of the pump, shall be suitable for the available electric service, and shall conform to the requirements of paragraph ELECTRICAL

EQUIPMENT. Each pump suction and discharge connection shall be provided with a pressure gauge as specified. The boiler circulating pump discharge heater shall be provided with a flow switch . Flow switch unit shall be a self-contained swinging vane type to indicate fluid flow. Pressure switch unit shall be a self-contained snap action type to indicate fluid pressure. Switch shall be a SPDT with 120-volt, 15-ampere rating.

2.6 FITTINGS AND ACCESSORIES

Boiler fittings and accessories shall be installed with each boiler in accordance with ASME BPVC SEC IV, unless otherwise specified.

2.6.1 Direct Vents

Direct venting shall be used for condensing type boilers. Both the air intake and exhaust vents shall be sized and located as indicated on the drawings and as recommended by the boiler manufacturer. A separate combustion air intake vent and exhaust vent shall be provided for each boiler.

2.6.1.1 Combustion Air Intake Vent

The combustion air intake piping shall be constructed of Schedule 40 PVC in accordance with ASTM D1784. The vent shall be suitable for the temperature at the boiler combustion air intake connection point. Each intake shall be provided complete with bird screen.

2.6.1.2 Exhaust Vent

The exhaust vent piping shall be constructed of Schedule 40 CPVC or stainless steel conforming to UL 1738 and the boiler manufacturer's recommendations. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. The exhaust vent shall be suitable for the maximum anticipated boiler exhaust temperature and shall withstand the corrosive effects of the condensate. A 0.3125 inch diameter hole shall be provided in the stack not greater than 6 inches from the boiler flue outlet for sampling of the exit gases. A method shall be provided to seal the hole to prevent exhaust gases from entering the boiler room when samples are not being taken. Each exhaust stack shall be provided complete with bird screen.

2.6.2 Expansion Tank

The hot water pressurization system shall include a diaphragm-type expansion tank which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting the pressure increase at all components in the system to the maximum allowable pressure at those components. The only air in the system shall be the permanent sealed-in air cushion contained in the diaphragm-type tank. The sizes shall be as indicated. The expansion tank shall be welded steel, constructed, tested, and stamped in accordance with ASME BPVC SEC VIII D1 for a working pressure of 125 psi and precharged to the minimum operating pressure. The tank's air chamber shall be fitted with an air charging valve and pressure gauge. The tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The tank shall have lifting rings and a drain connection. All components shall be suitable for a maximum operating temperature of 250 degrees F.

2.6.3 Air Separator

External air separation tank shall be steel, constructed, tested and stamped in accordance with ASME BPVC SEC VIII D1 for a working pressure of 125 psi. The capacity of the air separation tank indicated is minimum.

2.6.4 Filters

Filters shall conform to ASHRAE 52.2.

2.6.5 Foundation (Setting) Materials

2.6.5.1 Firebrick

Firebrick shall be ASTM C27 class as recommended by boiler manufacturer.

2.6.5.2 Tile

Tile shall be ASTM C34, Grade LBX.

2.6.5.3 Insulating Brick

Insulating brick shall comply with ASTM C155.

2.6.5.4 Refractory Mortar

Refractory mortar shall comply with ASTM F1097.

2.6.5.5 Castable Refractories

Castable refractories shall be ASTM C401. The minimum modulus of rupture for transverse strength shall be not less than 600 psi after being heat soaked for 5 hours or more at a temperature in excess of 2500 degrees F.

2.6.6 Steel Sheets

2.6.6.1 Galvanized Steel

Galvanized steel shall be ASTM A653/A653M.

2.6.6.2 Uncoated Steel

Uncoated steel shall be composition, condition, and finish best suited to the intended use.

2.6.7 Gaskets

Gaskets shall be nonasbestos material in accordance with ASME B16.20, full face or self-centering type. The gaskets shall be of the spiral wound type with graphite filler material.

2.6.8 Steel Pipe and Fittings

2.6.8.1 Steel Pipe

Steel pipe shall be ASTM A53/A53M, Type E or S, Grade A or B, black steel, standard weight.

2.6.8.2 Steel Pipe Fittings

Fittings shall have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer.

2.6.8.3 Steel Flanges

Flanged fittings including flanges, bolts, nuts, bolt patterns, etc. shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A105/A105M. Flanges for high temperature water systems shall be serrated or raised-face type. Blind flange material shall conform to ASTM A516/A516M cold service and ASTM A515/A515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A193/A193M. Submit written certification by the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

2.6.8.4 Welded Fittings

Welded fittings shall conform to ASTM A234/A234M with WPA marking. Buttwelded fittings shall conform to ASME B16.9, and socket-welded fittings shall conform to ASME B16.11.

2.6.8.5 Cast-Iron Fittings

Fittings shall be ASME B16.4, Class 125, type required to match connecting piping.

2.6.8.6 Malleable-Iron Fittings

Fittings shall be ASME B16.3, type as required to match connecting piping.

2.6.8.7 Unions

Unions shall be ASME B16.39, Class 150.

2.6.8.8 Threads

Pipe threads shall conform to ASME B1.20.1.

2.6.8.9 Grooved Mechanical fittings

Joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Fitting and coupling houses shall be ductile iron conforming to ASTM A536. Gaskets shall be molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D2000 for circulating medium up to 230 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A183.

2.6.9 Copper Tubing and Fittings

2.6.9.1 Copper Tubing

Tubing shall be ASTM B88, Type K or L. Adapters for copper tubing shall be brass or bronze for brazed fittings.

2.6.9.2 Solder-Joint Pressure Fittings

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B75/B75M. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18 and ASTM B828.

2.6.9.3 Flared Fittings

Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B62.

2.6.9.4 Adapters

Adapters may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used.

2.6.9.5 Threaded Fittings

Cast bronze threaded fittings shall conform to ASME B16.15.

2.6.9.6 Brazing Material

Brazing material shall conform to AWS A5.8/A5.8M.

2.6.9.7 Brazing Flux

Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides, and contain fluorides. Silver brazing materials shall be in accordance with AWS A5.8/A5.8M.

2.6.9.8 Solder Material

Solder metal shall conform to ASTM B32 95-5 tin-antimony.

2.6.9.9 Solder Flux

Flux shall be either liquid or paste form, non-corrosive and conform to ASTM B813.

2.6.9.10 Grooved Mechanical Fittings

Joints and fittings shall be designed for not less than 125 psig service and shall be the product of the same manufacturer. Fitting and coupling houses shall be ductile iron conforming to ASTM A536. Gaskets shall be molded synthetic rubber with central cavity, pressure responsible configuration and shall conform to ASTM D2000, for circulating medium up to 230 degrees F. Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A183.

2.6.10 Dielectric Waterways and Flanges

Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping.

Dielectric waterways shall include dielectric unions to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways.

2.6.11 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 125 psi or 150 psi service. Connectors shall be installed where indicated. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. Materials used and the configuration shall be suitable for the pressure, vacuum, and temperature medium. The flexible section shall be suitable for service intended and may have threaded, welded, soldered, flanged, or socket ends. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.6.12 Pipe Supports

Pipe supports shall conform to MSS SP-58.

2.6.13 Pipe Expansion

2.6.13.1 Expansion Loops

Expansion loops and offsets shall provide adequate expansion of the main straight runs of the system within the stress limits specified in ASME B31.1. The loops and offsets shall be cold-sprung and installed where indicated. Pipe guides and anchors shall be provided as indicated.

2.6.13.2 Expansion Joints

Expansion joints shall provide for either single or double slip of the connected pipes, as required or indicated, and for not less than the transverse indicated. The joints shall be designed for a hot water working pressure not less than psig and shall be in accordance with applicable requirements of EJMA Stds and ASME B31.1. End connection shall be flanged. Anchor bases or support bases shall be provided as indicated or required. Sliding surfaces and water wetted surfaces shall be chromium plated or fabricated of corrosion resistant steel. Initial setting shall be made in accordance with the manufacturer's recommendations to compensate for an ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by the joint manufacturer, but in any case shall not be more than 5 feet from expansion joint, except in lines 4 inches or smaller guides shall be installed not more than 2 feet from the joint. Service outlets shall be provided where indicated.

2.6.13.2.1 Bellows-Type joint

Bellows-type joints shall be flexible, guided expansion joints. The expansion element shall be stabilized corrosion resistant steel. Bellows-type expansion joints shall conform to the applicable requirements of EJMA Stds and ASME B31.1 with internal lines. Guiding of piping on both sides of expansion joint shall be in accordance with the published

recommendations of the manufacturer of the expansion joint. The joints shall be designed for the working temperature and pressure suitable for the application but shall not be less than 150 psig.

2.6.13.2.2 Flexible Ball Joint

Flexible ball joints shall be constructed of alloys as appropriate for the service intended. The joints shall be threaded, grooved, flanged, or welded end as required and shall be capable of absorbing the normal operating axial, lateral, or angular movements or combination thereof. Balls and sockets shall be polished, chromium-plated when materials are not of corrosion-resistant steel. The ball type joint shall be designed and constructed in accordance with ASME B31.1 and EJMA Stds. Flanges shall conform to the diameter and drilling of ASME B16.5. Molded gaskets shall be suitable for the service intended.

2.6.13.2.3 Slip Type Expansion Joint

Slip type expansion joints shall be EJMA Stds and ASME B31.1, Class 1 or 2. Type II joints shall be suitable for repacking under full line pressure.

2.6.14 Valves

Valves shall be Class 125 and shall be suitable for the application. Grooved ends in accordance with AWWA C606 may be used for water service only. Valves in nonboiler external piping shall meet the material, fabrication and operating requirements of ASME B31.1. The connection type of all valves shall match the same type of connection required for the piping on which installed.

2.6.14.1 Gate Valves

Gate valves 2-1/2 inches and smaller shall conform to MSS SP-80 bronze rising stem, threaded, solder, or flanged ends. Gate valves 3 inches and larger shall conform to MSS SP-70 cast iron bronze trim, outside screw and yoke, flanged, or threaded ends.

2.6.14.2 Globe Valves

Globe valves 2-1/2 inches and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Globe valves 3 inches and larger shall conform to MSS SP-85, cast iron, bronze trim, flanged, or threaded ends.

2.6.14.3 Check Valves

Check valves 2-1/2 inches and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Check valves 3 inches and larger shall conform to MSS SP-71, cast iron, bronze trim, flanged, or threaded ends.

2.6.14.4 Angle Valves

Angle valves 2-1/2 inches and smaller shall conform to MSS SP-80 bronze, threaded, soldered, or flanged ends. Angle valves 3 inches and larger shall conform to MSS SP-85, cast iron, bronze trim, flanged, or threaded ends.

2.6.14.5 Ball Valves

Ball valves 1/2 inch and larger shall conform to MSS SP-110, ductile iron or bronze, threaded, soldered, or flanged ends.

2.6.14.6 Plug Valves

Plug valves 2 inch and larger shall conform to MSS SP-78. Plug valves smaller than 2 inch shall conform to ASME B16.34.

2.6.14.7 Grooved End Valves

Valves with grooved ends in accordance with AWWA C606 may be used if the valve manufacturer certifies that their performance meets the requirements of the standards indicated for each type of valve.

2.6.14.8 Balancing Valves

Balancing valves shall have meter connections with positive shutoff valves. An integral pointer shall register the degree of valve opening. Valves shall be calibrated so that flow rate can be determined when valve opening in degrees and pressure differential across valve is known. Each balancing valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation. Valves shall be suitable for 250 degrees F temperature and working pressure of the pipe in which installed. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential. One portable differential meter shall be furnished. The meter suitable for the operating pressure specified shall be complete with hoses, vent, and shutoff valves, and carrying case. In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing.

2.6.14.9 Automatic Flow Control Valves

In lieu of the specified balancing valves, automatic flow control valves may be provided to maintain constant flow and shall be designed to be sensitive to pressure differential across the valve to provide the required opening. Valves shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Valves shall control the flow within 5 percent of the tag rating. Valves shall be suitable for the maximum operating pressure of 125 psi or 150 percent of the system operating pressure, whichever is greater. Where the available system pressure is not adequate to provide the minimum pressure differential that still allows flow control, the system pump head capability shall be increased. Valves shall be suitable for 250 degrees F temperature service. Valve materials shall be same as specified for the heating system check, globe, angle, and gate valves. Valve operator shall be the electric motor type or pneumatic type as applicable. Valve operator shall be capable of positive shutoff against the system pump head. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential across the automatic flow control valve. A portable meter shall be provided with accessory kit

as recommended for the project by the automatic valve manufacturer.

2.6.14.10 Butterfly Valves

Butterfly valves shall be 2-flange type or lug wafer type, and shall be bubbletight at 150 psig. Valve bodies shall be cast iron, malleable iron, or steel. ASTM A167, Type 404 or Type 316, corrosion resisting steel stems, bronze, or corrosion resisting steel discs, and synthetic rubber seats shall be provided. Valves smaller than 8 inches shall have throttling handles with a minimum of seven locking positions. Valves 8 inches and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

2.6.14.11 Drain valves

Drain valves shall be provided at each drain point of blowdown as recommended by the boiler manufacturer. Piping shall conform to ASME BPVC SEC IV and ASTM A53/A53M.

2.6.14.12 Safety Valves

Safety valves shall have steel bodies and shall be equipped with corrosion-resistant trim and valve seats. The valves shall be properly guided and shall be positive closing so that no leakage can occur. Adjustment of the desired back-pressure shall cover the range between 2 and 10 psig. The adjustment shall be made externally, and any shafts extending through the valve body shall be provided with adjustable stuffing boxes having renewable packing. Boiler safety valves of proper size and of the required number, in accordance with ASME BPVC SEC IV, shall be installed so that the discharge will be through piping extended to a location as indicated.

2.6.15 Pressure Gauges

Gauges shall conform to ASME B40.100 and shall be provided with throttling type needle valve or a pulsation dampener and shutoff valve. Minimum dial size shall be 3-1/2 inches. A pressure gauge shall be provided for each boiler in a visible location on the boiler. Pressure gauges shall be provided with readings in psi. Pressure gauges shall have an indicating pressure range that is related to the operating pressure of the fluid in accordance with the following table:

Operating Pressure (psi)	Pressure Range (psi)
76-150	0-200
16-75	0-100
2-15	0-30 (retard)

2.6.16 Thermometers

Thermometers shall be provided with wells and separable corrosion-resistant steel sockets. Mercury shall not be used in thermometers. Thermometers for inlet water and outlet water for each hot

water boiler shall be provided in a visible location on the boiler. Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a minimum 9 inch scale. The operating range of the thermometers shall be 32-212 degrees F. The thermometers shall be provided with readings in degrees F.

2.6.17 Air Vents

2.6.17.1 Manual Air Vents

Manual air vents shall be brass or bronze valves or cocks suitable for the pressure rating of the piping system and furnished with threaded plugs or caps.

2.6.17.2 Automatic Air Vents

Automatic air vents shall be 3/4 inch quick-venting float and vacuum air valves. Each air vent valve shall have a large port permitting the expulsion of the air without developing excessive back pressure, a noncollapsible metal float which will close the valve and prevent the loss of water from the system, an air seal that will effectively close and prevent the re-entry of air into the system when subatmospheric pressures prevail therein, and a thermostatic member that will close the port against the passage of steam from the system. The name of the manufacturer shall be clearly stamped on the outside of each valve. The air vent valve shall be suitable for the pressure rating of the piping system.

2.6.18 Steam Traps

2.6.18.1 Thermostatic Traps

Thermostatic traps shall conform to the requirements of ASTM F1139 and shall be installed in the return connection from each radiator and elsewhere as indicated. Drip traps for mains, risers, and similar lines shall be installed with a cooling leg of 5 feet of uncovered 3/4 inch pipe. The capacity of traps shall be based on a pressure differential of 2 psi. The traps shall be designed for a steam working pressure of 15 psig but shall operate with a supply pressure of approximately 2 psig. The traps shall be angle or straight-through pattern with union inlet connections as indicated. The trap bodies and covers shall be brass. Valve mechanisms and seats shall be monel, stainless steel or hard bronze and shall be removable for servicing or replacement.

2.6.18.2 Float-and-Thermostatic Traps

Float-and-thermostatic traps shall conform to the requirements of ASTM F1139 and be designed for a steam working pressure of 15 psig but shall operate with a supply pressure of approximately 5 psig. The trap capacity shall be based on a pressure differential of 2 psig. Each float-and-thermostatic trap shall have a cast iron body and shall be provided with a hard bronze, monel, or corrosion-resisting steel valve seat and mechanism, an open- or closed-type float of brass or equally corrosion-resistant metal, and a corrosion-resisting steel thermostatic air vent, all of which can be easily removed for inspection or replacement without disturbing the piping connections. The inlet to each trap shall have a brass or stainless steel strainer, either as an integral part of the trap or as a separate item of equipment.

2.6.18.3 Inverted Bucket Traps

Inverted bucket traps shall conform to the requirements of ASTM F1139 and be designed for a steam working pressure of 15 psig but shall operate with a supply pressure of approximately 5 psig. Each trap shall have a cast iron body and shall have a corrosion-resistant steel valve and seat and a brass or corrosion-resistant steel bucket, all of which can be easily removed for inspection or replacement without disturbing the piping connections. The inlet to each trap shall have a brass or stainless steel strainer, either as an integral part of the trap or as a separate item of equipment.

2.7 ELECTRICAL EQUIPMENT

Electric motor-driven equipment shall be provided complete with motors, motor starters, and necessary control devices. Electrical equipment, motor control devices, motor efficiencies and wiring shall be as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Motors which are not an integral part of a packaged boiler and which are integral in size shall be the premium efficiency type in accordance with NEMA MG 1. Motors which are an integral part of the packaged boiler shall be the highest efficiency available by the manufacturer of the packaged boiler. Motor starters shall be provided complete with properly sized thermal overload protections and other appurtenances necessary for the motor control specified. Starters shall be furnished in general purpose enclosures. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices but not shown shall be provided.

2.7.1 Motor Ratings

Motors shall be suitable for the voltage and frequency provided. Motors 1/2 hp and larger shall be three-phase, unless otherwise indicated. Motors shall be of sufficient capacity to drive the equipment at the specified capacity without exceeding the nameplate rating on the motor.

2.7.2 Motor Controls

Motor controllers shall be provided complete with properly sized thermal overload protection. Manual or automatic control and protective or signal devices required for the operation specified and any wiring required to such devices shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers may be provided to accomplish the same function. Solid state variable speed controllers shall be utilized for fractional through 10 hp ratings. Adjustable frequency drives shall be used for larger motors.

2.8 INSULATION

Shop and field-applied insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.9 TOOLS

Special tools shall be furnished. Special tools shall include uncommon tools necessary for the operation and maintenance of boilers, burners, pumps, fans, controls, meters, special piping systems, and other equipment. Small hand tools shall be furnished within a suitable cabinet,

mounted where directed.

2.9.1 Breeching Cleaner

A cleaner shall be provided to clean the breeching. The cleaner shall have a jointed handle of sufficient length to clean the breeching without dismantling.

2.9.2 Tube Cleaner

If a watertube boiler is being furnished, a water-driven tube cleaner with three rotary cutters and rotary wire brush complete with the necessary length of armored water hose, valves, and other appurtenances necessary for operation shall be provided. Tube cleaner and rotary brush shall be provided for each size of water tube in the boiler, with one extra set of cutters for each size cleaner. Necessary valves and fittings shall be provided to permit ready connection of the cleaner hose to a high-pressure pump for cold water supply to operate the cleaner.

2.9.3 Tube Brush

If a firetube boiler is being furnished, a tube brush, with steel bristles and jointed handle of sufficient length to clean full length of firetubes, shall be provided.

2.9.4 Wrenches

Wrenches shall be provided as required for specialty fittings such as manholes, handholes, and cleanouts. One set of extra gaskets shall be provided for all manholes and handholes, for pump barrels, and other similar items of equipment. Gaskets shall be packaged and properly identified.

2.10 BOILER WATER TREATMENT

Submit six complete copies of the proposed water treatment plan. The plan shall include a layout, control scheme, a list of the existing water conditions including the items listed in this paragraph, a list of all chemicals, the proportion of chemicals to be added, the final treated water conditions, and a description of environmental concerns for handling the chemicals. The water treatment system shall be capable of feeding chemicals and bleeding the system to prevent corrosion and scale within the boiler and piping distribution system. Submit 6 complete copies of operating and maintenance manuals for the step-by-step water treatment procedures, including procedures for testing the water quality. The water shall be treated to maintain the conditions recommended by the boiler manufacturer. Chemicals shall meet required federal, state, and local environmental regulations for the treatment of boilers and discharge to the sanitary sewer. The services of a company regularly engaged in the treatment of boilers shall be used to determine the correct chemicals and concentrations required for water treatment. The company shall maintain the chemical treatment and provide all chemicals required for a period of 1 year from the date of occupancy. Filming amines and proprietary chemicals shall not be used. The water treatment chemicals shall remain stable throughout the operating temperature range of the system and shall be compatible with pump seals and other elements of the system.

2.10.1 MakeUp Water Analysis

The makeup water conditions reported as prescribed in ASTM D596

2.10.2 Boiler Water Limits

The boiler manufacturer shall be consulted for the determination of the boiler water chemical composition limits. The boiler water limits shall be as follows unless dictated differently by the boiler manufacturer's recommendations:

Causticity	20-200 ppm
Total Alkalinity (CACO3)	900-1200 ppm
Phosphate	30-60 ppm
Tanin	Medium
Dissolved Solids	3000-5000 ppm
Suspended Solids	300 ppm Max
Sodium Sulfite	20-40 ppm Max
Silica	Less than 150 ppm
Dissolved Oxygen	Less than 7 ppm
Iron	10 ppm
pH (Condensate)	7 - 8

Sodium Sulfite	20-40 ppm
Hardness	Less than 2 ppm
pH	9.3 - 9.9

2.10.3 Chemical Feed Pumps

One pump shall be provided for each chemical feed tank. The chemical feed pumps shall be positive displacement diaphragm type. The capacity of the pumps shall be adjustable from 0 to 100 percent while in operation. The discharge pressure of the pumps shall be not less than 1.5 times the pressure at the point of connection. The pumps shall be provided with a pressure relief valve and a check valve mounted in the pump discharge.

2.10.4 Tanks

The tanks shall be constructed of high density polyethylene with a hinged cover. The tanks shall have sufficient capacity to require recharging only once per 7 days during normal operation. A level indicating device shall be included with each tank. An electric agitator shall be provided

for each tank.

2.10.5 Injection Assemblies

An injection assembly shall be provided at each chemical injection point located along the boiler piping as indicated. The injection assemblies shall be constructed of stainless steel. The discharge of the assemblies shall extend to the centerline of the piping. Each assembly shall include a shutoff valve and check valve at the point of entrance into the water line.

2.10.6 Water Meter

The water meter shall be provided with an electric contacting register and remote accumulative counter. The meter shall be installed within the makeup water line, as indicated.

2.10.7 Water Treatment Control Panel

The control panel shall be a NEMA 12, single door, wall-mounted box conforming with NEMA 250. The panel shall be constructed of stainless steel with a hinged door and lock. The panel shall contain, as a minimum, the following functions identified with a laminated plastic nameplate:

a. Main power switch and indicating light

b. MAN-OFF-AUTO selector switch

c. Indicating lamp for blow down

d. Indicating lamp for each chemical feed pump

e. Indicating lamp for the water softener

2.10.8 Sequence of Operation

The flow rate of chemical addition shall be based upon a manual setting. The boiler shall be provided with continuous blowdown. The required rate of chemical feed and boiler blowdown shall be determined by the water treatment company.

2.10.9 Chemical Shot Feeder

A shot feeder shall be provided as indicated. Size and capacity of feeder shall be based upon local requirements and water analysis. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping.

2.10.10 Chemical Piping

The piping and fittings shall be constructed of schedule 80 PVC steel .

2.10.11 Test Kits

One test kit of each type required to determine the water quality as outlined within the operation and maintenance manuals shall be provided.

2.10.12 Glycol Feed System

Design the Glycol feed system to automatically maintain the desired glycol content of the closed water recirculation system(s). Each system shall consist of the following components:

2.10.12.1 Supply Tank and Stand

Include a 50 gallon cross lined polyethylene tank and steel support stand. The tank shall have a cover and bottom outlet fitting for pump suction. Equip the tank stand with a pump mounting platform and support for the control panel and level switch.

2.10.12.2 Glycol Pump

Rotary gear type of bronze construction with a capacity of 1.8 gpm at 40 psi. The pump shall have a 1/3 horsepower, 1/115V/60hz motor and internal pressure relief. Provide the pump with a discharge check valve and shutoff valve.

2.10.12.3 Pressure Switch

The pressure switch shall be adjustable over the range of 3 - 15 psi with a 6 psi differential and have contacts rated for 115V.

2.10.12.4 Level Switch

Equipped with N/O and N/C contacts to activate upon sensing a low level condition.

2.10.12.5 Control Panel

The control panel shall be installed in a NEMA 1 enclosure with terminal strip and shall include a red low level alarm light, low level alarm bell and silence button, full voltage motor starter for the glycol pump, and a Hand-Off-Auto selector switch.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work or ordering any materials.

3.2 ERECTION OF BOILER AND AUXILIARY EQUIPMENT

Boiler and auxiliary equipment shall be installed in accordance with manufacturer's written instructions. Proper provision shall be made for expansion and contraction between boiler foundation and floor. This joint shall be packed with suitable nonasbestos rope and filled with suitable compound that will not become soft at a temperature of 100 degrees F. Boilers and firing equipment shall be supported from the foundations by structural steel completely independent of all brickwork. Boiler supports shall permit free expansion and contraction of each portion of the boiler without placing undue stress on any part of the boiler or setting. Boiler breeching shall be as indicated with full provision for expansion and contraction between all interconnected components.

3.3 PIPING INSTALLATION

Unless otherwise specified, nonboiler external pipe and fittings shall conform to the requirements of ASME B31.1. Pipe installed shall be cut accurately to suit field conditions, shall be installed without springing or forcing, and shall properly clear windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted. Pipes shall be free of burrs, oil, grease and other foreign material and shall be installed to permit free expansion and contraction without damaging the building structure, pipe, pipe joints, or pipe supports. Changes in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Vent pipes shall be carried through the roof as directed and shall be properly flashed. Unless otherwise indicated, horizontal supply mains shall pitch down in the direction of flow with a grade of not less than 1 inch in 40 feet. Open ends of pipelines and equipment shall be properly capped or plugged during installation to keep dirt or other foreign materials out of the systems. Pipe not otherwise specified shall be uncoated. Unless otherwise specified or shown, final connections to equipment shall be made with malleable-iron unions for steel pipe 2-1/2 inches or less in diameter and with flanges for pipe 3 inches or more in diameter. Unions for copper pipe or tubing shall be brass or bronze. Reducing fittings shall be used for changes in pipe sizes. In horizontal hot water lines, reducing fittings shall be eccentric type to maintain the top of the lines at the same level to prevent air binding.

3.3.1 Hot Water Piping and Fittings

Pipe shall be black steel or copper tubing. Fittings for steel piping shall be black malleable iron or cast iron to suit piping. Fittings adjacent to valves shall suit valve material. Grooved mechanical fittings will not be allowed for water temperatures above 230 degrees F.

3.3.2 Vent Piping and Fittings

Vent piping shall be black steel. Fittings shall be black malleable iron or cast iron to suit piping.

3.3.3 Gauge Piping

Piping shall be copper tubing.

3.3.4 Steam Piping and Fittings

Piping shall be black steel. Fittings shall be black, malleable iron, cast iron or steel. Fittings adjacent to valves shall suit valves specified. Grooved mechanical fittings will not be allowed for steam piping.

3.3.5 Condensate Return Pipe and Fittings

Piping shall be black steel. Fittings shall be malleable iron, cast iron, or steel. Grooved mechanical fittings will not be allowed for condensate piping.

3.3.6 Joints

Joints between sections of steel pipe and between steel pipe and fittings shall be threaded, grooved, flanged or welded as indicated or specified. Except as otherwise specified, fittings 1 inch and smaller shall be threaded; fittings 1-1/4 inches and up to but not including 3 inches shall be either threaded, grooved, or welded; and fittings 3 inches and larger shall be either flanged, grooved, or welded. Pipe and fittings 1-1/4 inches and larger installed in inaccessible conduit or trenches beneath concrete floor slabs shall be welded. Connections to equipment shall be made with black malleable-iron unions for pipe 2-1/2 inches or smaller in diameter and with flanges for pipe 3 inchesor larger in diameter. Joints between sections of copper tubing or pipe shall be flared, soldered, or brazed.

3.3.6.1 Threaded Joints

Threaded joints shall be made with tapered threads properly cut and shall be made perfectly tight with a stiff mixture of graphite and oil or with polytetrafluoroethylene tape applied to the male threads only and in no case to the fittings.

3.3.6.2 Welded Joints

Welded joints shall be in accordance with paragraph GENERAL REQUIREMENTS unless otherwise specified. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connections may be made with either welding tees or forged branch outlet fittings, either being acceptable without size limitation. Branch outlet fittings, where used, shall be forged, flared for improved flow characteristics where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength. Socket weld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 1/16 inch and no more than 1/8 inch.

3.3.6.3 Grooved Mechanical Joints

Grooved mechanical joints may be provided for hot water systems in lieu of unions, welded, flanged, or screwed piping connections in low temperature hot water systems where the temperature of the circulating medium does not exceed 230 degrees F. Grooves shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations. Mechanical joints shall use rigid mechanical pipe couplings, except at equipment connections. At equipment connections, flexible couplings may be used. Coupling shall be of the bolted type for use with grooved end pipes, fittings, valves, and strainers. Couplings shall be self-centering and shall engage in a watertight couple.

3.3.6.4 Flared and Brazed Copper Pipe and Tubing

Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Annealing of fittings and hard-drawn tubing shall not occur when making connections. Installation shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Brazed joints shall be made in conformance with AWS B2.2/B2.2M and CDA A4015 with flux. Copper-to-copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver or a silver brazing filler metal. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided in all branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Flared or brazed copper tubing to pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing.

3.3.6.5 Soldered Joints

Soldered joints shall be made with flux and are only acceptable for lines 2 inches and smaller. Soldered joints shall conform to ASME B31.5 and CDA A4015.

3.3.6.6 Copper Tube Extracted Joint

An extruded mechanical tee joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints will not be permitted.

3.3.7 Flanges and Unions

Flanges shall be faced true, provided with 1/16 inch thick gaskets, and made square and tight. Where steel flanges mate with cast-iron flanged fittings, valves, or equipment, they shall be provided with flat faces and full face gaskets. Union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Dielectric pipe unions shall be provided between ferrous and nonferrous piping to prevent galvanic corrosion. The dielectric unions shall have metal connections on both ends. The ends shall be threaded, flanged, or brazed to match adjacent piping. The metal parts of the union shall be separated so that the electrical current is below 1 percent of the galvanic current which would exist upon metal-to-metal contact. Gaskets, flanges, and unions shall be installed in accordance with manufacturer's recommendations.

3.3.8 Branch Connections

3.3.8.1 Branch Connections for Hot Water Systems

Branches from the main shall pitch up or down as shown to prevent air entrapment. Connections shall ensure unrestricted circulation, eliminate air pockets, and permit complete drainage of the system. Branches shall pitch with a grade of not less than 1 inch in 10 feet. When indicated, special flow fittings shall be installed on the mains to bypass portions of the water through each radiator. Special flow fittings shall be standard catalog products and shall be installed as recommended by the manufacturer.

3.3.9 Flared, Brazed, and Soldered Copper Pipe and Tubing

Copper tubing shall be flared, brazed, or soldered. Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Annealing of fittings and hard-drawn tubing shall not occur when making connections. Installation shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided on branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing. Brazed joints shall be made in conformance with CDA A4015. Copper-to-copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver, or a silver brazing filler metal. Soldered joints shall be made with flux and are only acceptable for lines 2 inches or smaller. Soldered joints shall conform to ASME B31.5 and shall be in accordance with CDA A4015.

3.3.10 Copper Tube Extracted Joint

An extracted mechanical tee joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints will not be permitted.

3.3.11 Supports

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. Threaded rods which are used for support shall not be formed or bent. Supports shall not be attached to the underside of concrete filled

floors or concrete roof decks unless approved by the Contracting Officer.

3.3.11.1 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58, except as modified herein.

3.3.11.1.1 Types 5, 12, and 26

Use of Types 5, 12, and 26 is prohibited.

3.3.11.1.2 Type 3

Type 3 shall not be used on insulated pipe which has a vapor barrier. Type 3 may be used on insulated pipe that does not have a vapor barrier if clamped directly to the pipe, if the clamp bottom does not extend through the insulation, and if the top clamp attachment does not contact the insulation during pipe movement.

3.3.11.1.3 Type 18

Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for Type 18 inserts.

3.3.11.1.4 Type 19 and 23 C-Clamps

Torque Type 19 and 23 C-clamps in accordance with MSS SP-58 and have both locknuts and retaining devices furnished by the manufacturer. Field fabricated C-clamp bodies or retaining devices are not acceptable.

3.3.11.1.5 Type 20 Attachments

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

3.3.11.1.6 Type 24

Type 24 may be used only on trapeze hanger systems or on fabricated frames.

3.3.11.1.7 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MSS SP-58 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves.

3.3.11.1.8 Vertical Pipe Support

Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.

3.3.11.1.9 Type 35 Guides

Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures,

atmospheric conditions, and bearing loads encountered.

a. Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle may be welded to the pipe and freely rested on a steel plate. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rested on a steel slide plate.

b. Where there are high system temperatures and welding to piping is not desirable, the Type 35 guide shall include a pipe cradle welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches or by an amount adequate for the insulation, whichever is greater.

3.3.11.1.10 Horizontal Insulated Pipe

Except for Type 3, pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation.

3.3.11.1.11 Piping in Trenches

Support piping in trenches as indicated.

3.3.11.1.12 Structural Steel Attachments

Structural steel attachments and brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Pipe hanger loads suspended from steel joist between panel points shall not exceed 50 pounds. Loads exceeding 50 pounds shall be suspended from panel points.

3.3.11.2 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support member shall not exceed the hanger and support spacing required for any individual pipe in the multiple pipe run. The clips or clamps shall be rigidly attached to the common base member. A clearance of 1/8 inch shall be provided between the pipe insulation and the clip or clamp for piping which may be subjected to thermal expansion.

3.3.12 Anchors

Anchors shall be provided where necessary to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results, using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline.

3.3.13 Valves

Valves shall be installed where indicated, specified, and required for functioning and servicing of the systems. Valves shall be safely accessible. Swing check valves shall be installed upright in horizontal lines and in vertical lines only when flow is in the upward direction.

Gate and globe valves shall be installed with stems horizontal or above. Valves to be brazed shall be disassembled prior to brazing and all packing removed. After brazing, the valves shall be allowed to cool before reassembling.

3.3.14 Pipe Sleeves

Pipe passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. A waterproofing clamping flange shall be installed as indicated where membranes are involved. Sleeves shall not be installed in structural members except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor, or roof. Sleeves through walls shall be cut flush with wall surface. Sleeves through floors shall be cut flush with floor surface. Sleeves through roofs shall extend above the top surface of roof at least 6 inches for proper flashing or finishing. Unless otherwise indicated, sleeves shall be sized to provide a minimum clearance of 1/4 inch between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in waterproofing membrane floors, bearing walls, and wet areas shall be galvanized steel pipe or cast-iron pipe. Sleeves in nonbearing walls, floors, or ceilings may be galvanized steel pipe, cast-iron pipe, or galvanized sheet metal with lock-type longitudinal seam. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve in nonfire rated walls shall be sealed as indicated and specified in Section 07 92 00 JOINT SEALANTS. Metal jackets shall be provided over insulation passing through exterior walls, firewalls, fire partitions, floors, or roofs.

a. Metal jackets shall not be thinner than 0.006 inch thick aluminum, if corrugated, and 0.016 inch thick aluminum, if smooth.

b. Secure metal jackets with aluminum or stainless steel bands not less than 3/8 inch wide and not more than 8 inches apart. When penetrating roofs and before fitting the metal jacket into place, a 1/2 inch wide strip of sealant shall be run vertically along the inside of the longitudinal joint of the metal jacket from a point below the backup material to a minimum height of 36 inches above the roof. If the pipe turns from vertical to horizontal, the sealant strip shall be run to a point just beyond the first elbow. When penetrating waterproofing membrane for floors, the metal jacket shall extend from a point below the back-up material to a minimum distance of 2 inches above the flashing. For other areas, the metal jacket shall extend from a point below the backup material to a point 12 inches above material to a minimum distance of 2 inches above the flashing. For other areas, the metal jacket shall extend from a point below the backup material to a point 12 inches above the floor; when passing through walls above grade, the jacket shall extend at least 4 inches beyond each side of the wall.

3.3.14.1 Pipes Passing Through Waterproofing Membranes

In addition to the pipe sleeves referred to above, pipes passing through waterproofing membranes shall be provided with a 4 pound lead flashing or a 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 8 inches from the pipe and shall set over the membrane in a troweled coating of bituminous cement. The flashing shall extend above

the roof or floor a minimum of 10 inches. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Pipes up to and including 10 inches in diameter which pass through waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.

3.3.14.2 Optional Modular Mechanical Sealing Assembly

At the option of the Contractor, a modular mechanical type sealing assembly may be installed in the annular space between the sleeve and conduit or pipe in lieu of a waterproofing clamping flange and caulking and sealing specified above. The seals shall include interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion-protected carbon steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved.

3.3.14.3 Optional Counterflashing

As alternates to caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may consist of standard roof coupling for threaded pipe up to 6 inches in diameter, lead flashing sleeve for dry vents with the sleeve turned down into the pipe to form a waterproof joint, or a tack-welded or banded-metal rain shield around the pipe, sealed as indicated.

3.3.14.4 Fire Seal

Where pipes pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section 07 84 00 FIRESTOPPING.

3.3.15 Balancing Valves

Balancing valves shall be installed as indicated.

3.3.16 Thermometer Wells

Provide a thermometer well in each return line for each circuit in multicircuit systems.

3.3.17 Air Vents

Install air vents in piping at all system high points. The vent shall remain open until water rises in the tank or pipe to a predetermined level at which time it shall close tight. An overflow pipe from the vent shall be run to a point designated by the Contracting Officer's representative. The inlet to the air vent shall have a gate valve or ball valve.

3.3.18 Escutcheons

Provide escutcheons at all finished surfaces where exposed piping, bare or insulated, passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be chromium-plated iron or chromium-plated brass, either one-piece or split pattern, held in place by internal spring tension or setscrews.

3.3.19 Drains

A drain connection with a 1 inch gate valve or 3/4 inch hose bib shall be installed at the lowest point in the return main near the boiler. In addition, threaded drain connections with threaded cap or plug shall be installed on the heat exchanger coil on each unit heater or unit ventilator and wherever required for thorough draining of the system.

3.3.20 Strainer Blow-Down Piping

Strainer blow-down connections shall be fitted with a black steel blow-down pipeline routed to an accessible location and provided with a blow-down valve.

3.3.21 Direct Venting for Combustion Intake Air and Exhaust Air

The intake air and exhaust vents shall be installed in accordance with NFPA 54 and boiler manufacturer's recommendations. The exhaust vent shall be sloped 1/4 inch/ft toward the boiler's flue gas condensate collection point.

3.4 GAS FUEL SYSTEM

Gas piping, fittings, valves, regulators, tests, cleaning, and adjustments shall be in accordance with these specifications. Submit proposed test schedules for the heating system and fuel system tests, at least 2 weeks prior to the start of related testing. NFPA 54 shall be complied with unless otherwise specified. Burners, pilots, and all accessories shall be listed in UL FLAMMABLE & COMBUSTIBLE. The fuel system shall be provided with a gas tight, manually operated, UL listed stop valve at the gas-supply connections, a gas strainer, a pressure regulator, pressure gauges, a burner-control valve, a safety shutoff valve suitable for size of burner and sequence of operation, and other components required for safe, efficient, and reliable operation as specified. Approved permanent and ready facilities to permit periodic valve leakage tests on the safety shutoff valve or valves shall be provided.

3.5 FUEL OIL SYSTEM

Fuel oil system shall be installed in accordance with NFPA 31, unless otherwise indicated.

3.5.1 Piping and Storage Tank

Fuel oil piping and storage tanks shall be installed in accordance with thses documents

3.5.2 Fuel-Oil Storage Tank Heating-Coil Piping

Supply and return piping and fittings for the heating coil shall be

installed in accordance with paragraph PIPING INSTALLATION. The hot water supply line to the heating coil shall be provided with an automatic temperature-control valve, a strainer and a three-valve bypass. The return line from the coil shall be provided with a check valve and a block valve.

3.5.3 Automatic Safety Shutoff Valve

Oil supply line to each oil burner shall be equipped with an automatically operated valve designed to shut off the oil supply in case of fire in the immediate vicinity of the burner. The valve shall be thermoelectrically actuated or thermomechanically actuated type and shall be located immediately downstream of the manual shutoff valve at the day tank inside of the building. If a day tank is not used, the automatic safety valve shall be located immediately downstream of the building shutoff devices where oil supply line enters the building. A thermoelectrical or thermomechanical detection device shall be located over the oil burner to activate the valve. A fire shutoff valve may be combined with other automatic shutoff devices if listed in UL FLAMMABLE & COMBUSTIBLE.

3.5.4 Earthwork

Excavation and backfilling for tanks and piping shall be as specified in Section 31 00 00 EARTHWORK.

3.6 MANUFACTURER'S SERVICES

Provide the services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified to supervise the installing, adjusting, and testing of the equipment.

3.7 TEST OF BACKFLOW PREVENTION ASSEMBLIES

Backflow prevention assemblies shall be tested in accordance with Section 22 00 00 PLUMBING, GENERAL PURPOSE.

3.8 HEATING SYSTEM TESTS

Submit the Qualifications of the firms in charge of installation and testing as specified. Submit a statement from the firms proposed to prepare submittals and perform installation and testing, demonstrating successful completion of similar services of at least five projects of similar size or scope, at least 2 weeks prior to the submittal of any other item required by this section. Before any covering is installed on pipe or heating equipment, the entire heating system's piping, fittings, and terminal heating units shall be hydrostatically tested and proved tight at a pressure of 1.5 times the design working pressure, but not less than 100 psi. Submit proposed test procedures for the heating system tests and fuel system tests, at least 2 weeks prior to the start of related testing.

a. Before pressurizing system for test, items or equipment (e.g., vessels, pumps, instruments, controls, relief valves) rated for pressures below the test pressure shall be blanked off or replaced with spool pieces.

b. Before balancing and final operating test, test blanks and spool pieces shall be removed; and protected instruments and equipment shall be reconnected. With equipment items protected, the system shall be pressurized to test pressure. Pressure shall be held for a period of

time sufficient to inspect all welds, joints, and connections for leaks, but not less than 2 hours. No loss of pressure will be allowed. Leaks shall be repaired and repaired joints shall be retested.

c. Repair joints shall not be allowed under the floor for floor radiant heating systems. If a leak occurs in tubing located under the floor in radiant heating systems, the entire zone that is leaking shall be replaced. If any repair is made above the floor for floor radiant heating systems, access shall be provided for the installed joint. Caulking of joints shall not be permitted.

d. System shall be drained and after instruments and equipment are reconnected, the system shall be refilled with service medium and maximum operating pressure applied. The pressure shall be held while inspecting these joints and connections for leaks. The leaks shall be repaired and the repaired joints retested.

Upon completion of hydrostatic tests and before acceptance of the installation, submit test reports for the heating system tests. Upon completion of testing complete with results, balance the heating system in accordance with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS and operating tests required to demonstrate satisfactory functional and operational efficiency. The operating test shall cover a period of at least 24 hours for each system, and shall include, as a minimum, the following specific information in a report, together with conclusions as to the adequacy of the system:

a. Certification of balancing.

b. Time, date, and duration of test.

c. Outside and inside dry bulb temperatures.

d. Temperature of hot water supply leaving boiler .

e. Temperature of heating return water from system at boiler inlet.

f. Quantity of water feed to boiler.

g. Boiler make, type, serial number, design pressure, and rated capacity.

h. Fuel burner make, model, and rated capacity; ammeter and voltmeter readings for burner motor.

j. Flue-gas temperature at boiler outlet.

k. Percent carbon dioxide in flue-gas.

l. Grade or type and calorific value of fuel.

m. Draft at boiler flue-gas exit.

n. Draft or pressure in furnace.

o. Quantity of water circulated.

p. Quantity of fuel consumed.

q. Stack emission pollutants concentration.

3.8.1 Boiler/Piping Test

At the conclusion of the 1 year period, the boiler and condensate piping shall be inspected for problems due to corrosion and scale. If the boiler is found not to conform to the manufacturer's recommendations, and the water treatment company recommendations have been followed, the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations. If corrosion is found within the condensate piping, proper repairs shall be made by the water treatment company.

3.9 CLEANING

3.9.1 Boilers and Piping

After the hydrostatic tests have been made and before the system is balanced and operating tests are performed, the boilers and piping shall be thoroughly cleaned by filling the system with a solution consisting of either 1 pound of caustic soda or 1 pound of trisodium phosphate per 50 gallons of water. The proper safety precautions shall be observed in the handling and use of these chemicals. The water shall be heated to approximately 150 degrees F and the solution circulated in the system for a period of 48 hours. The system shall then be drained and thoroughly flushed out with fresh water. Strainers and valves shall be thoroughly cleaned. Prior to operating tests, air shall be removed from all water systems by operating the air vents.

3.9.2 Heating Units

Inside space heating equipment, ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for fans that are operated during construction, and new provide filters after construction dirt has been removed from the building, and the ducts, plenum, casings, and other items specified have been vacuum cleaned. Perform and document that proper "Indoor Air Quality During Construction" procedures have been followed; provide documentation showing that after construction ends, and prior to occupancy, new filters were provided and installed. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.10 FIELD TRAINING

a. The field instructions shall cover all of the items contained in the approved operation and maintenance manuals, as well as demonstrations of routine maintenance operations and boiler safety devices.

b. Submit system layout diagrams that show the layout of equipment, piping, and ductwork and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system, framed under glass or laminated plastic, at least 2 weeks prior to the start of related testing. After approval, these items shall be posted where directed.

c. Submit six complete operation and maintenance instructions listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, simplified wiring and control diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization shall be capable of providing 4 hour onsite response to a service call on an emergency basis.

d. Notify the Contracting Officer at least 14 days prior to date of proposed conduction of the training course.

3.11 FUEL SYSTEM TESTS

Submit test reports for the fuel system tests, upon completion of testing complete with results.

3.11.1 Gas System Test

The gas fuel system shall be tested in accordance with the test procedures outlined in NFPA 54.

-- End of Section --

SECTION 23 64 00

PACKAGED WATER CHILLERS, ABSORPTION TYPE
11/16, CHG 2: 08/18

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 WELDING SOCIETY (AWS)

AWS Z49.1	(2012) Safety in Welding and Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F104	(2011; R 2020) Standard Classification System for Nonmetallic Gasket Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators
NEMA MG 11	(1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(2021) National Fuel Gas Code

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval.. When used, a code following the "G" classification 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

Drawings; G

SD-03 Product Data

Posted Instructions; G

Verification of Dimensions; G

System Performance Tests; G

Demonstrations

SD-06 Test Reports

Field Acceptance Testing; G

System Performance Tests; G

SD-07 Certificates

SD-08 Manufacturer's Instructions

Water Chiller - Installation Instructions; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

SD-11 Closeout Submittals

Indoor Air Quality During Construction; S

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 must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices must be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with AWS Z49.1. Fuel-fired equipment must be in accordance with NFPA 54.

1.4 DELIVERY, STORAGE, AND HANDLING

Stored items must 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 must be replaced at the Contractor's expense. During installation, piping and similar openings must be capped to keep out dirt and other foreign matter.

1.5 PROJECT REQUIREMENTS

1.5.1 Verification of Dimensions

The Contractor must 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 must carefully investigate the plumbing, fire protection, electrical, structural and finish conditions that would affect the work to be performed and must arrange such work accordingly, furnishing required offsets, fittings, and accessories to meet such conditions. The Contractor must submit detailed drawings consisting of:

a. Equipment layouts which identify assembly and installation details.

b. Plans and elevations which identify clearances required for maintenance and operation.

c. Wiring diagrams which identify each component individually and all interconnected or interlocked relationships between components.

d. Foundation drawings, bolt-setting information, and foundation bolts prior to concrete foundation construction for all equipment indicated or required to have concrete foundations.

e. Details, if piping and equipment are to be supported other than as indicated, which include loadings and type of frames, brackets, stanchions, or other supports.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment must be standard products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. The standard products must have been in satisfactory commercial or industrial use for two years prior to bid opening. The two year use must include applications of equipment and materials under similar circumstances and of similar size. The two years experience must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturer's catalogs, or brochures. Products having less than a two year field service record will 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. System components must be environmentally suitable for the indicated locations.

2.2 NAMEPLATES

Major equipment including chillers, water coolers, heat exchanges, and motors must 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 must be durable and legible throughout equipment life and made of anodized aluminum. Plates must be fixed in prominent locations with nonferrous screws or bolts.

2.3 ELECTRICAL WORK

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section

26 20 00 INTERIOR DISTRIBUTION SYSTEM. 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, must be provided. For packaged equipment, the manufacturer must provide controllers including the required monitors and timed restart.

b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11.

c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system, and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1.

d. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Motors must be rated for continuous duty with the enclosure specified. Motor duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque must 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 enclosure type may be either TEAO or TEFC.

e. Where two-speed motors are indicated, variable-speed controllers may be provided to accomplish the same function. Provide variable frequency drives for motors as specified in Section 26 29 23 ADJUSTABLE SPEED DRIVE (ASD) SYSTEMS UNDER 600 VOLTS.

f. Provide inverter duty premium efficiency motors for use with variable frequency drives.

2.4 CHILLER COMPONENTS

2.4.1 Tools

One complete set of special tools, as recommended by the manufacturer for field maintenance of the system, must be provided. Tools must be mounted on a tool board in the equipment room or contained in a toolbox as directed by the Contracting Officer.

2.5 ACCESSORIES

2.5.1 Cleaning Brushes

Furnish chiller with two brushes, having jointed rods, suitable for cleaning evaporator and condenser tubes.

2.5.2 Gaskets

Gaskets shall conform to ASTM F104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

2.5.3 Bolts and Nuts

Bolts and nuts, except as required for piping applications, shall be in accordance with ASTM A307. The bolt head shall be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A307.

2.6 FABRICATION

2.6.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish.

2.6.2 Factory Applied Insulation

Chiller shall be provided with factory installed insulation on surfaces subject to sweating including the water cooler, suction line piping, economizer, and cooling lines. Insulation on heads of coolers may be field applied, however it shall be installed to provide easy removal and replacement of heads without damage to the insulation. As a minimum, factory insulated items installed indoors shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes shall be determined by ASTM E84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E84.

2.7 SUPPLEMENTAL COMPONENTS/SERVICES

2.7.1 Charging and Testing

Unless fully assembled, tested, evacuated, and charged at factory, components shall be dried and sealed to prevent corrosion of internal surfaces prior to field assembly. Assemble, test, evacuate, and charge units under supervision of manufacturer's representative. Periodic tests shall be readily made on the concentration of the inhibitor and lithium bromide solution with a field test kit furnished by the manufacturer, or as recommended by the manufacturer.

2.7.2 Temperature Controls

Chiller control packages shall be fully coordinated with and integrated into the temperature control system indicated in Section 23 30 00 HVAC AIR DISTRIBUTION, into the existing air-conditioning system.

PART 3 EXECUTION

3.1 INSTALLATION

Installation of absorption chiller systems including materials, installation, workmanship, fabrication, assembly, erection, examination,

inspection, and testing shall be in accordance with the manufacturer's written installation instructions, including the following:

(1) Water chiller - installation instructions

3.1.1 Installation Instructions

Provide manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show features such as materials of construction, dimensions, options, performance and efficiency. Data must include manufacturer's recommended installation instructions and procedures. Data must be adequate to demonstrate compliance with contract requirements

3.1.2 Vibration Isolation

If vibration isolation is specified for a unit, vibration isolator literature must be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

3.1.3 Posted Instructions

Provide posted instructions including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions must include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions must be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

3.1.4 Verification of Dimensions

Provide a letter including the date the site was visited, conformation of existing conditions, and any discrepancies found.

3.1.5 System Performance Test Schedules

Provide a schedule, at least 2 weeks prior to the start of related testing, for the system performance tests. The schedules must identify the proposed date, time, and location for each test.

3.1.6 Demonstrations

Provide 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.

3.1.7 Certificates

Where the system, components, or equipment are specified to comply with requirements of AGA, NFPA, ARI, ASHRAE, ASME, or UL, proof of such compliance must be provided. The label or listing of the specified agency must be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted. When performance requirements of this project's drawings and specifications vary from standard ARI rating conditions,

computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above must be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

3.1.8 Operation and Maintenance Manuals

Provide Six complete copies of an operation manual in bound 8 1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets must include the manufacturer's name, model number, and parts list. The manuals must include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features. Six complete copies of maintenance manual in bound 8 1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals must include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

3.1.9 Connections to Existing Systems

Notify the Contracting Officer in writing at least 15 calendar days prior to the date the connections are required. Obtain approval before interrupting service. Furnish materials required to make connections into existing systems and perform excavating, backfilling, compacting , and other incidental labor as required. Furnish labor and tools for making actual connections to existing systems.

3.1.10 Mechanical Room Ventilation

Mechanical ventilation systems shall be in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

3.1.11 Field Applied Insulation

Field installed insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.1.12 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory.

3.2 MANUFACTURER'S FIELD SERVICE

The services of a factory-trained representative shall be provided. The representative shall advise on the following:

Absorption Units:

(1) Testing and evacuation.

(2) Charging the machine with lithium bromide solution and refrigerant water (distilled or deionized water).

(3) Starting the machine.

3.3 CLEANING AND ADJUSTING

Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Provide temporary filters for all fans that are operated during construction. Perform and document that proper Indoor Air Quality During Construction procedures have been followed; this includes providing documentation showing that after construction ends, and prior to occupancy, new filters were provided and installed. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions. Testing, adjusting, and balancing shall be as specified in Section 23 05 93 TESTING, ADJUSTING AND BALANCING FOR HVAC.

3.4 FIELD ACCEPTANCE TESTING

3.4.1 Test Plans

a. Manufacturer's Test Plans: Within 120 calendar days after contract award, submit the following plans:

Field acceptance test plans shall be developed by the absorption chiller 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.

The 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 tests of the absorption chiller 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 for the equipment provided under Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC.

c. Prerequisite testing: Absorption chillers for which performance testing is dependent upon the completion of the work covered by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC must have that work completed as a prerequisite to testing work under this section. Indicate in each field acceptance test plan when such prerequisite work is required.

d. Test procedure: Indicate in each field acceptance test plan each equipment manufacturers 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.

Controller shall be verified to be properly calibrated and have the proper set point to provide stable control of their respective equipment.

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. Chiller manufacturer shall furnish with each test procedure a description of acceptable results that have been verified.

Chiller manufacturer shall identify the acceptable limits or tolerance within which each tested performance variable shall acceptably operate.

f. Job specific: Each test plan shall be job specific and shall address the particular cooling towers and particular conditions which exist in this contract. Generic or general preprinted test procedures are not acceptable.

g. Specialized components: Each test plan shall include procedures for field testing and field adjusting specialized components, such as pressure valves.

3.4.2 Testing

a. Each absorption chiller 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:

3.5 SYSTEM PERFORMANCE TESTS

Six copies of the report must be provided in bound 8 1/2 by 11 inch booklets.

3.5.1 General Requirements

Before each refrigeration system is accepted, tests to demonstrate the general operating characteristics of all equipment shall be conducted by a registered professional engineer or an approved manufacturer's start-up representative experienced in system start-up and testing, at such times as directed. Tests shall cover a period of not less than 48 hours for each system and shall demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments shall be made as necessary and tests shall be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, service valve seal caps and blanks over gauge points shall be installed and tightened. Any refrigerant lost during the system startup shall be replaced. If tests do not demonstrate satisfactory system

performance, deficiencies shall be corrected and the system shall be retested. Tests shall be conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test shall be provided by the Contractor. Field tests shall be coordinated with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.5.2 Test Report

The report shall document compliance with the specified performance criteria upon completion and testing of the system. The report shall indicate the number of days covered by the tests and any conclusions as to the adequacy of the system. The report shall also include the following information and shall be taken at least three different times at outside dry-bulb temperatures that are at least 5 degrees F apart:

a. Date and outside weather conditions.

b. The load on the system based on the following:

(1) For absorption units, the cooling water pressures and temperatures entering and exiting the absorber and condenser. Also the refrigerant solution pressures, concentrations, and temperatures at each measurable point within the system.

(2) Running current, voltage and proper phase sequence for each phase of all motors.

(3) The actual on-site setting of all operating and safety controls.

(4) Chilled water pressure, flow and temperature in and out of the chiller.

(5) The position of the gas supply control valve at machine off, one-third loaded, one-half loaded, two-thirds loaded, and fully loaded.

3.6 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. The training course must cover all of the items contained in the approved operation and maintenance manuals as well as demonstrations of routine maintenance operations.

-- End of Section --

SECTION 23 64 10

WATER CHILLERS, VAPOR COMPRESSION TYPE
11/16, CHG 2: 08/18

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-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 550/590 I-P	(2015; ERTA 2016) Performance Rating Of Water-Chilling and Heat Pump Water-Heating Packages Using the Vapor Compression Cycle
AHRI 575	(2008) Method of Measuring Machinery Sound Within an Equipment Space

AMERICAN BEARING MANUFACTURERS ASSOCIATION (ABMA)

ABMA 9	(2015) Load Ratings and Fatigue Life for Ball Bearings
ABMA 11	(2014) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ANSI/ASHRAE 15 & 34	(2013) ANSI/ASHRAE Standard 15-Safety Standard for Refrigeration Systems and ANSI/ASHRAE Standard 34-Designation and Safety Classification of Refrigerants

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME BPVC SEC VIII D1	(2019) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

AMERICAN WELDING SOCIETY (AWS)

AWS Z49.1	(2012) Safety in Welding and Cutting and Allied Processes

ASTM INTERNATIONAL (ASTM)

ASTM A307	(2014; E 2017) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D520	(2000; R 2011) Zinc Dust Pigment

ASTM E84	(2020) Standard Test Method for Surface Burning Characteristics of Building Materials
ASTM F104	(2011; R 2020) Standard Classification System for Nonmetallic Gasket Materials

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators
NEMA MG 11	(1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors

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

40 CFR 82	Protection of Stratospheric Ozone

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Posted Instructions

Verification of Dimensions; G

Factory Tests; G

System Performance Tests; G

Demonstrations

Refrigerant; G

Water Chiller - Field Acceptance Test Plan

SD-06 Test Reports; G

Field Acceptance Testing

Factory Tests

System Performance Tests; G

SD-07 Certificates

Refrigeration System; G

Ozone Depleting Substances Technician Certification

SD-08 Manufacturer's Instructions

SD-11 Closeout Submittals

Indoor Air Quality During Construction; G; S

1.3 CERTIFICATIONS

1.3.1 Ozone Depleting Substances Technician Certification

All technicians working on equipment that contain ozone depleting refrigerants must be certified as a Section 608 Technician to meet requirements in 40 CFR 82, Subpart F. Provide copies of technician certifications to the Contracting Officer at least 14 calendar days prior to work on any equipment containing these refrigerants.

1.4 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 must be insulated, fully enclosed, guarded, or fitted with other types of safety devices. Safety devices must be installed so that proper operation of equipment is not impaired. Welding and cutting safety requirements must be in accordance with AWS Z49.1.

1.5 DELIVERY, STORAGE, AND HANDLING

Stored items must 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 will be the Contractor's responsibility. Any materials found to be damaged must be replaced at the Contractor's expense. During installation, piping and similar openings must be capped to keep out dirt and other foreign matter.

1.6 PROJECT REQUIREMENTS

1.6.1 Verification of Dimensions

The Contractor must 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.

PART 2 PRODUCTS

2.1 STANDARD COMMERCIAL PRODUCTS

Materials and equipment will be standard Commercial cataloged products of a manufacturer regularly engaged in the manufacturing of such products, which are of a similar material, design and workmanship. These products must have a two year record of satisfactory field service prior to bid opening. The two year record of service must include applications of equipment and materials under similar circumstances and of similar size. Products having less than a two year record of satisfactory field service will be acceptable if a certified record of satisfactory field service for not less than 6000 hours can be shown. The 6000 hour service record must not include any manufacturer's prototype or factory testing. Satisfactory field service must have been completed by a product that has been, and

presently is being sold or offered for sale on the commercial market through the following copyrighted means: advertisements, manufacturer's catalogs, or brochures.

2.2 MANUFACTURER'S STANDARD NAMEPLATES

2.3 ELECTRICAL WORK

a. Provide motors, controllers, integral disconnects, contactors, and controls with their respective pieces of equipment, except controllers indicated as part of motor control centers. Provide electrical equipment, including motors and wiring, as specified in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. 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, must be provided. For packaged equipment, the manufacturer must provide controllers including the required monitors and timed restart.

b. For single-phase motors, provide high-efficiency type, fractional-horsepower alternating-current motors, including motors that are part of a system, in accordance with NEMA MG 11.

c. For polyphase motors, provide squirrel-cage medium induction motors, including motors that are part of a system, and that meet the efficiency ratings for premium efficiency motors in accordance with NEMA MG 1.

d. Provide motors in accordance with NEMA MG 1 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor. Motors must be rated for continuous duty with the enclosure specified. Motor duty requirements must allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque must 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 must be fitted with grease supply fittings and grease relief to outside of the enclosure. Motor enclosure type may be either TEAO or TEFC.

e. Provide variable frequency drives for motors as specified in Section 26 29 23 ADJUSTABLE SPEED DRIVE (ASD) SYSTEMS UNDER 600 VOLTS.

f. Provide inverter duty premium efficiency motors for use with variable frequency drives.

2.4 SELF-CONTAINED WATER CHILLERS, VAPOR COMPRESSION TYPE

Unless necessary for delivery purposes, units must be assembled, leak-tested, charged (refrigerant and oil), and adjusted at the factory. In lieu of delivery constraints, a chiller may be assembled, leak-tested, charged (refrigerant and oil), and adjusted at the job site by a factory representative. Unit components delivered separately must be sealed and charged with a nitrogen holding charge. Parts weighing 50 pounds or more which must be removed for inspection, cleaning, or repair, such as motors, gear boxes, cylinder heads, casing tops, condenser, and cooler heads, must have lifting eyes or lugs. Chiller must be provided with a single point wiring connection for incoming power supply. Chiller's condenser and

water cooler must be provided with standard water boxes with grooved mechanical connections.

2.4.1 Scroll, Reciprocating, or Rotary Screw Type

Chiller must be certified for performance per AHRI 550/590 I-P. If specified performance is outside of the Application Rating Conditions of AHRI 550/590 I-P, Table 2 then the chiller's performance must be rated in accordance with AHRI 550/590 I-P. Chiller must conform to ANSI/ASHRAE 15 & 34. As a minimum, chiller must include the following components as defined in paragraph CHILLER COMPONENTS.

a. Refrigerant and oil

b. Structural base

c. Chiller refrigerant circuit

d. Controls package

e. Scroll, reciprocating, or rotary screw compressor

f. Compressor driver, electric motor

g. Compressor driver connection

h. Water cooler (evaporator)

i. Air-cooled condenser coil

2.5 CHILLER COMPONENTS

2.5.1 Refrigerant and Oil

Refrigerants must be one of the fluorocarbon gases. Refrigerants must have number designations and safety classifications in accordance with ANSI/ASHRAE 15 & 34. CFC-based refrigerants are prohibited. Refrigerants must have an Ozone Depletion Potential (ODP) no greater than 0.0, with the exception of R-123. Provide SDS sheets for all refrigerants.

2.5.2 Structural Base

Chiller and individual chiller components must be provided with a factory-mounted structural steel base (welded or bolted) or support legs. Chiller and individual chiller components must be isolated from the building structure by means of molded neoprene isolation pads.

2.5.3 Chiller Refrigerant Circuit

Chiller refrigerant circuit must be completely piped and factory leak tested in accordance with ANSI/ASHRAE 15 & 34. Circuit must include as a minimum a combination sight glass and moisture indicator, an electronic or thermostatic expansion valve with external equalizer or float valve, charging ports, compressor service valves for field-serviceable compressors, and superheat adjustment.

2.5.4 Controls Package

Provide chillers with a complete factory-mounted , microprocessor based operating and safety control system. Controls package must contain as a minimum a digital display, an on-auto-off switch, motor starters, disconnect switches, power wiring, and control wiring. Controls package must provide operating controls, monitoring capabilities, programmable setpoints, safety controls, and interfaces as defined below.

2.5.4.1 Operating Controls

Chiller must be provided with the following adjustable operating controls as a minimum.

a. Leaving chilled water temperature control

b. Adjustable timer or automated controls to prevent a compressor from short cycling

c. Automatic lead/lag controls (adjustable) for multi-compressor units

d. Load limiting

e. System capacity control to adjust the unit capacity in accordance with the system load and the programmable setpoints. Controls must automatically re-cycle the chiller on power interruption.

f. Startup and head pressure controls to allow system operation at all ambient temperatures down to degrees F.

g. Fan sequencing for air-cooled condenser

2.5.4.2 Monitoring Capabilities

During normal operations, the control system must be capable of monitoring and displaying the following operating parameters. Access and operation of display must not require opening or removing any panels or doors.

a. Entering and leaving chilled water temperatures

b. Chilled water flow

c.

d. Self diagnostic

e. Operation status

f. Operating hours

g. Number of starts

h. Compressor status (on or off)

i. Compressor load (percent)

j. Refrigerant discharge and suction pressures

k. Magnetic bearing levitation status (if applicable)

l. Magnetic bearing temperatures (if applicable)

m. Oil pressure

2.5.4.3 Configurable Setpoints

The control system must be capable of being configured directly at the unit's interface panel. The programmable setpoints must include the following as a minimum:

a. Leaving Chilled Water Temperature

c. Time Clock/Calendar Date

2.5.4.4 Safety Controls with Manual Reset

Chiller must be provided with the following safety controls which automatically shutdown the chiller and which require manual reset.

a. Low chilled water temperature protection

b. High condenser refrigerant discharge pressure protection

c. Low evaporator pressure protection

d. Chilled water flow detection

e. High motor winding temperature protection

f. Low oil flow protection if applicable

g. Magnetic bearing controller (MBC), Internal fault (if applicable)

h. MBC, High bearing temperature (if applicable)

i. MBC, Communication fault (if applicable)

j. MBC, Power supply fault (if applicable)

2.5.4.5 Safety Controls with Automatic Reset

Chiller must be provided with the following safety controls which automatically shutdown the chiller and which provide automatic reset.

a. Over/under voltage protection

b. Chilled water flow interlock

c. MBC, Vibration (if applicable)

d. MBC, No levitation (if applicable)

2.5.4.6 Remote Alarm

During the initiation of a safety shutdown, a chiller's control system must be capable of activating a remote alarm bell. In coordination with the chiller, the Contractor must provide an alarm circuit (including transformer if applicable) and a minimum 4 inch diameter alarm bell.

Alarm circuit must activate bell in the event of machine shutdown due to the chiller's monitoring of safety controls. The alarm bell must not sound for a chiller that uses low-pressure cutout as an operating control.

2.5.4.7 Utility Monitoring and Control System Interface

Provide a Utility Monitoring and Control System (UMCS) interface meeting the requirements of Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC and the requirements of . The interface must provide all system operating conditions, capacity controls, and safety shutdown conditions as network points. In addition, the following points must be overridable via the network interface:

a. Unit Start/Stop

b. Leaving Chilled Water Temperature Setpoint

2.5.5 Compressor(s)

2.5.5.1 Scroll Compressor(s)

Compressors must be of the hermetically sealed design. Compressors must be mounted on vibration isolators to minimize vibration and noise. Rotating parts must be statically and dynamically balanced at the factory to minimize vibration. Lubrication system must be centrifugal pump type equipped with a means for determining oil level and an oil charging valve. Crankcase oil heater must be provided. Provide continuous compressor unloading to 10 percent of full-load capacity by way of variable speed compressor motor controller or variable unloading of the scroll.

2.5.5.2 Rotary Screw Compressor(s)

Compressors must operate stably for indefinite time periods to at least 25 percent capacity reduction without gas bypass external to the compressor. Provision must be made to insure proper lubrication of bearings and shaft seals on shutdown with or without electric power supply. Rotary screw compressors must include:

a. An open or hermetic, positive displacement, oil-injected design directly driven by the compressor driver. Allow access to internal compressor components for repairs, inspection, and replacement of parts.

b. Rotors must be solid steel, possessing sufficient rigidity for proper operation.

c. A maximum rotor operating speed no greater than 3600 RPM. Provide cast iron rotor housing.

d. Casings of cast iron, precision machined for minimal clearance about periphery of rotors with minimal clearance at rotor tops and rotor ends.

e. A lubrication system of the forced-feed type that provides oil at the proper pressure to all parts requiring lubrication.

f. Bearing housing must be conservatively loaded and rated for an L(10) life of not less than 200,000 hours. Shaft main bearings of the

sleeve type with heavy duty bushings or rolling element type in accordance with ABMA 9 or ABMA 11.

g. A differential oil pressure or flow cutout to allow the compressor to operate only when the required oil pressure or flow is provided to the bearings.

h. A temperature- or pressure-initiated, hydraulically actuated, single-slide-valve, capacity-control system to provide minimum automatic capacity modulation from 100 percent to 15 percent.

i. An oil separator and oil return system to remove oil entrained in the refrigerant gas and automatically return the oil to the compressor.

j. Crankcase oil heaters must be provided.

2.5.5.3 Centrifugal Compressor(s)

Centrifugal compressors may be either single or multistage, having dynamically balanced impellers, either direct or gear driven by the compressor driver. Impellers must be over-speed tested at 1.2 times the impeller-shaft speed. Impeller shaft must be steel with sufficient rigidity for proper operation at any required operating speed. Compressors must be capable of variable speed operation and may have either oil-free bearing drives or oil-lubricated bearing drives. Centrifugal compressors must include:

a. Shaft main bearings that are either oil lubricated, oil free ceramic or magnetic levitated. The oil lubricated bearings must be the rolling element type in accordance with ABMA 9 or ABMA 11, journal type with bronze or babbitt liners, or of the aluminum-alloy one-piece insert type. Oil lubricated or oil free ceramic bearings must be rated for an L(10) life of not less than 200,000 hours. Magnetic levitated main shaft bearings must be in accordance with ISO 14839-1, ISO 14839-2, ISO 14839-3, ISO 14839-4, and provided with radial and axial magnetic levitated bearings (combination permanent and electro magnets) to levitate the shaft thereby eliminating metal to metal contact and thus eliminating the need for oil. The active magnetic bearings must be equipped with an automatic vibration reduction and balancing system. Each bearing position must be sensed by position sensors and provide real time positioning of the rotor shaft, controlled by on-board digital electronics. In the event of a power failure, the magnetic bearings will remain in operation throughout the compressor coast-down using a reserve power supply. Provide mechanical bearings designed for emergency touchdowns, as a backup to the magnetic bearings.

b. Casing of cast iron, aluminum, or steel plate with split sections gasketed and bolted or clamped together.

c. Lubrication system of the forced-feed type that provides oil at the proper pressure to all parts requiring lubrication.

d. Provisions to ensure proper lubrication of bearings and shaft seals prior to starting and upon stopping with or without electric power supply (if applicable). On units providing forced-feed lubrication prior to starting, a differential oil pressure cutout interlocked with the compressor starting equipment must allow the compressor to operate only when the required oil pressure is provided to the bearings (if

applicable).

e. Oil sump heaters controlled as recommended by the manufacturer.

f. Temperature-or pressure-actuated prerotation vane, variable geometry diffuser or suction damper to provide automatic capacity modulation from 100 percent capacity to 25 percent capacity. If operation to 25 percent capacity cannot be achieved without providing gas bypass external to the compressor, then the Contractor must indicate in the equipment submittal the load percent at which external hot gas bypass is required to prevent surge and to provide the specified capacity reduction and its impact on performance.

2.5.6 Compressor Driver, Electric Motor

Components such as motors, starters, and wiring must be in accordance with paragraph ELECTRICAL WORK. Motor starter must be unit mounted as indicated with starter type, wiring, and accessories coordinated with the chiller manufacturer.

2.5.7 Air-Cooled Condenser Coil

Condenser coil must be of the extended-surface fin-and-tube type and must be constructed of seamless copper or aluminum tubes with compatible copper or aluminum fins. Fins must be soldered or mechanically bonded to the tubes and installed in a metal casing. Coils must be circuited and sized for a minimum of 5 degrees F subcooling and full pumpdown capacity. Coil must be factory leak and pressure tested after assembly in accordance with ANSI/ASHRAE 15 & 34.

2.5.8 Receivers

Receiver must bear a stamp certifying compliance with ASME BPVC SEC VIII D1 and must meet the requirements of ANSI/ASHRAE 15 & 34. Inner surfaces must be thoroughly cleaned by sandblasting or other approved means. Each receiver must have a storage capacity not less than 20 percent in excess of that required for the fully-charged system. Each receiver must be equipped with inlet, outlet drop pipe, drain plug, purging valve, relief valves of capacity and setting required by ANSI/ASHRAE 15 & 34, and two bull's eye liquid-level sight glasses. Sight glasses must be in the same vertical plane, 90 degrees apart, perpendicular to the axis of the receiver, and not over 3 inches horizontally from the drop pipe measured along the axis of the receiver. In lieu of bull's eye sight glass, external gauge glass with metal glass guard and automatic closing stop valves may be provided.

2.5.9 Chiller Purge System

Chillers which operate at pressures below atmospheric pressure must be provided with a purge system. Purge system must automatically remove air, water vapor, and non-condensible gases from the chiller's refrigerant while keeping refrigerant emissions below requirements of ASHRAE Std 147. Purge units must be certified per AHRI 580. Purge system must condense, separate, and return all refrigerant back to the chiller. An oil separator must be provided with the purge system if required by the manufacturer. Purge system must not discharge to occupied areas, or create a potential hazard to personnel. Purge system must include a purge pressure gauge, number of starts counter, and an elapsed time meter. Purge system must include lights or an alarm which indicate excessive

purge or an abnormal air leakage into chiller.

2.5.10 Tools

One complete set of special tools, as recommended by the manufacturer for field maintenance of the system, must be provided. Tools must be mounted on a tool board in the equipment room or contained in a toolbox as directed by the Contracting Officer.

2.6 ACCESSORIES

2.6.1 Refrigerant Leak Detector

Detector must be the continuously-operating, halogen-specific type. Detector must be appropriate for the refrigerant in use. Detector must be specifically designed for area monitoring and must include a single sampling point installed where indicated. Detector design and construction must be compatible with the temperature, humidity, barometric pressure and voltage fluctuations of the operating area. Detector must have an adjustable sensitivity such that it can detect refrigerant at or above 3 parts per million (ppm). Detector must be supplied factory-calibrated for the appropriate refrigerant(s). Detector must be provided with an alarm relay output which energizes when the detector detects a refrigerant level at or above the TLV-TWA (or toxicity measurement consistent therewith) for the refrigerant(s) in use. The detector's relay must be capable of initiating corresponding alarms and ventilation systems as indicated on the drawings. Detector must be provided with a failure relay output that energizes when the monitor detects a fault in its operation.

2.6.2 Refrigerant Relief Valve/Rupture Disc Assembly

The assembly must be a combination pressure relief valve and rupture disc designed for refrigerant usage. The assembly must be in accordance with ASME BPVC SEC VIII D1 and ANSI/ASHRAE 15 & 34. The assembly must be provided with a pressure gauge assembly which will provide local indication if a rupture disc is broken. Rupture disc must be the non-fragmenting type.

2.6.3 Refrigerant Signs

Refrigerant signs must be a medium-weight aluminum type with a baked enamel finish. Signs must be suitable for indoor or outdoor service. Signs must have a white background with red letters not less than 0.5 inches in height.

2.6.3.1 Installation Identification

Each new refrigerating system must be provided with a refrigerant sign which indicates the following as a minimum:

a. Contractor's name.

b. Refrigerant number and amount of refrigerant.

c. The lubricant identity and amount.

d. Field test pressure applied.

2.6.3.2 Controls and Piping Identification

Refrigerant systems containing more than 110 lb of refrigerant must be provided with refrigerant signs which designate the following as a minimum:

a. Valves or switches for controlling the refrigerant flow and the refrigerant compressor(s).

b. Pressure limiting device(s).

2.6.4 Automatic Tube Brush Cleaning System

2.6.4.1 Brush and Basket Sets

One brush and basket set (one brush and two baskets) must be furnished for each condenser tube. Brushes must be made of nylon bristles, with titanium wire. Baskets must be polypropylene.

2.6.4.2 Flow-Diverter Valve

Each system must be equipped with one flow-diverter valve specifically designed for the automatic tube brush cleaning system and have parallel flow connections. The flow-diverter valve must be designed for a working pressure of 150 psig. End connections must be flanged. Each valve must be provided with an electrically operated air solenoid valve and position indicator.

2.6.4.3 Control Panel

The control panel must provide signals to the diverter valve at a preset time interval to reverse water flow to drive the tube brushes down the tubes and then signal the valve to reverse the water flow to drive the brushes back down the tubes to their original position. The controller must have the following features as a minimum:

a. Timer to initiate the on-load cleaning cycle.

b. Manual override of preset cleaning cycle.

c. Power-on indicator.

d. Diverter-position indicator.

e. Cleaning-cycle-time adjustment

f. Flow-switch bypass.

2.6.5 Gaskets

Gaskets must conform to ASTM F104 - classification for compressed sheet with nitrile binder and acrylic fibers for maximum 700 degrees F service.

2.6.6 Bolts and Nuts

Bolts and nuts, except as required for piping applications, must be in accordance with ASTM A307. The bolt head must be marked to identify the manufacturer and the standard with which the bolt complies in accordance with ASTM A307.

2.7 FABRICATION

2.7.1 Factory Coating

Unless otherwise specified, equipment and component items, when fabricated from ferrous metal, must be factory finished with the manufacturer's standard finish, except that items located outside of buildings must have weather resistant finishes that will withstand 125 hours exposure to the salt spray test specified in ASTM B117 using a 5 percent sodium chloride solution. Immediately after completion of the test, the specimen must show no signs of blistering, wrinkling, cracking, or loss of adhesion and no sign of rust creepage beyond 1/8 inch on either side of the scratch mark. Cut edges of galvanized surfaces where hot-dip galvanized sheet steel is used must be coated with a zinc-rich coating conforming to ASTM D520, Type I.

2.7.2 Factory Applied Insulation

Chiller must be provided with factory installed insulation on surfaces subject to sweating including the water cooler, suction line piping, economizer, and cooling lines. Insulation on heads of coolers may be field applied, however it must be installed to provide easy removal and replacement of heads without damage to the insulation. Where motors are the gas-cooled type, factory installed insulation must be provided on the cold-gas inlet connection to the motor per manufacturer's standard practice. Factory insulated items installed outdoors are not required to be fire-rated. As a minimum, factory insulated items installed indoors must have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Factory insulated items (no jacket) installed indoors and which are located in air plenums, in ceiling spaces, and in attic spaces must have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Flame spread and smoke developed indexes must be determined by ASTM E84. Insulation must be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket must be tested as a composite material. Jackets, facings, and adhesives must have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E84.

2.8 FACTORY TESTS

2.8.1 Chiller Performance Test

The Contractor and proposed chiller manufacturer shall be responsible for performing the chiller factory test to validate the specified full load capacity, full load EER, and IPLV in accordance with AHRI 550/590 I-P except as indicated. The Contractor and chiller manufacturer must provide to the Government a certified chiller factory test report in accordance with AHRI 550/590 I-P to confirm that the chiller performs as specified. Tests must be conducted in an AHRI certified test facility in conformance with AHRI 550/590 I-P procedures and tolerances, except as indicated. At a minimum, chiller capacity must be validated to meet the scheduled requirements indicated on the drawings. Tolerance or deviation must be in strict accordance with AHRI 550/590 I-P. Stable operation at minimum load of 10 percent of total capacity must be demonstrated during the factory test.

2.8.1.1 Temperature Adjustments

Temperature adjustments must adhere to AHRI 550/590 I-P to adjust from the design fouling factor to the clean tube condition. Test temperature adjustments must be verified prior to testing by the manufacturer. There must be no exceptions to conducting the test with clean tubes with the temperature adjustments per AHRI 550/590 I-P. The manufacturer must clean the tubes prior to testing to obtain a test fouling factor of 0.0000.

2.8.1.2 Test Instrumentation

The factory test instrumentation must be per AHRI 550/590 I-P and the calibration must be traceable to the National Institute of Standards and Technology.

2.8.1.3 Equipment Adjustments

If the equipment fails to perform within allowable tolerances, the manufacturer must be allowed to make necessary revisions to his equipment and retest as required. The manufacturer shall assume all expenses incurred by the Government to witness the retest.

2.8.2 Chiller Sound Test

Chillers must be sound tested at the factory prior to shipment to confirm the sound pressure level specified herein. Tests and data must be conducted and measured in strict accordance with AHRI 575 at the full load system operating conditions. The chiller sound pressure level, in decibels (dB), with a reference pressure of 20 micropascals, must not exceed 85 dB, A weighted. Ratings must be in accordance with AHRI 575. No reduction of entering condenser water temperature or raising of leaving chilled water temperature will be allowed. A minimum of 75 percent of the sound data points must be taken along the length of the machine, and established as the minimum percentage of total possible points used to determine sound levels. In the event that the chiller does not meet the dBA sound pressure level, the manufacturer shall, at his expense, provide sufficient attenuation to the machine to meet the specified value. This attenuation must be applied in such a manner that it does not hinder the operation or routine maintenance procedures of the chiller. The attenuation material, adhesives, coatings, and other accessories must have surface burning characteristics as determined by ASTM E84.

2.9 SUPPLEMENTAL COMPONENTS/SERVICES

2.9.1 Temperature Controls

Chiller control packages must be fully coordinated with and integrated into the temperature control system indicated in Section 23 30 00 HVAC AIR DISTRIBUTION and Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC .

PART 3 EXECUTION

3.1 INSTALLATION

Installation of water chiller systems including materials, installation, workmanship, fabrication, assembly, erection, examination, inspection, and testing must be in accordance with the manufacturer's written installation instructions.

3.1.1 Installation Instructions

Provide manufacturer's standard catalog data, at least 5 weeks prior to the purchase or installation of a particular component, highlighted to show features such as materials, dimensions, options, performance and efficiency. Data must include manufacturer's recommended installation instructions and procedures. Data must be adequate to demonstrate compliance with contract requirements.

3.1.2 Vibration Isolation

If vibration isolation is specified for a unit, vibration isolator literature must be included containing catalog cuts and certification that the isolation characteristics of the isolators provided meet the manufacturer's recommendations.

3.1.3 Posted Instructions

Provide posted instructions, including equipment layout, wiring and control diagrams, piping, valves and control sequences, and typed condensed operation instructions. The condensed operation instructions must include preventative maintenance procedures, methods of checking the system for normal and safe operation, and procedures for safely starting and stopping the system. The posted instructions must be framed under glass or laminated plastic and be posted where indicated by the Contracting Officer.

3.1.4 Verification of Dimensions

Provide a letter including the date the site was visited, conformation of existing conditions, and any discrepancies found.

3.1.5 System Performance Test Schedules

Provide a schedule, at least 2 weeks prior to the start of related testing, for the system performance tests. The schedules must identify the proposed date, time, and location for each test.

3.1.6 Certificates

Where the system, components, or equipment are specified to comply with requirements of AGA, NFPA, ARI, ASHRAE, ASME, or UL, proof of such compliance must be provided. The label or listing of the specified agency must be acceptable evidence. In lieu of the label or listing, a written certificate from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency may be submitted. When performance requirements of this project's drawings and specifications vary from standard ARI rating conditions, computer printouts, catalog, or other application data certified by ARI or a nationally recognized laboratory as described above must be included. If ARI does not have a current certification program that encompasses such application data, the manufacturer may self certify that his application data complies with project performance requirements in accordance with the specified test standards.

3.1.7 Operation and Maintenance Manuals

Provide Six complete copies of an operation manual in bound 8 1/2 by 11 inch booklets listing step-by-step procedures required for system startup, operation, abnormal shutdown, emergency shutdown, and normal shutdown at least 4 weeks prior to the first training course. The booklets must include the manufacturer's name, model number, and parts list. The manuals must include the manufacturer's name, model number, service manual, and a brief description of all equipment and their basic operating features. Six complete copies of maintenance manual in bound 8 1/2 by 11 inch booklets listing routine maintenance procedures, possible breakdowns and repairs, and a trouble shooting guide. The manuals must include piping and equipment layouts and simplified wiring and control diagrams of the system as installed.

3.1.8 Connections to Existing Systems

Notify the Contracting Officer in writing at least 15 calendar days prior to the date the connections are required. Obtain approval before interrupting service. Furnish materials required to make connections into existing systems and perform excavating, backfilling, compacting, and other incidental labor as required. Furnish labor and tools for making actual connections to existing systems.

3.1.9 Refrigeration System

3.1.9.1 Equipment

Refrigeration equipment and the installation thereof must conform to ANSI/ASHRAE 15 & 34. Necessary supports must be provided for all equipment, appurtenances, and pipe as required, including frames or supports for compressors, pumps, cooling towers, condensers, water coolers, and similar items. Compressors must be isolated from the building structure. If mechanical vibration isolators are not provided, vibration absorbing foundations must be provided. Each foundation must include isolation units consisting of machine and floor or foundation fastenings, together with intermediate isolation material. Other floor-mounted equipment must be set on not less than a 6 inch concrete pad doweled in place. Concrete foundations for floor mounted pumps must have a mass equivalent to three times the weight of the components, pump, base plate, and motor to be supported. In lieu of concrete pad foundation, concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. Concrete pedestal block must be of mass not less than three times the combined pump, motor, and base weights. Isolators must be selected and sized based on load-bearing requirements and the lowest frequency of vibration to be isolated. Isolators must limit vibration to percent at lowest equipment rpm. Lines connected to pumps mounted on pedestal blocks must be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts must be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Equipment must be properly leveled, aligned, and secured in place in accordance with manufacturer's instructions.

3.1.9.2 Field Refrigerant Charging

a. Initial Charge: Upon completion of all the refrigerant pipe tests, the vacuum on the system must be broken by adding the required charge of dry refrigerant for which the system is designed, in accordance

with the manufacturer's recommendations. Contractor must provide the complete charge of refrigerant in accordance with manufacturer's recommendations. Upon satisfactory completion of the system performance tests, any refrigerant that has been lost from the system must be replaced. After the system is fully operational, service valve seal caps and blanks over gauge points must be installed and tightened.

b. Refrigerant Leakage: If a refrigerant leak is discovered after the system has been charged, the leaking portion of the system must immediately be isolated from the remainder of the system and the refrigerant must be pumped into the system receiver or other suitable container. The refrigerant must not be discharged into the atmosphere.

c. Contractor's Responsibility: The Contractor must, at all times during the installation and testing of the refrigeration system, take steps to prevent the release of refrigerants into the atmosphere. The steps must include, but not be limited to, procedures which will minimize the release of refrigerants to the atmosphere and the use of refrigerant recovery devices to remove refrigerant from the system and store the refrigerant for reuse or reclaim. At no time must more than 3 ounces of refrigerant be released to the atmosphere in any one occurrence. Any system leaks within the first year must be repaired in accordance with the specified requirements including material, labor, and refrigerant if the leak is the result of defective equipment, material, or installation.

3.1.9.3 Oil Charging

Except for factory sealed units, two complete charges of lubricating oil for each compressor crankcase must be furnished. One charge must be used during the performance testing period, and upon the satisfactory completion of the tests, the oil must be drained and replaced with the second charge.

3.1.10 Mechanical Room Ventilation

Mechanical ventilation systems must be in accordance with Section 23 30 00 HVAC AIR DISTRIBUTION.

3.1.11 Field Applied Insulation

Field installed insulation must be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS, except as defined differently herein.

3.1.12 Field Painting

Painting required for surfaces not otherwise specified, and finish painting of items only primed at the factory.

3.2 FACTORY TEST SCHEDULING AND REPORTS

Provide schedules which identify the date, time, and location for each test. Schedules must be submitted for the Chiller Performance Tests .

Six copies of the certified test report must be forwarded to the Government for approval prior to project acceptance. Calibration curves and information sheets for all instrumentation must be included. Provide

copies in bound 8 1/2 by 11 inch booklets. Reports must certify the compliance with performance requirements and follow the format of the required testing standard for the Chiller Performance Tests and the Chiller Sound Tests. Test report must include certified calibration report of all test instrumentation. Calibration report must include certification that all test instrumentation has been calibrated within 6 months prior to the test date, identification of all instrumentation, and certification that all instrumentation complies with requirements of the test standard. Test report must be submitted 1 week after completion of the factory test.

3.3 MANUFACTURER'S FIELD SERVICE

The services of a factory-trained representative must be provided. The representative shall advise on the following:

a. Hermetic machines:

(1) Testing hermetic water-chilling unit under pressure for refrigerant leaks; evacuation and dehydration of machine to an absolute pressure of not over 300 micrometers.

(2) Charging the machine with refrigerant.

(3) Starting the machine.

b. Open Machines:

(1) Erection, alignment, testing, and dehydrating.

(2) Charging the machine with refrigerant.

(3) Starting the machine.

3.4 CLEANING AND ADJUSTING

Equipment must be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Provide temporary filters for all fans that are operated during construction. Perform and document that proper Indoor Air Quality During Construction procedures have been followed; this includes providing documentation showing that after construction ends, and prior to occupancy, new filters were provided and installed. System must be maintained in this clean condition until final acceptance. Bearings must be properly lubricated with oil or grease as recommended by the manufacturer. Belts must be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment must be adjusted to setting indicated or directed. Fans must be adjusted to the speed indicated by the manufacturer to meet specified conditions. At least one week before the official equipment warranty start date, all condenser coils on air-cooled water chillers and split-system water chillers must be cleaned in accordance with the chiller manufacturer's instructions. This work covers two coil cleanings. The condenser coils must be cleaned with an approved coil cleaner by a service technician, factory trained by the chiller manufacturer. The condenser coil cleaner must not have any detrimental affect on the materials or protective coatings on the condenser coils. Testing, adjusting, and balancing must be as specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.5 FIELD ACCEPTANCE TESTING

3.5.1 Test Plans

a. Manufacturer's Test Plans: Within 120 calendar days after contract award, submit the following plans:

(1) Water chiller - Field Acceptance Test Plan

Field acceptance test plans must be developed by the chiller 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.

The 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 tests of the chiller 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 for the equipment provided under Section 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC .

c. Prerequisite testing: Chillers for which performance testing is dependent upon the completion of the work covered by Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC must have that work completed as a prerequisite to testing work under this section. Indicate in each field acceptance test plan when such prerequisite work is required.

d. Test procedure: Indicate in each field acceptance test plan each equipment manufacturers 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 must include the required test reporting forms to be completed by the Contractor's testing representatives. Procedures must be structured to test the controls through all modes of control to confirm that the controls are performing with the intended sequence of control.

Controller must be verified to be properly calibrated and have the proper set point to provide stable control of their respective equipment.

e. Performance variables: Each test plan must 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. Chiller manufacturer must furnish with each test procedure a description of acceptable results that have been verified.

Chiller manufacturer must identify the acceptable limits or tolerance within which each tested performance variable must acceptably operate.

f. Job specific: Each test plan must be job specific and must address the particular cooling towers and particular conditions which exist in this contract. Generic or general preprinted test procedures are not acceptable.

g. Specialized components: Each test plan must include procedures for field testing and field adjusting specialized components, such as hot gas bypass control valves, or pressure valves.

3.5.2 Testing

a. Each water chiller system must be field acceptance tested in compliance with its approved field acceptance test plan and the resulting following field acceptance test report submitted for approval:

b. Manufacturer's recommended testing: Conduct the manufacturer's recommended 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 must be reviewed, approved, and signed by the Contractor's test director. The manufacturer's field test representative must review, approve, and sign the report of the manufacturer's recommended test. Signatures must be accompanied by the person's name typed.

f. Deficiency resolution: The test requirements acceptably met; deficiencies identified during the tests must be corrected in compliance with the manufacturer's recommendations and corrections retested in order to verify compliance.

3.6 SYSTEM PERFORMANCE TESTS

Six copies of the report must be provided in bound 8 1/2 by 11 inch booklets.

3.6.1 General Requirements

Before each refrigeration system is accepted, tests to demonstrate the general operating characteristics of all equipment must be conducted by the manufacturer's approved start-up representative experienced in system start-up and testing, at such times as directed. Tests must cover a period of not less than 48 hours for each system and must demonstrate that the entire system is functioning in accordance with the drawings and specifications. Corrections and adjustments must be made as necessary and tests must be re-conducted to demonstrate that the entire system is functioning as specified. Prior to acceptance, service valve seal caps and blanks over gauge points must be installed and tightened. Any refrigerant lost during the system startup must be replaced. If tests do not demonstrate satisfactory system performance, deficiencies must be corrected and the system must be retested. Tests must be conducted in the presence of the Contracting Officer. Water and electricity required for the tests will be furnished by the Government. Any material, equipment, instruments, and personnel required for the test must be provided by the Contractor. Field tests must be coordinated with Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

3.7 DEMONSTRATIONS

Provide 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.

-- End of Section --

SECTION 23 73 13.00 40

MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS
05/17

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, INC. (AMCA)

AMCA 99	(2016) Standards Handbook
AMCA 211	(2013; Rev 2017) Certified Ratings Program Product Rating Manual for Fan Air Performance
AMCA 300	(2014) Reverberant Room Method for Sound Testing of Fans

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 430 I-P	(2014) Performance Rating of Central Station Air-handling Unit Supply Fans
AHRI 880 I-P	(2011) Performance Rating of Air Terminals

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 51	(2016) Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
ASHRAE 52.2	(2012) Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

ASTM INTERNATIONAL (ASTM)

ASTM A653/A653M	(2020) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 21940-11	(2016) Mechanical vibration -- Rotor balancing -- Part 11: Procedures and Tolerances for Rotors with Rigid Behavior

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A (2021) Standard for the Installation of Air Conditioning and Ventilating Systems

UNDERWRITERS LABORATORIES (UL)

UL 900 (2015) Standard for Air Filter Units

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. When used, a code following the "G" classification 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

Installation Drawings; G

Fabrication and Connection Drawings; G

SD-03 Product Data

Equipment and Performance Data; G

Sample Warranty; G

Air Filter Gauges; G

SD-04 Samples

Coating Specimen; G

SD-06 Test Reports

Final Test Reports; G

SD-07 Certificates

List of Product Installations

Certificates of Conformance; G

Unit Cabinet

Fan

Drain Pans

Insulation

Plenums

Multizone AHU

Blow-Through AHU

Spare Parts

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

SD-11 Closeout Submittals

Warranty

1.3 QUALITY CONTROL

Submit a list of product installations for air-handling units showing a minimum of five installed units, similar to those proposed for use, that have been in successful service for at least 5 years. Provide a list that includes the purchaser, address of installation, service organization, and date of installation.

1.3.1 Certification of Conformance

Submit certificates of conformance for the following items, showing conformance with the referenced standards contained in this section:

a. Unit Cabinet

b. Fan

c. Drain Pans

d. Insulation

e. Plenums

f. Multizone AHU

g. Blow-Through AHU

h. Spare Parts

1.3.2 Sample Warranty

Submit samples of warranty language concurrently with Certificates for review and approval by the Contracting Officer.

Submit a sample warranty for the following items:

a. Unit Cabinet

b. Fan

c. Drain Pans

d. Insulation

e. Plenums

f. Multizone AHU

g. Blow-Through AHU

h. Spare Parts

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver, handle, and store equipment and accessories in a manner that prevents damage or deformity. Provide temporary skids under units.

1.5 WARRANTY

Final acceptance is dependent upon providing the warranty, based on approved sample warranty, to the Contracting Officer, along with final test reports. Ensure that the warranty is valid for at least 2 years from the date of project closeout, showing Government as the warranty recipient.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Submit equipment and performance data for air-handling units, including use life, total static pressure and coil face area classifications, and performance ratings.

Submit all required fabrication and connection drawings and obtain approval from the Contracting Officer before the start of work shown on these drawings.

Submit drawings and manuals that include a spare parts data sheet, with manufacture's recommended stock levels.

2.2 COMPONENTS

2.2.1 Air-Handling Unit (AHU)

Provide a central-station type, factory-fabricated, and fully assembled AHU. Provide AHU that includes components and auxiliaries in accordance with AHRI 430 I-P. Balance the AHU fan and motor according to ISO 21940-11.

Ensure that the total static pressure and coil face area classification conforms to AMCA 99.

Fans with enlarged outlets are not permitted.

2.2.2 Unit Cabinet

2.2.2.1 Class A and Class B Cabinets

Provide an AHU cabinet suitable for the pressure class shown and has leaktight joints, closures, penetrations, and access provisions. Provide a cabinet that does not expand or contract perceptibly when fans are starting or stopping and that does not pulsate during operation. Reinforce cabinet surfaces with deflections in excess of 0.004167 of unsupported span before acceptance. Stiffen pulsating panels, which produce low-frequency noise due to diaphragming of unstable panel walls,

to raise the natural frequency to an easily attenuated level. Fabricate the enclosure from continuous hot-dipped-galvanized steel no lighter than 20 gauge thickness, to match the industry standard. Provide mill-galvanized sheet-metal that conforms to ASTM A653/A653M and that is coated with not less than 1.25 ounces of zinc per square foot of a two-sided surface. Provide mill-rolled structural-steel that is hot-dip-galvanized or primed and painted. Corrosion-protect cut edges, burns, and scratches in galvanized surfaces. Provide primed and painted black carbon steel cabinet construction that complies with this specification.

Provide removable panels to access the interior of the unit cabinet. Provide seams that are welded, bolted, or gasketed and sealed with a rubber-based mastic. Make entire cabinet floor and ceiling hot-dipped-galvanized steel. Provide removable access doors on both sides of all access, filter, and fan sections for inspection and maintenance.

2.2.2.2 Class C Cabinets

Provide an AHU cabinet that is suitable for the pressure class shown and has leaktight joints, closures, penetrations, and access provisions. Provide a cabinet that does not expand or contract perceptibly when the fans are starting or stopping and that does not pulsate during operation. Reinforce cabinet surfaces with deflections in excess of 0.002778 of unsupported span before acceptance by the Contracting Officer. Stiffen pulsating panels, which produce low-frequency noise due to diaphragming of unstable panel walls, to raise the natural frequency to an easily attenuated level. Provide the enclosure that is fabricated from mill-galvanized or primed and painted carbon sheet steel. Provide mill-galvanized sheet metal that conforms to ASTM A653/A653M and that is coated with not less than 1.25 ounces of zinc per square foot of a two-sided surface. Provide mill-rolled structural steel that is hot-dip galvanized or primed and painted. Corrosion-protect edges, burns, and scratches in galvanized surfaces. Provide primed and painted black carbon steel cabinet construction that complies with this specification.

Provide removable panels to access the interior of the unit cabinet. Provide seams that are welded, bolted, or gasketed and sealed with a rubber-based mastic. Make the entire cabinet floor and ceiling hot-dipped galvanized steel. Provide removable access doors on both sides of all access, filter, and fan sections for inspection and maintenance.

2.2.2.3 Cabinet Construction

Where the cabinet size is such that personnel access is possible, strengthen the cabinet floor to permit entry without damaging any component. Hinge and latch the access doors and panels sufficiently close together to preclude leaks caused by distortion, and effectively gasket.

Black carbon steel cabinet construction is acceptable when the following conditions are met:

a. Coat all interior and exterior surfaces, including the lapped contacting surfaces, with a corrosion-protective coating.

b. Certify the coating as passing a 500-hour-exposure salt-spray fog test in accordance with ASTM B117.

c. Immediately after completing the test, provide a coating specimen that

shows no signs of wrinkling, cracking, or loss of adherence and no signs of rust creep beyond 1/8 inch on either side of the scratch mark.

d. Ensure that inspection of interior and exterior cabinet surfaces will pass examination for the same defects as the salt-spray fog test specimen, after 11 months of service and before the guarantee expires.

Interior surfaces of cabinets that are constructed of intact mill-galvanized steel require no further protection.

Provide cabinets with exterior surfaces constructed of mill-galvanized-steel that are left unpainted.

Provide cabinets and casings that are double-walled with 1 inch insulation. Provide a interior wall.

Weigh the fan and motor assembly at the AHU manufacturer's factory for isolator selection. Statically and dynamically balance fan section assemblies, including fan wheels, shafts, bearings, drives, belts, isolation bases, and isolators. Allow isolators to free-float when performing fan balance. Measure vibration at each fan shaft bearing in horizontal, vertical, and axial directions.

Factory install all motors on slide bases to permit adjustment of belt tension.

Provide heavy-duty, open drip-proof, three-phase fan motors, operable at 460 volts (V), 60 hertz (Hz). Provide high-efficiency motors.

Provide a marine-type, vapor-proof service light in the fan segment. Provide a 100 watt (W) service light that is wired to an individual switch and operates on 115 V, single-phase, 60 Hz service that is separate from the main power to the AHU. Provide a single 115 V outlet at the light switch.

2.2.3 Fan

Ensure that fan wheels are dynamically and statically balanced at the factory. Provide a fan with RPM that is 25 percent less than the first critical speed. Provide a fan shaft that is solid, ground and polished steel and coated with a rust inhibitor. Provide V-belt-driven fans that are designed for 50 percent overload capacity. For variable air volume AHUs that are provided with variable-frequency drives, have their fans balanced over the entire range of operation (20 percent to 100 percent RPM). Balancing fans of only 100 percent design of RPM is not acceptable for AHUs to be used with variable-frequency drives.

Mount fans on isolation bases. Internally mount motors on the same isolation bases and internally isolate fans and motors. Install flexible canvas ducts or a vibration absorbent fan discharge seal between the fan and casings to ensure complete isolation. Provide flexible canvas ducts that comply with NFPA 90A.

Provide an overall fan-section depth that is equal to or greater than the manufacturer's free-standing fan.

Locate the fan inlet where it provides not less than one-half fan-wheel diameter clearance from the cabinet wall or the adjacent fan inlet where double wheels are permitted.

Mount the AHU fan drive external to the casing.

Install the AHU fan motor and drive inside the fan cabinet. Provide a motor that conforms to NEMA MG 1 and is installed on an adjustable base. Provide an access door of adequate size for servicing the motor and drive. Provide a belt guard inside the cabinet or interlock the access door with the supply fan so that power to the fan is interrupted when the access door is opened.

2.2.4 Drain Pans

Provide intermediate-coil, 3 inch deep drip pans for each tiered coil bank.

Extend the top pan 12 inches beyond the face of the coil, and extend the bottom pan not less than 24 inches beyond the face of the coil. Where more than two pans are used, make the pan extension proportional. Make adequate supports from the same type of material as the pans or from hot-dip galvanized angle iron with isolation at the interface. Use 22-gauge, AISI Type 304, corrosion-resistant steel for pan material, with silver-soldered joints. Minimum size of the drain opening is 1-1/4 inches. Pipe the pan to the drain.

Extend the integral cabinet drain pan under all areas where condensate is collected and make it watertight with welded or brazed joints, piped to the drain. Provide corrosion protection in condensate collection areas, and insulate against sweating. Provide minimum 14-gauge sheet metal; however 16-gauge double-drain-pan construction is also acceptable.

Provide cooling coil ends that are enclosed by the cabinet and are factory insulated against sweating or drain to a drain pan.

Provide drain pans that are double-pan construction, thermally isolated from the exterior casing with 1 inch thick fiberglass insulation. Provide drain pans that slope to the drain and drain substantially dry by gravity alone when the drains are open.

Provide pans that have a double slope to the drain point.

2.2.5 Insulation

Provide a unit that is internally fitted at the factory with a sound-attenuating, thermal-attenuating, fibrous-glass material not less than 2 inches thick. Ensure that the insulation precludes any condensation on any exterior cabinet surface under conditions that are normal to the unit's installed location. Provide acoustic treatment that attenuates fan noise in compliance with specified noise criteria. Apply material to the entire cabinet with waterproof adhesives and permanent fasteners. Provide adhesive and insulating material in accordance with NFPA 90A.

2.2.6 Plenums

Provide plenums in the following minimum widths:

a. 6 inches for mounting temperature controls and to separate two or more coils of different size that are mounted in series

b. 14 inches between face and bypass dampers and upstream accessories and

at change in cross-section

c. 24 inches for access sections

2.2.7 Multizone AHU

Provide multizone unit delivery dampers that are part of the manufacturer's standard unit construction and that meet the requirements specified in the paragraph POWER-OPERATED DAMPERS of Section 23 09 33.00 40 ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC.

2.2.8 Blow-Through AHU

Fit the blow-through AHU with pressure-equalizing baffles.

2.2.9 Coils

2.2.9.1 Coil Section

Provide a coil section that encases cooling coils and drain pipes. Arrange coils for horizontal air flow. Provide intermediate drain pans for multiple-coils installation. Completely enclose coil headers with the insulated casing with only the connections extending through the cabinet.

2.2.9.2 Coil Pressure and Temperature Ratings

Ensure that the coils are designed for the following fluid operating pressures and temperatures:

SERVICE	PRESSURE	TEMPERATURE
Hot Water	200 PSI	250 degrees F
Chilled Water	200 PSI	40 degrees F

Provide coils that are air-pressure-tested under water at the following minimum pressures:

SERVICE	PRESSURE
Water (hot and chilled)	250 PSI

2.2.9.3 Coil Casings

Provide coils that are factory-tested, dehydrated, vacuum-tested, purged with inert gas, and sealed before shipped to the job site.

Provide stainless-steel casings. Provide cast iron, brass, or copper coil headers. Fit water coil headers with 0.25 inch ips spring-loaded plug drains and vent petcocks. Provide automatic air vents with ball-type isolation valves for each coil that is piped to the drain pan.

2.2.9.4 Chilled Water Coils

Provide 0.625 inch outside diameter copper tubing for coils. Provide fins that are aluminum and mechanically bonded by tubing expansion with a maximum spacing of 12 fins per 1 inch unless otherwise noted. Provide

coils that have supply and return connections on the same end. Provide a maximum of four coil rows.

2.2.9.5 Hot Water Coils

Provide heating coils that have copper tubing aluminum fins.

2.2.9.6 Drainable Coils

Provide drainable coils that are capable of being purged free of water with compressed air.

Provide self-draining coils that have a drain point at the end of every tube and are pitched to that point. Drain provisions include drained headers, U-bends with integral plugs, or nonferrous plugs in cast-iron headers. Provide tubes that drain substantially dry by gravity alone when the drains and vents are open.

2.2.10 Eliminators

Provide eliminators that are SMACNA three-break, hooked-edge design, constructed of reinforced 16 gauge galvanized steel with assembled brazed joints. Provide easily removable eliminator sections for cleaning from the side of the AHU without requiring partial or complete disassembly of the AHU casing.

2.2.11 Filters

2.2.11.1 Filter Housing

Provide factory-fabricated filter sections of the same construction and finish as the unit casings. Provide filter sections that have filter guides and full height, double-wall, hinged, and removable access doors for filter removal. Provide air sealing gaskets to prevent air bypass around filters. Provide visible identification on media frames showing the model number and airflow direction. Where a filter bank is indicated or required, provide a means of sealing to prevent bypass of unfiltered air. Ensure that the filters perform in accordance with ASHRAE 52.2.

2.2.11.2 Replaceable Air Filters

Select filters conforming to UL 900, Class 1. Ensure that when clean filters are exposed to flame, the filters do not contribute fuel when attacked by flame and emit only negligible amount of smoke. Provide permanent frames with replaceable media, 1 inch thickness, size as indicated.

2.2.11.3 Disposable Cartridge Air Filters

Provide UL 900, Class 2, UL-classified, and factory-assembled filters. Provide media of ultra-fine glass fibers having 50 to 55 percent average dust spot efficiencies with a maximum final resistance 0.75-inch water gauge, and maximum face velocity of 500 feet per minute. Construct filter frames of 18 gauge galvanized steel or aluminum with welded or riveted joints. Caulk or gasket the entire assembly to prevent air leakage around the frames. Ensure that the minimum efficiency of the filter is 60 percent per ASHRAE 52.2.

2.2.11.4 Outside Air Filters

Provide an extended-surface, factory-assembled air filters with supported cartridges. Provide extended surface filter units fabricated for disposal when the dust-load limit is reached as indicated by maximum (final) pressure drop.

Filter Classification: UL-approved for Class 1 or 2 conforming to UL 900.

Filter Grades, Nominal Efficiency and Application:

a. Grade B: 80 to 85 percent nominal efficiency outfitter

b. Grade D: 25 to 30 percent nominal efficiency prefilter

Filter Media: Grade B Supported (Rigid Pleated) Type: Provide media that is composed of high-density glass fibers. Use fastening methods to maintain pleat shape, seal aluminum separators in a proper enclosing frame to ensure that there is no air leakage for the life of filter. Staples and stays are prohibited.

Grade D Type: Provide media that is composed of synthetic/natural fibers. Bond a metal grid backing to the air leaving side of the media to maintain uniform pleat shape and stability for proper airflow and maximum dust loading. Provide a media frame that is constructed of high-strength, moisture-resistant fiber or beverage board. Bond the pleated media pack on all four edges to ensure that there is no air leakage for the life of the filter. Staples and stays are prohibited.

Filter Efficiency and Arrestance: Determine the efficiency and arrestance of filters in accordance with ASHRAE 52.2 Standard Atmospheric dust spot efficiency and synthetic dust weight arrestance that is not less than the following:

	Initial Efficiency (Percent)	Average Efficiency (Percent)	Final Efficiency (Percent)
Grade B	58	79	98
Grade D	Less than 20	22	89

Maximum initial and final resistance and inches of water gauge for each filter cartridge when operated at a face velocity of 500-feet per minute are as follows:

	Initial Resistance	Final Resistance
Grade B, Rigid Pleated	0.60	1.00
Grade D, 2-inches deep	0.32	0.70

Dust-Holding Capacity: When tested to 1.00 inch w.g. at 500 feet per minute face velocity, provide a dust-holding capacity from each 24 inch by 24 inch (face area) filter that is at least equal to the values listed below. For other filter sizes, provide a dust-holding capacity that is proportionally higher or lower.

Grade B, Rigid Pleated	6.17 ounces
Grade D, 2 inches Deep	2.29 ounces
Grade D, 4 inches Deep	10.58 ounces

Minimum Media Area: Provide a minimum net effective area in square feet for each 24 inch by 24 inch (face area) filter at 500 feet per minute face velocity of at least the values listed below. For other filter sizes, provide a net effective media that is proportionally higher or lower.

Grade B, Rigid Pleated	57.0
Grade D, 2-inches Deep	14.8

2.2.11.5 Air Filter Gauges

Provide manometer air filter gauges of the inclined tube differential type that have solid acrylic plastic construction with a built-in level vial and with an adjustable mirror-polished scale. Equip gauges with vent valves for zeroing and over-pressure safety traps. Ensure that the gauge range is adequate for the particular installation.

Provide one air filter gauge at each filter bank.

PART 3 EXECUTION

3.1 PREPARATION

Coordinate the size and location of concrete equipment pads, variable frequency drives, control, and electrical requirements.

3.2 INSTALLATION

Install equipment in accordance with the manufacturer's recommendations.

Provide installation drawings in accordance with referenced standards in this section.

3.2.1 Temporary Construction Filters

Have temporary construction filters in place during normal building construction whenever the AHUs are run for general ventilation, building dehumidification, or other purposes during construction. Install two layers of blanket filter at a time. Replace temporary construction filters as required during construction and after duct system cleaning is completed.

After systems have been cleaned and temporary construction filters are removed, and before test and balance operations are started, install a set of final filters. Avoid loading the filter with construction dust; do not have final filters in place while general building construction is taking place. Clean the permanent filter bank before testing and balancing.

The maximum number of coil rows is four. Maximum number of fins per inch is ten.

Provide variable air volume (VAV) terminal units that are certified by AHRI 880 I-P and UL-listed.

3.3 FIELD QUALITY CONTROL

3.3.1 Vibration Analyzer

Use an Fast Fourier Transform (FFT) analyzer to measure vibration levels. The following characteristics are required: A dynamic range greater than 70 dB; a minimum of 400-line resolution; a frequency response range of 5 Hz to 10 KHz(300-600000 cpm); the capacity to perform ensemble averaging, the capability to use a Hanning window; auto-ranging frequency amplitude; a minimum amplitude accuracy over the selected frequency range of plus or minus 20 percent or plus or minus 1.5 dB.

Use an accelerometer, either stud-mounted or mounted using a rare earth, low-mass magnet and sound disk (or finished surface) with the FFT analyzer to collect data. Ensure that the mass of the accelerometer and its mounting have minimal influence on the frequency response of the system over the selected measurement range.

3.3.2 Acceptance

Before final acceptance, use dial-indicator gauges to demonstrate that the fan and motor are aligned as specified.

Before final acceptance, verify conformance to specifications using vibration analysis. Ensure that the maximum vibration levels are 0.075 inches per second at 1 times run speed and at fan/blade frequency, and 0.04 inches per second at other multiples of run speed.

3.3.3 AHU Testing

Conduct performance test and rate the AHU and components in accordance with AMCA 211, AMCA 300, and ASHRAE 51. Provide AHU ratings in accordance with AHRI 430 I-P.

Provide final test reports to the Contracting Officer. Provide 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."

Perform AHU start-up in the presence of the Contracting Officer.

3.4 CLOSEOUT ACTIVITIES

3.4.1 Operation And Maintenance

Submit operation and maintenance manuals before testing the AHUs. Update and resubmit data for final approval no later than 30 calendar days before contract completion.

3.4.2 Acceptance

With the warranty, provide a cover letter/sheet clearly marked with the system name, date, and the words "Equipment Warranty" - "Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

-- End of Section --

SECTION 23 80 20.00 10

GAS-FIRED HEATING EQUIPMENT
05/20

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 NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.66/CGA 6.14	(2015; R 2020) Automatic Vent Damper Devices for Use with Gas-Fired Appliances
ANSI Z21.86/CSA 2.32	(2016) Vented Gas-Fired Space Heating Appliances
ANSI Z83.4/CSA 3.7	(2017) Non-Recirculating Direct Gas-Fired Heating and Forced Ventilation Appliances for Commercial and Industrial Application
ANSI Z83.8/CSA 2.6	(2016; Errata 2017) Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters, and Gas-Fired Duct Furnaces
ANSI Z83.19/CSA 2.35	(2017) Gas-Fired High-Intensity Infrared Heaters

CSA GROUP (CSA)

CSA Directory	(updated continuously online) Product Index

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(2021) National Fuel Gas Code
NFPA 211	(2019) Standard for Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances

UNDERWRITERS LABORATORIES (UL)

UL FLAMMABLE & COMBUSTIBLE	(2012) Flammable and Combustible Liquids and Gases Equipment Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. When used, a code following the "G"

classification 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

Detail Drawings; G
Installation; G

SD-03 Product Data

Spare Parts; G

SD-06 Test Reports

Testing, Adjusting, and Balancing; G

SD-10 Operation and Maintenance Data

Operation and Maintenance Instructions; G

1.3 QUALITY ASSURANCE

Submit detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operation of the system. Detail drawings for space heating equipment, controls, associated equipment, and for piping and wiring. 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.

1.4 DELIVERY, STORAGE, AND HANDLING

Protect all equipment delivered and placed in storage from weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.5 EXTRA MATERIALS

Submit spare parts data for each different item of material and equipment specified, after approval of the detail drawings, and not later than 3 months prior to the date of beneficial occupancy. Include in the data a complete list of parts and supplies, with current unit prices and source of supply.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 General

Provide materials and equipment which are standard products of a manufacturer regularly engaged in manufacturing of the products and that essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening. All gas fired appliances shall meet the requirements of NFPA 54.

2.1.2 Nameplates

Secure a plate to each major component of equipment containing the

manufacturer's name, address, type or style, model or serial number, and catalog number. Also, affix an ENERGY STAR label as applicable.

2.1.3 Equipment Guards

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 completely enclosed or guarded. High-temperature equipment and piping so located as to endanger personnel or create a fire hazard shall be guarded or covered with insulation of type specified for service.

2.2 ELECTRICAL WORK

Electrical motor driven equipment shall be provided complete with motors, motor starters, and controls. Motors shall conform to NEMA MG 1. Electrical equipment and wiring shall be in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electrical characteristics shall be as specified or indicated. Integral size motors shall be premium efficiency type in accordance with NEMA MG 1. 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.

2.3 HEATERS

Heaters shall be equipped for and adjusted to burn natural gas. Each heater shall be provided with a gas pressure regulator that will satisfactorily limit the main gas burner supply pressure. Heaters shall have an intermittent or interrupted electrically ignited pilot or a direct electric ignition system. Safety controls shall conform to the ANSI standard specified for each heater. Mounting brackets and hardware shall be furnished by the heater manufacturer and shall be factory finished to match the supported equipment. Seismic details shall be as indicated.

2.3.1 Direct Fired Make-Up Air Heaters

Heaters shall be in accordance with ANSI Z83.4/CSA 3.7. Direct fired make-up air heaters use outside air directly ducted to the heater. The products of combustion generated by the heater are released into the outside air stream being heated. Heaters shall be equipped with motorized inlet and outlet dampers, duct collar, air filters, and bird screen. Gas control valve shall be modulating type. Maximum air temperature rise during minimum burner fire shall be 7 degrees F. Fan shall be variable speed. Outdoor heaters shall be weatherized and shall have manufacturer's standard exterior finish for outdoor units. Motorized inlet and outlet dampers shall be closed when the unit is shut down. Dampers shall be interlocked to prevent burner operation when dampers are closed. Heaters shall be provided with a thermostat, a low limit air stream thermostat, and an ambient air thermostat. The thermostat shall control the gas control valve. The low limit air stream thermostat shall shut down the entire unit if the discharge air temperature drops below the thermostat setting. The ambient air thermostat shall shut down the burner if the outside air exceeds the thermostat setting.

2.3.2 Indirect Fired Make-Up Heaters

Heaters shall be in accordance with ANSI and CSA Standards. Heaters shall be equipped with motorized inlet dampers, duct collar, and air filters. Gas control valve shall be modulating type. Maximum air temperature rise during minimum burner fire shall be 7 degrees F. Fan shall be two speed, with low speed approximately two-thirds of high speed. Motorized inlet dampers shall be closed when the unit is shut down. Dampers shall be interlocked to prevent burner operation when dampers are closed. Heaters shall be provided with a space thermostat, a low limit air stream thermostat, and an ambient air thermostat. The space thermostat shall control the modulating gas control valve. The low limit air stream thermostat shall shut down the entire unit if the discharge air temperature drops below the space thermostat setting. The ambient air thermostat shall shut down the burner if the outside air exceeds the space thermostat setting.

2.3.3 Unit Heaters

Heaters shall conform to requirements of ANSI Z83.8/CSA 2.6. Heat exchangers shall be aluminized steel or stainless steel. Air discharge section shall be equipped with adjustable horizontal louvers. Fan shafts shall be either directly connected to the driving motor, or indirectly connected by multiple V-belt drive. Fans in one unit shall be of the same size. Heaters shall be power-vented type, suitable for sidewall vent discharge and single-wall-thickness vent piping. Heaters shall have automatic ignition. Heaters shall employ metered combustion air with enclosed draft diverter (no open flue collar). Heaters shall be provided with a space thermostat which controls both unit's fan and burner.

2.3.4 Wall Furnace

Wall furnace shall be the gravity type in accordance with ANSI Z21.86/CSA 2.32 and as indicated. Furnace shall be provided with a space thermostat which controls both the unit's fan and burner.

2.3.5 Duct Furnace

Duct furnace shall be in accordance with ANSI Z83.8/CSA 2.6. Furnace shall be power-vented type, suitable for sidewall vent discharge and single wall thickness vent piping. Furnace shall have automatic ignition. Furnace shall employ metered combustion air with enclosed draft diverter (no open flue collar). Furnace heat exchangers shall be aluminized steel or stainless steel. Furnace shall have minimum steady state thermal efficiency of 80 percent at maximum rated capacity and 75 percent at minimum rated capacity that is provided and allowed by the controls. Furnace shall be provided with a thermostat which controls the unit's burner.

2.3.6 Infrared Heaters

Heaters shall conform to the requirements of ANSI Z83.19/CSA 2.35 and shall be vented or unvented type. Heater style shall be surface combustion type. Reflector shape shall be parabolic or standard. Heaters shall be provided with space thermostats which control the unit's burner. Thermostats located in the direct radiation pattern shall be covered with a metal shield.

2.4 THERMOSTATS

Thermostats shall be the adjustable electric or electronic type. Control wiring required to complete the space temperature control system shall be included. Thermostats shall have a 3 degree F differential and a set point range of 0 to 100 degrees F. Thermostats shall be the single stage type.

2.5 VENT PIPING

Vent piping shall conform to the requirements of NFPA 54. Plastic material polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases.

2.6 ELECTRIC AUTOMATIC VENT DAMPERS

Electric automatic vent dampers shall conform to the requirements of ANSI Z21.66/CGA 6.14 and shall be provided in the vents of heaters using indoor air for combustion air.

2.7 INSULATION

Insulation for piping and equipment and application shall be in accordance with Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.8 FACTORY FINISHES

Equipment and component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming thoroughly 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.

3.2 INSTALLATION

install equipment as indicated and in accordance with the recommendations of the equipment manufacturer and the listing agency, except as otherwise specified.

3.2.1 Heating Equipment

Install heaters with clearance to combustibles, complying with minimum distances as determined by CSA Directory, UL FLAMMABLE & COMBUSTIBLE and as indicated on each heater approval and listing plate. Support heaters independently from the building structure, as indicated, but not relying on suspended ceiling systems for support.

3.2.2 Vents

Locate vent dampers, piping and structural penetrations as indicated. Vent damper installation shall conform to ANSI Z21.66/CGA 6.14. Vent pipes, where not connected to a masonry chimney conforming to NFPA 211, shall extend through the roof or an outside wall and shall terminate, in compliance with NFPA 54. Vents passing through waterproof membranes shall

be provided with the necessary flashings to obtain waterproof installations.

3.2.3 Gas Piping

Connect gas piping as indicated.

3.3 TRAINING

Conduct a training course for the maintenance and operating staff. The training period of 4 hours normal working time shall start after the system is functionally complete but before the final acceptance tests. Give the Contracting Officer at least two weeks advance notice of such training. The training shall include all of the items contained in the approved operation and maintenance instructions as well as demonstrations of routine maintenance operations. Submit 6 complete copies of operating instructions outlining the step-by-step procedures required for system startup, operation and shutdown. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and basic operating features. Submit 6 complete copies of maintenance instructions listing routine maintenance, possible breakdowns, repairs and troubleshooting guide. The instructions shall include simplified piping, wiring, and control diagrams for the system as installed.

3.4 TESTING, ADJUSTING, AND BALANCING

Perform testing, adjusting, and balancing as specified in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS. Submit test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

-- End of Section --

SECTION 23 82 19.00 40

FAN COIL UNITS
05/17

PART 1 GENERAL

Section 23 30 00 HVAC AIR DISTRIBUTION applies to work specified in this section.

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 S12.23	(1989; R 2016) Method for the Designation of Sound Power Emitted by Machinery and Equipment

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 440	(2008) Performance Rating of Room Fan-Coils

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 1940-1	(2003; R 2008) Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerances

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 90A	(2021) Standard for the Installation of Air Conditioning and Ventilating Systems

U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-810	(2019; Rev H) Environmental Engineering Considerations and Laboratory Tests

UNDERWRITERS LABORATORIES (UL)

UL 1995	(2015) UL Standard for Safety Heating and Cooling Equipment
UL Bld Mat Dir	(updated continuously online) Building Materials Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. When used, a code following the "G" classification 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

Fabrication Drawings; G,

Installation Drawings; G

SD-03 Product Data

Equipment and Performance Data; G

Coils; G

Casing; G

Enclosure; G

Motors; G

Fan; G

Drain Pans; G

Filters; G

Controls; G

Vibration Isolation; G

SD-04 Samples

Manufacturer's Standard Color Chart; G

SD-07 Certificates

List of Product Installations

Certificates of Conformance

SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals

SD-11 Closeout Submittals

Warranty

1.3 QUALITY ASSURANCE

Submit a list of product installations for fan coil units showing a minimum of five installed units, similar to those proposed for use, that

have been in successful service for a minimum of 5 years. Include the name of the purchaser, address of installation, name of service organization, and date of installation.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

Include an enclosure for cabinet models and a casing for concealed models.

Provide a base unit complete with galvanized casing, a water coil assembly with an auxiliary water or steam heating-coil, valve and piping package, drain pans, air filter, fan motor, and motor control. Ensure that the sound power level, as measured in decibels at 10 to the minus 12 watt at the fan operating speed selected to meet the specified capacity, does not exceed the following values at the midfrequency of each octave band:

OCTAVE BANDS					
	3rd	4th	5th	6th	7th
Frequency (hertz)	250	500	1,000	2,000	4,000
Power Level (decibels)	60	55	53	50	48

Obtain values for sound power level for these units in accordance with the test procedures specified in ASA S12.23. Sound power values apply to units provided with factory-fabricated cabinet enclosures and standard grilles. Values obtained for the standard cabinet models are acceptable for concealed models without the need for separate tests, provided there is no variation between models as to the coil configuration, blowers, motor speeds, and relative arrangement of parts. Fasten each unit securely to the building structure. Ensure that the capacity of the units is as indicated. Ensure that room fan coil units are certified as complying with AHRI 440 and meet the requirements of UL 1995.

2.2 COMPONENTS

Provide a list of material and equipment including the manufacturer's style or catalog numbers, specification and drawing reference numbers, and warranty information.

Submit fabrication drawings for fan coil units including the fabrication and assembly details performed in the factory.

Submit equipment and performance data for fan coil units including information on the service life, system functional flows, safety features, and mechanical automated details. Also submit curves indicating that the equipment response and performance characteristics, including vibration isolation have been tested and certified. Submit certificates of conformance for the following:

a. Enclosure

b. Casing

c. Fan

d. Coils

e. Drain Pans

f. Filters

g. Motors

h. Controls

Submit product data for vibration isolation components.

Submit the manufacturer's standard color chart, indicating the manufacturer's standard color selections and finishes for fan coil units.

2.2.1 Enclosure

Construct an enclosure of 18-gage or heavier steel, properly reinforced and braced. Ensure that the front panel of the enclosure is removable. Ensure that discharge louvers are four-way adjustable and are designed to properly distribute air throughout the conditioned space. Ensure that ferrous surfaces are galvanized or treated with a rust-inhibiting finish. Ensure that exposed enclosure corners and edges are rounded. Ensure that discharge louvers are mounted in a top panel that can be removed to allow for coil cleaning. Ensure that access doors are hinged and provided for all piping and control compartments. Ensure that the finish is in the manufacturer's standard color, as selected by the Contracting Officer.

2.2.2 Casing

Ensure that the interior of the casing is acoustically and thermally insulated with insulation that is not less than 1/2-inch thick, that conforms to NFPA 90A, and that is fastened with waterproof and fire-resistant adhesive.

2.2.3 Fan

Provide a centrifugal fan made of galvanized steel or aluminum, with blades. In lieu of metal, fabricate or mold the wheels and scrolls from reinforced nonmetallic compounds certified to have passed the low-temperature, high-temperature, temperature-shock, and sand and dust tests for ground equipment, as outlined in MIL-STD-810. Ensure that the fan passes tests without showing characteristics that indicate deformation, cracking, corrosion, or loss of balance. Ensure that surfaces are smooth, that assemblies are accessible for maintenance, and that disassembly and reassembly are done by mechanical fastening devices, not adhesives. After the fan is assembled in the unit, ensure that the fan was dynamically and statically balanced to ISO 1940-1 standards at the factory.

2.2.4 Coils

Ensure that the water coil was constructed with not less than 1/2-inch outside diameter (OD) seamless copper tubing with copper or aluminum plate fins mechanically bonded or soldered to the tubes. Ensure that the coil construction includes at least 5/8-inch OD female solder connectors, an accessory piping package with terminal connections for control valves, and manual air vents on returns. Make provisions for coil removal.

2.2.5 Drain Pans

Size and locate drain pans to collect condensed water dripping from any item within the unit enclosure. Do not construct drain pans of galvanized steel that is lighter than 20-gage and thermally insulated to prevent condensation. Coat the thermal insulation with a waterproofing compound. Provide a copper drain connection in the drain pan that is no less than 3/4-inch National Pipe Thread (NPT) or 5/8-inch OD. Ensure that the drain pan slopes not less than 1/8-inch per foot to the drain.

2.2.6 Filters

For each unit, provide filters that are glass fiber throwaway or permanent and washable, with a 1 inch nominal thickness, in conformance with UL Bld Mat Dir. Ensure that filters can be removed without tools.

2.2.7 Motors

Provide permanent split-capacitor motors that are direct connected, two-bearing, and built-in overload protection, and that conform to NEMA MG 1. Mount motors on a resilient base. Furnish motors with three built-in speeds and with four insulated leads (common, high, medium, and low) that terminate in a control-junction box.

When specified, provide a solid-state variable speed controller capable of not less than 50 percent speed reduction in lieu of step speed control.

2.2.8 Controls

Provide a unit with factory-installed control valves furnished by the automatic temperature-control manufacturer.

Ensure that the motor speed-control switch provides for speed selection, has an off position, and is mounted for convenient use from an access door.

PART 3 EXECUTION

3.1 INSTALLATION

Install equipment in accordance with the manufacturer's recommendations. Set the dampers in a fixed position to provide outside air in the quantity scheduled.

Submit installation drawings for fan coil systems in accordance with referenced standards in this section.

Contain thermal and acoustical insulation within a double-walled enclosure or seal the insulation with a moistureproof coating impervious.

Install the controls in a unit-mounted control panel. Provide remote-mounted controllers where indicated.

3.2 FIELD QUALITY CONTROL

Hydrostatically the test coils at 250 pounds per square inch (psi) or under water at 250 psi air pressure. Ensure that the coils are suitable for 200 psi working pressure.

3.3 CLOSEOUT ACTIVITIES

Submit six copies of the operation and maintenance manuals at least 30 calendar days before the fan coil units are tested. Update and resubmit data for final approval no later than 30 calendar days before contract completion.

Submit the manufacturer's standard warranty to the Contracting Officer.

-- End of Section --

SECTION 25 05 11.01

CYBERSECURITY FOR UTILITY MONITORING CONTROL SYSTEMS (UMCS)
05/21

PART 1 GENERAL

This section includes requirements in support of the DOD Risk Management Framework (RMF) for implementing cybersecurity. For requirements on incorporating cybersecurity into control system design and for general information on the RMF process as it applies to control systems, refer to UFC 4-010-06 Cybersecurity for Facility–Related Control Systems, DODI 8510.01 Risk Management Framework for DoD Information Technology, and DODI 8500.01 Cybersecurity.

Many subparts in this Section contain text in curly braces ("{" and "}") indicating which cybersecurity control and control correlation identifier (CCI) the requirements of the subpart relate to. The text inside these curly braces is for Government reference only and enables coordination of the requirements of this Section with the RMF process throughout the design and construction process. Text in curly braces are not contractor requirements.

This Section refers to Security Requirements Guide (SRGs) and Security Technical Implementation Guide (STIGs). STIGs and SRGs are available online at the Information Assurance Support Environment (IASE) website at https://public.cyber.mil/stigs/downloads/ and an SRG/STIG Applicability Guide and Collection Tool is available at https://public.cyber.mil/stigs/SCAP/. Not all control system components have applicable STIGs or SRGs. The "Control Systems SRG" does not apply to work performed under this Section; all requirements within this section to apply applicable SRGs DO NOT include the "Control Systems SRG".

This specification is intended to address cybersecurity during construction. The Contractor WILL NOT be providing new UMCS components except for new field devices (e.g. sensors, actuators, etc.). The Contractor will reconfigure and reprogram existing controllers and associated devices. The Contractor will integrate all new work into the existing installation-wide front-end system for the control system(s) covered by this Section.

1.1 CONTROL SYSTEM APPLICABILITY

This specific Section applies only to the following control systems: UTILITY MONITORING CONTROL SYSTEMS which includes the following subsystem(s).

a. HEATING VENTILATION AND AIR CONDITIONING (HVAC) - e.g. DDC

1.1.1 CONTROL SYSTEM IMPACT RATINGS

The cybersecurity Confidentiality-Integrity-Availability (C-I-A) impact

ratings for the control system(s) covered by this Section have been determined to be LOW-LOW-LOW (L-L-L) or LOW when referenced in this document.

1.1.2 INTEGRATION WITH EXISTING CONTROL SYSTEM

Existing UMCS equipment will be reused as well as the DDC within the Child Development Center. The Contractor will configure the existing front-end system (e.g. graphics, tags, alarms, trends, reports, etc.) and integrate new work related to this Section as needed to match the conventions and functionality (e.g. monitoring, control) of the existing production environment system.

1.1.3 FRONT-END AND NETWORKING CYBERSECURITY CONTROLS

The existing control system(s) addressed by this Section do not have an Authority To Operate (ATO) per DODI 8510.01. The Contractor will configure front-end and networking cybersecurity controls to match the existing production environment system unless otherwise noted in these contract documents.

1.1.4 INTEGRATION COORDINATION WITH ONSITE MAINTENANCE STAFF

The Contractor will obtain a copy of the existing Child Development Center (CDC) JACE controller configuration and programming. The Contractor will make modifications to the configuration and programming offline (using Contractor equipment) until ready for deployment back to the production environment (i.e. CDC JACE controller). The Contractor will then deploy the new configuration and programming back to the production environment with up to twenty-four (24) hours of assistance from the Systems Integrator (i.e. Spectrum) that maintains the JACE controller and the associated base-wide computer front-end human machine interface. The Contractor will perform all startup tasks (e.g. adjustments, testing, etc.) to meet the requirements of the Contract Documents. After the Contractor has deployed and successfully tested the new configuration and programming, Spectrum may, at their discretion, opt to test the monitoring and control features of the newly deployed configuration and programming.

1.2 RELATED REQUIREMENTS

This section does not contain sufficient requirements to procure a control system and must be used in conjunction with other Sections which specify control systems. This Section adds cybersecurity requirements to the control systems specified in other Sections, and as these requirements are conditioned on the control system being provided, there may be requirements in this Section that will not apply to this project. All Sections containing facility-related control systems or control system components are related to the requirements of this Section. Review all specification sections to determine related requirements.

In cases where a requirement is specified in both this Section and in another Section, the more stringent requirement must be met. In cases where a requirement in this Section conflicts with the requirements of another Section such that both requirements cannot be met at the same time, request direction from the Contracting Officer Representative to determine which requirement applies to the project.

1.2.1 Cybersecurity Requirements

Implement cybersecurity in accordance with the following standards, guidelines, and instructions:

a. UFC 4-010-06 Cybersecurity of Facility–Related Control Systems.

b. DODI 8510.01 Risk Management Framework (RMF) for DoD Information Technology (IT)

c. DODI 8500.01 Cybersecurity

d. ECB 2020-10 Facility-Related Control System Cybersecurity Coordination Requirement

e. ECB 2022-2 Cybersecurity Requirements For Design And Construction Of Control Systems And Integrated Low Voltage Systems For Permanent And Non-Permanent Construction

The Government is responsible for obtaining an Authority To Operate (ATO). The Contractor will support the Government with information needed to obtain the ATO.

1.2.2 Network Equipment

Not applicable. Existing network equipment will be used.

1.3 REFERENCES

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

CONSUMER ELECTRONICS ASSOCIATION (CEA)

CEA-709.1-D	(2014) Control Network Protocol Specification

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 802.1x	(2010) Local and Metropolitan Area Networks - Port Based Network Access Control

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST FIPS 140-2	(2001) Security Requirements for Cryptographic Modules

U.S. ARMY CORPS OF ENGINEERS (USACE)

ECB 2020-10	(2020) Facility-Related Control System Cybersecurity Coordination Requirement
ECB 2022-2	(2022) Cybersecurity Requirements For Design And Construction Of Control Systems And Integrated Low Voltage Systems For Permanent And Non-Permanent Construction

U.S. DEPARTMENT OF DEFENSE (DOD)

DODI 8500.01	(2014; Change 1-2019) Cybersecurity
DODI 8510.01	(2020; Change 1-2020) Risk Management Framework (RMF) for DoD Information Technology (IT)
DTM 08-060	(2008) Policy on Use of Department of Defense (DoD) Information Systems - Standard Consent Banner and User Agreement
UFC 4-010-06	(2016; with Change 1, 2017) Cybersecurity of Facility-Related Control Systems

1.4 DEFINITIONS

1.4.1 Administrator Account

An administrator account is an account with full permissions to a device, application, or operating system, including the ability to create and modify other user accounts.

Note that the operating system Administrator Account may be different than Administrator Accounts for applications hosted on that operating system. Also, most controllers will not have any support for accounts and will therefore not have an 'Administrator Account'.

1.4.2 Computer

A computer is one of the following:

a. a device running a non-embedded desktop or server version of Microsoft Windows

b. a device running a non-embedded version of MacOS

c. a device running a non-embedded version of Linux

d. a device running a version or derivative of the Android Operating System, where Android is considered separate from Linux

e. a device running a version of Apple iOS

Unless otherwise indicated or clear from context use of the word "device" in this Section includes computers.

1.4.3 Controller

A device other than a computer or Ethernet switch.

1.4.4 Mission Space

A device or media is in mission space if physical access to the device or media is controlled by the organization served by the device. For example, a VAV box controller in a suspended ceiling is in mission space if the VAV box serves that room; an electrical switchgear in an electrical room or an AHU in a mechanical room or on a rooftop may still be

considered to be in mission space if the organization (mission) served by that switchgear or AHU controls access to the electrical room, mechanical room or rooftop.

1.4.5 Network

A network is a group of two or more devices that can communicate using a network protocol. Network protocols must provide a method for addressing devices on the network; a communication method that does not provide an addressing scheme is not a networked form of communication. Devices that communicate using a method of communication that does not support device addressing are not using a network.

1.4.6 Network Connected

A component is network connected (or "connected to a network") only when the device has a network transceiver which is directly connected to the network and implements the network protocol. A device lacking a network transceiver (and accompanying protocol implementation) can never be considered network connected. Note that (unlike many IT definitions of "Network Connected") a device connected to a non-IP network is still considered network connected (an IP connection or IP address is not required for a device to be network connected).

1.4.6.1 Wireless Network Connected

Any device that supports wireless network communication is network connected to a wireless network, regardless of whether the device is communicating using wireless. Unless physically disabled, devices with wireless transceivers support wireless, it is not sufficient to disable the wireless in software.

1.4.7 Network Media

The thing that provides the communication channel between the devices on a network. Typically wire, but might include wireless, fiber optic, or even power line (some network protocols allow sending network signals over power wiring).

1.4.8 User Account Support Levels

The support for user accounts is categorized in this Section as one of three levels:

1.4.8.1 FULLY Supported

Device supports configurable individual accounts. Accounts can be created, deleted, modified, etc. Privileges can be assigned to accounts. These devices support user-based (as opposed to role-based) authentication.

1.4.8.2 MINIMALLY Supported

Device supports a small, fixed number of accounts (perhaps only one). Accounts cannot be modified. A device with only a "User" and an "Administrator" account would fit this category. Similarly, a device with two PINs for logon - one for restricted and one for unrestricted rights would fit here (in other words, the accounts do not have to be the traditional "username and password" structure). These devices typically only support role-based authentication.

Examples of devices which MINIMALLY support accounts are a) a variable frequency drive with a single account which requires a PIN for access to configuration; and b) a room lighting control touchpad interface that has a single account.

1.4.8.3 NOT Supported

Device does not support any Access Enforcement therefore the whole concept of "account" is meaningless.

1.4.9 Manual Local Input

Manual Local Inputs are system analog or binary inputs that are adjustable by a person but are, by intrinsic hardware design, very limited in potential capabilities. Manual Local Inputs do not have touch screens or full keyboards, but may have a few buttons or dials to allow input. Manual Local Inputs do not have full graphic screens or dot-matrix displays, but may have simple lights (LEDs) or 7-segment displays. Manual Local Inputs do not have any sort of menu structure, each button has a single well-defined function.

Examples of Manual Local Inputs are H-O-A switches, simple thermostats, and disconnect switches.

1.4.10 Card Reader

A card reader is an input/output device whose primary function is to assist in two-factor authentication. A card reader must have an interface to read data from a card and may be able to write data to a card. A card reader may have a means (such as buttons, keypad, touchscreen, etc.) for a user to input a PIN or password, as well as a limited display.

1.4.11 User Interface

A User Interface (UI) is something other than a Manual Local Input or Card Reader that allows a person to interact with the system or device. Note that while a Card Reader is not by itself a User Interface, a User Interface may contain a Card Reader in order for it to authenticate its user. Within control systems, there are a wide range of User Interfaces.

Two important distinctions are 1) whether the user interface is Local or Remote, and 2) the effective capabilities of the User Interface to alter data, which is the "privilege" of the user interface (where effective privilege available to a specific user at a specific user interface is the combination of the greatest privilege offered by the user interface and the specific account the user is logged into).

1.4.11.1 Local User Interface

A Local User Interface is a user interface where the physical hardware the user interacts with (keyboard, buttons, display, etc.) is physically part of the device being affected. All of the relevant characteristics of the user interface are embodied within a single device.

Note that a Local UI may be able to access data in a different device, Local versus Remote in this context refers to the user interface itself; the capability to access data in a different device is covered under "Full User Interface".

1.4.11.2 Remote User Interface

A Remote User Interface implements a Client/Server model where the physical hardware the user interacts with (Client) is physically distinct from the device being affected (Server). Most or all of the security and functionality characteristics of the user interface are defined by the Server, not the Client. The Client and Server communicate via a network connection. A common example of a remote user interface is a web-based interface where the browser (client) is generally on different hardware than the web server (server). A Remote UI remains a Remote UI even if the user happens to be at a Client on the same hardware as the Server. What is important is that a) the Client may be on different hardware than the Server and b) the majority of the security and functional characteristics of the interface are defined at the Server.

Note that this definition of "remote" is consistent with that generally used in the control industry but is not aligned with the NIST 800-53 definition of "Remote", which refers to "outside the system". The term "Remote" here better aligns with the NIST 800-53 definition of "Network" (remote from within the system) Access.

1.4.11.3 Types of User Interface (by capability)

User interfaces are also categorized by their capabilities as being Read Only, Limited, or Full.

1.4.11.3.1 Read-Only User Interface

A Read Only User Interface (also referred to as a View-Only User Interface) is a user interface that only allows for reading data, it does not allow (have the capability to) modify data. A Read Only User Interface may be either Local or Remote. A User Interface that is configured to be Read Only (by some other means than the interface itself, such as using configuration software on a laptop) is a Read-Only Interface. Note a Read Only User Interface may have buttons (or touch screen, etc.) allowing the user to navigate through the presentation of data.

Examples of a Read Only User Interfaces are a) a publicly viewable "energy dashboard" showing weather data and energy usage within a building and b) digital wayfinding signage.

1.4.11.3.2 Limited User Interface

A Limited User Interface is a user interface that - by design - can only alter information local to the user interface. Note that the determination of "alter" includes only direct interactions, it explicitly excludes interactions that might occur as secondary effects. For example, an interface changing the flow setpoint in a pump controller is a direct interaction, the subsequent change in flow (as well as any subsequent downstream changes in valve position) are not direct interactions.

Two examples of LIMITED UIs are: a) a variable speed drive has a Limited Local User Interface which allows the user to change properties within the drive, but does not allow affecting things outside the drive; and b) a typical home WiFi Router has a Limited Remote User Interface which allows configuration of the Router, but does not allow direct interaction with other devices.

1.4.11.3.3 Full User Interface

A Full User Interface can alter information in devices outside the device with the user interface. For example, a typical Local Display Panel is a Full Local User Interface while a browser-based front end is a Full Remote User Interface.

1.4.11.3.4 View-Only User Interface

See Read-Only User Interface

1.4.11.4 Other User Interface Terminology

In addition to defining whether a user interface is a Hardware Limited, Read-Only, Limited or Full, and whether it is Local or Remote, user interfaces are classified by whether they are writable or privileged.

1.4.11.4.1 Writable User Interface

Any User Interface that is not Read-Only is Writable. (Limited User Interfaces and Full User Interfaces are both writable user interfaces (as they are capable of changing a value)).

1.4.11.4.2 Privileged User Interface

A Privileged UI is a UI that has sufficient capabilities or functionality that it requires specific cybersecurity measures to be put in place to limit its unauthorized use. Ultimately, whether a specific user interface is considered a Privileged User Interface must be determined by usage. Unless otherwise specified, user interfaces can be determined to be privileged or not using the following:

a. Read-Only User Interfaces are not privileged user interfaces.

b. Full User Interfaces are privileged user interfaces.

c. User interfaces that allow for configuration of auditing or allows for modification or deletion of audit logs are privileged user interface.

d. User interfaces that allow for reprogramming a network connected device is a privileged user interface.

e. Except as specified above, a Limited User Interface must be determined to be privileged or not based on the specific capabilities and use case of the user interface. In general however, user interfaces that do not offer significant capabilities above and beyond those available at that location via other means (e.g. such as a disconnect switch, breaker, or hand-off-auto switch, or physical attack) are not privileged.

1.4.12 Wireless Network

Any network that communicates without using wires or fiber optics as the communication media. Wireless networks include: WiFi, Bluetooth, ZigBee, cellular, satellite, 900 MHz radio, 2.4 GHz, free space optical, point-to-point laser, and IR.

1.4.13 Wired Broadcast Network

Wired Broadcast Networks are any network, such as powerline carrier networks and modem (wired telephony), that use wire-based technologies where there is not a clearly defined boundary for signal propagation.

1.4.14 C-I-A Impact Level

A reference to the security objectives of Confidentiality (C), Integrity (I), Availability (A) associated with a control system. These values are determined by the System Owner (SO) in conjunction with the Authorizing Official (AO). The potential impact levels for each security objective are LOW (L), MODERATE (M), and HIGH (H); note that these ratings are not for this control system. Refer to other areas of this Section for actual impact ratings for this control system. The determination of control system impact levels is a requirement of UFC 4-010-06.

1.5 ADMINISTRATIVE REQUIREMENTS

1.5.1 Points of Contact

Coordinate with the following Points of Contact as indicated in this Section and as required. Not all projects will require coordination with all Points of Contact. When coordination is required and no Point of Contact is indicated, coordinate with The Contracting Office Representative (COR).

a. Government Computer Access Point of Contact: The Contracting Office Representative (COR)

b. HTTPS Certificate Point of Contact: The Contracting Office Representative (COR)

c. Email Address Point of Contact: The Contracting Office Representative (COR)

d. Password Point of Contact: The Contracting Office Representative (COR)

e. Mobile Code Point of Contact: The Contracting Office Representative (COR)

f. PKI Infrastructure Point of Contact: The Contracting Office Representative (COR)

1.5.2 Coordination

Coordinate the execution of this Section with the execution of all other Sections related to control systems as indicated in the paragraph RELATED REQUIREMENTS. Items that must be considered when coordinating project efforts include but are not limited to:

a. If requesting permission for wireless or wired broadcast communication, the Wireless and Wired Broadcast Communication Request submittal must be approved prior to control system device selection and installation.

b. If requesting permission for alternate account lock permissions, the Device Account Lock Exception Request must be approved prior to

control system device selection and installation.

c. If requesting permission for the use of a device with multiple physical connections to IP networks, the Multiple IP Connection Device Request must be approved prior to control system device selection and installation.

d. Wireless testing may be required as part of the control system testing. See requirements for the Wireless Communication Test Report submittal.

e. If the Device Audit Record Upload Software is to be installed on a computer not being provided as part of the control system, coordination is required to identify the computer on which to install the software.

f. The Cybersecurity Interconnection Schedule must be coordinated with other work that will be interconnected to, and interconnections must be approved by the Government before relying on them for system functionality.

g. Cybersecurity testing support must be coordinated across control systems and with the Government cybersecurity testing schedule.

h. Passwords must be coordinated with the indicated contact for the project site.

i. If applicable, HTTPS web server certificates must be obtained from the indicated HTTPS Certificate Point of Contact.

j. Contractor Computer Cybersecurity Compliance Statements must be provided for each contractor using contractor owned computers.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. The approval authority for submittals marked "AE" is the Architect-Engineer. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Qualifications; G, AE

Wireless and Wired Broadcast Communication Request; G, AE

Device Account Lock Exception Request; G, AE

Multiple Ethernet Connection Device Request; G, AE

Contractor Computer Cybersecurity Compliance Statements; G, AE

Contractor Temporary Network Cybersecurity Compliance Statements; G, AE

Cybersecurity Interconnection Schedule; G, AE

Proposed STIG and SRG Applicability Report; G, AE

SD-02 Shop Drawings

Network Communication Report; G, AE

Cybersecurity Riser Diagram; G, AE

SD-03 Product Data

Control System Cybersecurity Documentation; G, AE

SD-06 Test Reports

Control System Cybersecurity Testing Procedures; G, AE

Control System Cybersecurity Testing Report; G, AE

SD-11 Closeout Submittals

Confidential Password Report; G, AE

Password Change Summary Report; G, AE

Enclosure Keys; G, AE

Software and Configuration Backups; G, AE

STIG, SRG and Vendor Guide Compliance Result Report; G, AE

Control System Inventory Report; G, AE

1.7 QUALITY CONTROL

1.7.1 Qualifications

Control System Cybersecurity Subject Matter Expert and Computing Environment and Network Personnel can serve across the contract.

1.7.1.1 Control System Cybersecurity Subject Matter Expert

The individual will oversee all work within this specification. This position requires that the individual currently meets Information Assurance Manager Level II Certification in accordance with DoDI 8140 Information Workforce Improvement Program.

Individuals for this position should have experience securing DOD systems and with Risk Management Framework. Control System Experience is highly desirable.

Resumes should be submitted to the Government within 14 days after notice to proceed. All certifications to include computing environment must be in effect prior to beginning work.

1.7.1.2 Computing Environment (System Administrator) and Networking Personnel

Not applicable for the control system covered by this Section on this

project.

1.8 CYBERSECURITY DOCUMENTATION

{For Government Reference Only: This subpart (and its subparts) relates to PL-7; CCI-003071}

1.8.1 Proposed STIG and SRG Applicability Report

For each model of network connected or network infrastructure device, use the DISA SRG/STIG Applicability Guide and Collection Tool (available at https://public.cyber.mil/stigs/SCAP/to identify applicable STIGs or SRGs and provide a report indicating applicable STIGs and SRGs for each model.

1.8.2 Cybersecurity Interconnection Schedule

{For Government Reference Only: This subpart relates to CA-3(b), PL-8, SC-7(9), SC-7(11); CCI-000258, CCI-003072, CCI-003073, CCI-003075, CCI-002398, CCI-002399, CCI-002401, CCI-002402, CCI-002403.}

Provide a completed Cybersecurity Interconnection Schedule documenting network connections between the installed system and other systems. Provide the following information for each device directly communicating between systems: Device Identifier, Device Description, Transport layer Protocol, Network Address, Port (if applicable), MAC (Layer 2) address (if applicable), Media, Application Protocol, Service (if applicable), Descriptive Purpose of communication. For communication with other authorized systems also provide the Foreign Destination and POC for Destination. If other control system Sections used on this project include submittals documenting this information, provide copies of those submittals to meet this requirement.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Cybersecurity Interconnection Schedule as an editable Microsoft Excel file (a template Cybersecurity Interconnection Schedule in Excel format is available at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1

1.8.3 Network Communication Report

{For Government Reference Only: This subpart (and its subparts) relates to CA-9, PL-8; CCI-003075; CCI-002102, CCI-002103, CCI-002104, CCI-002105, CCI-003072, CCI-003073, CCI-003075 and also the submittal requirements associated with CM-6, CM-7, SC-8 and SC-41 including CM-7(3), CCI-000388.}

Provide a network communication report. For each networked device, document the communication characteristics of the device including communication protocols, services used, encryption employed, and a general description of what information is communicated over the network. For each device using IP, document all TCP and UDP ports used. For non-IP communications, document communication protocol and media used. If other control system Sections used on this project include submittals documenting this information, provide copies of those submittals to meet this requirement.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Network Communication Report as an editable Microsoft Excel file.

1.8.4 Control System Inventory Report

{For Government Reference Only: This subpart (and its subparts) relates to CM-8(a), SI-17, IA-3; CCI-000389, CCI-000392, CCI-000398, CCI-002773, CCI-002774, CCI-002775, CCI-000777, CCI-000778, CCI-001958}

Provide a Control System Inventory report using the Inventory Spreadsheet listed under this Section at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 documenting all devices, including networked devices, network infrastructure devices, non-networked devices, input devices (e.g. sensors) and output devices (e.g. actuators). For each device provide all applicable information for which there is a field on the spreadsheet in accordance with the instructions on the spreadsheet.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Control System Inventory Report as an editable Microsoft Excel file.

1.8.5 Software and Configuration Backups

{For Government Reference Only: This subpart (and its subparts) relates to CP-10; CCI-000550, CCI-000551, CCI-000552}

For each programmable control system device, provide a recovery image or complete downloadable configuration of the final as-built device. This image must allow for the firmware compatible restoration of the image sufficient to restore system operation to the imaged state.

If any or all of these are provided under another Section, provide documentation indicating this and referencing those submittals.

1.8.6 Cybersecurity Riser Diagram

{For Government Reference Only: This subpart (and its subparts) relates to PL-2(a), PL-8; CCI-003051, CCI-003053, CCI-003072, CCI-003073, CCI-003075}

Provide a cybersecurity riser diagram of the complete control system including all network and device hardware. If the control system specifications require a riser diagram submittal, provide a copy of that submittal as the cybersecurity riser diagram. Otherwise, provide a riser diagram in one-line format.

1.8.7 STIG, SRG and Vendor Guide Compliance Result Report

For every component (device or software) with an applicable STIG or SRG in the Proposed STIG and SRG Applicability Report, provide a result report documenting compliance with the STIG or SRG requirements. For components which are scannable by the SCAP (security content automation protocol) tool (available online at https://public.cyber.mil/stigs/scap), provide the SCAP report and raw scan results.

For every component (device or software) with manufacturer provided cybersecurity documentation, procedure, or method for secure configuration or installation, provide a report documenting how the component was configured and any deviation from the manufacturer instructions.

1.8.8 Control System Cybersecurity Documentation

{For Government Reference Only: This subpart (and its subparts) relates to SA-5 (a),(b),(c); CCIs: CCI-003124, CCI-003125, CCI-003126, CCI-003127, CCI-003128, CCI-003129, CCI-003130, CCI-003131}

Provide a Control System Cybersecurity Documentation submittal containing the indicated information for each device and software application.

1.8.8.1 For HVAC Control System Devices

1.8.8.1.1 HVAC Control System Devices FULLY Supporting User Accounts

For all HVAC Control System Devices which FULLY support user accounts, provide:

a. Documentation that describes secure configuration of the device {For Government Reference Only: relates to CCI-003124}

b. Documentation that describes secure operation of the device {For Government Reference Only: relates to CCI-003124}

c. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {For Government Reference Only: relates to CCI-003127}

d. Documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the device {For Government Reference Only: relates to CCI-003128}

e. Documentation that describes user-accessible security functions or mechanisms in the device and how to effectively use those security functions or mechanisms; or a specific indication that there are no user-accessible security functions or mechanisms in the device {For Government Reference Only: relates to CCI-003129}

f. Documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {For Government Reference Only: relates to CCI-003130}

1.8.8.1.2 All Other HVAC Control System Devices

For all HVAC Control System Devices which do not FULLY support user accounts, provide:

a. Documentation that describes secure configuration of the device; or a specific indication that there are no secure configuration steps that apply {For Government Reference Only: relates to CCI-003124}

b. Documentation that describes effective use and maintenance of security functions or mechanisms for the device; or a specific indication that there are no security functions or mechanisms in the device {For Government Reference Only: relates to CCI-003127}

c. For devices which include a user interface, documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {For Government Reference Only: relates to CCI-003130}

1.8.8.2 Default Requirements for Control System Devices

For control system devices where Control System Cybersecurity Documentation requirements are not otherwise indicated in this Section, provide:

a. Documentation that describes secure configuration of the device {For Government Reference Only: relates to CCI-003124}

b. Documentation that describes secure installation of the device {For Government Reference Only: relates to CCI-003125}

c. Documentation that describes secure operation of the device {For Government Reference Only: relates to CCI-003124}

d. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {For Government Reference Only: relates to CCI-003127}

e. Documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the device {For Government Reference Only: relates to CCI-003128}

f. Documentation that describes user-accessible security functions or mechanisms in the device and how to effectively use those security functions or mechanisms {For Government Reference Only: relates to CCI-003129}

g. Documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {For Government Reference Only: relates to CCI-003130}

h. Documentation that describes user responsibilities in maintaining the security of the device {For Government Reference Only: relates to CCI-003131}

1.9 CYBERSECURITY DURING CONSTRUCTION

{For Government Reference Only: This subpart (and its subparts) relates to AC-18, SA-3; CCI-000258}

In addition to the control system cybersecurity requirements indicated in this section, meet following requirement throughout the construction process.

1.9.1 Contractor Computer Equipment

Contractor owned computers may be used for construction. Contractor computers connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

1.9.1.1 Operating System

The operating system must be an operating system currently supported by the manufacturer of the operating system. The operating system must be current on security patches and operating system manufacturer required updates.

1.9.1.2 Anti-Malware Software

The computer must run anti-malware software from a reputable software manufacturer. Anti-malware software must be a version currently supported by the software manufacturer, must be current on all patches and updates, and must use the latest definitions file. Computers used on this project must be scanned using the installed software at least once per day.

1.9.1.3 Passwords and Passphrases

The passwords and passphrases for computers, applications, and web-based applications supporting passwords must be changed from their default values. Passwords must be a minimum of eight characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.9.1.4 User-Based Authentication

Each user must have a unique account; sharing of a single account between multiple users is prohibited.

1.9.1.5 Demonstration of Compliance

The Government has the right to require demonstration of computer compliance with these requirements at any time during the project.

1.9.1.6 Contractor Computer Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Computer Cybersecurity Compliance Statements for each company using contractor owned computers. Contractor Computer Cybersecurity Compliance Statements must use the template published at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 Each Statement must be signed by a cybersecurity representative for the relevant company.

1.9.2 Temporary IP Networks

Temporary contractor-installed IP networks may be used during construction. When used, temporary contractor-installed IP networks connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

1.9.2.1 Network Boundaries and Connections

The network must not extend outside the project site and must not connect to any IP network other than those specifically provided or furnished for this project. Any and all access to the network from outside the project site is prohibited. Unused network access ports are to be disabled via the management console or command line when not in use.

1.9.3 Government Access to Network

Government personnel must be allowed to have complete and immediate access to the network at any time in order to verify compliance with this specification.

1.9.4 Temporary Wireless IP Networks

In addition to the other requirements on temporary IP networks, temporary wireless IP (WiFi) networks, when permitted, must not interfere with existing wireless networks, must use WPA2 security and must not broadcast the network name (SSID). Network names (SSID) for wireless networks must be changed from their default values.

1.9.5 Passwords and Passphrases

The passwords and passphrases for all network devices and network access must be changed from their default values. Passwords must be a minimum 8 characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.9.6 Contractor Temporary Network Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Temporary Network Cybersecurity Compliance Statements for each company implementing a temporary IP network. Contractor Temporary Network Cybersecurity Compliance Statements must use the template published at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 Each Statement must be signed by a cybersecurity representative for the relevant company. If no temporary IP networks will be used, provide a single copy of the Statement indicating this.

1.10 CYBERSECURITY DURING WARRANTY PERIOD

All work performed on the control system after acceptance must be performed using Government Furnished Equipment or equipment specifically and individually approved by the Government.

PART 2 PRODUCTS

Existing equipment will be reused.

PART 3 EXECUTION

3.1 CYBERSECURITY HARDENING AND CONFIGURATION GUIDES

Install, configure, and harden all hardware and software furnished on this project in accordance with manufacturer provided documentation, procedures, or methods for secure configuration or installation. Do not implement specific hardening actions if that action would conflict with required functionality or another requirement of this Section.

3.2 NETWORK REQUIREMENTS

3.2.1 Wireless and Wired Broadcast Communication

{For Government Reference Only: This subpart (and its subparts) relates to AC-18, AC-18(3); CCI-001438, CCI-001439, CCI-002323, CCI-001441, CCI-002252}

3.2.1.1 Wireless and Wired Broadcast IP Communications

Wireless communication is not authorized for use for the control system

covered by this Section.

Do not install wireless or wired broadcast IP networks, including: do not install a wireless access point; do not install or configure an ad-hoc wireless network; do not install or configure a WiFi Direct communication.

3.2.1.2 Non-IP Wireless Communication

Wireless communication is not authorized for use for the control system covered by this Section.

3.2.1.3 Wireless and Wired Broadcast Communication Request

Provide a report documenting the proposed use of wireless or wired broadcast communication prior to device selection using the Wireless and Wired Broadcast Communication Request Schedule at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 If there is no proposed use of wireless or wired broadcast communication, provide a document indicating this instead of the Request Schedule.

For each device proposed to use wireless or wired broadcast communication show: the device identifier, a description of the device, the location of the device, the device identifiers of other devices communicating with the device, the protocol used for communication, encryption type and strength. For wireless communication, also show: RF Frequency, Radiated Power in dBm (decibel with a milliwatt reference), free-space range, and the expected as-installed range.

3.2.2 Non-IP Control Networks

When control system specifications require particular communication protocols, use only those communication protocols and only as specified. Do not implement any other communication protocol.

When control system specifications do not indicate requirements for communication protocols, use only those protocols required for operation of the system as specified.

3.2.2.1 Allowable Non-IP Control Protocols

3.2.2.1.1 LonWorks

For device communications.

3.2.2.1.2 Protocols Currently In Use

Non-IP control protocols currently in use by the existing UMCS system are permitted.

3.2.2.1.3 Serial RS-232 and USB

For device configuration and troubleshooting only. These are allowable in a point-to-point configuration only.

3.2.3 IP Control Networks

{For Government Reference Only: This subpart relates to CM-6(a), CM-7(a), CM-7(b), CM-7(1)(b), SC-41; CCI-001588, CCI-000381, CCI-000380,

CCI-000381, CCI-000382, CCI-001761, CCI-001762, CCI-002544, CCI-002545, CCI-002546.}

3.2.3.1 Allowable IP Ports and Protocols

3.2.3.1.1 Protocols Currently In Use

IP control protocols currently in use by the existing UMCS system are permitted.

3.2.3.1.2 Unspecified Protocol Approval

When unspecified communications protocols are required for proper system operation submit to the Government for approval the protocol, port number if IP based, functional requirement, and cybersecurity conformance.

3.2.3.2 IP Network Routers

Do not install any device that performs IP routing.

3.2.3.3 IP Devices With Multiple Ethernet Connection

Except for Ethernet Switches and Daisy Chain IP Controllers, devices must not have more than one Ethernet connection to IP networks unless doing so is required by the project specifications and the specific application is approved. If a device with Multiple Ethernet Connections to IP networks is required, provide a Multiple Ethernet Connection Device Request using the Multiple Ethernet Connection Device Request Template at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 to request approval for each device. If a device with Multiple Ethernet Connections to IP networks is not required, instead provide a document stating that no approval is being requested.

3.2.4 Cryptographic Protection

{For Government Reference Only: This subpart relates to IA-2(9), IA-3(1), SC-8, SC-13, SC-23(1), SC-23(3); CCI-001942, CCI-001959, CCI-001967, CCI-002418, CCI-002449, CCI-002450, CCI-001185, CCI-001188, CCI-001664.}

For devices that have STIG/SRGs related to cryptographic protection (CCI-002450), comply with the requirements of those STIG/SRGs.

3.2.5 Device Identification and Authentication3.2.5.1 For HVAC Control System Devices

Devices using HTTP as a control protocol must use HTTPS instead. Devices using Ethernet must support IEEE 802.1x. Devices using LonWorks must support network security as specified in CEA-709.1-D.

3.2.5.2 Default Requirements for Control System Devices

For control system devices where Device Identification and Authentication requirements are not otherwise indicated in this Section: Devices using Ethernet must support IEEE 802.1x. Devices using HTTP as a control protocol must use HTTPS instead.

3.2.6 Cryptographic Module Authentication

{For Government Reference Only: This subpart (and its subparts) relates

to IA-7; CCI-000803}

For devices (including but not limited to NIST FIPS 140-2 compliant radios) that have STIG/SRGs related to cryptographic module authentication (CCI-000803), comply with the requirements of those STIG/SRGs.

3.3 ACCESS CONTROL REQUIREMENTS

3.3.1 User Accounts

{For Government Reference Only: This subpart (and its subparts) relate to AC-2(a), AC-3, AC-6(1), AC-6(10), AC-6(2), AC-6(9), CM-11(2), and IA-2; CCI-002110, CCI-000213, CCI-002235, CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-002235, CCI-000039, CCI-001419, CCI-002234, CCI-001812, and CCI-000764.}

Any user interface supporting user accounts (either FULLY or MINIMALLY) must limit access according to specified limitations for each account. Install and configure any device having a STIG or SRG in accordance with that STIG or SRG.

All user interfaces FULLY supporting accounts must implement user-based authentication where each account is uniquely assigned to a specific user. User interfaces FULLY supporting accounts must implement at least three (3) levels of user account privilege including: 1) an account with read-only permissions 2) an account with full permissions including account creation and modification and 3) an account with greater permissions than read-only but without account creation and modification.

3.3.1.1 Controllers

For user interfaces provided by controllers, provide access control in accordance with the User Interface Requirements table for the applicable control system and user interface type.

a. For table entries of "NA": NA means Not Applicable, there are no interfaces in this category.

b. For table entries of "None Required": The user interface is not required to support user accounts.

c. For table entries of "MINIMALLY": The user interface must at least MINIMALLY support user accounts.

d. For table entries of "FULLY": The user interface must at FULLY support user accounts.

e. For table entries of "KEY": The user interface must have physical security in the form of either a key lock on the interface itself or be furnished inside a locked enclosure. Where this is required for a read only interface, this lock must prevent viewing of data on the interface; for other interfaces, this lock must prevent using the interface to alter data.

f. For table entries of "Physical Security": For Local FULL interfaces, the interface must be located inside mission space. For Local Limited (not FULL) interfaces, the user interface must either a) be located

within mission space or b) be protected by physical security at least as good as the control devices (and equipment controlled by the control devices) affected by the interface. For purposes of this requirement, 'affected' includes controllers with data that can be directly altered by the interface, as well as mechanical and/or electrical equipment directly controlled by those controllers, but does not include other interactions.

g. Entries of the form "X and Y" must meet both the requirement indicated for X and the requirement indicated for Y. For example, an entry of "MINIMALLY and Physical Security" indicates the user interface must both MINIMALLY support accounts and have physical security.

h. Entries of the form "X or Y" must meet either the requirement indicated for X or the requirement indicated for Y.

3.3.1.1.1 HVAC Control Systems

User Interface Requirements for LOW Impact HVAC Control Systems	
User Interface Type	**Access Control Requirement**
Local Read Only (see note 1)	None Required
Local Limited, Non-privileged	MINIMALLY
Local Limited, Privileged	Physical Security
Local Full	MINIMALLY
Remote Read Only	None Required
Remote Limited, Non-Privileged	MINIMALLY
Remote Limited, Privileged AND Remote Full (see note 2)	FULLY
Notes: 1)Local Read Only User Interfaces are always Non-Privileged 2)Remote Full User Interfaces are always Privileged	

3.3.1.1.2 Default Requirements for Other Control Systems

For control system devices where User Interface Requirements are not otherwise indicated in this Section, use the Default User Interface Requirements tables.

Default User Interface Requirements for LOW Impact Control Systems	
User Interface Type	**Access Control Requirement**
Local Read Only (see note 1)	MINIMALLY

Default User Interface Requirements for LOW Impact Control Systems	
User Interface Type	**Access Control Requirement**
Local Limited, Non-privileged	MINIMALLY
Local Limited, Privileged	MINIMALLY
Local Full	FULLY
Remote Read Only	MINIMALLY
Remote Limited, Non-Privileged	MINIMALLY
Remote Limited, Privileged AND Remote Full (see note 2)	FULLY
Notes: 1)Local Read Only User Interfaces are always Non-Privileged 2)Remote Full User Interfaces are always Privileged	

3.3.2 Unsuccessful Logon Attempts

{For Government Reference Only: This subpart (and its subparts) relate to AC-7 (a), AC-7 (b); CCI-000043, CCI-000044, CCI-001423, CCI-002236, CCI-002237, CCI-002238}

Except for high availability user interfaces indicated as exempt, devices must meet the indicated requirements for handling unsuccessful logon attempts. If a device cannot meet these requirements, document device capabilities to protect from subsequent logon attempts and propose alternate protections in a Device Account Lock Exception Request submittal. Do not implement alternate protection measures in lieu of the indicated requirements without explicit permission from the Government. If no Device Account Lock Exceptions are requested, provide a document stating that no approval is being requested as the Device Account Lock Exception Request.

3.3.2.1 Devices MINIMALLY Supporting Accounts

For LOW Impact Systems: Devices which MINIMALLY (but not FULLY) support accounts must lock the user account after five consecutive failed login attempts and must unlock the user account after 15 minutes have elapsed without an unsuccessful login attempt or by a successful login to a separate administrator account.

3.3.2.2 Devices FULLY Supporting Accounts

Devices which FULLY support accounts must meet the following requirements.

a. It must lock the user account when three unsuccessful logon attempts occur within a 15 minute interval.

b. Once an account is locked, the account must stay locked until unlocked

by an administrator. If the account being locked is the sole administrator account on the device, the account must stay locked for 1 hour and then automatically unlock.

c. Once the indicated number of unsuccessful logon attempts occurs, delay further logon prompts by 5 seconds.

3.3.2.3 High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements

There are no high availability interfaces which are exempt from unsuccessful logon attempts requirements.

3.3.3 System Use Notification

{For Government Reference Only: This subpart (and its subparts) relates to AC-8; CCI-000048, CCI-002247, CCI-002243, CCI-002244, CCI-002245, CCI-002246, CCI-000050, CCI-002248}

3.3.3.1 System Use Notification for Remote User Interfaces

Remote user interfaces must display a warning banner meeting the requirements of DTM 08-060 on screen.

3.3.3.2 System Use Notification for Local User Interfaces

Devices which are connected to a network and have a local user interface must display a warning banner meeting the requirements of DTM 08-060 on the user interface screen if capable of doing so and must have a permanently affixed label with an approved banner from DTM 08-060 if unable to display the warning banner on the screen. Where it is impractical (perhaps due to device size) to affix the label to the device, affix the label to the device enclosure.

Labels must be machine printed or engraved, plastic or metal, designed for permanent installation, must use a font no smaller than 14 point, and must provide a high contrast between font and background colors.

3.3.4 Permitted Actions Without Identification or Authentication

{For Government Reference Only: This subpart (and its subparts) relates to AC-14; CCI-000061, CCI-000232}

The control system must require identification and authentication before allowing any actions except read-only actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.

3.3.5 Enclosures

Prior to final acceptance of the system, lock all lockable enclosures. Submit an Enclosure Keys submittal with all copies of keys for all enclosures and a key inventory list documenting all keys. Label each key with the matching enclosure identifier.

3.4 USER IDENTIFICATION AND AUTHENTICATION

{For Government Reference Only: This subpart (and its subparts) relates to IA-2, IA-2(1),IA-2(12), IA-5 IA-5(b), IA-5(c), IA-5(e), IA-5(g), IA-5(1), IA-5(11); CCI-000764, CCI-000765, CCI-001953, CCI-001954,

CCI-001544, CCI-001989, CCI-000182, CCI-001610, CCI-000192, CCI-000193, CCI-000194, CCI-000205, CCI-001619, CCI-001611, CCI-001612, CCI-001613, CCI-001614, CCI-000195, CCI-001615, CCI-000196, CCI-000197, CCI-000199, CCI-000198, CCI-001616, CCI-001617, CCI-000200, CCI-001618, CCI-002041, CCI-002002, CCI-002003. }

This subpart indicates requirements for specific methods of identification and authentication for users and user accounts. Where these requirements conflict apply the following order of precedence: 1) If present, Device Specific Requirements take precedence over any other requirements; and then 2) multifactor authentication requirements take precedence over password requirements.

3.4.1 User Identification and Authentication for All System Types

Unless otherwise indicated, all user interfaces supporting accounts (either FULLY or MINIMALLY) must implement Identification and Authorization via passwords.

3.4.2 User Identification and Authentication for Specific System Types

System specific requirements are in addition to and supersede those indicated for all system types. When no additional requirements are indicated for a specific system type the requirements for all systems still apply to that system type.

3.4.2.1 HVAC Control Systems Devices

No additional system specific requirements apply.

3.4.3 User Identification and Authentication for Specific Devices

There are no additional device specific user interface requirements

3.4.4 Implementation of Identification and Authorization Requirements

Identification and Authorization must be met by one of the following methods:

a. Direct implementation in the user interface.

3.4.5 Password-Based Authentication Requirements

3.4.5.1 Passwords for Controllers FULLY Supporting Accounts

All controllers FULLY supporting accounts and supporting password-based authentication must enforce the following requirements:

a. Minimum password length of fifteen (15) characters.

b. Password must contain at least two (2) uppercase characters.

c. Password must contain at least two (2) lowercase characters.

d. Password must contain at least two (2) numeric characters.

e. Password must contain at least two (2) special characters. The list of supported special characters must include at least 4 separate characters.

f. Password must have a maximum lifetime of sixty (60) days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.

g. Password must differ from previous ten (10) passwords, where differ is defined as changing at least fifty percent of the characters.

h. Passwords must be cryptographically protected during storage and transmission.

3.4.5.2 Passwords for Remote Interfaces

Passwords for connecting to a Remote User Interface supporting password-based authentication must enforce the following requirements:

a. Minimum password length of fifteen (15) characters.

b. Password must contain at least two (2) uppercase characters.

c. Password must contain at least two (2) lowercase characters.

d. Password must contain at least two (2) numeric characters.

e. Password must contain at least two (2) special characters. The list of supported special characters must include at least 4 separate characters.

f. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.

g. Password must differ from previous ten (10) passwords, where differ is defined as changing at least 50 percent of the characters (where location is significant, a character may be reused if it is in a different position).

h. Passwords must be cryptographically protected during storage and transmission.

3.4.5.3 Passwords for Devices Minimally Supporting Accounts

Devices MINIMALLY supporting accounts must support passwords with a minimum length of four (4) characters.

3.4.5.4 Password Configuration and Reporting

For all devices with a password, change the password from the default password. Coordinate selection of passwords with the Password Point of Contact. Do not use the same password for more than one device unless specifically instructed to do so. Provide a Confidential Password Report documenting the password for each device and describing the procedure to change the password for each device.

Do not provide the Confidential Password Report in electronic format. Provide two (2) hardcopies of the Confidential Password Report, each copy in its own sealed envelope.

For all devices with a password, coordinate the changing of passwords with

the project site following testing of the system but prior to turnover to the Government. Coordinate with Password Point of Contact to determine appropriate project site personnel to complete password changes. Accompany identified personnel to each device with a password and instruct personnel on the process of changing password. Record the time, date and personnel present when each device's password is changed and submit a Password Change Summary Report documenting this information.

Provide the Password Change Summary Report electronically in both PDF and Microsoft Excel.

3.4.6 Authenticator Feedback

{For Government Reference Only: This subpart relates to IA-6; CCI-000206}

Devices must never show authentication information, including passwords, on a display. Devices that momentarily display a character as it is entered, and then obscure the character, are acceptable. For devices that have STIGs or SRGs related to obscuring of authenticator feedback (CCI-000206), comply with the requirements of those STIGS/SRGs.

3.5 REQUIREMENTS FOR LEAST FUNCTIONALITY

{For Government Reference Only: This subpart (and its subparts), along with the network communication report submittal specified elsewhere in this section, relates to CM-6(a), CM-6(c), CM-7, CM-7(1)(b), SC-41; CCI-000363, CCI-000364, CCI-000365, CCI-001588, CCI-001755, CCI-000381, CCI-000380, CCI-00382, CCI-001761, CCI-001762, CCI-002544, CCI-002545, CCI-002546. }

For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I/O access for least functionality), install and configure the device in accordance with that STIG or SRGs.

3.5.1 Device Capabilities

For HVAC Control Systems: Do not provide devices with remote user interfaces or with full user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

For Other Control Systems: For LOW Impact Systems: Do not provide devices with remote user interfaces or with full user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

3.5.2 Software

For software that has a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port access for least functionality), install and configure the software in accordance with that STIG or SRG.

3.6 SYSTEM AND COMMUNICATION PROTECTION

3.6.1 Communication With Other Control Systems

Communication with other Facility Related Control Systems (e.g. Fire Alarm, Elevator) or Field Control Systems shall be accomplished using hardwired analog signals (e.g. 4-20 mADC, 0-10 VDC, etc.) or binary signals (e.g. dry contact). The use of digital communication protocols is not allowed unless explicitly stated or shown elsewhere in these contract documents.

3.6.2 Personal Area Networks (PAN)

Disable all wireless personal area network protocols including, but not limited to: Bluetooth, Near-Field Communications (NFC), infrared, etc.

3.6.3 Physical Port Access

Furnish and install port blocking devices on all unused communication ports on UMCS equipment modified as part of this project. This includes, but is not limited to: Ethernet ports, RS-232 ports, USB ports, etc.

Furnish and install cable lock devices on all used communication ports on UMCS equipment modified as part of this project. This includes, but is not limited to: Ethernet ports, RS-232 ports, USB ports, etc.

Furnish and deliver keys needed to remove port blocking and cable locks to the System Owner (SO) and also local base management staff that will be responsible for the maintenance of this control system. Provide a minimum of six (6) keys for each unique key device.

3.6.4 Collaborative Computing

{For Government Reference Only: This subpart relates to SC-15(a), SC-15(b); CCI-001150, CCI-001152.}

Without explicit approval from the project site, control systems must not use collaborative computing technologies.

3.6.5 Denial of Service Protection

{For Government Reference Only: This subpart relates to SC-5, SC-39, SC-7(a); CCI-001093, CCI-002385, CCI-002386, CCI-002430, CCI-001097. }

To the greatest extent practical, implement control logic without reliance on the network. Except when required to meet the requirements of the control system Section (where the requirement can only be met using computer hardware), do not implement control logic in computers.

3.7 SAFE MODE AND FAIL SAFE OPERATION

{For Government Reference Only: This subpart (and its subparts) relates to CP-12, SI-10(3), SI-17; CCI-002855, CCI-002856, CCI-002857, CCI-002754, CCI-002773, CCI-002774, CCI-002775}

For all control system components with an applicable STIG or SRG, configure the component in accordance with all applicable STIGs and SRGs.

3.8 DEVICE POWER

{For Government Reference Only: This subpart (and its subparts) relates to PE-11, PE-11(1); CCI-002955, CCI-000961. }

For LOW Impact Systems: Provide emergency power in accordance with the control system and equipment specification Sections.

3.9 SYSTEM AND INTEGRATION INTEGRITY

3.10 CONTROL SYSTEM CYBERSECURITY TESTING

3.10.1 Control System Cybersecurity Testing Procedures

Prepare Control System Cybersecurity Testing Procedures explaining step-by-step, the actions and expected results that will demonstrate that the control system meets the requirements of this Section.

Submit four (4) copies of the Control System Cybersecurity Testing Procedures. The Control System Cybersecurity Testing Procedures may be submitted as a Technical Data Package.

3.10.2 Control System Cybersecurity Testing Execution

Using the Control System Cybersecurity Testing Procedures verify that the control system meets the requirements of this Section. UNLESS GOVERNMENT WITNESSING OF A TEST IS SPECIFICALLY WAIVED BY THE GOVERNMENT, PERFORM ALL TESTS WITH A GOVERNMENT WITNESS. If testing reveals deficiencies in the system, correct the deficiency and retest until successful.

3.10.3 Control System Cybersecurity Testing Report

Prepare and submit a Control System Cybersecurity Testing Report documenting all tests performed and their results. Include all tests in the Control System Cybersecurity Testing Procedures and any additional tests performed during testing. Document test failures and repairs conducted with the test results.

Submit four (4) copies of the Control System Cybersecurity Testing Report. The Control System Cybersecurity Testing Report may be submitted as a Technical Data Package.

3.11 FIELD QUALITY CONTROL, CYBERSECURITY VALIDATION SUPPORT

In addition to testing and testing support required by other Sections, provide a minimum of twenty-four (24) hours of technical support for cybersecurity testing of control systems to support the DoD Risk Management Framework process Cybersecurity assessment of the control system. This support is independent of (and in addition to) the Control System Cybersecurity Testing specified in this section.

3.12 CYBERSECURITY TRAINING

Provide eight (8) hours of classroom and hands-on training for six (6) Government personnel on the cybersecurity operation and maintenance of the control system provided. This training is in addition to and must be coordinated with control system training specified in other Sections.

The Government will provide the training location. Training must cover, at

a minimum: (a) applying software and firmware updates, (b) user account creation, modification and deletion, (c) audit log upload procedures and (d) identification of privileged user interfaces and system impact of those interfaces. Training session must include a question and answer period during which government staff questions about cybersecurity aspects of the control system are answered.

-- End of Section --

SECTION 25 05 11.02

CYBERSECURITY FOR FIRE LIFE SAFETY (FLS)
05/21

PART 1 GENERAL

This section includes requirements in support of the DOD Risk Management Framework (RMF) for implementing cybersecurity. For requirements on incorporating cybersecurity into control system design and for general information on the RMF process as it applies to control systems, refer to UFC 4-010-06 Cybersecurity for Facility–Related Control Systems, DODI 8510.01 Risk Management Framework for DoD Information Technology, and DODI 8500.01 Cybersecurity.

Many subparts in this Section contain text in curly braces ("{" and "}") indicating which cybersecurity control and control correlation identifier (CCI) the requirements of the subpart relate to. The text inside these curly braces is for Government reference only and enables coordination of the requirements of this Section with the RMF process throughout the design and construction process. Text in curly braces are not contractor requirements.

This Section refers to Security Requirements Guide (SRGs) and Security Technical Implementation Guide (STIGs). STIGs and SRGs are available online at the Information Assurance Support Environment (IASE) website at https://public.cyber.mil/stigs/downloads/ and an SRG/STIG Applicability Guide and Collection Tool is available at https://public.cyber.mil/stigs/SCAP/. Not all control system components have applicable STIGs or SRGs. The "Control Systems SRG" does not apply to work performed under this Section; all requirements within this section to apply applicable SRGs DO NOT include the "Control Systems SRG".

This specification is intended to address cybersecurity during construction. The Contractor WILL NOT be providing new FLS components except for new field devices (e.g. sensors, actuators, etc.). The Contractor will reconfigure and reprogram the existing control panel and associated devices as needed. The Contractor will integrate all new work into the existing installation-wide front-end system for the control system(s) covered by this Section.

1.1 CONTROL SYSTEM APPLICABILITY

There are multiple versions of this Section associated with this project. Different versions have requirements applicable to different control systems. This specific Section applies only to the following control systems: FIRE & LIFE SAFETY SYSTEMS which includes the following subsystem(s).

a. FIRE ALARM REPORTING SYSTEM (FARS)

b. FIRE DITECTION AND ALARM SYSTEM (FDAS)

1.1.1 CONTROL SYSTEM IMPACT RATINGS

The cybersecurity Confidentiality-Integrity-Availability (C-I-A) impact ratings for the control system(s) covered by this Section have been determined to be LOW-MODERATE-MODERATE (L-M-M) or MODERATE when referenced in this document.

1.1.2 INTEGRATION WITH EXISTING CONTROL SYSTEM

Existing FLS equipment will be reused. The Contractor will configure the existing front-end system (e.g. graphics, tags, alarms, trends, reports, etc.) and integrate new work related to this Section as needed to match the conventions and functionality (e.g. monitoring, control) of the existing production environment system.

1.1.3 FRONT-END AND NETWORKING CYBERSECURITY CONTROLS

The existing control system(s) addressed by this Section do not have an Authority To Operate (ATO) per DODI 8510.01. The Contractor will configure front-end and networking cybersecurity controls to match the existing production environment system unless otherwise noted in these contract documents.

1.2 RELATED REQUIREMENTS

This section does not contain sufficient requirements to procure a control system and must be used in conjunction with other Sections which specify control systems. This Section adds cybersecurity requirements to the control systems specified in other Sections, and as these requirements are conditioned on the control system being provided, there may be requirements in this Section that will not apply to this project. All Sections containing facility-related control systems or control system components are related to the requirements of this Section. Review all specification sections to determine related requirements.

In cases where a requirement is specified in both this Section and in another Section, the more stringent requirement must be met. In cases where a requirement in this Section conflicts with the requirements of another Section such that both requirements cannot be met at the same time, request direction from the Contracting Officer Representative to determine which requirement applies to the project.

1.2.1 Cybersecurity Requirements

Implement cybersecurity in accordance with the following standards, guidelines, and instructions:

a. UFC 4-010-06 Cybersecurity of Facility–Related Control Systems.

b. DODI 8510.01 Risk Management Framework (RMF) for DoD Information Technology (IT)

c. DODI 8500.01 Cybersecurity

d. ECB 2020-10 Facility-Related Control System Cybersecurity Coordination Requirement

e. ECB 2022-2 Cybersecurity Requirements For Design And Construction Of Control Systems And Integrated Low Voltage Systems For Permanent And Non-Permanent Construction

The Government is responsible for obtaining an Authority To Operate (ATO). The Contractor will support the Government with information needed to obtain the ATO.

1.2.2 Network Equipment

Not applicable. Existing network equipment will be used.

1.3 REFERENCES

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

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST FIPS 140-2	(2001) Security Requirements for Cryptographic Modules

U.S. ARMY CORPS OF ENGINEERS (USACE)

ECB 2020-10	(2020) Facility-Related Control System Cybersecurity Coordination Requirement
ECB 2022-2	(2022) Cybersecurity Requirements For Design And Construction Of Control Systems And Integrated Low Voltage Systems For Permanent And Non-Permanent Construction

U.S. DEPARTMENT OF DEFENSE (DOD)

DODI 8500.01	(2014; Change 1-2019) Cybersecurity
DODI 8510.01	(2020; Change 1-2020) Risk Management Framework (RMF) for DoD Information Technology (IT)
DTM 08-060	(2008) Policy on Use of Department of Defense (DoD) Information Systems - Standard Consent Banner and User Agreement
UFC 4-010-06	(2016; with Change 1, 2017) Cybersecurity of Facility-Related Control Systems

1.4 DEFINITIONS

1.4.1 Administrator Account

An administrator account is an account with full permissions to a device, application, or operating system, including the ability to create and modify other user accounts.

Note that the operating system Administrator Account may be different than Administrator Accounts for applications hosted on that operating system. Also, most controllers will not have any support for accounts and will

therefore not have an 'Administrator Account'.

1.4.2 Computer

A computer is one of the following:

a. a device running a non-embedded desktop or server version of Microsoft Windows

b. a device running a non-embedded version of MacOS

c. a device running a non-embedded version of Linux

d. a device running a version or derivative of the Android Operating System, where Android is considered separate from Linux

e. a device running a version of Apple iOS

Unless otherwise indicated or clear from context use of the word "device" in this Section includes computers.

1.4.3 Controller

A device other than a computer or Ethernet switch. For Fire Protection systems this includes fire alarm control panels, remote operating consoles, and remote annunciators.

1.4.4 Mission Space

A device or media is in mission space if physical access to the device or media is controlled by the organization served by the device. For example, a VAV box controller in a suspended ceiling is in mission space if the VAV box serves that room; an electrical switchgear in an electrical room or an AHU in a mechanical room or on a rooftop may still be considered to be in mission space if the organization (mission) served by that switchgear or AHU controls access to the electrical room, mechanical room or rooftop.

1.4.5 Network

A network is a group of two or more devices that can communicate using a network protocol. Network protocols must provide a method for addressing devices on the network; a communication method that does not provide an addressing scheme is not a networked form of communication. Devices that communicate using a method of communication that does not support device addressing are not using a network.

1.4.6 Network Connected

A component is network connected (or "connected to a network") only when the device has a network transceiver which is directly connected to the network and implements the network protocol. A device lacking a network transceiver (and accompanying protocol implementation) can never be considered network connected. Note that (unlike many IT definitions of "Network Connected") a device connected to a non-IP network is still considered network connected (an IP connection or IP address is not required for a device to be network connected).

1.4.6.1 Wireless Network Connected

Any device that supports wireless network communication is network connected to a wireless network, regardless of whether the device is communicating using wireless. Unless physically disabled, devices with wireless transceivers support wireless, it is not sufficient to disable the wireless in software.

1.4.7 Network Media

The thing that provides the communication channel between the devices on a network. Typically wire, but might include wireless, fiber optic, or even power line (some network protocols allow sending network signals over power wiring).

1.4.8 User Account Support Levels

The support for user accounts is categorized in this Section as one of three levels:

1.4.8.1 FULLY Supported

Device supports configurable individual accounts. Accounts can be created, deleted, modified, etc. Privileges can be assigned to accounts. These devices support user-based (as opposed to role-based) authentication.

1.4.8.2 MINIMALLY Supported

Device supports a small, fixed number of accounts (perhaps only one). Accounts cannot be modified. A device with only a "User" and an "Administrator" account would fit this category. Similarly, a device with two PINs for logon - one for restricted and one for unrestricted rights would fit here (in other words, the accounts do not have to be the traditional "username and password" structure). These devices typically only support role-based authentication.

Examples of devices which MINIMALLY support accounts are a) a variable frequency drive with a single account which requires a PIN for access to configuration; and b) a room lighting control touchpad interface that has a single account.

1.4.8.3 NOT Supported

Device does not support any Access Enforcement therefore the whole concept of "account" is meaningless.

1.4.9 Manual Local Input

Manual Local Inputs are system analog or binary inputs that are adjustable by a person but are, by intrinsic hardware design, very limited in potential capabilities. Manual Local Inputs do not have touch screens or full keyboards, but may have a few buttons or dials to allow input. Manual Local Inputs do not have full graphic screens or dot-matrix displays, but may have simple lights (LEDs) or 7-segment displays. Manual Local Inputs do not have any sort of menu structure, each button has a single well-defined function.

Examples of Manual Local Inputs are H-O-A switches, simple thermostats,

and disconnect switches.

1.4.10 Card Reader

A card reader is an input/output device whose primary function is to assist in two-factor authentication. A card reader must have an interface to read data from a card and may be able to write data to a card. A card reader may have a means (such as buttons, keypad, touchscreen, etc.) for a user to input a PIN or password, as well as a limited display.

1.4.11 User Interface

A User Interface (UI) is something other than a Manual Local Input or Card Reader that allows a person to interact with the system or device. Note that while a Card Reader is not by itself a User Interface, a User Interface may contain a Card Reader in order for it to authenticate its user. Within control systems, there are a wide range of User Interfaces.

Two important distinctions are 1) whether the user interface is Local or Remote, and 2) the effective capabilities of the User Interface to alter data, which is the "privilege" of the user interface (where effective privilege available to a specific user at a specific user interface is the combination of the greatest privilege offered by the user interface and the specific account the user is logged into).

1.4.11.1 Local User Interface

A Local User Interface is a user interface where the physical hardware the user interacts with (keyboard, buttons, display, etc.) is physically part of the device being affected. All of the relevant characteristics of the user interface are embodied within a single device.

Note that a Local UI may be able to access data in a different device, Local versus Remote in this context refers to the user interface itself; the capability to access data in a different device is covered under "Full User Interface".

1.4.11.2 Remote User Interface

A Remote User Interface implements a Client/Server model where the physical hardware the user interacts with (Client) is physically distinct from the device being affected (Server). Most or all of the security and functionality characteristics of the user interface are defined by the Server, not the Client. The Client and Server communicate via a network connection. A common example of a remote user interface is a web-based interface where the browser (client) is generally on different hardware than the web server (server). A Remote UI remains a Remote UI even if the user happens to be at a Client on the same hardware as the Server. What is important is that a) the Client may be on different hardware than the Server and b) the majority of the security and functional characteristics of the interface are defined at the Server.

Note that this definition of "remote" is consistent with that generally used in the control industry but is not aligned with the NIST 800-53 definition of "Remote", which refers to "outside the system". The term "Remote" here better aligns with the NIST 800-53 definition of "Network" (remote from within the system) Access.

1.4.11.3 Types of User Interface (by capability)

User interfaces are also categorized by their capabilities as being Read Only, Limited, or Full.

1.4.11.3.1 Read-Only User Interface

A Read Only User Interface (also referred to as a View-Only User Interface) is a user interface that only allows for reading data, it does not allow (have the capability to) modify data. A Read Only User Interface may be either Local or Remote. A User Interface that is configured to be Read Only (by some other means than the interface itself, such as using configuration software on a laptop) is a Read-Only Interface. Note a Read Only User Interface may have buttons (or touch screen, etc.) allowing the user to navigate through the presentation of data.

Examples of a Read Only User Interfaces are a) a publicly viewable "energy dashboard" showing weather data and energy usage within a building and b) digital wayfinding signage.

1.4.11.3.2 Limited User Interface

A Limited User Interface is a user interface that - by design - can only alter information local to the user interface. Note that the determination of "alter" includes only direct interactions, it explicitly excludes interactions that might occur as secondary effects. For example, an interface changing the flow setpoint in a pump controller is a direct interaction, the subsequent change in flow (as well as any subsequent downstream changes in valve position) are not direct interactions.

Two examples of LIMITED UIs are: a) a variable speed drive has a Limited Local User Interface which allows the user to change properties within the drive, but does not allow affecting things outside the drive; and b) a typical home WiFi Router has a Limited Remote User Interface which allows configuration of the Router, but does not allow direct interaction with other devices.

1.4.11.3.3 Full User Interface

A Full User Interface can alter information in devices outside the device with the user interface. For example, a typical Local Display Panel is a Full Local User Interface while a browser-based front end is a Full Remote User Interface.

1.4.11.3.4 View-Only User Interface

See Read-Only User Interface

1.4.11.4 Other User Interface Terminology

In addition to defining whether a user interface is a Hardware Limited, Read-Only, Limited or Full, and whether it is Local or Remote, user interfaces are classified by whether they are writable or privileged.

1.4.11.4.1 Writable User Interface

Any User Interface that is not Read-Only is Writable. (Limited User Interfaces and Full User Interfaces are both writable user interfaces (as

they are capable of changing a value)).

1.4.11.4.2 Privileged User Interface

A Privileged UI is a UI that has sufficient capabilities or functionality that it requires specific cybersecurity measures to be put in place to limit its unauthorized use. Ultimately, whether a specific user interface is considered a Privileged User Interface must be determined by usage. Unless otherwise specified, user interfaces can be determined to be privileged or not using the following:

a. Read-Only User Interfaces are not privileged user interfaces.

b. Full User interfaces for Fire Alarm Systems are privileged user interfaces as indicated and shown, or when another requirement of this Section establishes they are privileged. For all other systems, Full User Interfaces are privileged user interfaces.

c. User interfaces that allow for configuration of auditing or allows for modification or deletion of audit logs are privileged user interface.

d. User interfaces that allow for reprogramming a network connected device is a privileged user interface.

e. For Fire Protection Systems, User Interfaces that can inhibit or force the activation of a fire suppression system (e.g. such as for a pre-action or deluge system) are privileged user interfaces.

e. Except as specified above, a Limited User Interface must be determined to be privileged or not based on the specific capabilities and use case of the user interface. In general however, user interfaces that do not offer significant capabilities above and beyond those available at that location via other means (e.g. such as a disconnect switch, breaker, or hand-off-auto switch, or physical attack) are not privileged.

1.4.12 Wireless Network

Any network that communicates without using wires or fiber optics as the communication media. Wireless networks include: WiFi, Bluetooth, ZigBee, cellular, satellite, 900 MHz radio, 2.4 GHz, free space optical, point-to-point laser, and IR.

1.4.13 Wired Broadcast Network

Wired Broadcast Networks are any network, such as powerline carrier networks and modem (wired telephony), that use wire-based technologies where there is not a clearly defined boundary for signal propagation.

1.4.14 C-I-A Impact Level

A reference to the security objectives of Confidentiality (C), Integrity (I), Availability (A) associated with a control system. These values are determined by the System Owner (SO) in conjunction with the Authorizing Official (AO). The potential impact levels for each security objective are LOW (L), MODERATE (M), and HIGH (H); note that these ratings are not for this control system. Refer to other areas of this Section for actual impact ratings for this control system. The determination of control system impact levels is a requirement of UFC 4-010-06.

1.5 ADMINISTRATIVE REQUIREMENTS

1.5.1 Points of Contact

Coordinate with the following Points of Contact as indicated in this Section and as required. Not all projects will require coordination with all Points of Contact. When coordination is required and no Point of Contact is indicated, coordinate with The Contracting Office Representative (COR).

a. Government Computer Access Point of Contact: The Contracting Office Representative (COR)

b. HTTPS Certificate Point of Contact: The Contracting Office Representative (COR)

c. Email Address Point of Contact: The Contracting Office Representative (COR)

d. Password Point of Contact: The Contracting Office Representative (COR)

e. Mobile Code Point of Contact: The Contracting Office Representative (COR)

f. PKI Infrastructure Point of Contact: The Contracting Office Representative (COR)

1.5.2 Coordination

Coordinate the execution of this Section with the execution of all other Sections related to control systems as indicated in the paragraph RELATED REQUIREMENTS. Items that must be considered when coordinating project efforts include but are not limited to:

a. If requesting permission for wireless or wired broadcast communication, the Wireless and Wired Broadcast Communication Request submittal must be approved prior to control system device selection and installation.

b. If requesting permission for alternate account lock permissions, the Device Account Lock Exception Request must be approved prior to control system device selection and installation.

c. If requesting permission for the use of a device with multiple physical connections to IP networks, the Multiple IP Connection Device Request must be approved prior to control system device selection and installation.

d. Wireless testing may be required as part of the control system testing. See requirements for the Wireless Communication Test Report submittal.

e. If the Device Audit Record Upload Software is to be installed on a computer not being provided as part of the control system, coordination is required to identify the computer on which to install the software.

f. The Cybersecurity Interconnection Schedule must be coordinated with other work that will be interconnected to, and interconnections must be approved by the Government before relying on them for system functionality.

g. Cybersecurity testing support must be coordinated across control systems and with the Government cybersecurity testing schedule.

h. Passwords must be coordinated with the indicated contact for the project site.

i. If applicable, HTTPS web server certificates must be obtained from the indicated HTTPS Certificate Point of Contact.

j. Contractor Computer Cybersecurity Compliance Statements must be provided for each contractor using contractor owned computers.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. The approval authority for submittals marked "AE" is the Architect-Engineer. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Device Account Lock Exception Request; G, AE

Multiple Ethernet Connection Device Request; G, AE

Contractor Computer Cybersecurity Compliance Statements; G, AE

Contractor Temporary Network Cybersecurity Compliance Statements; G, AE

Proposed STIG and SRG Applicability Report; G, AE

Qualifications; G, AE

SD-02 Shop Drawings

Network Communication Report; G, AE

Cybersecurity Riser Diagram; G, AE

SD-03 Product Data

Control System Cybersecurity Documentation; G, AE

SD-06 Test Reports

Control System Cybersecurity Testing Procedures; G, AE

Control System Cybersecurity Testing Report; G, AE

SD-11 Closeout Submittals

Confidential Password Report; G, AE

Password Change Summary Report; G, AE

Enclosure Keys; G, AE

Software and Configuration Backups; G, AE

STIG, SRG and Vendor Guide Compliance Result Report; G, AE

Control System Inventory Report; G, AE

Integrity Verification Software; G, AE

1.7 QUALITY CONTROL

1.7.1 Qualifications

Control System Cybersecurity Subject Matter Expert and Computing Environment and Network Personnel can serve across the contract.

1.7.1.1 Control System Cybersecurity Subject Matter Expert

The individual will oversee all work within this specification. This position requires that the individual currently meets Information Assurance Manager Level II Certification in accordance with DoDI 8140 Information Workforce Improvement Program.

Individuals for this position should have experience securing DOD systems and with Risk Management Framework. Control System Experience is highly desirable.

Resumes should be submitted to the Government within 14 days after notice to proceed. All certifications to include computing environment must be in effect prior to beginning work.

1.7.1.2 Computing Environment (System Administrator) and Networking Personnel

Not applicable for the control system covered by this Section on this project.

1.8 CYBERSECURITY DOCUMENTATION

{For Government Reference Only: This subpart (and its subparts) relates to PL-7; CCI-003071}

1.8.1 Proposed STIG and SRG Applicability Report

For each model of network connected or network infrastructure device, use the DISA SRG/STIG Applicability Guide and Collection Tool (available at https://public.cyber.mil/stigs/SCAP/to identify applicable STIGs or SRGs and provide a report indicating applicable STIGs and SRGs for each model.

1.8.2 Network Communication Report

{For Government Reference Only: This subpart (and its subparts) relates to CA-9, PL-8; CCI-003075; CCI-002102, CCI-002103, CCI-002104, CCI-002105, CCI-003072, CCI-003073, CCI-003075 and also the submittal requirements associated with CM-6, CM-7, SC-8 and SC-41 including CM-7(3), CCI-000388.}

Provide a network communication report. For each networked device, document the communication characteristics of the device including communication protocols, services used, encryption employed, and a general description of what information is communicated over the network. For each device using IP, document all TCP and UDP ports used. For non-IP communications, document communication protocol and media used. If other control system Sections used on this project include submittals documenting this information, provide copies of those submittals to meet this requirement.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Network Communication Report as an editable Microsoft Excel file.

1.8.3 Control System Inventory Report

{For Government Reference Only: This subpart (and its subparts) relates to CM-8(a), SI-17, IA-3; CCI-000389, CCI-000392, CCI-000398, CCI-002773, CCI-002774, CCI-002775, CCI-000777, CCI-000778, CCI-001958}

Provide a Control System Inventory report using the Inventory Spreadsheet listed under this Section at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 documenting all devices, including networked devices, network infrastructure devices, non-networked devices, input devices (e.g. sensors) and output devices (e.g. actuators). For each device provide all applicable information for which there is a field on the spreadsheet in accordance with the instructions on the spreadsheet.

In addition to the requirements of Section 01 33 00 SUBMITTAL PROCEDURES, provide the Control System Inventory Report as an editable Microsoft Excel file.

1.8.4 Software and Configuration Backups

{For Government Reference Only: This subpart (and its subparts) relates to CP-10; CCI-000550, CCI-000551, CCI-000552}

For each programmable control system device, provide a recovery image or complete downloadable configuration of the final as-built device. This image must allow for the firmware compatible restoration of the image sufficient to restore system operation to the imaged state.

If any or all of these are provided under another Section, provide documentation indicating this and referencing those submittals.

1.8.5 Cybersecurity Riser Diagram

{For Government Reference Only: This subpart (and its subparts) relates to PL-2(a), PL-8; CCI-003051, CCI-003053, CCI-003072, CCI-003073,

CCI-003075}

Provide a cybersecurity riser diagram of the complete control system including all network and device hardware. If the control system specifications require a riser diagram submittal, provide a copy of that submittal as the cybersecurity riser diagram. Otherwise, provide a riser diagram in one-line format.

1.8.6 STIG, SRG and Vendor Guide Compliance Result Report

For every component (device or software) with an applicable STIG or SRG in the Proposed STIG and SRG Applicability Report, provide a result report documenting compliance with the STIG or SRG requirements. For components which are scannable by the SCAP (security content automation protocol) tool (available online at https://public.cyber.mil/stigs/scap), provide the SCAP report and raw scan results.

For every component (device or software) with manufacturer provided cybersecurity documentation, procedure, or method for secure configuration or installation, provide a report documenting how the component was configured and any deviation from the manufacturer instructions.

1.8.7 Control System Cybersecurity Documentation

{For Government Reference Only: This subpart (and its subparts) relates to SA-5 (a),(b),(c); CCIs: CCI-003124, CCI-003125, CCI-003126, CCI-003127, CCI-003128, CCI-003129, CCI-003130, CCI-003131}

Provide a Control System Cybersecurity Documentation submittal containing the indicated information for each device and software application.

1.8.7.1 Default Requirements for Control System Devices

For control system devices where Control System Cybersecurity Documentation requirements are not otherwise indicated in this Section, provide:

a. Documentation that describes secure configuration of the device {For Government Reference Only: relates to CCI-003124}

b. Documentation that describes secure installation of the device {For Government Reference Only: relates to CCI-003125}

c. Documentation that describes secure operation of the device {For Government Reference Only: relates to CCI-003124}

d. Documentation that describes effective use and maintenance of security functions or mechanisms for the device {For Government Reference Only: relates to CCI-003127}

e. Documentation that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions for the device {For Government Reference Only: relates to CCI-003128}

f. Documentation that describes user-accessible security functions or mechanisms in the device and how to effectively use those security functions or mechanisms {For Government Reference Only: relates to CCI-003129}

g. Documentation that describes methods for user interaction which enables individuals to use the device in a more secure manner {For Government Reference Only: relates to CCI-003130}

h. Documentation that describes user responsibilities in maintaining the security of the device {For Government Reference Only: relates to CCI-003131}

1.9 CYBERSECURITY DURING CONSTRUCTION

{For Government Reference Only: This subpart (and its subparts) relates to AC-18, SA-3; CCI-000258}

In addition to the control system cybersecurity requirements indicated in this section, meet following requirement throughout the construction process.

1.9.1 Contractor Computer Equipment

Contractor owned computers may be used for construction. Contractor computers connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

1.9.1.1 Operating System

The operating system must be an operating system currently supported by the manufacturer of the operating system. The operating system must be current on security patches and operating system manufacturer required updates.

1.9.1.2 Anti-Malware Software

The computer must run anti-malware software from a reputable software manufacturer. Anti-malware software must be a version currently supported by the software manufacturer, must be current on all patches and updates, and must use the latest definitions file. Computers used on this project must be scanned using the installed software at least once per day.

1.9.1.3 Passwords and Passphrases

The passwords and passphrases for computers, applications, and web-based applications supporting passwords must be changed from their default values. Passwords must be a minimum of eight characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.9.1.4 User-Based Authentication

Each user must have a unique account; sharing of a single account between multiple users is prohibited.

1.9.1.5 Demonstration of Compliance

The Government has the right to require demonstration of computer compliance with these requirements at any time during the project.

1.9.1.6 Contractor Computer Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Computer Cybersecurity Compliance Statements for each company using contractor owned computers. Contractor Computer Cybersecurity Compliance Statements must use the template published at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 Each Statement must be signed by a cybersecurity representative for the relevant company.

1.9.2 Temporary IP Networks

Temporary contractor-installed IP networks may be used during construction. When used, temporary contractor-installed IP networks connected to the control system, control system network, or a control system component at any point during construction must meet the following requirements:

1.9.2.1 Network Boundaries and Connections

The network must not extend outside the project site and must not connect to any IP network other than those specifically provided or furnished for this project. Any and all access to the network from outside the project site is prohibited. Unused network access ports are to be disabled via the management console or command line when not in use.

1.9.3 Government Access to Network

Government personnel must be allowed to have complete and immediate access to the network at any time in order to verify compliance with this specification.

1.9.4 Temporary Wireless IP Networks

In addition to the other requirements on temporary IP networks, temporary wireless IP (WiFi) networks, when permitted, must not interfere with existing wireless networks, must use WPA2 security and must not broadcast the network name (SSID). Network names (SSID) for wireless networks must be changed from their default values.

1.9.5 Passwords and Passphrases

The passwords and passphrases for all network devices and network access must be changed from their default values. Passwords must be a minimum 8 characters with a minimum of one uppercase letter, one lowercase letter, one number and one special character.

1.9.6 Contractor Temporary Network Cybersecurity Compliance Statements

Provide a single submittal containing completed Contractor Temporary Network Cybersecurity Compliance Statements for each company implementing a temporary IP network. Contractor Temporary Network Cybersecurity Compliance Statements must use the template published at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 Each Statement must be signed by a cybersecurity representative for the relevant company. If no temporary IP networks will be used, provide a single copy of the Statement indicating this.

1.10 CYBERSECURITY DURING WARRANTY PERIOD

All work performed on the control system after acceptance must be performed using Government Furnished Equipment or equipment specifically and individually approved by the Government.

PART 2 PRODUCTS

Existing equipment will be reused.

PART 3 EXECUTION

3.1 CYBERSECURITY HARDENING AND CONFIGURATION GUIDES

Install, configure, and harden all hardware and software furnished on this project in accordance with manufacturer provided documentation, procedures, or methods for secure configuration or installation. Do not implement specific hardening actions if that action would conflict with required functionality or another requirement of this Section.

3.2 NETWORK REQUIREMENTS

3.2.1 Wireless and Wired Broadcast Communication for Fire Protection Systems

The use of wireless and wired broadcast communication for fire protection systems within a facility is prohibited. Wireless communication may be used to provide communication from the fire protection system in a facility to the central monitoring station.

3.2.2 Non-IP Control Networks

When control system specifications require particular communication protocols, use only those communication protocols and only as specified. Do not implement any other communication protocol.

When control system specifications do not indicate requirements for communication protocols, use only those protocols required for operation of the system as specified.

3.2.2.1 Allowable Non-IP Control Protocols

3.2.2.1.1 Protocols Currently In Use

Non-IP control protocols currently in use by the existing FLS system are permitted.

3.2.2.1.2 Serial RS-232 and USB

For device configuration and troubleshooting only. These are allowable in a point-to-point configuration only.

3.2.3 IP Control Networks

{For Government Reference Only: This subpart relates to CM-6(a), CM-7(a), CM-7(b), CM-7(1)(b), SC-41; CCI-001588, CCI-000381, CCI-000380, CCI-000381, CCI-000382, CCI-001761, CCI-001762, CCI-002544, CCI-002545,

CCI-002546. For Moderate Impact Systems, this subpart (and its subparts) also relates to SC-5(1), SC-5(2); CCI-001094 CCI-001095}

For MODERATE Impact Systems, unless explicitly authorized, do not use IP networks if the same control functionality is available through the use of non-IP networks.

3.2.3.1 Allowable IP Ports and Protocols

3.2.3.1.1 Protocols Currently In Use

IP control protocols currently in use by the existing FLS system are permitted.

3.2.3.1.2 Unspecified Protocol Approval

When unspecified communications protocols are required for proper system operation submit to the Government for approval the protocol, port number if IP based, functional requirement, and cybersecurity conformance.

3.2.3.2 IP Network Routers

Do not install any device that performs IP routing.

3.2.3.3 IP Devices With Multiple Ethernet Connection

Except for Ethernet Switches and Daisy Chain IP Controllers, devices must not have more than one Ethernet connection to IP networks unless doing so is required by the project specifications and the specific application is approved. If a device with Multiple Ethernet Connections to IP networks is required, provide a Multiple Ethernet Connection Device Request using the Multiple Ethernet Connection Device Request Template at https://www.wbdg.org/ffc/dod/unified-facilities-guide-specifications-ufgs/ufgs-25-05-1 to request approval for each device. If a device with Multiple Ethernet Connections to IP networks is not required, instead provide a document stating that no approval is being requested.

3.2.4 Cryptographic Protection

{For Government Reference Only: This subpart relates to IA-2(9), IA-3(1), SC-8, SC-13, SC-23(1), SC-23(3); CCI-001942, CCI-001959, CCI-001967, CCI-002418, CCI-002449, CCI-002450, CCI-001185, CCI-001188, CCI-001664.}

For devices that have STIG/SRGs related to cryptographic protection (CCI-002450), comply with the requirements of those STIG/SRGs.

3.2.5 Cryptographic Module Authentication

{For Government Reference Only: This subpart (and its subparts) relates to IA-7; CCI-000803}

For devices (including but not limited to NIST FIPS 140-2 compliant radios) that have STIG/SRGs related to cryptographic module authentication (CCI-000803), comply with the requirements of those STIG/SRGs.

3.3 ACCESS CONTROL REQUIREMENTS

3.3.1 User Accounts

{For Government Reference Only: This subpart (and its subparts) relate to AC-2(a), AC-3, AC-6(1), AC-6(10), AC-6(2), AC-6(9), CM-11(2), and IA-2; CCI-002110, CCI-000213, CCI-002235, CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-002235, CCI-000039, CCI-001419, CCI-002234, CCI-001812, and CCI-000764. For MODERATE Impact systems, this subpart (and its subparts) also relate to AC-2 (2), AC-2(3), AC-2(4), AC-6(1), and CM-5(1); CCI-001361, CCI-000017, CCI-000217, CCI-000018, CCI-001403, CCI-001404, CCI-001405, CCI-002130, CCI-001683, CCI-001684, CCI-001685, CCI-001686, CCI-002132, CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-001813.}

Any user interface supporting user accounts (either FULLY or MINIMALLY) must limit access according to specified limitations for each account. Install and configure any device having a STIG or SRG in accordance with that STIG or SRG.

All user interfaces FULLY supporting accounts must implement user-based authentication where each account is uniquely assigned to a specific user. User interfaces FULLY supporting accounts must implement at least three (3) levels of user account privilege including: 1) an account with read-only permissions 2) an account with full permissions including account creation and modification and 3) an account with greater permissions than read-only but without account creation and modification.

3.3.1.1 Controllers

For user interfaces provided by controllers, provide access control in accordance with the User Interface Requirements table for the applicable control system and user interface type.

a. For table entries of "NA": NA means Not Applicable, there are no interfaces in this category.

b. For table entries of "None Required": The user interface is not required to support user accounts.

c. For table entries of "MINIMALLY": The user interface must at least MINIMALLY support user accounts.

d. For table entries of "FULLY": The user interface must at FULLY support user accounts.

e. For table entries of "KEY": The user interface must have physical security in the form of either a key lock on the interface itself or be furnished inside a locked enclosure. Where this is required for a read only interface, this lock must prevent viewing of data on the interface; for other interfaces, this lock must prevent using the interface to alter data.

f. For table entries of "Physical Security": For Local FULL interfaces, the interface must be located inside mission space. For Local Limited (not FULL) interfaces, the user interface must either a) be located within mission space or b) be protected by physical security at least as good as the control devices (and equipment controlled by the

control devices) affected by the interface. For purposes of this requirement, 'affected' includes controllers with data that can be directly altered by the interface, as well as mechanical and/or electrical equipment directly controlled by those controllers, but does not include other interactions.

g. Entries of the form "X and Y" must meet both the requirement indicated for X and the requirement indicated for Y. For example, an entry of "MINIMALLY and Physical Security" indicates the user interface must both MINIMALLY support accounts and have physical security.

h. Entries of the form "X or Y" must meet either the requirement indicated for X or the requirement indicated for Y.

3.3.1.1.1 Fire Protection Systems

User Interface Requirements for MODERATE Impact Fire Protection Systems	
User Interface Type	**Access Control Requirement** (See note 2)
Local Read Only	None Required
Local Limited, Non-privileged	KEY or MINIMALLY
Local Limited, Privileged	KEY and Physical Security
Local Full	KEY
Remote Read Only	None Required
Remote Limited, Non-Privileged	FULLY
Remote Limited, Privileged AND Remote Full	FULLY
Notes: 1)Local Read Only User Interfaces are always Non-Privileged 2)Devices outside mission space require physical security protections as indicated (in "PHYSICAL SECURITY IN MODERATE IMPACT SYSTEMS")	

3.3.1.1.2 Default Requirements for Other Control Systems

For control system devices where User Interface Requirements are not otherwise indicated in this Section, use the Default User Interface Requirements tables.

Default User Interface Requirements for MODERATE Impact Control Systems	
User Interface Type	**Access Control Requirement** (See note 3)
Local Read Only (see note 1)	MINIMALLY

Default User Interface Requirements for MODERATE Impact Control Systems	
User Interface Type	**Access Control Requirement** (See note 3)
Local Limited, Non-privileged	MINIMALLY
Local Limited, Privileged	MINIMALLY and Physical Security
Local Full	MINIMALLY and Physical Security
Remote Read Only	None Required
Remote Limited, Non-Privileged	FULLY
Remote Limited, Privileged AND Remote Full (see note 2)	FULLY
Notes: 1)Local Read Only User Interfaces are always Non-Privileged 2)Remote Full User Interfaces are always Privileged 3)Devices outside mission space require physical security protections as indicated (in "PHYSICAL SECURITY IN MODERATE IMPACT SYSTEMS")	

3.3.1.2 Additional User Account Expiration Requirements In MODERATE Impact Systems:

In addition to other user account requirements, user account expiration and auditing must be configured as indicated.

3.3.1.2.1 For Other Control System Devices FULLY Supporting Accounts

If temporary accounts are supported, expire temporary accounts 72 hours after creation. Expire all other accounts after 365 days of inactivity .

3.3.2 Unsuccessful Logon Attempts

{For Government Reference Only: This subpart (and its subparts) relate to AC-7 (a), AC-7 (b); CCI-000043, CCI-000044, CCI-001423, CCI-002236, CCI-002237, CCI-002238}

Except for high availability user interfaces indicated as exempt, devices must meet the indicated requirements for handling unsuccessful logon attempts. If a device cannot meet these requirements, document device capabilities to protect from subsequent logon attempts and propose alternate protections in a Device Account Lock Exception Request submittal. Do not implement alternate protection measures in lieu of the indicated requirements without explicit permission from the Government. If no Device Account Lock Exceptions are requested, provide a document stating that no approval is being requested as the Device Account Lock Exception Request.

3.3.2.1 Devices MINIMALLY Supporting Accounts

For MODERATE Impact Systems: Devices which MINIMALLY (but not FULLY) support accounts must lock the user account accountafter five consecutive failed login attempts and must unlock the user account after 15 minutes have elapsed without an unsuccessful login attempt or by a successful login to a separate administrator account.

3.3.2.2 Devices FULLY Supporting Accounts

Devices which FULLY support accounts must meet the following requirements.

a. It must lock the user account when three unsuccessful logon attempts occur within a 15 minute interval.

b. Once an account is locked, the account must stay locked until unlocked by an administrator. If the account being locked is the sole administrator account on the device, the account must stay locked for 1 hour and then automatically unlock.

c. Once the indicated number of unsuccessful logon attempts occurs, delay further logon prompts by 5 seconds.

3.3.2.3 High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements

The following high availability interfaces are exempt from unsuccessful logon attempts requirements:

High Availability Interfaces Exempt from Unsuccessful Logon Attempts Requirements		
User Interface	**Location**	**Action to take in lieu of locking screen**
FACP	As shown in Drawings	None

3.3.3 System Use Notification

{For Government Reference Only: This subpart (and its subparts) relates to AC-8; CCI-000048, CCI-002247, CCI-002243, CCI-002244, CCI-002245, CCI-002246, CCI-000050, CCI-002248}

3.3.3.1 System Use Notification for Remote User Interfaces

Remote user interfaces must display a warning banner meeting the requirements of DTM 08-060 on screen.

3.3.3.2 System Use Notification for Local User Interfaces

Devices which are connected to a network and have a local user interface must display a warning banner meeting the requirements of DTM 08-060 on the user interface screen if capable of doing so and must have a permanently affixed label with an approved banner from DTM 08-060 if unable to display the warning banner on the screen. Where it is impractical (perhaps due to device size) to affix the label to the device, affix the label to the device enclosure.

Labels must be machine printed or engraved, plastic or metal, designed for permanent installation, must use a font no smaller than 14 point, and must provide a high contrast between font and background colors.

3.3.4 Session Lock and Session Termination Requirements In MODERATE Impact Systems:

{For Government Reference Only: This subpart (and its subparts) relates to AC-11(a), AC-11(b), AC-11(1), AC-12, SC-10; AC-10; CCI-000058, CCI-000059, CCI-000056, CCI-000057, CCI-000060, CCI-002360, CCI-002361, CCI-001133, CCI-001134, CCI-000054, CCI-000055, CCI-002252}

3.3.4.1 Session Termination

When session termination is required for a User Interface, the User Interface must implement session termination a) based on manual initiation, or b) based on lack of activity, or c) based on either manual initiation or lack of activity, as indicated.

Session Termination must result in logging out the user. A logged out User Interface may only perform actions as indicated in the "Permitted Actions Without Identification or Authentication" subpart of this Section or display a publicly viewable image or blank screen. User Interfaces must remain logged out (session terminated) until a user enters correct authentication information, which must initiate a new session. All User Interfaces running on computers and all Remote User Interfaces must also terminate network connections as part of session termination.

3.3.4.2 Session Lock

When session lock is required for a User Interface, the User Interface must implement session lock a) based on manual initiation, or b) based on lack of activity, or c) based on either manual initiation or lack of activity, as indicated.

Session lock must result in the User Interface being suspended and the user interface must display a publicly viewable image or blank screen. No interaction with the user interface shall be possible until either a) the same user enters valid authentication information, in which case that session must be continued, or b) until a different user enters valid authentication information at which point the first session must be terminated and a new session initiated for the new user.

3.3.4.3 Session Lock and Termination for Computers

Except as shown in the Session Lock and Session Termination Exception Table, User Interface sessions provided by computer operating systems must

support the requirement for both Session Lock and Session Termination. Session Lock and Session Termination must be capable of being initiated by the user and must also be initiated by lack of activity. Session Lock must occur after 15 minutes of inactivity, and Session Termination must occur after 30 minutes total of inactivity (including, not in addition to, the time for Session Lock). When a user initiates a new session, terminate existing sessions if necessary to limit the total number of concurrent sessions to 1.

Except as shown in the Session Lock and Session Termination Exception Table, Other User Interface sessions running on computers (for local user interfaces) or hosted on a computer (for remote user interfaces) and supporting accounts must support user initiation of Session Termination and session lock. Session lock may be initiated by user initiation or automatically after 15 minutes of inactivity. In addition, remote User Interface sessions must also initiate Session Termination after 30 minutes of inactivity unless otherwise indicated in the Session Lock and Termination Exceptions table.

3.3.4.4 Session Lock and Termination for Controllers

Except as shown in the Session Lock and Session Termination Exception Table, Writable Remote User Interfaces must support requirements for Session Termination, and must both be capable of being initiated by the user and initiated by lack of activity. Session Termination must initiate after 30 minutes of inactivity.

Except as shown in the Session Lock and Session Termination Exception Table, Local User Interfaces supporting accounts must support manual initiation of Session Termination. Privileged Local User Interfaces must also support timed initiation of Session Termination, unless otherwise indicated in the Session Lock and Termination Exceptions table, with Session Termination initiated at 30 minutes of inactivity.They must also support session lock, where session lock may be initiated by user initiation or automatically after 15 minutes of inactivity.

3.3.4.5 Session Lock and Termination Exceptions

Table: Session Lock and Termination Exceptions

Device	**Location**	**Session Lock and Termination Requirements for Device (or "none" to indicate session lock or session termination is not required)**
FACP	As Shown in Drawing	None

3.3.5 Permitted Actions Without Identification or Authentication

{For Government Reference Only: This subpart (and its subparts) relates to AC-14; CCI-000061, CCI-000232}

The control system must require identification and authentication before allowing any actions except read-only actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.

3.3.6 Pysical Security in MODERATE Impact Systems

{For Government Reference Only: This subpart relates to PE-3(1), PE-4, PE-5, SC-7(a), SC-7(c), SC-8, SC-8(1); CCI-000928, CCI-002926, CCI-000936, CCI-002930, CCI-002931, CCI-000937, CCI-001097, CCI-001109, CCI-002418, CCI-002419, CCI-002421.}

3.3.6.1 Physical Security for Media

3.3.6.1.1 Physical Security for Media Inside Mission Space

Install all non-IP network media located inside of the mission space in conduit. Install all IP network media located inside of the mission space in intermediate metallic conduit.

3.3.6.1.2 Physical Security for Media Outside Mission Space

Install all network media (both IP and non-IP) located outside of the mission space in rigid metallic conduit.

3.3.6.1.3 Physical Security for Non-Network Media in Fire Protection Systems

For Fire Supression Systems which can be be inhibited or forced to activate by manipulation of non-network wiring, install all non-network media outside of mission space, including analog and binary instrumentation wiring and power wiring, in rigid metallic conduit.

3.3.6.2 Physical Security for Devices

Install all devices (computers and controllers) which are located outside of mission space in lockable enclosures. (Recall that per definition of mission space, a room controlled by the mission is mission space regardless of whether it is contiguous with other mission space.)

Install all controllers connected to an IP network in lockable enclosures (both inside and outside of mission space).

3.3.6.2.1 Physical Security for Devices in Fire Protection Systems

For Fire Supression systems with a release panel, install all components of the supression system either inside mission space, or within locked enclosures. Components of these systems include: release panel, any relay or interface panels, analog and binary inputs or outputs, control valves, manual valves.

3.3.6.3 Physical Security for User Interfaces

Physical security requirements for User Interfaces are specified in the preceeding paragraphs of this Section.

3.3.7 Enclosures

Prior to final acceptance of the sytsem, lock all lockable enclosures.

Submit an Enclosure Keys submittal with all copies of keys for all enclosures and a key inventory list documenting all keys. Label each key with the matching enclosure identifier.

3.4 USER IDENTIFICATION AND AUTHENTICATION

{For Government Reference Only: This subpart (and its subparts) relates to IA-2, IA-2(1),IA-2(12), IA-5 IA-5(b), IA-5(c), IA-5(e), IA-5(g), IA-5(1), IA-5(11); CCI-000764, CCI-000765, CCI-001953, CCI-001954, CCI-001544, CCI-001989, CCI-000182, CCI-001610, CCI-000192, CCI-000193, CCI-000194, CCI-000205, CCI-001619, CCI-001611, CCI-001612, CCI-001613, CCI-001614, CCI-000195, CCI-001615, CCI-000196, CCI-000197, CCI-000199, CCI-000198, CCI-001616, CCI-001617, CCI-000200, CCI-001618, CCI-002041, CCI-002002, CCI-002003. For MODERATE Impact systems, this subpart also relates to AC-6 (1), AC-6(10), AC-6(2), AC-6(9)IA-2(4), IA-5(13); CCI-001558, CCI-002221, CCI-002222, CCI-002223, CCI-002235, CCI-000039, CCI-001419, CCI-002234, CCI-000768, CCI-002007.}

This subpart indicates requirements for specific methods of identification and authentication for users and user accounts. Where these requirements conflict apply the following order of precedence: 1) If present, Device Specific Requirements take precedence over any other requirements; and then 2) multifactor authentication requirements take precedence over password requirements.

3.4.1 User Identification and Authentication for All System Types

Unless otherwise indicated, all user interfaces supporting accounts (either FULLY or MINIMALLY) must implement Identification and Authorization via passwords.

3.4.2 User Identification and Authentication for Specific System Types

System specific requirements are in addition to and supersede those indicated for all system types. When no additional requirements are indicated for a specific system type the requirements for all systems still apply to that system type.

3.4.3 User Identification and Authentication for Specific Devices

There are no additional device specific user interface requirements

3.4.4 Implementation of Identification and Authorization Requirements

Identification and Authorization must be met by one of the following methods:

a. Direct implementation in the user interface.

3.4.5 Password-Based Authentication Requirements

3.4.5.1 Passwords for Controllers FULLY Supporting Accounts

All controllers FULLY supporting accounts and supporting password-based authentication must enforce the following requirements:

a. Minimum password length of fifteen (15) characters.

b. Password must contain at least two (2) uppercase characters.

c. Password must contain at least two (2) lowercase characters.

d. Password must contain at least two (2) numeric characters.

e. Password must contain at least two (2) special characters. The list of supported special characters must include at least 4 separate characters.

f. Password must have a maximum lifetime of sixty (60) days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.

g. Password must differ from previous ten (10) passwords, where differ is defined as changing at least fifty percent of the characters.

h. Passwords must be cryptographically protected during storage and transmission.

3.4.5.2 Passwords for Remote Interfaces

Passwords for connecting to a Remote User Interface supporting password-based authentication must enforce the following requirements:

a. Minimum password length of fifteen (15) characters.

b. Password must contain at least two (2) uppercase characters.

c. Password must contain at least two (2) lowercase characters.

d. Password must contain at least two (2) numeric characters.

e. Password must contain at least two (2) special characters. The list of supported special characters must include at least 4 separate characters.

f. Password must have a maximum lifetime of 60 days. When passwords expire, prompt users to change passwords. Do not lock accounts due to expired passwords.

g. Password must differ from previous ten (10) passwords, where differ is defined as changing at least 50 percent of the characters (where location is significant, a character may be reused if it is in a different position).

h. Passwords must be cryptographically protected during storage and transmission.

3.4.5.3 Passwords for Devices Minimally Supporting Accounts

Devices MINIMALLY supporting accounts must support passwords with a minimum length of four (4) characters.

3.4.5.4 Password Configuration and Reporting

For all devices with a password, change the password from the default password. Coordinate selection of passwords with the Password Point of Contact. Do not use the same password for more than one device unless

specifically instructed to do so. Provide a Confidential Password Report documenting the password for each device and describing the procedure to change the password for each device.

Do not provide the Confidential Password Report in electronic format. Provide two (2) hardcopies of the Confidential Password Report, each copy in its own sealed envelope.

For all devices with a password, coordinate the changing of passwords with the project site following testing of the system but prior to turnover to the Government. Coordinate with Password Point of Contact to determine appropriate project site personnel to complete password changes. Accompany identified personnel to each device with a password and instruct personnel on the process of changing password. Record the time, date and personnel present when each device's password is changed and submit a Password Change Summary Report documenting this information.

Provide the Password Change Summary Report electronically in both PDF and Microsoft Excel.

3.4.6 Authenticator Feedback

{For Government Reference Only: This subpart relates to IA-6; CCI-000206}

Devices must never show authentication information, including passwords, on a display. Devices that momentarily display a character as it is entered, and then obscure the character, are acceptable. For devices that have STIGs or SRGs related to obscuring of authenticator feedback (CCI-000206), comply with the requirements of those STIGS/SRGs.

3.5 REQUIREMENTS FOR LEAST FUNCTIONALITY

{For Government Reference Only: This subpart (and its subparts), along with the network communication report submittal specified elsewhere in this section, relates to CM-6(a), CM-6(c), CM-7, CM-7(1)(b), SC-41; CCI-000363, CCI-000364, CCI-000365, CCI-001588, CCI-001755, CCI-000381, CCI-000380, CCI-00382, CCI-001761, CCI-001762, CCI-002544, CCI-002545, CCI-002546. For MODERATE Impact systems, this subpart (and its subparts) also relates to CM-7(2), CM-7(5)(a), CM-7(5)(b); CCI-000381, CCI-000380, CCI-00382, CCI-001761, CCI-001762}

For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I/O access for least functionality), install and configure the device in accordance with that STIG or SRGs.

3.5.1 Device Capabilities

Do not provide devices with remote user interfaces or full user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice.

Unless specifically required by the government, do not provide a capability to update device firmware over the network.

3.5.2 Software

For software that has a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port access for least functionality), install and configure the software in accordance with that STIG or SRG.

For MODERATE Impact Systems: Do not provide (install) software that is not specifically required to meet a contract requirement. Do not implement functionality within software
that is not specifically required to meet contract requirements.

3.6 SYSTEM AND COMMUNICATION PROTECTION

3.6.1 Communication With Other Control Systems

Communication with other Facility Related Control Systems (e.g. HVAC, Elevator) or Field Control Systems shall be accomplished using hardwired analog signals (e.g. 4-20 mADC, 0-10 VDC, etc.) or binary signals (e.g. dry contact). The use of digital communication protocols is not allowed unless explicitly stated or shown elsewhere in these contract documents.

3.6.2 Personal Area Networks (PAN)

Disable all wireless personal area network protocols including, but not limited to: Bluetooth, Near-Field Communications (NFC), infrared, etc.

3.6.3 Physical Port Access

Furnish and install port blocking devices on all unused communication ports on UMCS equipment modified as part of this project. This includes, but is not limited to: Ethernet ports, RS-232 ports, USB ports, etc.

Furnish and install cable lock devices on all used communication ports on UMCS equipment modified as part of this project. This includes, but is not limited to: Ethernet ports, RS-232 ports, USB ports, etc.

Furnish and deliver keys needed to remove port blocking and cable locks to the System Owner (SO) and also local base management staff that will be responsible for the maintenance of this control system. Provide a minimum of six (6) keys for each unique key device.

3.6.4 Collaborative Computing

{For Government Reference Only: This subpart relates to SC-15(a), SC-15(b); CCI-001150, CCI-001152.}

Without explicit approval from the project site, control systems must not use collaborative computing technologies.

3.6.5 Denial of Service Protection and Application Partitioning In MODERATE Impact Systems:

{For Government Reference Only: This subpart relates to SC-5, SC-39, SC-7(a); CCI-001093, CCI-002385, CCI-002386, CCI-002430, CCI-001097. For MODERATE Impact systems, this subpart also relates to SC-2; CCI-001082.}

To the greatest extent practical, implement control logic without reliance

on the network. Except when required to meet the requirements of the control system Section (where the requirement can only be met using computer hardware), do not implement control logic in computers. For MODERATE Impact systems, do not implement control logic in a device providing (i.e. acting as a server for) a Full Remote User Interface.

3.6.5.1 Default Requirements for MODERATE Impact Control Systems

Except for networked input and outputs on input-output buses specifically designed to provide high reliability or redundancy, sensors and actuators must not rely on the network to exchange data with the controller executing the sequence of operation which uses the sensor value or determines the actuator command.

Sensor values required by multiple devices may be shared over the network provided they are connected to a controller requiring the value for execution of the sequence and that controller shares the value on the network.

3.6.6 Process Isolation and Boundary Protection in Moderate Impact Fire Protection Systems

{For Government Reference Only: This subpart relates to SC-7(a), SC-7(c), SC-7(4)(a), SC-7(4)(c), SC-7(5), SC-7(7), SC-7(9)(a), SC-7(11), SC-7(13), SC-7(13), SC-7(18); CCI-001097, CCI-001098, CCI-001102, CCI-002396, CCI-001109, CCI-002397, CCI-002398, CCI-002399, CCI-002403, CCI-001120, CCI-001119, CCI-001126}

3.6.6.1 Radio Interfaces for Fire Protection Systems

When radios interfacing a local fire protection system to a supervisory system are not NIST FIPS 140-2 validated, use a relay panel interface between the local fire protection system and the radio. Install and configure the relay panel to prohibit initiating any action within the local fire protection system other than causing the system to play a pre-recorded message or causing the system to play a live audio message. Install relays using the normally closed contact such that they pass a signal when they open, and so that a relay that loses power or has a failed coil passes the signal

3.6.6.2 Fire Supression System Network Isolation

For fire suppression systems including a release panel, any network used in these systems shall be dedicated to these systems and must be isolated from any other network, including other components of the Fire Alarm and Fire Suppression systems. Use only dry contacts and relays to transfer signals from these systems to any other systems. Install relays using the normally closed contact such that they pass a signal when they open, and so that a relay that loses power or has a failed coil passes the signal

3.7 SAFE MODE AND FAIL SAFE OPERATION

{For Government Reference Only: This subpart (and its subparts) relates to CP-12, SI-10(3), SI-17; CCI-002855, CCI-002856, CCI-002857, CCI-002754, CCI-002773, CCI-002774, CCI-002775}

For all control system components with an applicable STIG or SRG,

configure the component in accordance with all applicable STIGs and SRGs.

3.8 DEVICE POWER

{For Government Reference Only: This subpart (and its subparts) relates to PE-11, PE-11(1); CCI-002955, CCI-000961. For MODERATE Impact systems, this subpart (and its subparts) also relates to PE-9, PE-9(1); CCI-000952, CCI-002953, CCI-002954.}

For MODERATE Impact Systems: Provide control system with power supply meeting or exceeding the reliability of the controlled equipment. Powering control system devices using the same power source as the equipment controlled by the device is a permissible method of meeting this requirement. Without explicit approval from the government, do not install local uninterruptible power supplies (UPSs) as a source of device power.

3.8.1 Device Behavior on Loss of Power In MODERATE Impact Systems:

Application programs and configuration settings must be stored in devices in manner such that a loss of power does not result in a loss of the application program or configuration settings: Loss of power must never result in the loss of application programs, regardless of the length of time power is lost; and loss of power for less than 2,500 hours must not result in the loss of configured settings.

In the event of a loss of power, when power is restored, controllers and computers executing control logic (and the underlying equipment) must recover and resume their normal sequences of operation. Note that the sequence of operation may require specific actions (e.g. startup sequences) upon recovery from loss of power.

3.9 SYSTEM AND INTEGRATION INTEGRITY

3.9.1 Software, Firmware, and Information Integrity In MODERATE Impact Systems:

If there exists Integrity Verification Software that can check software, firmware, or information in the control system and verify its integrity, provide it. If no such software exists provide a statement to this affect in lieu of the software.

3.10 CONTROL SYSTEM CYBERSECURITY TESTING

{For Government Reference Only: For MODERATE Impact systems, this subpart (and its subparts) relates to SA-11(a), SA-11(b), SA-11(c), SA-11(d), SA-11(e); CCI-003171, CCI-003172, CCI-003173, CCI-003174, CCI-003175, CCI-003176, CCI-003177, CCI-003178.}

3.10.1 Control System Cybersecurity Testing Procedures

Prepare Control System Cybersecurity Testing Procedures explaining step-by-step, the actions and expected results that will demonstrate that the control system meets the requirements of this Section.

Submit four (4) copies of the Control System Cybersecurity Testing

Procedures. The Control System Cybersecurity Testing Procedures may be submitted as a Technical Data Package.

3.10.2 Control System Cybersecurity Testing Execution

Using the Control System Cybersecurity Testing Procedures verify that the control system meets the requirements of this Section. UNLESS GOVERNMENT WITNESSING OF A TEST IS SPECIFICALLY WAIVED BY THE GOVERNMENT, PERFORM ALL TESTS WITH A GOVERNMENT WITNESS. If testing reveals deficiencies in the system, correct the deficiency and retest until successful.

3.10.3 Control System Cybersecurity Testing Report

Prepare and submit a Control System Cybersecurity Testing Report documenting all tests performed and their results. Include all tests in the Control System Cybersecurity Testing Procedures and any additional tests performed during testing. Document test failures and repairs conducted with the test results.

Submit four (4) copies of the Control System Cybersecurity Testing Report. The Control System Cybersecurity Testing Report may be submitted as a Technical Data Package.

3.11 FIELD QUALITY CONTROL, CYBERSECURITY VALIDATION SUPPORT

In addition to testing and testing support required by other Sections, provide a minimum of four (4) hours of technical support for cybersecurity testing of control systems to support the DoD Risk Management Framework process Cybersecurity assessment of the control system. This support is independent of (and in addition to) the Control System Cybersecurity Testing specified in this section.

3.12 CYBERSECURITY TRAINING

Provide four (4) hours of classroom and hands-on training for six (6) Government personnel on the cybersecurity operation and maintenance of the control system provided. This training is in addition to and must be coordinated with control system training specified in other Sections.

The Government will provide the training location. Training must cover, at a minimum: (a) applying software and firmware updates, (b) user account creation, modification and deletion, (c) audit log upload procedures and (d) identification of privileged user interfaces and system impact of those interfaces. Training session must include a question and answer period during which government staff questions about cybersecurity aspects of the control system are answered.

-- End of Section --

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-002110	AC-2(a)	The organization defines the information system account types that support the organizational missions / business functions.	FRONT END SERVERS AND WORKSTATIONS will FULLY support accounts. Accounts and associated roles to gain access to the system through the Operating System (OS) are different than account and associated roles to gain access to the control system (CS) application. Users shall be given a unique username and assigned to a role reflecting the level of access that they are required to have. CS users should only require a general user account when authenticating to the front end server or workstation. In some cases, programmers and developers may need permissions at the local administrator level in order to execute CS tools. Users requiring administrator access to the system in order to execute special CS tools will have an administrator account and a general user account. FIELD POINT OF CONNECTIONS (FPOC's) which consists of standard IT managed Ethernet switch's or IP routers will FULLY support accounts. FPOCS should only have a single role relegated to administration of the device. Also known as Building Point of Connections (BPOC). FIELD CONTROL SYSTEM IP (FCS-IP) Network Controllers on an IP network shall FULLY support accounts on capable devices and WEAKLY support accounts on those with accounts that cannot be	N/A	Role based authentication not supported by field devices.	N/A	N/A	Role based authentication not supported by field devices.	N/A
M	CCI-001361	AC-2(2)	The organization defines a time period after which temporary accounts are automatically terminated.	DoD has defined the time period as 72 hours. The time period of 72 hours applies to temporary user accounts. Recommended Compelling Evidence: **Automatically compliant**	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A
M	CCI-001365	AC-2(2)	The organization defines a time period after which emergency accounts are automatically terminated.	DoD has defined the time period as never. The time period of never applies to emergency admin accounts. Recommended Compelling Evidence: **Automatically compliant**	N/A	This is policy to be provided by the Government. See CCI-1682 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-1682 for design and implementation.	N/A
M	CCI-001682	AC-2(2)	The information system automatically removes or disables emergency accounts after an organization-defined time period for each type of account.	The organization being inspected / assessed configures the information system to never automatically remove or disable emergency accounts. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1682. DoD has defined the time period as never. Recommended Compelling Evidence: 1.) Signed and dated documentation which defines how emergency accounts are never disabled or removed. 2.) Applicable STIG checks. 3.) Log trail of emergency accounts.	N/A	Devices at this level do not support emergency accounts.	N/A	N/A	Devices at this level do not support emergency accounts.	N/A
M	CCI-000217	AC-2(3)	The organization defines a time period after which inactive accounts are automatically disabled.	DoD has defined the time period as 35 days. Recommended Compelling Evidence: Automatically compliant	N/A	This is policy to be provided by the Government. See CCI-17 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-17 for design and implementation.	N/A
M	CCI-000017	AC-2(3)	The information system automatically disables inactive accounts after an organization-defined time period.	The organization being inspected / assessed configures the information system to disable inactive accounts after 35 days. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000017. DoD has defined the time period as 35 days. Recommended Compelling Evidence: 1.) Access control policy which defines the process for disabling inactive accounts after 35 days. 2.) Applicable STIG / SRG checks.	N/A	User logins at this level are stored locally within device and unable to inherit inactivity rules from the domain. Hardware at this level does not support inactivity monitoring for local accounts.	N/A	N/A	User logins at this level are stored locally within device and unable to inherit inactivity rules from the domain. Hardware at this level does not support inactivity monitoring for local accounts.	N/A
M	CCI-000018	AC-2(4)	The information system automatically audits account creation actions.	The organization being inspected / assessed configures the information system to automatically audit account creation actions. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 18. Recommended Compelling Evidence: 1.) Audit trails of account creation. 2.) Applicable STIG / SRG checks.	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-001683	AC-2(4)	The information system notifies organization-defined personnel or roles for account creation actions.	The organization being inspected / assessed configures the information system to notify the system administrator and ISSO for account creation actions. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1683. DoD has defined the personnel or roles as the system administrator and ISSO. Recommended Compelling Evidence: 1.) Signed and dated documentation which defines the process for notifying the system administrator and ISSO of account creation actions. 2.) Applicable STIG / SRG checks.	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A
M	CCI-001405	AC-2(4)	The information system automatically audits account removal actions.	The organization being inspected / assessed configures the information system to automatically audit account removal actions. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1405. Recommended Compelling Evidence: 1.) Audit trails of account removal. 2.) Applicable STIG / SRG checks.	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A
M	CCI-001686	AC-2(4)	The information system notifies organization-defined personnel or roles for account removal actions.	The organization being inspected / assessed configures the information system to notify the system administrator and ISSO for account removal actions. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1686. DoD has defined the personnel or roles as the system administrator and ISSO. Recommended Compelling Evidence: 1.) Signed and dated documentation which defines the process for notifying the system administrator and ISSO of account removal actions. 2.) Applicable STIG / SRG checks.	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A
M	CCI-001403	AC-2(4)	The information system automatically audits account modification actions.	The organization being inspected / assessed configures the information system to automatically audit account modification actions. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1403. Recommended Compelling Evidence: 1.) Audit trails of account modification. 2.) Applicable STIG / SRG checks.	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A
M	CCI-001684	AC-2(4)	The information system notifies organization-defined personnel or roles for account modification actions.	The organization being inspected / assessed configures the information system to notify the system administrator and ISSO for account modification actions. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1684. DoD has defined the personnel or roles as the system administrator and ISSO. Recommended Compelling Evidence: 1.) Signed and dated documentation which defines the process for notifying the system administrator and ISSO of account modification actions. 2.) Applicable STIG / SRG checks.	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A
M	CCI-002130	AC-2(4)	The information system automatically audits account enabling actions.	The organization being inspected / assessed configures the information system to automatically audit account enabling actions. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 2130. Recommended Compelling Evidence: 1.) Signed and dated documentation which defines who the personnel and roles are to receive account enabling notifications. 2.) Audit trail of account enabling actions. 3.) Applicable STIG / SRG checks.	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-002132	AC-2(4)	The information system notifies organization-defined personnel or roles for account enabling actions.	The organization being inspected / assessed configures the information system to notify the system administrator and ISSO for account enabling actions. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 2132. DoD has defined the personnel or roles as the system administrator and ISSO. Recommended Compelling Evidence: 1.) Audit trail of account enabling actions. 2.) Applicable STIG / SRG checks.	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A
M	CCI-001404	AC-2(4)	The information system automatically audits account disabling actions.	The organization being inspected / assessed configures the information system to automatically audit account disabling actions. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1404. Recommended Compelling Evidence: 1.) Audit trails of account disabling. 2.) Applicable STIG / SRG checks.	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A
M	CCI-001685	AC-2(4)	The information system notifies organization-defined personnel or roles for account disabling actions.	The organization being inspected / assessed configures the information system to notify the system administrator and ISSO for account disabling actions. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1685. DoD has defined the personnel or roles as the system administrator and ISSO. Recommended Compelling Evidence: 1.) Signed and dated documentation which defines the process for notifying the system administrator and ISSO of account disabling actions. 2.) Applicable STIG / SRG checks.	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A
L	CCI-000213	AC-3	The information system enforces approved authorizations for logical access to information and system resources in accordance with applicable access control policies.	Any device supporting accounts (either FULLY or WEAKLY) must limit access to the device according to specified limitations for each account. Install and configure any device having a Security Technical Implementation Guide (STIG) or Security Requirements Guide (SRG) in accordance with that STIG or SRG.	App	Contractor to configure authentication, authorization, and roles by device type as stated in specifications. Apply STIG/SRGs.	Con	App	Contractor to configure authentication, authorization, and roles by device type as stated in specifications. Apply STIG/SRGs.	Con
M	CCI-001548	AC-4	The organization defines the information flow control policies for controlling the flow of information within the system.	The organization being inspected / assessed defines and documents the information flow control policies for controlling the flow of information within the system. DoD has determined the information flow control policies are not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) Signed and dated access control policy. 2.) Signed and dated data flow diagram. 3.) Signed and dated documentation that defines the information flow control policies.	N/P	This is policy to be provided by the Government. See CCI-1368 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-1368 for design and implementation.	N/A
M	CCI-001550	AC-4	The organization defines approved authorizations for controlling the flow of information within the system.	The organization being inspected / assessed defines and documents approved authorizations for controlling the flow of information within the system. Recommended Compelling Evidence: 1.) Signed and dated access control policy. 2.) Signed and dated data flow diagram. 3.) Signed and dated documentation that defines approved authorizations for controlling the flow of information	N/P	This is policy to be provided by the Government. See CCI-1368 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-1368 for design and implementation.	N/A
M	CCI-001368	AC-4	The information system enforces approved authorizations for controlling the flow of information within the system based on organization-defined information flow control policies.	The organization being inspected / assessed configures the information system to enforce approved authorizations for controlling the flow of information within the system based on information flow control policies defined in AC-4, CCI 1548. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1368. Recommended Compelling Evidence: 1.) Signed and dated access control policy. 2.) Signed and dated data flow diagram. 3.) Applicable STIG / SRG checks.	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-001549	AC-4	The organization defines the information flow control policies for controlling the flow of information between interconnected systems.	The organization being inspected / assessed defines and documents the information flow control policies for controlling the flow of information between interconnected systems. DoD has determined the information flow control policies are not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) Signed and dated access control policy. 2.) Signed and dated data flow diagram. 3.) Signed and dated documentation that defines the information flow control policies.	N/P	This is policy to be provided by the Government. See CCI-1414 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-1414 for design and implementation.	N/A
M	CCI-001551	AC-4	The organization defines approved authorizations for controlling the flow of information between interconnected systems.	The organization being inspected / assessed defines and documents approved authorizations for controlling the flow of information between interconnected systems. Recommended Compelling Evidence: 1.) Signed and dated access control policy. 2.) Signed and dated data flow diagram. 3.) Signed and dated documentation that defines approved authorizations for controlling the flow of information 4.) Applicable STIG / SRG checks.	N/P	This is policy to be provided by the Government. See CCI-1414 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-1414 for design and implementation.	N/A
M	CCI-001414	AC-4	The information system enforces approved authorizations for controlling the flow of information between interconnected systems based on organization-defined information flow control policies.	The organization being inspected / assessed configures the information system to enforce approved authorizations for controlling the flow of information between interconnected systems based on information flow control policies defined in AC-4,CCI 1549. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1414 Recommended Compelling Evidence: 1.) Signed and dated access control policy. 2.) Signed and dated data flow diagram. 3.) Applicable STIG / SRG checks.	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A
M	CCI-002221	AC-6(1)	The organization defines the security-relevant information for which access must be explicitly authorized.	DoD has defined the security-relevant information as all security-relevant information not publicly available. Recommended Compelling Evidence: **Automatically compliant**	App	This is policy to be provided by the Government. See CCI-2223 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-2223 for design and implementation.	Gov
M	CCI-002223	AC-6(1)	The organization explicitly authorizes access to organization-defined security-relevant information.	The organization being inspected / assessed documents and implements a process to explicitly authorize access to all security-relevant information not publicly available. Explicit authorization can be in the form of an acceptable use policy signed by the user at the time of access being granted. DoD has defined the security-relevant information as all security-relevant information not publicly available. Recommended Compelling Evidence: 1.) Signed and dated access control policy 2.) Signed and dated system security plan (SSP) 3.) Signed and dated documentation that defines the process to explicitly authorize access to all security-relevant information not publicly available	App	Contractor to configure authentication, authorization, and roles by device type as stated in specifications.	Con	App	Contractor to configure authentication, authorization, and roles by device type as stated in specifications.	Con
M	CCI-001558	AC-6(1)	The organization defines the security functions (deployed in hardware, software, and firmware) for which access must be explicitly authorized.	DoD has defined the security functions as all functions not publicly accessible. Recommended Compelling Evidence: **Automatically compliant**	App	This is policy to be provided by the Government. See CCI-2222 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-2222 for design and implementation.	Gov
M	CCI-002222	AC-6(1)	The organization explicitly authorizes access to organization-defined security functions.	The organization being inspected / assessed documents and implements a process to explicitly authorize access to all functions not publicly accessible. Explicit authorization can be in the form of an acceptable use policy signed by the user at the time of access being granted. DoD has defined the security functions as all functions not publicly accessible. Recommended Compelling Evidence: 1.) Signed and dated access control policy 2.) Signed and dated system security plan (SSP) 3.) Signed and dated documentation that defines the process to explicitly authorize access to all functions not publicly accessible	App	Contractor to configure authentication, authorization, and roles by device type as stated in specifications.	Con	App	Contractor to configure authentication, authorization, and roles by device type as stated in specifications.	Con

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-001419	AC-6(2)	The organization defines the security functions or security-relevant information to which users of information system accounts, or roles, have access.	DoD has defined the security functions and security-relevant information as any privileged security functions or security-relevant information. Recommended Compelling Evidence: **Automatically compliant**	App	Automatically compliant.	Gov	App	Automatically compliant.	Gov
M	CCI-000039	AC-6(2)	The organization requires that users of information system accounts or roles, with access to organization-defined security functions or security-relevant information, use non-privileged accounts, or roles, when accessing non-security functions.	The organization being inspected / assessed documents and implements a process to require that users of information system accounts or roles, with access to any privileged security functions or security-relevant information, use non-privileged accounts, or roles, when accessing non-security functions. DoD has defined the security functions and security-relevant information as any privileged security functions or security-relevant information. Recommended Compelling Evidence: 1.) Signed and dated access control policy 2.) Signed and dated system security plan (SSP) 3.) Provide signed and dated documentation that defines the process to require that users of information system accounts or roles, with access to any privileged security functions or security-relevant information, use non-privileged accounts, or roles, when accessing non-security functions.	App	This is primarily a policy-based control to be provided by the Government. Where supported, local user accounts based on privilege will be created.	Gov	App	This is primarily a policy-based control to be provided by the Government. Where supported, local user accounts based on privilege will be created.	Gov
M	CCI-002234	AC-6(9)	The information system audits the execution of privileged functions.	The organization being inspected / assessed configures the information system to audit the execution of privileged functions. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 2234. Recommended Compelling Evidence: 1.) Applicable STIG / SRG checks 2.) Documentation that shows the system is configured to audit the execution of privileged functions	N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
M	CCI-002235	AC-6(10)	The information system prevents non-privileged users from executing privileged functions to include disabling, circumventing, or altering implemented security safeguards / countermeasures.	The organization being inspected / assessed configures the information system to prevent non-privileged users from executing privileged functions to include disabling, circumventing, or altering implemented security safeguards / countermeasures.	App	Contractor to configure authentication, authorization, and roles by device type as stated in specifications.	Con	App	Contractor to configure authentication, authorization, and roles by device type as stated in specifications.	Con
L	CCI-000043	AC-7(a)	The organization defines the maximum number of consecutive invalid logon attempts to the information system by a user during an organization-defined time period.	DoD has defined the maximum number as three (3). Recommended Compelling Evidence: Automatically Compliant	App	This is policy to be provided by the Government. See CCI-44 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-44 for design and implementation.	Gov
L	CCI-001423	AC-7(a)	The organization defines the time period in which the organization-defined maximum number of consecutive invalid logon attempts occur.	DOD policy requires the system to Lock the user account when [3] unsuccessful login attempts occur within a [60 minute] interval unless a life safety issue will occur.	App	This is policy to be provided by the Government. See CCI-44 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-44 for design and implementation.	Gov
L	CCI-000044	AC-7(a)	The information system enforces the organization-defined limit of consecutive invalid logon attempts by a user during the organization-defined time period.	The information system shall be set to Lock the user account when three (3) unsuccessful login attempts occur within a 60 minute interval. Devices which WEAKLY supports accounts shall implement the requirements of a FULLY support account when possible. If unsuccessful login attempts and accounts lockouts are not supported by the device, then physical access to the device should limited to only authorized personnel. Document any device incapable of meeting the defined requirement and state actual implementation.	N/P	Devices which MINIMALLY support accounts are not required to lock based on unsuccessful logon attempts.	N/A	N/P	Devices which MINIMALLY support accounts are not required to lock based on unsuccessful logon attempts.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-002237	AC-7(b)	The organization defines the delay algorithm to be employed by the information system to delay the next login prompt when the maximum number of unsuccessful attempts is exceeded.	DOD policy requires that once the indicated number of unsuccessful login attempts occurs, delay login prompts by [5] seconds. If the provided software cannot meet these requirements, document software capabilities to protest from subsequent unsuccessful login attempts and propose alternate protections. Do not implement alternate protection measures without explicit permission from the Government	App	This is policy to be provided by the Government. See CCI-2238 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-2238 for design and implementation.	Gov
L	CCI-002236	AC-7(b)	The organization defines the time period the information system will automatically lock the account or node when the maximum number of unsuccessful attempts is exceeded.	DOD policy requires for systems that once an account is locked, the account must stay locked until unlocked by an administrator.	App	This is policy to be provided by the Government. See CCI-2238 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-2238 for design and implementation.	Gov
L	CCI-002238	AC-7(b)	The information system automatically locks the account or node for either an organization-defined time period, until the locked account or node is released by an administrator, or delays the next login prompt according to the organization-defined delay algorithm when the maximum number of unsuccessful attempts is exceeded.	The information system shall be configured to automatically lock the account or node until the locked account is released by an administrator and delays the next login prompt for a minimum of 5 seconds when the maximum number of unsuccessful attempts is exceeded. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 2238. DoD has defined the delay algorithm as a minimum of [5] seconds. DoD has defined the time period as until released by an administrator. Devices which WEAKLY supports accounts shall implement the requirements of a FULLY support account when possible. If unsuccessful login attempts and accounts lockouts are not supported by the device, then physical access to the device should limited to only authorized personnel.	N/P	Devices which MINIMALLY support accounts are not required to lock based on unsuccessful logon attempts.	N/A	N/P	Devices which MINIMALLY support accounts are not required to lock based on unsuccessful logon attempts.	N/A
L	CCI-002247	AC-8(a)	The organization defines the use notification message or banner the information system displays to users before granting access to the system.	The DOD Consent Banner is defined on the RMF Knowledge service along with the Army Regulation 25-2 and can be found on the RMF Knowledge Service site at https: / / rmfks.osd.mil / rmf / Guidance / GoverningPolicy / Pages / ConsentBanner.aspx	App	This is policy to be provided by the Government. See CCI-48, 2243, 2244, 2245, 2246, and 2250 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-48, 2243, 2244, 2245, 2246, and 2250 for design and implementation.	Gov
L	CCI-000048	AC-8(a)	The information system displays an organization-defined system use notification message or banner before granting access to the system that provides privacy and security notices consistent with applicable federal laws, Executive Orders, directives, policies, regulations, standards, and guidance.	All devices (PC's, BPOCs, Network switches, etc....) with a user interface supporting the use of a password or PIN, and capable of displaying 50 or more alphanumeric characters shall be configured to display the DoD Information Systems – Standard Consent Banner and User Agreement before granting access to the system that provides privacy and security notices consistent with applicable federal laws, Executive Orders, directives, policies, regulations, standards, and guidance. For information system components that have applicable STIGs or SRGs, the organization must comply with the STIG / SRG guidance that pertains to CCI 48. The DOD Consent Banner can be found on the RMF Knowledge Service site at: https: / / rmfks.osd.mil / rmf / Guidance / GoverningPolicy / Pages / ConsentBanner.aspx Devices connected to a network, with a user interface supporting use of a password or PIN, and not capable of displaying 50 or more alphanumeric characters must have a permanently affixed label displaying an approved banner from the policy listed above.	N/A	Devices at this level are not connected to an IP Network.	N/A	N/A	Devices at this level are not connected to an IP Network.	N/A
L	CCI-002243	AC-8(a)(1)	The organization-defined information system use notification message or banner is to state that users are accessing a U.S. Government information system.	The DOD Consent Banner is defined on the RMF Knowledge service along with the Army Regulation 25-2 and can be found on the RMF Knowledge Service site at https: / / rmfks.osd.mil / rmf / Guidance / GoverningPolicy / Pages / ConsentBanner.aspx	N/A	Devices at this level are not connected to an IP Network.	N/A	N/A	Devices at this level are not connected to an IP Network.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-002244	AC-8(a)(2)	The organization-defined information system use notification message or banner is to state that information system usage may be monitored, recorded, and subject to audit.	The DOD Consent Banner is defined on the RMF Knowledge service along with the Army Regulation 25-2 and can be found on the RMF Knowledge Service site at https: / / rmfks.osd.mil / rmf / Guidance / GoverningPolicy / Pages / ConsentBanner.aspx	N/A	Devices at this level are not connected to an IP Network.	N/A	N/A	Devices at this level are not connected to an IP Network.	N/A
L	CCI-002245	AC-8(a)(3)	The organization-defined information system use notification message or banner is to state that unauthorized use of the information system is prohibited and subject to criminal and civil penalties.	The DOD Consent Banner is defined on the RMF Knowledge service along with the Army Regulation 25-2 and can be found on the RMF Knowledge Service site at https: / / rmfks.osd.mil / rmf / Guidance / GoverningPolicy / Pages / ConsentBanner.aspx	N/A	Devices at this level are not connected to an IP Network.	N/A	N/A	Devices at this level are not connected to an IP Network.	N/A
L	CCI-002246	AC-8(a)(4)	The organization-defined information system use notification message or banner is to state that use of the information system indicates consent to monitoring and recording.	The DOD Consent Banner is defined on the RMF Knowledge service along with the Army Regulation 25-2 and can be found on the RMF Knowledge Service site at https: / / rmfks.osd.mil / rmf / Guidance / GoverningPolicy / Pages / ConsentBanner.aspx	N/A	Devices at this level are not connected to an IP Network.	N/A	N/A	Devices at this level are not connected to an IP Network.	N/A
L	CCI-000050	AC-8(b)	The information system retains the notification message or banner on the screen until users acknowledge the usage conditions and take explicit actions to log on to or further access.	Configure the information system to retain the notification message or banner on the screen until users acknowledge the usage conditions and take explicit actions to log on to or further access. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000050.	N/A	Devices at this level are not connected to an IP Network.	N/A	N/A	Devices at this level are not connected to an IP Network.	N/A
L	CCI-002248	AC-8(c)(1)	The organization defines the conditions of use which are to be displayed to users of the information system before granting further access.	The DOD Consent Banner is defined on the RMF Knowledge service along with the Army Regulation 25-2 and can be found on the RMF Knowledge Service site at https: / / rmfks.osd.mil / rmf / Guidance / GoverningPolicy / Pages / ConsentBanner.aspx	N/A	Devices at this level are not connected to an IP Network.	N/A	N/A	Devices at this level are not connected to an IP Network.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-000059	AC-11(a)	The organization defines the time period of inactivity after which the information system initiates a session lock.	DoD has defined the time period as 15 minutes. Recommended Compelling Evidence: **Automatically compliant**	App	This is policy to be provided by the Government. See CCI-0057 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-0057 for design and implementation.	Gov
M	CCI-000057	AC-11	The information system initiates a session lock after the organization-defined time period of inactivity.	The information system initiates a session lock after the organization-defined time period of inactivity.	N/P	Session lock not recommended for control systems.	N/A	N/P	Session lock not recommended for control systems.	N/A
M	CCI-000058	AC-11(a)	The information system provides the capability for users to directly initiate session lock mechanisms.	The organization being inspected / assessed configures the information system to provide the capability for users to directly initiate session lock mechanisms. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI-000058 Recommended Compelling Evidence: 1.) Applicable STIG / SRG checks 2.) Documentation that shows the system is configured to provide the capability for users to directly initiate session lock mechanisms	N/A	Session lock does not apply to non-IP equipment.	N/A	N/A	Session lock does not apply to non-networked equipment.	N/A
M	CCI-000056	AC-11(b)	The information system retains the session lock until the user reestablishes access using established identification and authentication procedures.	The organization being inspected / assessed configures the information system to retain the session lock until the user reestablishes access using established identification and authentication procedures. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI-000056 Recommended Compelling Evidence: 1.) Applicable STIG / SRG checks	N/A	Session lock does not apply to non-IP equipment.	N/A	N/A	Session lock does not apply to non-networked equipment.	N/A
M	CCI-000060	AC-11(1)	The information system conceals, via the session lock, information previously visible on the display with a publicly viewable image.	The organization being inspected / assessed configures the information system to conceal, via the session lock, information previously visible on the display with a publicly viewable image. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI-000060. Recommended Compelling Evidence: 1.) Signed and dated system security plan (SSP) 2.) Applicable STIG / SRG checks	N/A	Session lock does not apply to non-IP equipment.	N/A	N/A	Session lock does not apply to non-networked equipment.	N/A
M	CCI-002360	AC-12	The organization defines the conditions or trigger events requiring session disconnect to be employed by the information system when automatically terminating a user session.	The organization being inspected / assessed defines and documents the conditions or trigger events requiring session disconnect to be employed by the information system when automatically terminating a user session. DoD has determined the conditions or trigger events are not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) Signed and dated system security plan (SSP) 2.) Applicable STIG / SRG checks 3.) Signed and dated documentation that defines the conditions or trigger events requiring session disconnect to be employed by the information system when automatically terminating a user session.	App	This is policy to be provided by the Government. See CCI-2361for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-2361for design and implementation.	Gov
M	CCI-002361	AC-12	The information system automatically terminates a user session after organization-defined conditions or trigger events requiring session disconnect.	The organization being inspected / assessed configures the information system to automatically terminate a user session after conditions or trigger events requiring session disconnect, as defined in AC-12, CCI 2360. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 2361. Recommended Compelling Evidence: 1.) Signed and dated system security plan (SSP) 2.) Applicable STIG / SRG checks	N/A	Session lock does not apply to non-IP equipment.	N/A	N/A	Session lock does not apply to non-networked equipment.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-000061	AC-14(a)	The organization identifies and defines organization-defined user actions that can be performed on the information system without identification or authentication consistent with organizational missions / business functions.	Workstations, Servers, Network Switches, etc., shall not allow any actions without identification or authentication. This is usually automatically met by authenticating (logging in) to a system. The control system must use identification and authentication except for the following: - Read only access via a user interface from other than a PC and via other than a web interface. - Interactions via devices other than user interfaces. Devices that do not support authentication should have physical security implemented by lockable enclosures, tamper switches, room access control, people trap, or paper access logs.	App	The control system must require identification and authentication before allowing any actions except read-only actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.	Con	App	The control system must require identification and authentication before allowing any actions except read-only actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.	Con
L	CCI-000232	AC-14(b)	The organization documents and provides supporting rationale in the security plan for the information system, user actions not requiring identification and authentication.	Workstations, Servers, Network Switches, etc., shall not allow any actions without identification or authentication. This is usually automatically met by authenticating (logging in) to a system. The control system must use identification and authentication except for the following: • Read only access via a user interface from other than a PC and via other than a web interface. • Interactions via devices other than user interfaces. Devices that do not support authentication should have physical security implemented by lockable enclosures, tamper switches, room access control, people trap, or paper access logs.	App	The control system must require identification and authentication before allowing any actions except read-only actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.	Con	App	The control system must require identification and authentication before allowing any actions except read-only actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.	Con
L	CCI-001438	AC-18(a)	The organization establishes usage restrictions for wireless access.	Wireless policies, procedures and configuration guides need to be created for the use of wireless capability.	App	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	Con	N/A	Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	N/A
L	CCI-001439	AC-18(a)	The organization establishes implementation guidance for wireless access.	Wireless policies, procedures and configuration guides need to be created for the use of wireless capability.	App	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	Con	N/A	Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	N/A
L	CCI-002323	AC-18(a)	The organization establishes configuration / connection requirements for wireless access.	Wireless policies, procedures and configuration guides need to be created for the use of wireless capability.	App	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	Con	N/A	Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	N/A
L	CCI-001441	AC-18(b)	The organization authorizes wireless access to the information system prior to allowing such connections.	Wireless policies, procedures and configuration guides need to be created for the use of wireless capability.	App	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	Con	N/A	Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-001443	AC-18(1)	The information system protects wireless access to the system using authentication of users and / or devices.	The organization being inspected / assessed configures the information system to protect wireless access to the system using authentication of users and / or devices. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1443. Recommended Compelling Evidence: 1.) Signed and dated system security plan (SSP) 2.) Signed and dated wireless access policy	App	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	Con	N/A	Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	N/A
M	CCI-001444	AC-18(1)	The information system protects wireless access to the system using encryption.	The organization being inspected / assessed configures the information system to protect wireless access to the system using encryption. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1444. Recommended Compelling Evidence: 1.) Signed and dated system security plan (SSP) 2.) Signed and dated wireless access policy 3.) Applicable STIG / SRG checks	App	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	Con	N/A	Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	N/A
M	CCI-001449	AC-18 (3)	The organization disables, when not intended for use, wireless networking capabilities internally embedded within information system components prior to issuance and deployment.	The organization being inspected/assessed documents and implements a process to disable wireless networking capabilities internally embedded within information system components prior to issuance and deployment when not intended for use. DISA Compelling Evidence 1) Signed and dated documentation (SOP or CONOP or SSP) 2) Verify that the documentation describes the process of how the site disables, when not intended for use, wireless networking capabilities internally embedded within information system components prior to issuance and deployment. 3) Via site personal examine a sampling of information system (ex. network diagram etc.). 4) Validate that any internally embedded wireless networking capabilities are disabled unless a documented need exists. 5) If the need exist, validate that the need is documented in the site's document which must be signed and dated by ISSO or ISSM).	App	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	Con	N/A	Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	N/A
L	CCI-000123	AU-2(a)	The organization determines the information system must be capable of auditing an organization-defined list of auditable events.	HW (workstations, servers, network switches / infrastructure, etc....) capable of auditing shall audit the following: • Successful and unsuccessful logon attempts • Privileged activities or other system level access • Starting and ending time for user access to the system • Concurrent logons from different workstations. • Successful and unsuccessful accesses to objects • All program initiators • All direct access to the information system • All account creations, modifications, disabling, and terminations • All kernel module load, unload, and restart	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001571	AU-2(a)	The organization defines the information system auditable events.	DoD has defined the information system auditable events as successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels). Successful and unsuccessful logon attempts, Privileged activities or other system level access, Starting and ending time for user access to the system, Concurrent logons from different workstations, Successful and unsuccessful accesses to objects, All program initiations, All direct access to the information system. All account creations, modifications, disabling, and terminations. All kernel module load, unload, and restart.	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-000125	AU-2(c)	The organization provides a rationale for why the list of auditable events is deemed to be adequate to support after-the-fact investigations of security incidents.	The organization documents in the audit and accountability policy the list of auditable system events, the organization provides clearly stated rationale for the selection of each system vent. The rationale will support any after-action investigations of security event.	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001485	AU-2(d)	The organization defines the events which are to be audited on the information system on an organization-defined frequency of (or situation requiring) auditing for each identified event.	The organization being inspected / assessed defines and documents events which are to be audited on the information system. Events should be selected from the events the information system is capable of auditing as defined in AU-2 (a) and should be based on ongoing risk assessments of current threat information and environment. DoD has determined that the events are not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) Signed and dated audit and accountability policy and / or procedures.	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-000130	AU-3	The information system generates audit records containing information that establishes what type of event occurred.	The information system shall be configured to generate audit records containing information that establishes what type of event occurred. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 130. Other IP devices (BPOCs, other field devices) may not be able to generate audit records. Document if these components are incapable of implementing the requirements set forth in policy.	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-000131	AU-3	The information system generates audit records containing information that establishes when an event occurred.	The information system shall be configured to generate audit records containing information that establishes when an event occurred. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000131. Other IP devices (BPOCs, other field devices) may not be able to generate audit records. Document if these components are incapable of implementing the requirements set forth in policy.	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-000132	AU-3	The information system generates audit records containing information that establishes where the event occurred.	The information system shall be configured to generate audit records containing information that establishes where the event occurred. For information system components that have applicable STIGs or SRGs, the organization EING inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000132. Other IP devices (BPOCs, other field devices) may not be able to generate audit records. Document if these components are incapable of implementing the requirements set forth in policy.	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-000133	AU-3	The information system generates audit records containing information that establishes the source of the event.	The information system shall be configured to generate audit records containing information that establishes where the event occurred. For information system components that have applicable STIGs or SRGs, the organization EING inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000133. Other IP devices (BPOCs, other field devices) may not be able to generate audit records. Document if these components are incapable of implementing the requirements set forth in policy.	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-000134	AU-3	The information system generates audit records containing information that establishes the outcome of the event.	The information system shall be configured to generate audit records containing information that establishes where the event occurred. For information system components that have applicable STIGs or SRGs, the organization EING inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000134. Other IP devices (BPOCs, other field devices) may not be able to generate audit records. Document if these components are incapable of implementing the requirements set forth in policy.	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001487	AU-3	The information system generates audit records containing information that establishes the identity of any individuals or subjects associated with the event.	The information system shall be configured to generate audit records containing information that establishes the identity of any individuals or subjects associated with the event. For information system components that have applicable STIGs or SRGs, the organization must comply with the STIG / SRG guidance that pertains to CCI 001487. Other IP devices (BPOCs, other field devices) may not be able to generate audit records. Document if these components are incapable of implementing the requirements set forth in policy.	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
M	CCI-001488	AU-3(1)	The organization defines additional, more detailed information to be included in the audit records.	The organization being inspected / assessed defines and documents additional, more detailed information to be included in the audit records. The additional information must include at a minimum, full-text recording of privileged commands or the individual identities of group account users. The additional information must provide sufficient detail to reconstruct events to determine cause of compromise and magnitude of damage, malfunction, or security violation. DoD has determined that additional, more detailed information must include, at a minimum, full-text recording of privileged commands or the individual identities of group account users. DoD has determined that all additional, more detailed information is not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) Signed and dated audit and accountability policy and / or procedures	App	This is policy to be provided by the Government. See CCI-135 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-135 for design and implementation.	Gov

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-000135	AU-3(1)	The information system generates audit records containing the organization-defined additional, more detailed information that is to be included in the audit records.	The organization being inspected / assessed configures the information system to generate audit records containing the organization defined additional, more detailed information as defined in AU-3 (1), CCI 1488 that is to be included in the audit records. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI-000135. Recommended Compelling Evidence: 1.) Sample of generated audit records 2.) Applicable STIG / SRG checks	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001848	AU-4	The organization defines the audit record storage requirements.	Devices that have STIG / SRGs must comply with the requirements of those STIG / SRGs. For BPOCs and field devices (not front end computers) capable of generating audit records, the front end server shall be configured to retrieve audit records from the devices. Provide a secure mechanism of uploading these audit records to a front end PC for storage and review.	App	This is policy to be provided by the Government. See CCI-1849 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-1849 for design and implementation.	Gov
L	CCI-001849	AU-4	The organization allocates audit record storage capacity in accordance with organization-defined audit record storage requirements.	The organization allocates, and configures the information system to allocate audit record storage capacity as defined in AU-4, CCI 001848. For information system components that have applicable STIGs or SRGs, the organization must comply with the STIG / SRG guidance that pertains to CCI 001849. Provide a secure mechanism of uploading these audit records to a front end PC for storage and review.	App	For devices which support audit logs, configure storage per specifications. Apply STIG / SRGs.	Con	App	For devices which support audit logs, configure storage per specifications. Apply STIG / SRGs.	Con
L	CCI-000139	AU-5(a)	The information system alerts designated organization - defined personnel or roles in the event of an audit processing failure.	If the front end server can be configured to automatically archive full logs or write audit logs to an audit server (from all connected audit capable devices), then this control shall be considered not-applicable(NA). Otherwise, if email services are available, configure the workstations and servers to alert at a minimum, the system administrator (SA) and or the designated Information System Security Officer / Manager in the event of an audit processing failure. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 139. If email services are not available then the workstations and servers shall configure the system to provide an alert on the screen in the event of an audit processing failure. For BPOCs and other field devices see CCI-001848.	N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001490	AU-5(b)	The organization defines actions to be taken by the information system upon audit failure (e.g., shut down information system, overwrite oldest audit records, stop generating audit records).	The organization being inspected / assessed will define and document actions to be taken by the information system upon audit failure as described in CCI-000139 and CCI-000140.	App	This is policy to be provided by the Government. See CCI-140 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-140 for design and implementation.	Gov
L	CCI-000140	AU-5(b)	The information system takes organization defined actions upon audit failure (e.g., shut down information system, overwrite oldest audit records, stop generating audit records).	In case of an audit failure, if possible, configure the system to continue to collect audit records by overwriting existing audit records starting with the oldest records first. Ideal configuration would be to configure the system to send audit records directly to an audit server, or automatically archive full logs and document as such with the ISSO. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 00140.	N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
X	CCI-000154	AU-06(4)	The information system provides the capability to centrally review and analyze audit records from multiple components within the system.		N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
M	CCI-001880	AU-7(a)	The information system provides a report generation capability that supports after-the-fact investigations of security incidents.	The organization being inspected / assessed must employ information systems that provide a report generation capability that support after-the-fact investigations of security incidents (either natively or through the use of third-party tools). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1880. Recommended Compelling Evidence: 1.) After action reports which include audit logs	App	For devices which support audit logs, configure devices to allow review of audit records. Apply STIG / SRGs.	Con	App	For devices which support audit logs, configure devices to allow review of audit records. Apply STIG / SRGs.	Con

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-001878	AU-7(a)	The information system provides a report generation capability that supports on-demand audit review and analysis.	The organization being inspected / assessed must employ information systems that provide a report generation capability that support on-demand audit review and analysis (either natively or through the use of third-party tools). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1878. Recommended Compelling Evidence: 1.) Example of on-demand audit review and analysis	App	For devices which support audit logs, configure devices to allow review of audit records. Apply STIG / SRGs.	Con	App	For devices which support audit logs, configure devices to allow review of audit records. Apply STIG / SRGs.	Con
M	CCI-001879	AU-7(a)	The information system provides a report generation capability that supports on-demand reporting requirements.	The organization being inspected / assessed must employ information systems that provide a report generation capability that support on-demand reporting requirements (either natively or through the use of third-party tools). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1879. Recommended Compelling Evidence: 1.) Example of on-demand audit review and analysis	App	For devices which support audit logs, configure devices to allow review of audit records. Apply STIG / SRGs.	Con	App	For devices which support audit logs, configure devices to allow review of audit records. Apply STIG / SRGs.	Con
M	CCI-001875	AU-7(a)	The information system provides an audit reduction capability that supports on-demand audit review and analysis.	The organization being inspected / assessed must employ information systems that provide an audit reduction capability that support on-demand audit review and analysis (either natively or through the use of third-party tools). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1875. Recommended Compelling Evidence: 1.) Audit reduction capability system logs	N/A	Applies to Level 5 CS Management (syslog, SIEM, etc.).	N/A	N/A	Applies to Level 5 CS Management (syslog, SIEM, etc.).	N/A
M	CCI-001876	AU-7(a)	The information system provides an audit reduction capability that supports on-demand reporting requirements.	The organization being inspected / assessed must employ information systems that provide an audit reduction capability that support on-demand reporting requirements (either natively or through the use of third-party tools). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1876. Recommended Compelling Evidence: 1.) Audit reduction capability system logs	N/A	Applies to Level 5 CS Management (syslog, SIEM, etc.).	N/A	N/A	Applies to Level 5 CS Management (syslog, SIEM, etc.).	N/A
M	CCI-001877	AU-7(a)	The information system provides an audit reduction capability that supports after-the-fact investigations of security incidents.	The organization being inspected / assessed must employ information systems that provide an audit reduction capability that support after-the-fact investigations of security incidents (either natively or through the use of third-party tools). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1877. Recommended Compelling Evidence: 1.) After action reports which include audit logs	N/A	Applies to Level 5 CS Management (syslog, SIEM, etc.).	N/A	N/A	Applies to Level 5 CS Management (syslog, SIEM, etc.).	N/A
M	CCI-001882	AU-7(b)	The information system provides a report generation capability that does not alter original content or time ordering of audit records.	The organization being inspected / assessed must ensure that the report generation capability does not alter the original audit records. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1882. Recommended Compelling Evidence: 1.) Example of audit log before and after audit reduction capability	N/A	Applies to Level 5 CS Management (syslog, SIEM, etc.).	N/A	N/A	Applies to Level 5 CS Management (syslog, SIEM, etc.).	N/A
M	CCI-001881	AU-7(b)	The information system provides an audit reduction capability that does not alter original content or time ordering of audit records.	The organization being inspected / assessed must ensure that the audit reduction capability does not alter the original audit records. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1881. Recommended Compelling Evidence: 1.) Example of audit log before and after audit reduction capability	N/A	Applies to Level 5 CS Management (syslog, SIEM, etc.).	N/A	N/A	Applies to Level 5 CS Management (syslog, SIEM, etc.).	N/A
M	CCI-000158	AU-7(1)	The information system provides the capability to process audit records for events of interest based on organization-defined audit fields within audit records.	The organization being inspected / assessed must employ information systems that provide the capability to process audit records for events of interest based on audit fields within audit records defined in AU-7 (1), CCI 1883. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 158. Recommended Compelling Evidence: 1.) Example of audit log report based on events of interest	N/A	Applies to Level 5 CS Management (syslog, SIEM, etc.).	N/A	N/A	Applies to Level 5 CS Management (syslog, SIEM, etc.).	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-000159	AU-8(a)	The information system uses internal system clocks to generate time stamps for audit records.	Workstations and servers on the domain shall be configured to synchronize with domain controllers. If an NTP server is configured it should synchronize with a secure, authorized source. If not on a domain or NTP server, workstations, server or other components that generate audit records, the timing requirement inherent in the control system will be sufficient. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 00159.	N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001889	AU-8(b)	The information system records time stamps for audit records that meets organization-defined granularity of time measurement.	DoD has defined the granularity of time measurement as one second. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 001889.	N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001890	AU-8(b)	The information system records time stamps for audit records that can be mapped to Coordinated Universal Time (UTC) or Greenwich Mean Time (GMT).	All devices which provide audit capabilities, configure them to generate time stamps for audit records that contain time zones or time offsets that can be mapped to Coordinated Universal Time (UTC) or Greenwich Mean Time (GMT). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1890.	N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
M	CCI-001892	AU-8(1)	The organization defines the time difference which, when exceeded, will require the information system to synchronize the internal information system clocks to the organization-defined authoritative time source.	The organization being inspected / assessed defines and documents the time difference, which, when exceeded, will require the information system to synchronize the internal information system clocks. DoD has determined the time difference is not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) Signed and dated audit and accountability policy	N/P	This is policy to be provided by the Government. See CCI-1891 and 2046 for design and implementation.	N/A	N/P	This is policy to be provided by the Government. See CCI-1891 and 2046 for design and implementation.	N/A
M	CCI-001891	AU-8(1)	The information system compares internal information system clocks on an organization-defined frequency with an organization-defined authoritative time source.	The organization being inspected / assessed configures the information system to synchronize internal information system clocks every 24 hours for networked systems with an authoritative time server which is synchronized with redundant United States Naval Observatory (USNO) time servers as designated for the appropriate DoD network (NIPRNet / SIPRNet) and / or the Global Positioning System (GPS) when the time difference is greater than the difference defined in AU-8 (1), CCI 1892. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1891. DoD has defined the frequency as every 24 hours for networked systems. DoD has defined the authoritative time source as an authoritative time server which is synchronized with redundant United States Naval Observatory (USNO) time servers as designated for the appropriate DoD network (NIPRNet / SIPRNet) and / or the Global Positioning System (GPS). Recommended Compelling Evidence: 1.) Signed and dated audit and accountability policy	N/A	NTP time synchronization not supported by non-IP devices.	N/A	N/A	NTP time synchronization not supported by non-networked devices.	N/A
M	CCI-002046	AU-8(1)	The information system synchronizes the internal system clocks to the authoritative time source when the time difference is greater than the organization-defined time period.	The organization being inspected / assessed configures the information system to synchronize the internal system clocks to the authoritative time source when the time difference is greater than the time period defined in AU-8 (1), CCI 1892. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 2046. Recommended Compelling Evidence: 1.) Signed and dated audit and accountability policy 2.) Example of how the information system synchronizes internal information system clocks at least hourly with a NIST Internet Time Service server	N/A	NTP time synchronization not supported by non-IP devices.	N/A	N/A	NTP time synchronization not supported by non-networked devices.	N/A
L	CCI-001459	AU-12(a)	The organization defines information system components that provide audit record generation capability.	DoD has defined the information system components as all information system and network components. Devices which ARE NOT capable of generating an audit log are exempt. System documentation should define which components are capable and are not capable of generating audit logs.	App	This is policy to be provided by the Government. See CCI-169 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-169 for design and implementation.	Gov

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-000169	AU-12(a)	The information system provides audit record generation capability for the auditable events defined in AU-2 a at organization defined information system components.	CCI-000123 defines auditable events for an information system. Level 4 devices (workstations, servers, network switches, routers, etc.) shall implement to the extent possible the requirements in CCI-000123 and AU-2(a). Requirements that cannot be implemented must be documented and justification provided. Other devices (non level 4) that provide auditing capabilities shall implement the requirements in CCI-000123 where the capability exists and the ISSM deems relevant. Example, for components. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance.	N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001910	AU-12(b)	The organization defines the personnel or roles allowed select which auditable events are to be audited by specific components of the information system.	DoD has defined the personnel or roles as the ISSM or individuals appointed by the ISSM.	App	This is policy to be provided by the Government. See CCI-171 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-171 for design and implementation.	Gov
L	CCI-000171	AU-12(b)	The information system allows organization-defined personnel or roles to select which auditable events are to be audited by specific components of the information system.	Configure all capable devices to ensure that only the ISSM or individuals appointed by the ISSM select which auditable events are to be audited by specific components of the information system. DoD has defined the personnel or roles as the ISSM or individuals appointed by the ISSM. System administrator personnel will inherently have the rights associated with their accounts to select auditable events, however, organizational policy shall only authorize the ISSM or individuals appointed by the ISSM to select and make those necessary changes.	N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-000172	AU-12(c)	The information system generates audit records for the events defined in AU-2 (d) with the content defined in AU-3.	Audit record requirements are defined in CCI-000130,CCI-000131, CCI-000132, CCI-000133, CCI-000134, CCI-001487 above. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 172.	N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
X	CCI-001919	AU-14	The information system provides the capability for authorized users to select a user session to capture/record or view/hear.		N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A
L	CCI-001464	AU-14 (1)	The information system initiates session audits at system start-up.	The organization being inspected/assessed configures the information system to initiate session audits at system start-up. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI-001464. DISA Compelling Evidence 1) audit and accountability policy 2) Applicable STIGs or SRGs	App	For devices capable of supporting audit logs, configure the system to initiate the auditing system at start-up as indicated in the specification. Apply STIG/SRGs.	Con	N/P	Field devices do not support accounts and do not typically support auditing. These devices are not network connected making monitoring of audit logs impractical.	N/A
X	CCI-001462	AU-14(2)	The information system provides the capability for authorized users to capture/record and log content related to a user session.		N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A
X	CCI-001920	AU-14(3)	The information system provides the capability for authorized users to remotely view/hear all content related to an established user session in real time.		N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A

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M	CCI-001855	AU-05 (1)	The information system provides a warning to organization-defined personnel, roles, and/or locations within an organization-defined time period when allocated audit record storage volume reaches an organization-defined percentage of repository maximum audit record storage capacity.	The organization being inspected/assessed configures the information system to immediately provide a warning to personnel, roles, and/or locations defined in AU-5 (1), CCI-001852 when allocated audit record storage volume reaches 75 percent of repository maximum audit record storage capacity. DoD has defined the time period as immediate. DoD has defined the percentage as 75 percent. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI-001855. DISA Compelling Evidence 1) list of personnel who receive indications of organization-defined inappropriate or unusual activity 2) Applicable STIGs or SRGs	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A
L	CCI-000258	CA-3(b)	The organization documents, for each interconnection, the interface characteristics.	Interconnections to other systems WILL NOT be implemented. Front end servers and workstations may reside on the local Network Enterprise Center's (NECs) network allowing a connection into the control system (CS) components.	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-002102	CA-9(a)	The organization defines the information system components or classes of components that that are authorized internal connections to the information system.	Define and document the information system components or classes of components that are authorized internal connections to the information system. (e.g. Network Controllers, switches, routers, etc.…)	App	Contractor will provide a network communication report, per specifications.	Con	N/A	Does not apply to non-networked devices.	N/A
L	CCI-002103	CA-9(b)	The organization documents, for each internal connection, the interface characteristics.	The organization documents, for each internal connection (network controllers, etc.…) the communication protocols used and a general description of what information is communicated over the network. This can be accomplished through a network communication report.	App	Contractor will provide a network communication report, per specifications.	Con	N/A	Does not apply to non-networked devices.	N/A
L	CCI-002104	CA-9(b)	The organization documents, for each internal connection, the security requirements.	The organization documents, for each internal connection, the security requirements.	App	Contractor will provide a network communication report, per specifications.	Con	N/A	Does not apply to non-networked devices.	N/A
L	CCI-002105	CA-9(b)	The organization documents, for each internal connection, the nature of the information communicated.	The organization documents, for each internal connection (network controllers, etc.…) the communication protocols used and a general description of what information is communicated over the network. This can be accomplished through a network communication report.	App	Contractor will provide a network communication report, per specifications.	Con	N/A	Does not apply to non-networked devices.	N/A
X	CCI-001812	CM-11 (2)	The information system prohibits user installation of software without explicit privileged status.	The organization being inspected/assessed must configure the information system to prevent the installation of software by non-privileged users. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI-001812. DISA Compelling Evidence 1) Verify the organization has configured the information system to prevent the installation of software by non-privileged users 2) Demonstrate that installation of software without explicit privileged status is prohibited/that the system is configured properly	App	For devices that have a STIG or SRG, install and configure the device in accordance with that STIG or SRGs. For devices without a STIG and SRG, consult vendor documentation and install and configure with the most restrictive security-related modes consistent with the mission. Apply STIG/SRGs.	Con	App	For devices that have a STIG or SRG, install and configure the device in accordance with that STIG or SRGs. For devices without a STIG and SRG, consult vendor documentation and install and configure with the most restrictive security-related modes consistent with the mission. Apply STIG/SRGs.	Con
L	CCI-000293	CM-2	The organization develops and documents a current baseline configuration of the information system.	Develop and document a current baseline configuration of the information system to include, drawings, software licenses, source code, hardware, etc.…	App	Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.).	Con	App	Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.).	Con

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
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M	CCI-000298	CM-2(1)(c)	The organization reviews and updates the baseline configuration of the information system as an integral part of information system component installations.	The organization being inspected / assessed reviews and updates the baseline configuration of the information system as an integral part of information system component installations. The organization must document each occurrence of the reviews and update actions as an audit trail. Recommended Compelling Evidence: 1.) Signed and dated configuration management policy referencing section with reviews and updates to baseline configuration	App	Contractor to maintain documentation and provide required artifacts through contract as-installed submissions (drawings, license turnover, application files, etc.)	Con	App	Contractor to maintain documentation and provide required artifacts through contract as-installed submissions (drawings, license turnover, application files, etc.)	Con
M	CCI-001737	CM-2(7)a	The organization defines the information systems, system components, or devices that are to have organization-defined configurations applied when located in areas of significant risk.	The organization being inspected / assessed defines and documents, in the configuration management policy, the information systems, system components, or devices that are to have configurations defined in CM-2 (7), CCI 1738 applied when located in areas of significant risk. DoD has determined that this value is not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) Signed and dated network diagram	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
M	CCI-001738	CM-2(7)a	The organization defines the security configurations to be implemented on information systems, system components, or devices when they are located in areas of significant risk.	The organization being inspected / assessed defines and documents, in the configuration management policy, the security configurations to be implemented on information systems, system components, or devices when they are located in areas of significant risk. DoD has determined that this value is not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) Signed and dated network diagram	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-000363	CM-6(a)	The organization defines security configuration checklists to be used to establish and document configuration settings for the information system technology products employed.	DoD has defined the security configuration checklists as DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.). Document in the security plan, the configuration guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) which apply to their information system components. Field Devices (BPOCs, etc....) that do not have STIGs, SRGs, etc....obtain vendor configuration guides.	App	This is policy to be provided by the Government. See CCI-364 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-364 for design and implementation.	Gov
L	CCI-000364	CM-6(a)	The organization establishes configuration settings for information technology products employed within the information system using organization-defined security configuration checklists.	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) meet the DoD requirement for establishing configuration settings. DoD Components are automatically compliant with this control because they are covered by the DoD level security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.).	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con
L	CCI-001588	CM-6(a)	The organization-defined security configuration checklists reflect the most restrictive mode consistent with operational requirements.	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) meet the DoD requirement for ensuring security configuration checklists reflect the most restrictive mode consistent with operational requirements. DoD Components are automatically compliant with this control because they are covered by the DoD level security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.). Vendor should provide secure configuration guides	App	This is policy to be provided by the Government. See CCI-365 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-365 for design and implementation.	Gov

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
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L	CCI-000365	CM-6(a)	The organization documents configuration settings for information technology products employed within the information system using organization-defined security configuration checklists that reflect the most restrictive mode consistent with operational requirements.	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) meet the DoD requirement for documenting configuration settings. DoD Components are automatically compliant with this control because they are covered by the DoD level security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.). Vendor should provide secure configuration guides	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con
L	CCI-001755	CM-6(c)	The organization defines the information system components for which any deviation from the established configuration settings are to be identified, documented and approved.	DoD has defined the information system components as all configurable information system components.	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con
X	CCI-000388	CM-7 (3)	The organization ensures compliance with organization-defined registration requirements for functions, ports, protocols, and services.	The organization being inspected/assessed implements DoDI 8551.01. DISA Compelling Evidence 1) The organization documents a listing of ports, protocols, and services in use. 2) Reviews a sampling of those ports, protocols, and services to ensure the organization being inspected/assessed is compliant with DoDI 8551.01	N/P	Devices at this level do not support IP Network connectivity.	N/A	N/P	Devices at this level do not support IP Network connectivity.	N/A
L	CCI-000381	CM-7(a)	The organization configures the information system to provide only essential capabilities.	Disable all ports, protocols and services not specifically needed by any device or component within the Control system (server, workstations, field devices, BPOCS, switches, etc....) Remove all software not specifically needed for use in the control system.	App	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	App	Specifications require procurement of equipment with least functionality to perform the mission. i.e. do not use a networked actuator unless it is required.	Con
L	CCI-000380	CM-7(b)	The organization defines for the information system prohibited or restricted functions, ports, protocols, and / or services.	Disable all ports, protocols and services not specifically needed by any device or component within the Control system (server, workstations, field devices, BPOCS, switches, etc....) Remove all software not specifically needed for use in the control system.	App	This is policy to be provided by the Government. See CCI-382 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-382 for design and implementation.	Gov

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-000382	CM-7(b)	The organization configures the information system to prohibit or restrict the use of organization-defined functions, ports, protocols, and / or services.	Disable all ports, protocols and services not specifically needed by any device or component within the Control system (server, workstations, field devices, BPOCS, switches, etc....) Remove all software not specifically needed for use in the control system.	App	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	App	Specifications require procurement of equipment with least functionality to perform the mission. i.e. do not use a networked actuator unless it is required.	Con
L	CCI-001761	CM-7(1)(b)	The organization defines the functions, ports, protocols and services within the information system that are to be disabled when deemed unnecessary and / or non-secure.	Define and document in the system security plan, the functions, ports, protocols and services within the control system that are to be disabled when deemed unnecessary.	App	This is policy to be provided by the Government. See CCI-1762 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-1762 for design and implementation.	Gov
L	CCI-001762	CM-7(1)(b)	The organization disables organization-defined functions, ports, protocols, and services within the information system deemed to be unnecessary and / or non-secure.	Disable functions, ports, protocols, and services within the control system deemed to be unnecessary and / or non-secure, non-secure functions, ports, protocols, and services.	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	N/A	Does not apply to non-networked devices.	N/A
M	CCI-001763	CM-7(2)	The organization defines the policies regarding software program usage and restrictions.	The organization being inspected / assessed defines and documents their rules for approval of software program usage. For network capable software programs, the organization being inspected / assessed complies with DoDI 8551.01. DoD has determined that the rules authorizing the terms and conditions of software program usage on the information system are not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) Approved software list 2.) Rules for approval of software program usage	App	This is policy to be provided by the Government. See CCI-1764 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-1764 for design and implementation.	Gov
M	CCI-001592	CM-7(2)	The organization defines the rules authorizing the terms and conditions of software program usage on the information system.	The organization being inspected / assessed defines and documents their rules for approval of software program usage. For network capable software programs, the organization being inspected / assessed complies with DoDI 8551.01. DoD has determined that the rules authorizing the terms and conditions of software program usage on the information system are not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) Approved software list 2.) Rules for approval of software program usage	App	This is policy to be provided by the Government. See CCI-1764 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-1764 for design and implementation.	Gov
M	CCI-001764	CM-7(2)	The information system prevents program execution in accordance with organization-defined policies regarding software program usage and restrictions, and / or rules authorizing the terms and conditions of software program usage.	The organization being inspected / assessed configures the information system to prevent the execution of programs not authorized in accordance with CM-7 (2) CCIs 1592 and 1763. Recommended Compelling Evidence: 1.) Applicable STIG / SRG checks	N/A	No software at this level.	N/A	N/A	No software at this level.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-001772	CM-7(5)a	The organization defines the software programs authorized to execute on the information system.	The organization being inspected / assessed must define and document software programs that are authorized to execute on the information system. DoD has determined that a comprehensive list of unauthorized software programs is not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) Approved software list 2.) Rules for approval of software program usage	App	This is policy to be provided by the Government. See CCI-1773 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-1773 for design and implementation.	Gov
M	CCI-001773	CM-7(5)a	The organization identifies the organization-defined software programs authorized to execute on the information system.	The organization being inspected / assessed must define and document software programs that are authorized to execute on the information system. Recommended Compelling Evidence: 1.) Approved software list 2.) Rules for approval of software program usage	App	Contractor to supply software list.	Con	App	Contractor to supply software list.	Con
M	CCI-001774	CM-7(5)b	The organization employs an deny-all, permit-by-exception policy to allow the execution of authorized software programs on the information system.	The organization being inspected / assessed configures the information system to deny-all and only permit by exception the execution of authorized software programs on the information system. Recommended Compelling Evidence: 1.) Signed and dated system security plan (SSP)	App	Apply STIG/SRGs.	Con	App	Apply STIG/SRGs.	Con
L	CCI-000389	CM-8(a)(1)	The organization develops and documents an inventory of information system components that accurately reflects the current information system.	Provide a Control System inventory report covering all networked, including network infrastructure devices. Provide the following information (where applicable): • If the device has (in other project documentation) a unique identifier • Description, make, mode, serial number, location • Software / firmware version Network information: protocol, network address	App	Contactor to provide comprehensive asset inventory (Control System Inventory Report).	Con	App	Contactor to provide comprehensive asset inventory (Control System Inventory Report).	Con
L	CCI-000392	CM-8(a)(2)	The organization develops and documents an inventory of information system components that includes all components within the authorization boundary of the information system.	Provide a Control System inventory report covering all networked, including network infrastructure devices. Provide the following information (where applicable): • If the device has (in other project documentation) a unique identifier • Description, make, mode, serial number, location • Software / firmware version Network information: protocol, network address	App	Contactor to provide comprehensive asset inventory (Control System Inventory Report).	Con	App	Contactor to provide comprehensive asset inventory (Control System Inventory Report).	Con
L	CCI-000398	CM-8(a)(4)	The organization defines information deemed necessary to achieve effective information system component accountability.	DoD has defined the information as hardware inventory specifications (manufacturer, type, model, serial number, physical location), software license information, information system / component owner, and for a networked component / device, the machine name.	App	This is policy-related to be provided by Government.	Gov	App	This is policy-related to be provided by Government.	Gov
M	CCI-002828	CP-2(8)	The organization identifies critical information system assets supporting essential missions.	The organization being inspected / assessed configures the information system to maintain the association of the security attributes defined in AC-16 (3), CCI 2278 to objects defined in AC-16 (3), CCI 2280.	App	This is policy-related to be provided by Government.	Gov	App	This is policy-related to be provided by Government.	Gov
L	CCI-000550	CP-10	The organization provides for the recovery and reconstitution of the information system to a known state after a disruption.	The organization must develop a contingency plan (CP) addressing recovery and reconstitution of the control system to a known state after a disruption In essence, restoring the system to the appropriate operational state. The CP will be site specific and should be developed in conjunction with stakeholders of the system. Copies of required software, backup data, hardware list and baseline configurations should be identified in the CP. NOTE-known state shall also include the accepted “as-built” documentation and include any custom programming and configuration for controllers or workstations.	App	Contractor to provide recovery and reconstitution images for programmable and / or configurable devices.	Con	App	Contractor to provide recovery and reconstitution images for programmable and / or configurable devices.	Con
L	CCI-000551	CP-10	The organization provides for the recovery and reconstitution of the information system to a known state after a compromise.	The organization shall provide automated mechanisms or manual procedures, or a combination of the two, for the recovery and reconstitution of its information system to a known state after a compromise. The organization must identify the selected method in the contingency plan. See also CCI-000550	App	Contractor to provide recovery and reconstitution images for programmable and / or configurable devices.	Con	App	Contractor to provide recovery and reconstitution images for programmable and / or configurable devices.	Con
L	CCI-000552	CP-10	The organization provides for the recovery and reconstitution of the information system to a known state after a failure.	The organization shall provide automated mechanisms or manual procedures, or a combination of the two, for the recovery and reconstitution of its information system to a known state after a failure. The organization must identify the selected method in the contingency plan. See also CCI-000550	App	Contractor to provide recovery and reconstitution images for programmable and / or configurable devices.	Con	App	Contractor to provide recovery and reconstitution images for programmable and / or configurable devices.	Con

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-000553	CP-10(2)	The information system implements transaction recovery for systems that are transaction-based.	The organization shall provide automated mechanisms or manual procedures, or a combination of the two, for the recovery and reconstitution of its information system to a known state after a failure. The organization must identify the selected method in the contingency plan. See also CCI-000550	N/A	No transaction-based systems at this level.	N/A	N/A	No transaction-based systems at this level.	N/A
L	CCI-002856	CP-12	The organization defines the conditions, that when detected, the information system enters a safe mode of operation with organization-defined restrictions of safe mode of operation.	When the following conditions are detected, the control system shall enter a safe mode of operation. • Commercial Power Loss • Fire • Water	App	This is policy to be provided by the Government. See CCI-2855 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-2855 for design and implementation.	Gov
L	CCI-002857	CP-12	The organization defines the restrictions of safe mode of operation that the information system will enter when organization-defined conditions are detected.	Commercial Power Failure: Upon loss of commercial power, the control system will switch to Generator power and only Mission Critical Infrastructure (deemed by the organization) will received continued control system service. All other infrastructure / areas services will cease until commercial power is restored. Fire: The system shall be integrated with fire detectors. Upon detection of fire, the system will ensure dampers and air handlers are shut down to prevent the propagation of smoke, gasses and fire through the system. The system shall remain in a shutdown / closed state until manually restarted / rebooted by organization personnel. Water: Upon detection of water (sprinkler system), the servers shall perform a graceful shutdown in order to minimize component failure due to water.	App	This is policy to be provided by the Government. See CCI-2855 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-2855 for design and implementation.	Gov
L	CCI-002855	CP-12	The information system, when organization-defined conditions are detected, enters a safe mode of operation with organization-defined restrictions of safe mode of operation.	Configure the information system to enter a safe mode of operation with restrictions of safe mode of operation defined in CP-12, CCI 002857 when conditions defined in CP-12, CCI 2856 are detected. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 2855.	App	Specification requires contractor to coordinate failure responses. Apply requirements contained in specifications. Where no safe state is indicated, configure appropriately and report configuration in documentation. Contractor to provide control system inventory report. Apply STIG / SRGs.	Con	App	Specification requires contractor to coordinate failure responses. Apply requirements contained in specifications. Where no safe state is indicated, configure appropriately and report configuration in documentation. Contractor to provide control system inventory report. Apply STIG / SRGs.	Con
L	CCI-001942	IA-02(9)	The information system implements replay-resistant authentication mechanisms for network access to non-privileged accounts.		App	For devices that have STIG/SRGs related to cryptographic protection, comply with the requirements of those STIG/SRGs.	Con	App	For devices that have STIG/SRGs related to cryptographic protection, comply with the requirements of those STIG/SRGs.	Con
X	CCI-002007	IA-05(13)	The information system prohibits the use of cached authenticators after an organization-defined time period.		App	Software running on computers and computer operating systems must manage cached authenticators in accordance with the relevant STIGs. All other devices and software must not use cached authenticators.	Con	App	Software running on computers and computer operating systems must manage cached authenticators in accordance with the relevant STIGs. All other devices and software must not use cached authenticators.	Con
L	CCI-000764	IA-2	The information system uniquely identifies and authenticates organizational users (or processes acting on behalf of organizational users).	All components capable of user accounts will be configured to uniquely identify and authenticate users (or processes acting on behalf of organizational users). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000764.	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-000768	IA-2 (4)	The information system implements multifactor authentication for local access to non-privileged accounts.	The organization being inspected/assessed configures the information system to implement multifactor authentication for local access to non-privileged accounts. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI-000768. DISA Compelling Evidence 1)Provide the Access Control Policy to verify the information system has a implementation of multifactor authentication for local access of non-privileged accounts. Information must be compliant with STIG/SRG guidance that pertains to CCI-000768.	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-000765	IA-2(1)	The information system implements multifactor authentication for network access to privileged accounts.	Multifactor authentication shall be implemented for users that require privileged level accounts to servers and workstations residing on the network (not standalone or private VLAN segregated systems). Multifactor authentication can be implemented with through common access card (CAC) authentication. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000765.	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
M	CCI-000766	IA-2(2)	The information system implements multifactor authentication for network access to non-privileged accounts.	Multifactor authentication shall be implemented for users that require privileged level accounts to servers and workstations residing on the network (not standalone or private VLAN segregated systems). Multifactor authentication can be implemented with through common access card (CAC) authentication. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 765.	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
M	CCI-000767	IA-2(3)	The information system implements multifactor authentication for local access to privileged accounts.	Multifactor authentication shall be implemented for users that require privileged level accounts to servers and workstations residing on the network (not standalone or private VLAN segregated systems). Multifactor authentication can be implemented with through common access card (CAC) authentication. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 765.	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-001953	IA-2(12)	The information system accepts Personal Identity Verification (PIV) credentials.	This control enhancement applies to organizations implementing logical access control systems (LACS) and physical access control systems (PACS). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 001953	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-001954	IA-2(12)	The information system electronically verifies Personal Identity Verification (PIV) credentials.	This control enhancement applies to organizations implementing logical access control systems (LACS) and physical access control systems (PACS). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 001954.	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-000777	IA-3	The organization defines a list of specific and / or types of devices for which identification and authentication is required before establishing a connection to the information system.	All network connected endpoint devices (including but not limited to: workstations, printers, servers) shall be identified and authenticated before establishing a connection to the information system. Any device incapable of being authenticated to the system shall be documented.	N/A	This is policy to be provided by the Government. See CCI-778 and 1958 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-778 and 1958 for design and implementation.	N/A
L	CCI-000778	IA-3	The information system uniquely identifies an organization defined list of specific and / or types of devices before establishing a local, remote, or network connection.	Configure the network infrastructure to identify all network connected endpoint devices (including but not limited to: workstations, printers, servers) before establishing a local, remote, network connection. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 778. See CCI-000777	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-001958	IA-3	The information system authenticates an organization defined list of specific and / or types of devices before establishing a local, remote, or network connection.	Configure the network infrastructure to authenticate all network connected endpoint devices (including but not limited to: workstations, printers, servers) before establishing a local, remote, network connection. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1958. See CCI-000777	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
M	CCI-001959	IA-3(1)	The organization defines the specific devices and / or type of devices the information system is to authenticate before establishing a connection.	DoD has defined the value as all network connected endpoint devices (including but not limited to: workstations, printers, servers (outside a datacenter), VoIP Phones, VTC CODECs). Recommended Compelling Evidence: **Automatically Compliant**	N/A	This is policy to be provided by the Government. See CCI-1967 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-1967 for design and implementation.	N/A
M	CCI-001967	IA-3(1)	The information system authenticates organization-defined devices and / or types of devices before establishing a local, remote and / or network connection using bidirectional authentication that is cryptographically based.	The organization being inspected / assessed configures the information system to use cryptographically based bidirectional authentication. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1967. Recommended Compelling Evidence: 1.) Signed and dated documentation for use of cryptographically based bidirectional authentication. 2.) Applicable STIG / SRG checks.	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-000176	IA-5(b)	The organization manages information system authenticators by establishing initial authenticator content for authenticators defined by the organization.	The ISSM / O or designee will manage the password generation, issuance, and control process. If used, generate passwords in accordance with the BBP for Army Password Standards. The authenticators (passwords) will follow format and complexity as defined in the BBP for Army Password Standards and be changed immediately upon initial login. Control system component that are not capable of implementing the complexity requirements shall implement password strength to the greatest extent possible. Physical security mechanisms can be implemented as a layered defense to further protect access to non-conforming components. For information system components that have applicable STIGs or SRGs, the organization must comply with the STIG / SRG guidance.	App	Government to define acceptable credential authentication requirements for systems. Apply STIG / SRGs.	Gov	App	Government to define acceptable credential authentication requirements for systems. Apply STIG / SRGs.	Gov
L	CCI-001544	IA-5(c)	The organization manages information system authenticators by ensuring that authenticators have sufficient strength of mechanism for their intended use.	For information system components that have applicable STIGs or SRGs, the organization must comply with the STIG / SRG guidance. Components which do not have an applicable STIG or SRG will configure (to the extent possible) them to comply with the complexity requirements set forth in the BBP for Army Password Standards.	App	Government to define acceptable credential authentication requirements for systems. Apply STIG / SRGs.	Gov	App	Government to define acceptable credential authentication requirements for systems. Apply STIG / SRGs.	Gov
L	CCI-001989	IA-5(e)	The organization manages information system authenticators by changing default content of authenticators prior to information system installation.	Document and implement procedures to change default authenticators (passwords, etc.) or apply authenticators to all capable components prior to system installation.	App	Government to define acceptable credential authentication requirements for systems.	Gov	App	Government to define acceptable credential authentication requirements for systems.	Gov
L	CCI-001610	IA-5(g)	The organization defines the time period (by authenticator type) for changing / refreshing authenticators.	DoD has defined the time period as CAC - every 3 years, or 1 year from term of contract. Password: 60 days. Biometrics: every 3 years.	App	This is policy to be provided by the Government. See CCI-182 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-182 for design and implementation.	Gov
L	CCI-000182	IA-5(g)	The organization manages information system authenticators by changing / refreshing authenticators in accordance with the organization defined time period by authenticator type.	Document and implement procedures for changing / refreshing authenticators.	App	Government to define acceptable credential authentication requirements for systems.	Gov	App	Government to define acceptable credential authentication requirements for systems.	Gov

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
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L	CCI-001612	IA-5(1)(a)	The organization defines the minimum number of upper case characters for password complexity enforcement.	The BBP for Army Password Standards defines the minimum number of upper case characters to be 2.	App	This is policy to be provided by the Government. See CCI-192 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-192 for design and implementation.	Gov
L	CCI-000192	IA-5(1)(a)	The information system enforces password complexity by the minimum number of upper case characters used.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 192. All other components will be configured to implement and enforce the minimum number of upper case characters used as defined in the BBP for Army Password Standards.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con
L	CCI-001613	IA-5(1)(a)	The organization defines the minimum number of lower case characters for password complexity enforcement.	The BBP for Army Password Standards defines the minimum number of special characters to be 2.	App	This is policy to be provided by the Government. See CCI-193 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-193 for design and implementation.	Gov
L	CCI-000193	IA-5(1)(a)	The information system enforces password complexity by the minimum number of lower case characters used.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000193. All other components will be configured to implement and enforce the minimum number of lower case characters used as defined in the BBP for Army Password Standards.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con
L	CCI-001614	IA-5(1)(a)	The organization defines the minimum number of numeric characters for password complexity enforcement.	The BBP for Army Password Standards defines the minimum number of numeric characters to be 2.	App	This is policy to be provided by the Government. See CCI-194 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-194 for design and implementation.	Gov
L	CCI-000194	IA-5(1)(a)	The information system enforces password complexity by the minimum number of numeric characters used.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000192. All other components will be configured to implement and enforce the minimum number of numeric characters used as defined in the BBP for Army Password Standards.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con
L	CCI-001611	IA-5(1)(a)	The organization defines the minimum number of special characters for password complexity enforcement.	The BBP for Army Password Standards defines the minimum number of special characters to be 2.	App	This is policy to be provided by the Government. See CCI-1619 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-1619 for design and implementation.	Gov
L	CCI-001619	IA-5(1)(a)	The information system enforces password complexity by the minimum number of special characters used.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1619. All other components will be configured to implement and enforce the minimum password length as defined in the BBP for Army Password Standards.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
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L	CCI-000205	IA-5(1)(a)	The information system enforces minimum password length.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000205. All other components will be configured to implement and enforce the minimum password length as defined in the BBP for Army Password Standards.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con
L	CCI-001615	IA-5(1)(b)	The organization defines the minimum number of characters that are changed when new passwords are created.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 195. DoD has defined the minimum number of characters as 50% of the minimum password length.	App	This is policy to be provided by the Government. See CCI-195 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-195 for design and implementation.	Gov
L	CCI-000195	IA-5(1)(b)	The information system, for password-based authentication, when new passwords are created, enforces that at least an organization-defined number of characters are changed.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 195.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con
L	CCI-000196	IA-5(1)(c)	The information system, for password-based authentication, stores only cryptographically-protected passwords.	Configure the information system to store only encrypted representations of passwords. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 196.	App	Passwords must be cryptographically protected during storage and transmission. Apply STIG / SRGs.	Con	App	Passwords must be cryptographically protected during storage and transmission. Apply STIG / SRGs.	Con
L	CCI-000197	IA-5(1)(c)	The information system, for password-based authentication, transmits only cryptographically-protected passwords.	Configure the information system to transmit only encrypted representations of passwords. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 197.	App	Passwords must be cryptographically protected during storage and transmission. Apply STIG / SRGs.	Con	App	Passwords must be cryptographically protected during storage and transmission. Apply STIG / SRGs.	Con
L	CCI-001616	IA-5(1)(d)	The organization defines minimum password lifetime restrictions.	DoD has defined the minimum password lifetime restrictions as 24 hours.	App	This is policy to be provided by the Government. See CCI-198 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-198 for design and implementation.	Gov
L	CCI-000198	IA-5(1)(d)	The information system enforces minimum password lifetime restrictions.	Configure the information system to enforce minimum password lifetime restrictions. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 198.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con
L	CCI-001617	IA-5(1)(d)	The organization defines maximum password lifetime restrictions.	DoD has defined the maximum password lifetime restrictions as 60 days and not being “0”.	App	This is policy to be provided by the Government. See CCI-199 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-199 for design and implementation.	Gov
L	CCI-000199	IA-5(1)(d)	The information system enforces maximum password lifetime restrictions.	Configure the information system to enforce maximum password lifetime restrictions. For capable components, set maximum password age to 60 days or less (excluding “0”). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 199.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to configure based on specification for passwords.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to configure based on specification for passwords.	Con

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L	CCI-001618	IA-5(1)(e)	The organization defines the number of generations for which password reuse is prohibited.	Per the STIGs for Windows based systems, the DOD has defined this to be set at a minimum of 24.	App	This is policy to be provided by the Government. See CCI-200 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-200 for design and implementation.	Gov
L	CCI-000200	IA-5(1)(e)	The information system prohibits password reuse for the organization defined number of generations.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 200. All other components utilizing passwords, the password reuse should be set to 24. If the components are incapable of being set to 24 then implement the maximum possible.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to configure based on specification for passwords.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to configure based on specification for passwords.	Con
L	CCI-002041	IA-5(1)(f)	The information system allows the use of a temporary password for system logons with an immediate change to a permanent password.	Configure the information system to allow the use of a temporary password for system logons with an immediate change to a permanent password. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 2041. For components that cannot technically require password change upon initial login, document in organizational policy as a requirement for personnel logging in with a temporary password to immediately change the password to the standards defined in the BBP for Army Password Standards.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to configure based on specification for passwords.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to configure based on specification for passwords.	Con
M	CCI-000185	IA-5(2)(a)	The information system, for PKI-based authentication validates certifications by constructing and verifying a certification path to an accepted trust anchor including checking certificate status information.	The information system performing hardware token-based authentication must be configured to validate DoD-approved PKI credentials in accordance with RFC 5280. The information system must be configured to perform a revocation check as part of the certificate validation process. Revocation checking may be performed using certificate revocation lists (CRLs) published by the issuing PKI or Online Certificate Status Protocol (OCSP) services. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 185. Recommended Compelling Evidence: 1.) Signed and dated SOP / TTP documenting the use of a validated DoD-approved PKI credentials in accordance with RFC 5280 2.) Applicable STIG / SRG checks	N/P	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/P	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A
M	CCI-000186	IA-5(2)(b)	The information system, for PKI-based authentication enforces authorized access to the corresponding private key.	Information systems must not have access to users' private keys. The cryptographic container in which the private keys are stored (e.g. smart card or software module) implements access controls and protections to ensure that only the authorized user can activate the private key. DoD users agree to protect their PKI credentials in accordance with the DD-2842 agreement that is executed for each credential. They are reminded of these responsibilities in annual IA training. The private key identifying the information system must be stored in a cryptographic container that is FIPS 140-2validated. Only authorized information system operators should have access to activation data (e.g. password or PIN) for the private key. Recommended Compelling Evidence: 1.) Signed and dated SOP / TTP, referencing section on private key access 2.) Applicable STIG / SRG checks	N/P	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/P	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-000187	IA-5(2)(c)	The information system, for PKI-based authentication, maps the authenticated identity to the account of the individual or group.	The information system performing PKI-based authentication must be configured to map the authenticated PKI credential to a corresponding network or information system account or role in accordance with DoDI 8520.03. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 187. Recommended Compelling Evidence: 1.) Signed and dated SOP / TTP for configuring the information system mapping of the authenticated PKI credentials to a corresponding network or information system account or role in accordance with DoDI 8520.03. 2.) Applicable STIG / SRG checks	N/P	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/P	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A
M	CCI-001991	IA-5(2)(d)	The information system, for PKI-based authentication, implements a local cache of revocation data to support path discovery and validation in case of inability to access revocation information via the network.	The information system must be configured to locally cache revocation data to support path discovery and validation in case of inability to access revocation information via the network. The information system may meet this requirement by locally caching certificate revocation lists (CRLs), Online Certificate Status Protocol (OCSP) responses, or a combination thereof. Cached revocation data must include revocation information from all PKIs serving known or anticipated users of the information system. Cached data must be refreshed with a frequency shorter than the life of the data (e.g. if a CRL is valid for 7 days, a new CRL must be retrieved and cached more frequently than every 7 days) to ensure that cached data is valid and not expired. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1991. Recommended Compelling Evidence: 1.) Signed and dated SOP / TTP configuring the information system to locally cache revocation data to support path discovery and validation in case of inability to access revocation information via the network. 2.) Applicable STIG / SRG checks	N/P	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/P	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A
L	CCI-002002	IA-5(11)	The organization defines the token quality requirements to be employed by the information system mechanisms for token-based authentication.	DoDI 8520.03 defines types of authentication credentials that are acceptable for authentication to different systems based on the systems' information sensitivity levels and the users' access environments. The definitions for credential strengths D, E and H found in DoDI 8520.03 Enclosure 3, Section 3 specifically deal with acceptable types of hardware PKI credentials. DoD Components are automatically compliant with this control because they are covered by the DoD-level policy, DoDI 8520.03.	N/P	This is policy to be provided by the Government. See CCI-2003 for design and implementation.	N/A	N/P	This is policy to be provided by the Government. See CCI-2003 for design and implementation.	N/A
L	CCI-002003	IA-5(11)	The information system, for token-based authentication, employs mechanisms that satisfy organization-defined token quality requirements.	The information system performing hardware token-based authentication must be configured to accept only DoD-approved PKI credentials in accordance with DoDI 8520.02 and DoDI 8520.03. For unclassified systems, DoD-approved PKI credentials include DoD PKI credentials, External Certification Authority (ECA) PKI credentials, and DoD-approved external PKI credentials. If the information system accepts DoD-approved external PKI credentials, the information system must be configured to accept only certificates at approved assurance levels, as represented by the Certificate Policy Object Identifiers (OIDs) asserted in the certificate. The current list of DoD-approved external PKIs and acceptable Object Identifiers (OIDs) for each approved external PKI is available at http: / / iase.disa.mil / pki-pke / interoperability Windows based control systems on the network, utilizing CAC authentication and configured with the Army Gold Master (AGM) should automatically be compliant with this.	N/P	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/P	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A
L	CCI-000206	IA-6	The information system obscures feedback of authentication information during the authentication process to protect the information from possible exploitation / use by unauthorized individuals.	Configure the information system to obscure feedback of authentication information during the authentication process to protect the information from possible exploitation / use by unauthorized individuals. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 206. Applicable to networked devices. Does not apply to devices that have NO feedback during password / PIN entry. Devices shall never show authentication information, including passwords, on a display. Devices that momentarily display a character as it is entered, and then obscure the character, are acceptable. For devices that have STIGs or SRGs related to CCI-000206, comply with the requirements of those STIGS / SRGs.	App	Contractor to configure devices to never show authentication information on devices which support this feature. Apply STIG / SRGs.	Con	App	Contractor to configure devices to never show authentication information on devices which support this feature. Apply STIG / SRGs.	Con

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-000803	IA-7	The information system implements mechanisms for authentication to a cryptographic module that meet the requirements of applicable federal laws, Executive Orders, directives, policies, regulations, standards, and guidance for such authentication.	For devices that have STIG / SRGs related to CCI-000803,comply with the requirements of those STIG / SRGs.	N/A	Cryptographic functions not available at this level.	N/A	N/A	Cryptographic functions not available at this level.	N/A
M	CCI-000865	MA-3	The organization approves information system maintenance tools.	The organization being inspected / assessed documents the approved maintenance tools within the Security Plan. Recommended Compelling Evidence: 1.) Signed and dated System Security Plan (SSP), including a list of approved maintenance tools	App	Maintenance provided by Government not contractor.	Gov	App	Maintenance provided by Government not contractor.	Gov
M	CCI-002930	PE-4	The organization defines information system distribution and transmission lines within organizational facilities to control physical access using organization-defined security safeguards.	The organization being inspected / assessed defines and documents information system distribution and transmission lines within organizational facilities to control physical access using organization-defined security safeguards. If transmission lines carry classified information, a protected distribution system (PDS) must be used to transmit unencrypted classified information through an area of lesser classification or control. For additional information, see NSTISSI No. 7003. DoD has determined the information system distribution and transmission lines are not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) Facility access policy and procedures	App	This is policy to be provided by the Government. See CCI-936 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-936 for design and implementation.	Gov
M	CCI-002931	PE-4	The organization defines security safeguards to control physical access to organization-defined information system distribution and transmission lines within organizational facilities.	The organization being inspected / assessed defines and documents security safeguards to control physical access to organization-defined information system distribution and transmission lines within organizational facilities. DoD has determined the security safeguards are not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) Facility access policy and procedures 2.) Access audit records for areas that include transmission or distribution lines 3.) Lines must be secured from tampering	App	This is policy to be provided by the Government. See CCI-936 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-936 for design and implementation.	Gov
M	CCI-000936	PE-4	The organization controls physical access to organization-defined information system distribution and transmission lines within organizational facilities using organization-defined security safeguards.	The organization being inspected / assessed controls physical access to information system distribution and transmission lines defined in PE-4, CCI 2930 within organizational facilities using security safeguards defined in PE-4, CCI 2931. Recommended Compelling Evidence: 1.) Facility access policy and procedures 2.) Locked Cabinets / Closets / Key Control etc.	App	Applicable UFGS design standards incorporate access control to equipment, electrical and mechanical spaces. FRCS provided with lockable enclosures.	Con	App	Applicable UFGS design standards incorporate access control to equipment, electrical and mechanical spaces. FRCS provided with lockable enclosures.	Con
M	CCI-000937	PE-5	The organization controls physical access to information system output devices to prevent unauthorized individuals from obtaining the output.	Physical Security should be applied where applicable and does not violate life safety.	App	Applicable UFGS design standards incorporate access control to equipment, electrical and mechanical spaces. FRCS provided with lockable enclosures.	Con	App	Applicable UFGS design standards incorporate access control to equipment, electrical and mechanical spaces. FRCS provided with lockable enclosures.	Con
M	CCI-000952	PE-9	The organization protects power equipment and power cabling for the information system from damage and destruction.	The organization being inspected / assessed provides a list of protective measures in place to prevent damage and / or destruction of power equipment and power cabling for their information system environment, IAW CP-2 (1), CCI 469. Recommended Compelling Evidence: 1.) List of protective measures to prevent damage to the system 2.) Verify devices are secure.	App	Applicable UFGS design standards incorporate access control to equipment, electrical and mechanical spaces. FRCS provided with lockable enclosures.	Con	App	Applicable UFGS design standards incorporate access control to equipment, electrical and mechanical spaces. FRCS provided with lockable enclosures.	Con
M	CCI-002954	PE-9(1)	The organization defines the distance to physically separate redundant power cabling paths.	Installed in accordance with code.	N/P	This is policy to be provided by the Government. See CCI-2953 for design and implementation.	N/A	N/P	This is policy to be provided by the Government. See CCI-2953 for design and implementation.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-002953	PE-9(1)	The organization employs redundant power cabling paths that are physically separated by organization-defined distance.	Apply and use redundant cable where practical, within code and cost effective.	N/P	This control system is not mission-critical, redundant connections not applied.	N/A	N/P	This control system is not mission-critical, redundant connections not applied.	N/A
M	CCI-002955	PE-11	The organization provides a short-term uninterruptible power supply to facilitate an orderly shutdown of the information system and/or transition of the information system to long-term alternate power in the event of a primary power source loss.	The organization being inspected/assessed implements an uninterruptible power supply with sufficient capacity to support orderly shutdown of the system or transition the system to long-term alternate power in the event of a primary power source loss. DISA Compelling Evidence Uninterruptable power system (UPS)	App	Provide control system with power supply meeting or exceeding the reliability of the controlled equipment. Without explicit approval from the government, do not install local uninterruptible power supplies (UPSs) as a source of device power.	Con	App	Provide control system with power supply meeting or exceeding the reliability of the controlled equipment. Without explicit approval from the government, do not install local uninterruptible power supplies (UPSs) as a source of device power.	Con
L	CCI-003051	PL-2(a)(2)	The organization's security plan for the information system explicitly defines the authorization boundary for the system.	Develop a diagram and explain within the system security plan (SSP) the authorization boundary for the complete control system including all networked devices and controller hardware.	App	Contractor to provide riser diagrams, connectivity diagrams and data flows per specifications. Only isolated control networks or standalone systems planned for this project. No connections to existing networks.	Con	N/A	Does not apply to field devices	N/A
L	CCI-003053	PL-2(a)(4)	The organization's security plan for the information system provides the security categorization of the information system including supporting rationale.	The recommended Security Category = {(confidentiality, Low), (integrity, Low), (availability, Low)} Therefore the system shall be categorized as a LOW-LOW-LOW system.	App	This is policy-related to be provided by Government.	Gov	App	This is policy-related to be provided by Government.	Gov
M	CCI-003071	PL-7(a)	The organization develops a security Concept of Operations (CONOPS) for the information system containing at a minimum, how the organization intends to operate the system from the perspective of information security.	The organization being inspected / assessed documents and implements a process to require individuals who have signed a previous version of the rules of behavior to read and resign when the rules of behavior are revised / updated.	App	This is policy-related to be provided by Government.	Gov	App	This is policy-related to be provided by Government.	Gov
M	CCI-003072	PL-8(a)	The organization develops an information security architecture for the information system.	The organization being inspected / assessed develops and documents an information security architecture for the information system. Recommended Compelling Evidence: 1.) Current documented information security architecture which includes information security implementation and safeguards, both externally and internally facing. 2). Architectural drawings should be provided	App	System designed to adhere to the approved CCIs and BOD. Detailed network architecture drawings and other artifacts provided during construction by contractor.	Con	N/A	Does not apply to non-networked devices.	N/A
M	CCI-003073	PL-8(a)(1)	The organization's information security architecture for the information system describes the overall philosophy, requirements, and approach to be taken with regard to protecting the confidentiality, integrity, and availability of organizational information.	The organization being inspected / assessed describes within the information security architecture for the information system, the overall philosophy, requirements, and approach to be taken with regard to protecting the confidentiality, integrity, and availability of organizational information. Recommended Compelling Evidence: 1.) Current documented information security architecture which includes the overall philosophy, requirements, and approach to protect the confidentiality, integrity, and availability of organizational information.	App	System designed to adhere to the approved CCIs and BOD. Detailed network architecture drawings and other artifacts provided during construction by contractor.	Con	App	System designed to adhere to the approved CCIs and BOD. Detailed network architecture drawings and other artifacts provided during construction by contractor.	Con
M	CCI-003075	PL-8(a)(3)	The organization's information security architecture for the information system describes any information security assumptions about, and dependencies on, external services.	The organization being inspected / assessed describes within the information security architecture for the information system, any information security assumptions about, and dependencies on, external services. Recommended Compelling Evidence: 1.) Current documented information security architecture which identifies any information security assumptions about, and dependencies on, external services.	App	System designed to adhere to the approved CCIs and BOD. Detailed network architecture drawings and other artifacts provided during construction by contractor.	Con	App	System designed to adhere to the approved CCIs and BOD. Detailed network architecture drawings and other artifacts provided during construction by contractor.	Con

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-000207	PM-5	The organization develops and maintains an inventory of its information systems.	Initial inventory is provided by as-built bill of materials. Army requires any system utilizing IT dollars to be registered in the Army Portfolio Management System (APMS). This would be a requirement of the system owner (SO). 1.) Vendor to provide needed information 2.) System Owner responsible for registration in APMS	App	Contractor to provide asset inventory list for all network-capable enabled devices.	Con	App	Contractor to provide asset inventory list for all network-capable enabled devices.	Con
L	CCI-000236	PM-11(b)	The organization determines information protection needs arising from the defined mission / business processes and revises the processes as necessary, until an achievable set of protection needs are obtained.	No additional protection needs are needed aside from what the network provider supplies. Control system components (not including servers and workstations) will be on a private VLAN without public access thereby further segregating the components from the cyber domain.	App	System designed to adhere to the approved CCIs and BOD which are reviewed at each stage of design.	Con	App	System designed to adhere to the approved CCIs and BOD which are reviewed at each stage of design.	Con
L	CCI-001048	RA-3(a)	The organization conducts an assessment of risk of the information system and the information it processes, stores, or transmits that includes the likelihood and magnitude of harm from the unauthorized access, use, disclosure, disruption, modification, or destruction.	The conducting of a Risk Assessment will most likely be site specific. The owning organization will need to conduct an assessment of risk of the information system and the information it processes, stores, or transmits that includes the likelihood and magnitude of harm from the unauthorized access, use, disclosure, disruption, modification, or destruction. The Designer can assist in identifying risk to the owing organization in order to complete the risk assessment.	App	Government to complete risk assessments per current policies and procedures. No affect on design and implementation.	Gov	App	Government to complete risk assessments per current policies and procedures. No affect on design and implementation.	Gov
L	CCI-001055	RA-5(a)	The organization defines a frequency for scanning for vulnerabilities in the information system and hosted applications.	DoD has defined the frequency as every 30 days or as directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs).	N/P	This is policy to be provided by the Government. See CCI-1054 for design and implementation.	N/A	N/P	This is policy to be provided by the Government. See CCI-1054 for design and implementation.	N/A
L	CCI-001054	RA-5(a)	The organization scans for vulnerabilities in the information system and hosted applications on an organization-defined frequency.	Servers, workstations and network infrastructure on the network will be scanned for vulnerabilities by the network provider. All other IP devices associated with the system (whether on the public or private side of the network) must be scannable such that the device can be scanned by industry standard IP network scanning utilities without harm to the device, application or functionality. The owning organization will need a service level agreement (SLA) with the network provider to perform scanning of IP devices on a private VLAN or dark fiber network, or have in-house personnel assigned to perform the vulnerability scanning. DoD has defined the frequency as every 30 days or as directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs).	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-001641	RA-5(a)	The organization defines the process for conducting random vulnerability scans on the information system and hosted applications.	DoD has defined the requirement for vulnerability scanning periodicity of every 30 days. If the organization has determined a requirement for random scanning they must document that process. DoD has defined the frequency as every 30 days or as directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs).	N/P	This is policy to be provided by the Government. See CCI-1643 for design and implementation.	N/A	N/P	This is policy to be provided by the Government. See CCI-1643 for design and implementation.	N/A
L	CCI-001643	RA-5(a)	The organization scans for vulnerabilities in the information system and hosted applications in accordance with the organization-defined process for random scans.	Servers, workstations and network infrastructure on the network will follow the process for random scans as defined by the Network Provider. The organization will conduct random vulnerability scans every 30 days or as directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs) for all other control system components on a private VLAN or the portion not scannable by the Network Provider.. The organization will document the vulnerability scans as an audit trail for future reference. The audit trail must be maintained IAW DoD, CYBERCOM, or component policies. DoD has defined the frequency as every 30 days or as directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs).	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-001056	RA-5(a)	The organization scans for vulnerabilities in the information system and hosted applications when new vulnerabilities potentially affecting the system / applications are identified and reported.	Conduct vulnerability scans of the information system and hosted applications when new vulnerabilities potentially affecting the system / applications are identified and reported via authoritative sources (e.g., IAVM, CTO, DTM, STIG, product vendor).	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-001057	RA-5(b)	The organization employs vulnerability scanning tools and techniques that facilitate interoperability among tools and automate parts of the vulnerability management process by using standards for: enumerating platforms, software flaws, and improper configurations; formatting checklists and test procedures; and measuring vulnerability impact.	The organization whether through the Network Provider or otherwise, employs the DoD Enterprise scanning tool.	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-001058	RA-5(c)	The organization analyzes vulnerability scan reports and results from security control assessments.	The organization analyzes vulnerability scan reports and security control assessment results with the intent of identifying legitimate vulnerabilities and the relationship between vulnerabilities and security controls.	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-001059	RA-5(d)	The organization remediates legitimate vulnerabilities in organization-defined response times in accordance with an organizational assessment risk.	The organization being inspected / assessed takes corrective actions as appropriate on legitimate vulnerabilities identified in RA-5, CCI 001058 IAW an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs). Audit records of actions must be maintained IAW applicable DoD, CYBERCOM, and / or component policies. DoD has defined the response times as IAW an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs).	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
M	CCI-001062	RA-5(1)	The organization employs vulnerability scanning tools that include the capability to readily update the information system vulnerabilities to be scanned.	The organization being inspected / assessed will employ scanning tools that maintain currency with industry standard information system vulnerabilities to ensure that scanning activities are conducted with the most up to date list of known vulnerabilities to include USCYBERCOM issued IAVMs. DoD has provided an enterprise scanning tool that FULLY meets this requirement. Organizations that choose not to use the enterprise scanning tool must identify which scanning tool they are using and ensure that it meets these requirements. Recommended Compelling Evidence: 1.) Documentation that scanning tool being used can be updated.	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
M	CCI-002906	RA-5(5)	The organization defines the vulnerability scanning activities in which the information system implements privileged access authorization to organization-identified information system components.	The organization being inspected / assessed defines and documents the vulnerability scanning activities in which the information system implements privileged access authorization to organization-identified information system components. DoD has determined the vulnerability scanning activities are not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) Reference to system security plan (SSP) section pertaining to the roles and responsibilities of vulnerability scanning.	App	This is policy to be provided by the Government. See CCI-1067 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-1067 for design and implementation.	Gov
M	CCI-001645	RA-5(5)	The organization identifies the information system components to which privileged access is authorized for selected organization-defined vulnerability scanning activities.	DoD has defined the information system components as all information systems and infrastructure components. Recommended Compelling Evidence: **Automatically compliant.**	App	This is policy to be provided by the Government. See CCI-1067 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-1067 for design and implementation.	Gov
M	CCI-001067	RA-5(5)	The information system implements privileged access authorization to organization-identified information system components for selected organization-defined vulnerability scanning activities.	The organization being inspected / assessed configures the information system to implement privileged access authorization to all information systems and infrastructure components for selected vulnerability scanning activities defined in RA-5 (5), CCI 2906. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1067. DoD has defined the information system components as all information systems and infrastructure components. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) Reference to system security plan (SSP) section pertaining to the roles and responsibilities of vulnerability scanning.	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP) App	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP) Designer Text	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP) Resp	LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED) App	LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED) Designer Text	LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED) Resp
M	CCI-000623	SA-4(1)	The organization requires the developer of the information system, system component, or information system service to provide a description of the functional properties of the security controls to be employed.	DoDI 8510.01 system categorization meets the DoD requirement for providing a description of the functional properties of the security controls to be employed. DoD Components are automatically compliant with this CCI because they are covered by the DoD level policy, DoDI 8510.01. Recommended Compelling Evidence: **Automatically compliant per DoDI 8510.01.**	App	Automatically compliant.	Gov	App	Automatically compliant.	Gov
M	CCI-003104	SA-4(2)	The organization defines the implementation information that the developer of the information system, system component, or information system service is required to provide for the security controls to be employed.	The organization being inspected / assessed defines and documents the implementation information that the developer of the information system, system component, or information system service is required to provide for the security controls to be employed. DoD has determined the implementation information is not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation includes implementation information by the system developer, as it related to security controls to be employed.	App	This is policy to be provided by the Government. See CCI-3102 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-3102 for design and implementation.	Gov
M	CCI-003106	SA-4(2)	The organization defines the level of detail the implementation information of the security controls is required to be provided by the developer of the information system, system component, or information system services.	The organization being inspected / assessed defines and documents the level of detail the implementation information of the security controls is required to be provided by the developer of the information system, system component, or information system services. DoD has determined the level of detail is not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) System security plan (SSP) defines level of detail required in design information of all security controls, to be provided by developer of information system, component, or service.	App	This is policy to be provided by the Government. See CCI-3102 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-3102 for design and implementation.	Gov
M	CCI-003102	SA-4(2)	The organization requires the developer of the information system, system component, or information system service to provide implementation information for the security controls to be employed that includes security-relevant external system interfaces, high-level design, low-level design, source code and / or hardware schematics organization-defined implementation information at organization-defined level of detail.	The organization being inspected / assessed defines and documents in contracts / agreements, the implementation information for the security controls that the developer will employ in the information system to include security-relevant external system interfaces, high-level design, low-level design, source code and / or hardware schematics and / or implementation information defined in SA-4 (2), CCI 3104 at the level of detail defined in SA-4 (2), CCI 3106. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation includes implementation information by the system developer. 3.) Security control documentation includes security-relevant external system interfaces, high-level design, low-level design, source code, hardware schematics and organization defined design / information level of detail.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
M	CCI-003103	SA-4(2)	The organization defines the design information that the developer of the information system, system component, or information system service is required to provide for the security controls to be employed.	The organization being inspected / assessed defines and documents the design information that the developer of the information system, system component, or information system service is required to provide for the security controls to be employed. DoD has determined the design information is not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation includes design information by the system developer, as it related to security controls to be employed.	App	This is policy to be provided by the Government. See CCI-3101 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-3101 for design and implementation.	Gov
M	CCI-003105	SA-4(2)	The organization defines the level of detail the design information of the security controls is required to be provided by the developer of the information system, system component, or information system services.	The organization being inspected / assessed defines and documents the level of detail the design information of the security controls is required to be provided by the developer of the information system, system component, or information system services. DoD has determined the level of detail is not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) System security plan (SSP) defines level of detail required in design information of all security controls, to be provided by developer of information system, component, or service.	App	This is policy to be provided by the Government. See CCI-3101 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-3101 for design and implementation.	Gov

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-003101	SA-4(2)	The organization requires the developer of the information system, system component, or information system service to provide design information for the security controls to be employed that includes security-relevant external system interfaces, high-level design, low-level design, source code, hardware schematics and / or organization-defined design / information at organization-defined level of detail.	The organization being inspected / assessed defines and documents in contracts / agreements, the design information for the security controls that the developer will employ in the information system to include security-relevant external system interfaces, high-level design, low-level design, source code, hardware schematics and / or design / information defined in SA-4 (2), CCI 3103 at the level of detail defined in SA-4 (2), CCI 3105. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation includes design information by the system developer. 3.) Security control documentation includes security-relevant external system interfaces, high-level design, low-level design, source code, hardware schematics and organization defined design / information level of detail.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
M	CCI-003114	SA-4(9)	The organization requires the developer of the information system, system component, or information system service to identify early in the system development life cycle, the functions, ports, protocols, and services intended for organizational use.	The organization being inspected / assessed documents within contracts / agreements, the requirement that the developer of the information system, system component, or information system service identify early in the system development life cycle, the functions, ports, protocols, and services intended for organizational use. Ports identified shall be assessed and planned for in light of DISA's PPSM requirements. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation identifies functions, ports, protocols and services intended for use.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
L	CCI-003116	SA-4(10)	The organization employs only information technology products on the FIPS 201-approved products list for Personal Identity Verification (PIV) capability implemented within organizational information systems.	Servers and workstations on the network (Network Provider) and configured with the Army Gold Master (AGM) will be compliant with CCI-003116. Devices on the Network Provider will be compliant with FIPS 201-2 approved products list. Components not CAC enabled (those on private side, or private VLAN) will not implement PKI or a PIV capability.	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-003124	SA-5(a)(1)	The organization obtains administrator documentation for the information system, system component, or information system services that describes secure configuration of the system, component, or service.	Document within contracts / agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe secure configuration of the system, component, or service. To the extent possible this should also apply to Control System software applications. This generally would not apply to physical servers and workstations on the network since they will be configured to Army requirements.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
L	CCI-003125	SA-5(a)(1)	The organization obtains administrator documentation for the information system, system component, or information system services that describes secure installation of the system, component, or service.	Document within contracts / agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe secure installation of the system, component, or service. To the extent possible this should also apply to Control System software applications. This generally would not apply to physical servers and workstations on the network since they will be configured to Army requirements.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
L	CCI-003126	SA-5(a)(1)	The organization obtains administrator documentation for the information system, system component, or information system services that describes secure operation of the system, component, or service.	Document within contracts / agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe secure operation of the system, component, or service. To the extent possible this should also apply to Control System software applications. This generally would not apply to physical servers and workstations on the network since they will be configured to Army requirements.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-003127	SA-5(a)(2)	The organization obtains administrator documentation for the information system, system component, or information system services that describes effective use and maintenance of security functions / mechanisms.	Document within contracts / agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe effective use and maintenance of the system, component, or service. To the extent possible this should also apply to Control System software applications.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
L	CCI-003128	SA-5(a)(3)	The organization obtains administrator documentation for the information system, system component, or information system services that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions.	Document within contracts / agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe known vulnerabilities of the system, component, or service. To the extent possible this should also apply to Control System software applications.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
L	CCI-003129	SA-5(b)(1)	The organization obtains user documentation for the information system, system component, or information system service that describes user-accessible security functions / mechanisms and how to effectively use those security functions / mechanisms.	Document within contracts / agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe user-accessible security functions / mechanisms and how to effectively use those security functions / mechanisms. To the extent possible this should also apply to Control System software applications.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
L	CCI-003130	SA-5(b)(2)	The organization obtains user documentation for the information system, system component or information system service that describes methods for user interaction which enables individuals to use the system, component, or service in a more secure manner.	Document within contracts / agreements, requirements that the developer provide user documentation for the information system, system component or information system service that describes methods for user interaction which enables individuals to use the system, component, or service in a more secure manner. To the extent possible this should also apply to Control System software applications.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
L	CCI-003131	SA-5(b)(3)	The organization obtains user documentation for the information system, system component or information system service that describes user responsibilities in maintaining the security of the system, component, or service.	Document within contracts / agreements, requirements that the developer provide user documentation for the information system, system component or information system service that describes user responsibilities in maintaining the security of the system, component, or service. To the extent possible this should also apply to Control System software applications.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
M	CCI-003155	SA-10(a)	The organization requires the developer of the information system, system component, or information system service to perform configuration management during system, component or service design, development, implementation and / or operation.	The organization being inspected / assessed requires within contracts / agreements that the developer of the information system, system component, or information system service perform configuration management during system, component or service design, development, implementation and / or operation. The configuration management process applies to: 1. Documentation developed or used in the lifecycle, including requirements and interface specifications; 2. Elements including design libraries; 3. Tools including design tools and test tools; 4. Technical data including test data; and 5. Information on element and system lifecycle processes Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation. 3.) Continuous monitoring plan must require developer to perform configuration management during system, component or service design, development, implementation, and / or operation.	App	Contractor to supply cybersecurity plan and adhere to change management procedures.	Con	App	Contractor to supply cybersecurity plan and adhere to change management procedures.	Con

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-003159	SA-10(b)	The organization defines the configuration items under configuration management that require the integrity of changes to be documented, managed and controlled.	The organization being inspected / assessed defines and documents the configuration items under configuration management that require the integrity of changes to be documented, managed and controlled. DoD has determined the configuration items are not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation. 3.) Continuous monitoring plan must define configuration items under configuration management that require integrity of changes to be documented, managed and controlled.	App	This is policy to be provided by the Government. See CCI-3156 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-3156 for design and implementation.	Gov
M	CCI-003156	SA-10(b)	The organization requires the developer of the information system, system component, or information system service to document the integrity of changes to organization-defined configuration items under configuration management.	The organization being inspected / assessed requires within contracts / agreements that the developer of the information system, system component, or information system service document the integrity of changes to configuration items under configuration management defined in SA-10, CCI 3159 Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation. 3.) Continuous monitoring plan must require developer to perform configuration management during system, component or service design, development, implementation, and / or operation.	App	Contractor to supply cybersecurity plan and adhere to change management procedures.	Con	App	Contractor to supply cybersecurity plan and adhere to change management procedures.	Con
M	CCI-003157	SA-10(b)	The organization requires the developer of the information system, system component, or information system service to manage the integrity of changes to organization-defined configuration items under configuration management.	The organization being inspected / assessed requires within contracts / agreements the requirement that the developer of the information system, system component, or information system service manage the integrity of changes to configuration items under configuration management defined in SA-10, CCI 3159. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation. 3.) Continuous monitoring plan must require developer to perform configuration management during system, component or service design, development, implementation, and / or operation.	App	Contractor to supply cybersecurity plan and adhere to change management procedures.	Con	App	Contractor to supply cybersecurity plan and adhere to change management procedures.	Con
M	CCI-003158	SA-10(b)	The organization requires the developer of the information system, system component, or information system service to control the integrity of changes to organization-defined configuration items under configuration management.	The organization being inspected / assessed requires within contracts / agreements that the developer of the information system, system component, or information system service control the integrity of changes to configuration items under configuration management defined in SA-10, CCI 3159. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation. 3.) Continuous monitoring plan must require developer to perform configuration management during system, component or service design, development, implementation, and / or operation.	App	Contractor to supply cybersecurity plan and adhere to change management procedures.	Con	App	Contractor to supply cybersecurity plan and adhere to change management procedures.	Con
M	CCI-000692	SA-10(c)	The organization requires the developer of the information system, system component, or information system service to implement only organization - approved changes to the system, component, or service.	The organization being inspected / assessed requires within contracts / agreements that the developer of the information system, system component, or information system service implement only organization-approved changes to the system, component, or service throughout its life cycle. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation. 3.) Continuous monitoring plan must require that only organization-approved changes are implemented.	App	Contractor to supply cybersecurity plan and adhere to change management procedures.	Con	App	Contractor to supply cybersecurity plan and adhere to change management procedures.	Con
M	CCI-000694	SA-10(d)	The organization requires the developer of the information system, system component, or information system service to document approved changes to the system, component, or service.	The organization being inspected / assessed requires within contracts / agreements that the developer of the information system, system component, or information system service document approved changes to the system, component, or service. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation. 3.) Continuous monitoring plan must require that only organization-approved changes are implemented, and documented.	App	Contractor to supply cybersecurity plan and adhere to change management procedures.	Con	App	Contractor to supply cybersecurity plan and adhere to change management procedures.	Con
M	CCI-003160	SA-10(d)	The organization requires the developer of the information system, system component, or information system service to document the potential security impacts of approved changes to the system, component, or service.	The organization being inspected / assessed requires within contracts / agreements that the developer of the information system, system component, or information system service document the potential security impacts of approved changes to the system, component, or service. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation. 3.) Continuous monitoring plan must document developer evaluated assessments of potential security impacts of approved changes.	App	Contractor to supply cybersecurity plan and adhere to change management procedures.	Con	App	Contractor to supply cybersecurity plan and adhere to change management procedures.	Con

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-003161	SA-10(e)	The organization requires the developer of the information system, system component, or information system service to track security flaws within the system, component, or service.	The organization being inspected / assessed requires within contracts / agreements that the developer of the information system, system component, or information system service track security flaws within the system, component, or service. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation. 3.) Continuous monitoring plan must document developer flaw tracking.	App	Contract specifications include provision of OEM software support for patches and upgrades. Additionally Contractor supplied cybersecurity documentation must detail any known vulnerabilities at time of submission.	Con	App	Contract specifications include provision of OEM software support for patches and upgrades. Additionally Contractor supplied cybersecurity documentation must detail any known vulnerabilities at time of submission.	Con
M	CCI-003162	SA-10(e)	The organization requires the developer of the information system, system component, or information system service to track flaw resolution within the system, component, or service.	The organization being inspected / assessed requires within contracts / agreements that the developer of the information system, system component, or information system service track flaw resolution within the system, component, or service. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation. 3.) Continuous monitoring plan must document developer flaw tracking, and resolution.	App	Contract specifications include provision of OEM software support for patches and upgrades. Additionally Contractor supplied cybersecurity documentation must detail any known vulnerabilities at time of submission.	Con	App	Contract specifications include provision of OEM software support for patches and upgrades. Additionally Contractor supplied cybersecurity documentation must detail any known vulnerabilities at time of submission.	Con
M	CCI-003163	SA-10(e)	The organization requires the developer of the information system, system component, or information system service to report security flaws and flaw resolution within the system, component, or service findings to organization-defined personnel.	The organization being inspected / assessed requires within contracts / agreements that the developer of the information system, system component, or information system service report security flaws and flaw resolution within the system, component, or service findings to at a minimum, the ISSO and ISSM. DoD has defined the personnel as at a minimum, the ISSO and ISSM. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation. 3.) Continuous monitoring plan must document developer flaw tracking, and resolution.	App	Contract specifications include provision of OEM software support for patches and upgrades. Additionally Contractor supplied cybersecurity documentation must detail any known vulnerabilities at time of submission.	Con	App	Contract specifications include provision of OEM software support for patches and upgrades. Additionally Contractor supplied cybersecurity documentation must detail any known vulnerabilities at time of submission.	Con
M	CCI-003171	SA-11(a)	The organization requires the developer of the information system, system component, or information system service to create a security assessment plan.	The organization being inspected / assessed requires that the developer create and document a security assessment plan that includes: 1. The types of analyses, testing, evaluation, and reviews of software and firmware components; 2. The degree of rigor to be applied; and 3. The types of artifacts produced during those processes. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation must contain developer-created Security Assessment Plan.	App	Contractor to supply cybersecurity plan. Additionally product submissions will include applicable cybersecurity documentation and certification.	Con	App	Contractor to supply cybersecurity plan. Additionally product submissions will include applicable cybersecurity documentation and certification.	Con
M	CCI-003172	SA-11(a)	The organization requires the developer of the information system, system component, or information system service to implement a security assessment plan.	The organization being inspected / assessed requires that the developer implement the security assessment plan developed in SA-11, CCI 003171. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation must require implementation of developer-created Security Assessment Plan.	App	Contractor to supply cybersecurity plan. Additionally product submissions will include applicable cybersecurity documentation and certification.	Con	App	Contractor to supply cybersecurity plan. Additionally product submissions will include applicable cybersecurity documentation and certification.	Con
M	CCI-003174	SA-11(b)	The organization defines the depth and coverage to perform unit, integration, system, and / or regression testing / evaluation.	The organization being inspected / assessed defines and documents the depth and coverage to perform unit, integration, system, and / or regression testing / evaluation. Examples of approaches or tool types that could be required are: 1. Approaches such as static analyses, dynamic analyses, binary analysis, or a hybrid of the three approaches; and 2. Tools such as web-based application scanners, static analysis tools, binary analyzers. DoD has determined the depth and coverage are not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation must define organization depth and coverage of unit, integration, system, and / or regression testing for developer to perform.	N/P	This is policy to be provided by the Government. See CCI-3173 for design and implementation.	N/A	N/P	This is policy to be provided by the Government. See CCI-3173 for design and implementation.	N/A
M	CCI-003173	SA-11(b)	The organization requires the developer of the information system, system component, or information system service to perform unit, integration, system, and / or regression testing / evaluation at organization-defined depth and coverage.	The organization being inspected / assessed documents within the contracts / agreements, the requirement that the developer of the information system, system component, or information system service perform unit, integration, system, and / or regression testing / evaluation at depth and coverage defined in SA-11, CCI 3174. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation must require developer to perform unit, integration, system, and / or regression testing at organization defined depth and coverage.	N/P	Testing described by CCI cannot be run on a control system without potential adverse affect. This testing should occur on Government test and development environment.	N/A	N/P	Testing described by CCI cannot be run on a control system without potential adverse affect. This testing should occur on Government test and development environment.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-003175	SA-11(c)	The organization requires the developer of the information system, system component, or information system service to produce evidence of the execution of the security assessment plan.	The organization being inspected / assessed requires the developer to produce and provide evidence of the execution of the security assessment plan. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation must require execution of developer-created Security Assessment Plan.	App	Contractor to supply cybersecurity plan and test procedures for testing required by specification.	Con	App	Contractor to supply cybersecurity plan and test procedures for testing required by specification.	Con
M	CCI-003176	SA-11(c)	The organization requires the developer of the information system, system component, or information system service to produce the results of the security testing / evaluation.	The organization being inspected / assessed requires the developer to produce and provide results of the security testing / evaluation. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation must require developer results of security testing / evaluation.	App	Contractor to supply cybersecurity plan and test procedures for testing required by specification.	Con	App	Contractor to supply cybersecurity plan and test procedures for testing required by specification.	Con
M	CCI-003177	SA-11(d)	The organization requires the developer of the information system, system component, or information system service to implement a verifiable flaw remediation process.	The organization being inspected / assessed requires the developer to implement a verifiable flaw remediation process. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation must require developer to implement verifiable flaw remediation process.	App	Contractor to supply cybersecurity plan and test procedures for testing required by specification.	Con	App	Contractor to supply cybersecurity plan and test procedures for testing required by specification.	Con
M	CCI-003178	SA-11(e)	The organization requires the developer of the information system, system component, or information system service to correct flaws identified during security testing / evaluation.	The organization being inspected / assessed requires the developer to correct flaws identified during security testing / evaluation and to document and provide evidence that the flaws were corrected. Recommended Compelling Evidence: 1.) System security plan (SSP). 2.) System development life cycle (SDLC) documentation must require developer correct flaws identified during security testing / evaluation process.	App	Contractor to supply cybersecurity plan and test procedures for testing required by specification. Contractor to resolve flaws as stated in Factory and PVT testing plan and supply maintenance support as stated in specification.	Con	App	Contractor to supply cybersecurity plan and test procedures for testing required by specification. Contractor to resolve flaws as stated in Factory and PVT testing plan and supply maintenance support as stated in specification.	Con
M	CCI-001082	SC-2	The information system separates user functionality (including user interface services) from information system management functionality.	The organization being inspected / assessed configures the information system to separate user functionality (including user interface services) from information system management functionality. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1082 Recommended Compelling Evidence: 1.) Data flow diagram. 2.) Applicable STIG / SRG checks.	App	Contractor to provide data flow diagram submission per specification. Contractor to configure user roles and privileges per specification including isolation of account types.	Con	App	Contractor to provide data flow diagram submission per specification. Contractor to configure user roles and privileges per specification including isolation of account types.	Con
L	CCI-001093	SC-5	The organization defines the types of denial of service attacks (or provides references to sources of current denial of service attacks) that can be addressed by the information system.	Definition of the types of denial of service attacks will be defined at the Network Provider level.	N/A	This is policy to be provided by the Government. See CCI-2385 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-2385 for design and implementation.	N/A
L	CCI-002386	SC-5	The organization defines the security safeguards to be employed to protect the information system against, or limit the effects of, denial of service attacks.	Definition of the security safeguard to be employed to protect the information system will be defined at the Network Provider level for all devices on the Network Provider. To the greatest extent practical, the hardware performs control logic without reliance on the network.	N/A	This is policy to be provided by the Government. See CCI-2385 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-2385 for design and implementation.	N/A

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L	CCI-002385	SC-5	The information system protects against or limits the effects of organization-defined types of denial of service attacks by employing organization-defined security safeguards.	For information system components that have applicable STIGs or SRGs, the organization must comply with the STIG / SRG guidance that pertains to CCI 2385. To the greatest extent practical, the hardware performs control logic without reliance on the network.	N/P	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/P	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A
X	CCI-001094	SC-05(1)	The information system restricts the ability of individuals to launch organization-defined denial of service attacks against other information systems.		N/P	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/P	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A
X	CCI-001095	SC-05(2)	The information system manages excess capacity, bandwidth, or other redundancy to limit the effects of information flooding types of denial of service attacks.		N/P	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/P	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A
L	CCI-001097	SC-7(a)	The information system monitors and controls communications at the external boundary of the system and at key internal boundaries within the system.	Monitoring and the controlling of communications at the external boundary of the system will be the responsibility of the Network Provider. The control system shall not be publicly accessible.	N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A
X	CCI-001098	SC-07 (c)	The information system connects to external networks or information systems only through managed interfaces consisting of boundary protection devices arranged in accordance with an organizational security architecture.		N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A
M	CCI-001102	SC-07(4) (a)	The organization implements a managed interface for each external telecommunication service.		N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A
M	CCI-002396	SC-07(4) (c)	The organization protects the confidentiality and integrity of the information being transmitted across each interface for each external telecommunication service.		N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
M	CCI-001109	SC-7(5)	The information system at managed interfaces denies network communications traffic by default and allows network communications traffic by exception (i.e., deny all, permit by exception).	The organization being inspected / assessed configures the information system to deny network communications traffic at managed interfaces by default and allows network communications traffic by exception (i.e., deny all, permit by exception). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1109. Recommended Compelling Evidence: 1.) Current Network diagram. 2.) Applicable firewall rule set. 3.) Applicable firewall logs. 4.) Applicable STIG / SRG checks.	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
M	CCI-002397	SC-07(7)	The information system, in conjunction with a remote device, prevents the device from simultaneously establishing non-remote connections with the system and communicating via some other connection to resources in external networks.		N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A
X	CCI-002398	SC-07(9) (a)	The information system detects outgoing communications traffic posing a threat to external information systems.		N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A
X	CCI-002399	SC-07(9) (a)	The information system denies outgoing communications traffic posing a threat to external information systems.		N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A
X	CCI-002400	SC-07(9) (b)	The information system audits the identity of internal users associated with denied outgoing communications traffic posing a threat to external information systems.		N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A
X	CCI-002401	SC-07(11)	The organization defines the authorized sources from which the information system will allow incoming communications.		N/A	This is policy to be provided by the Government. See CCI-2403 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-2403 for design and implementation.	N/A
X	CCI-002402	SC-07(11)	The organization defines the authorized destinations for routing inbound communications.		N/A	This is policy to be provided by the Government. See CCI-2403 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-2403 for design and implementation.	N/A
X	CCI-002403	SC-07(11)	The information system only allows incoming communications from organization-defined authorized sources routed to organization-defined authorized destinations.		N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A
X	CCI-001120	SC-07(13)	The organization defines key information security tools, mechanisms, and support components to be isolated.		N/P	This is policy to be provided by the Government. See CCI-1119 for design and implementation.	N/A	N/P	This is policy to be provided by the Government. See CCI-1119 for design and implementation.	N/A

M	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp
X	CCI-001119	SC-07(13)	The organization isolates organization-defined information security tools, mechanisms, and support components from other internal information system components by implementing physically separate subnetworks with managed interfaces to other components of the system.		N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A	N/A	Existing FACP/MNS will be reused. No cybersecurity changes will be made to the production environment.	N/A

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-002110	AC-2(a)	The organization defines the information system account types that support the organizational missions / business functions.	FRONT END SERVERS AND WORKSTATIONS will FULLY support accounts. Accounts and associated roles to gain access to the system through the Operating System (OS) are different than account and associated roles to gain access to the control system (CS) application. Users shall be given a unique username and assigned to a role reflecting the level of access that they are required to have. CS users should only require a general user account when authenticating to the front end server or workstation. In some cases, programmers and developers may need permissions at the local administrator level in order to execute CS tools. Users requiring administrator access to the system in order to execute special CS tools will have an administrator account and a general user account. FIELD POINT OF CONNECTIONS (FPOC's) which consists of standard IT managed Ethernet switch's or IP routers will FULLY support accounts. FPOCS should only have a single role relegated to administration of the device. Also known as Building Point of Connections (BPOC). FIELD CONTROL SYSTEM IP (FCS-IP) Network Controllers on an IP network shall FULLY support accounts on capable devices and WEAKLY support accounts on those with accounts that cannot be modified. Many building point of connections (BPOCS) support more than one account but are relegated to a single role utilizing administrator rights. Whether by web interface or direct connection each user requiring access shall have a unique username. FIELD CONTROL SYSTEM NON-IP devices generally do NOT support any access enforcement therefore the concept of "account" is meaningless. HUMAN MACHINE INTERFACES (HMI'S) and or GRAPHICAL USER INTERFACES (GUI'S) are NOT supported accounts. Aside from manufacturer's access for maintenance, devices generally do not support any access enforcement. If the HMI / GUI does support unique accounts and roles, then they SHALL be implemented.	App	Contractor to configure authentication and roles by device type as stated in specifications.	Con	N/A	Role based authentication not supported by field devices.	N/A	N/A	Role based authentication not supported by field devices.	N/A
L	CCI-000213	AC-3	The information system enforces approved authorizations for logical access to information and system resources in accordance with applicable access control policies.	Any device supporting accounts (either FULLY or WEAKLY) must limit access to the device according to specified limitations for each account. Install and configure any device having a Security Technical Implementation Guide (STIG) or Security Requirements Guide (SRG) in accordance with that STIG or SRG.	App	Contractor to configure authentication, authorization, and roles by device type as stated in specifications. Apply STIG/SRGs.	Con	App	Contractor to configure authentication, authorization, and roles by device type as stated in specifications. Apply STIG/SRGs.	Con	App	Contractor to configure authentication, authorization, and roles by device type as stated in specifications. Apply STIG/SRGs.	Con
L	CCI-000043	AC-7(a)	The organization defines the maximum number of consecutive invalid logon attempts to the information system by a user during an organization-defined time period.	DoD has defined the maximum number as three (3). Recommended Compelling Evidence: Automatically Compliant	App	This is policy to be provided by the Government. See CCI-44 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-44 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-44 for design and implementation.	Gov
L	CCI-001423	AC-7(a)	The organization defines the time period in which the organization-defined maximum number of consecutive invalid logon attempts occur.	DOD policy requires the system to Lock the user account when [3] unsuccessful login attempts occur within a [60 minute] interval unless a life safety issue will occur.	App	This is policy to be provided by the Government. See CCI-44 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-44 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-44 for design and implementation.	Gov
L	CCI-000044	AC-7(a)	The information system enforces the organization-defined limit of consecutive invalid logon attempts by a user during the organization-defined time period.	The information system shall be set to Lock the user account when three (3) unsuccessful login attempts occur within a 60 minute interval. Devices which WEAKLY supports accounts shall implement the requirements of a FULLY support account when possible. If unsuccessful login attempts and accounts lockouts are not supported by the device, then physical access to the device should limited to only authorized personnel. Document any device incapable of meeting the defined requirement and state actual implementation.	App	Devices which MINIMALLY support accounts must meet the indicated requirements for handling unsuccessful logon attempts. Devices which FULLY support accounts, except for high availability user interfaces indicated as exempt in specification, must meet the indicated requirements for handling unsuccessful logon attempts.	Con	N/P	Devices which MINIMALLY support accounts must meet the indicated requirements for handling unsuccessful logon attempts.	N/A	N/P	Devices which MINIMALLY support accounts must meet the indicated requirements for handling unsuccessful logon attempts.	N/A
L	CCI-002237	AC-7(b)	The organization defines the delay algorithm to be employed by the information system to delay the next login prompt when the maximum number of unsuccessful attempts is exceeded.	DOD policy requires that once the indicated number of unsuccessful login attempts occurs, delay login prompts by [5] seconds. If the provided software cannot meet these requirements, document software capabilities to protest from subsequent unsuccessful login attempts and propose alternate protections. Do not implement alternate protection measures without explicit permission from the Government	App	This is policy to be provided by the Government. See CCI-2238 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-2238 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-2238 for design and implementation.	Gov

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-002236	AC-7(b)	The organization defines the time period the information system will automatically lock the account or node when the maximum number of unsuccessful attempts is exceeded.	DOD policy requires for systems that once an account is locked, the account must stay locked until unlocked by an administrator.	App	This is policy to be provided by the Government. See CCI-2238 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-2238 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-2238 for design and implementation.	Gov
L	CCI-002238	AC-7(b)	The information system automatically locks the account or node for either an organization-defined time period, until the locked account or node is released by an administrator, or delays the next login prompt according to the organization-defined delay algorithm when the maximum number of unsuccessful attempts is exceeded.	The information system shall be configured to automatically lock the account or node until the locked account is released by an administrator and delays the next login prompt for a minimum of 5 seconds when the maximum number of unsuccessful attempts is exceeded. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 2238. DoD has defined the delay algorithm as a minimum of [5] seconds. DoD has defined the time period as until released by an administrator. Devices which WEAKLY supports accounts shall implement the requirements of a FULLY support account when possible. If unsuccessful login attempts and accounts lockouts are not supported by the device, then physical access to the device should limited to only authorized personnel.	App	Devices which MINIMALLY support accounts must meet the indicated requirements for handling unsuccessful logon attempts. Devices which FULLY support accounts, except for high availability user interfaces indicated as exempt in specification, must meet the indicated requirements for handling unsuccessful logon attempts.	Con	N/P	Devices which MINIMALLY support accounts must meet the indicated requirements for handling unsuccessful logon attempts.	N/A	N/P	Devices which MINIMALLY support accounts must meet the indicated requirements for handling unsuccessful logon attempts.	N/A
L	CCI-002247	AC-8(a)	The organization defines the use notification message or banner the information system displays to users before granting access to the system.	The DOD Consent Banner is defined on the RMF Knowledge service along with the Army Regulation 25-2 and can be found on the RMF Knowledge Service site at https: / / rmfks.osd.mil / rmf / Guidance / GoverningPolicy / Pages / ConsentBanner.aspx	App	This is policy to be provided by the Government. See CCI-48, 2243, 2244, 2245, 2246, and 2250 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-48, 2243, 2244, 2245, 2246, and 2250 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-48, 2243, 2244, 2245, 2246, and 2250 for design and implementation.	Gov
L	CCI-000048	AC-8(a)	The information system displays an organization-defined system use notification message or banner before granting access to the system that provides privacy and security notices consistent with applicable federal laws, Executive Orders, directives, policies, regulations, standards, and guidance.	All devices (PC's, BPOCs, Network switches, etc.…) with a user interface supporting the use of a password or PIN, and capable of displaying 50 or more alphanumeric characters shall be configured to display the DoD Information Systems – Standard Consent Banner and User Agreement before granting access to the system that provides privacy and security notices consistent with applicable federal laws, Executive Orders, directives, policies, regulations, standards, and guidance. For information system components that have applicable STIGs or SRGs, the organization must comply with the STIG / SRG guidance that pertains to CCI 48. The DOD Consent Banner can be found on the RMF Knowledge Service site at: https: / / rmfks.osd.mil / rmf / Guidance / GoverningPolicy / Pages / ConsentBanner.aspx Devices connected to a network, with a user interface supporting use of a password or PIN, and not capable of displaying 50 or more alphanumeric characters must have a permanently affixed label displaying an approved banner from the policy listed above.	App	Devices which are connected to a network and have a user interface must display a warning banner meeting the requirements of DTM 08-060 if capable of doing so. Devices which are connected to a network and have a user interface but are not capable of displaying a banner must have a permanently affixed label displaying an approved banner from DTM 08-060 Apply STIG / SRGs.	Con	N/A	Devices at this level are not connected to an IP Network.	N/A	N/A	Devices at this level are not connected to an IP Network.	N/A
L	CCI-002243	AC-8(a)(1)	The organization-defined information system use notification message or banner is to state that users are accessing a U.S. Government information system.	The DOD Consent Banner is defined on the RMF Knowledge service along with the Army Regulation 25-2 and can be found on the RMF Knowledge Service site at https: / / rmfks.osd.mil / rmf / Guidance / GoverningPolicy / Pages / ConsentBanner.aspx	App	Devices which are connected to a network and have a user interface must display a warning banner meeting the requirements of DTM 08-060 if capable of doing so. Devices which are connected to a network and have a user interface but are not capable of displaying a banner must have a permanently affixed label displaying an approved banner from DTM 08-060 Apply STIG / SRGs.	Con	N/A	Devices at this level are not connected to an IP Network.	N/A	N/A	Devices at this level are not connected to an IP Network.	N/A

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-002244	AC-8(a)(2)	The organization-defined information system use notification message or banner is to state that information system usage may be monitored, recorded, and subject to audit.	The DOD Consent Banner is defined on the RMF Knowledge service along with the Army Regulation 25-2 and can be found on the RMF Knowledge Service site at https: / / rmfks.osd.mil / rmf / Guidance / GoverningPolicy / Pages / ConsentBanner.aspx	App	Devices which are connected to a network and have a user interface must display a warning banner meeting the requirements of DTM 08-060 if capable of doing so. Devices which are connected to a network and have a user interface but are not capable of displaying a banner must have a permanently affixed label displaying an approved banner from DTM 08-060 Apply STIG / SRGs.	Con	N/A	Devices at this level are not connected to an IP Network.	N/A	N/A	Devices at this level are not connected to an IP Network.	N/A
L	CCI-002245	AC-8(a)(3)	The organization-defined information system use notification message or banner is to state that unauthorized use of the information system is prohibited and subject to criminal and civil penalties.	The DOD Consent Banner is defined on the RMF Knowledge service along with the Army Regulation 25-2 and can be found on the RMF Knowledge Service site at https: / / rmfks.osd.mil / rmf / Guidance / GoverningPolicy / Pages / ConsentBanner.aspx	App	Devices which are connected to a network and have a user interface must display a warning banner meeting the requirements of DTM 08-060 if capable of doing so. Devices which are connected to a network and have a user interface but are not capable of displaying a banner must have a permanently affixed label displaying an approved banner from DTM 08-060 Apply STIG / SRGs.	Con	N/A	Devices at this level are not connected to an IP Network.	N/A	N/A	Devices at this level are not connected to an IP Network.	N/A
L	CCI-002246	AC-8(a)(4)	The organization-defined information system use notification message or banner is to state that use of the information system indicates consent to monitoring and recording.	The DOD Consent Banner is defined on the RMF Knowledge service along with the Army Regulation 25-2 and can be found on the RMF Knowledge Service site at https: / / rmfks.osd.mil / rmf / Guidance / GoverningPolicy / Pages / ConsentBanner.aspx	App	Devices which are connected to a network and have a user interface must display a warning banner meeting the requirements of DTM 08-060 if capable of doing so. Devices which are connected to a network and have a user interface but are not capable of displaying a banner must have a permanently affixed label displaying an approved banner from DTM 08-060 Apply STIG / SRGs.	Con	N/A	Devices at this level are not connected to an IP Network.	N/A	N/A	Devices at this level are not connected to an IP Network.	N/A
L	CCI-000050	AC-8(b)	The information system retains the notification message or banner on the screen until users acknowledge the usage conditions and take explicit actions to log on to or further access.	Configure the information system to retain the notification message or banner on the screen until users acknowledge the usage conditions and take explicit actions to log on to or further access. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000050.	App	Devices which are connected to a network and have a user interface must display a warning banner meeting the requirements of DTM 08-060 if capable of doing so. Devices which are connected to a network and have a user interface but are not capable of displaying a banner must have a permanently affixed label displaying an approved banner from DTM 08-060 Apply STIG / SRGs.	Con	N/A	Devices at this level are not connected to an IP Network.	N/A	N/A	Devices at this level are not connected to an IP Network.	N/A

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-002248	AC-8(c)(1)	The organization defines the conditions of use which are to be displayed to users of the information system before granting further access.	The DOD Consent Banner is defined on the RMF Knowledge service along with the Army Regulation 25-2 and can be found on the RMF Knowledge Service site at https: / / rmfks.osd.mil / rmf / Guidance / GoverningPolicy / Pages / ConsentBanner.aspx	App	Devices which are connected to a network and have a user interface must display a warning banner meeting the requirements of DTM 08-060 if capable of doing so. Devices which are connected to a network and have a user interface but are not capable of displaying a banner must have a permanently affixed label displaying an approved banner from DTM 08-060 Apply STIG / SRGs.	Con	N/A	Devices at this level are not connected to an IP Network.	N/A	N/A	Devices at this level are not connected to an IP Network.	N/A
L	CCI-000061	AC-14(a)	The organization identifies and defines organization-defined user actions that can be performed on the information system without identification or authentication consistent with organizational missions / business functions.	Workstations, Servers, Network Switches, etc., shall not allow any actions without identification or authentication. This is usually automatically met by authenticating (logging in) to a system. The control system must use identification and authentication except for the following: - Read only access via a user interface from other than a PC and via other than a web interface. - Interactions via devices other than user interfaces. Devices that do not support authentication should have physical security implemented by lockable enclosures, tamper switches, room access control, people trap, or paper access logs.	App	The control system must require identification and authentication before allowing any actions except read-only actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.	Con	App	The control system must require identification and authentication before allowing any actions except read-only actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.	Con	App	The control system must require identification and authentication before allowing any actions except read-only actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.	Con
L	CCI-000232	AC-14(b)	The organization documents and provides supporting rationale in the security plan for the information system, user actions not requiring identification and authentication.	Workstations, Servers, Network Switches, etc., shall not allow any actions without identification or authentication. This is usually automatically met by authenticating (logging in) to a system. The control system must use identification and authentication except for the following: • Read only access via a user interface from other than a PC and via other than a web interface. • Interactions via devices other than user interfaces. Devices that do not support authentication should have physical security implemented by lockable enclosures, tamper switches, room access control, people trap, or paper access logs.	App	The control system must require identification and authentication before allowing any actions except read-only actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.	Con	App	The control system must require identification and authentication before allowing any actions except read-only actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.	Con	App	The control system must require identification and authentication before allowing any actions except read-only actions by a user acting from a user interface which MINIMALLY or FULLY supports accounts.	Con
L	CCI-001438	AC-18(a)	The organization establishes usage restrictions for wireless access.	Wireless policies, procedures and configuration guides need to be created for the use of wireless capability.	N/A	Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	N/A	App	N/A. Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	Con	N/A	Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	N/A
L	CCI-001439	AC-18(a)	The organization establishes implementation guidance for wireless access.	Wireless policies, procedures and configuration guides need to be created for the use of wireless capability.	N/A	Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	N/A	App	N/A. Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	Con	N/A	Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	N/A

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-002323	AC-18(a)	The organization establishes configuration / connection requirements for wireless access.	Wireless policies, procedures and configuration guides need to be created for the use of wireless capability.	N/A	Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	N/A	App	N/A. Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	Con	N/A	Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	N/A
L	CCI-001441	AC-18(b)	The organization authorizes wireless access to the information system prior to allowing such connections.	Wireless policies, procedures and configuration guides need to be created for the use of wireless capability.	N/A	Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	N/A	App	N/A. Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	Con	N/A	Wireless Not Authorized for use in this Project for this control system. All specifications updated to disable any wireless interfaces.	N/A
L	CCI-000123	AU-2(a)	The organization determines the information system must be capable of auditing an organization-defined list of auditable events.	HW (workstations, servers, network switches / infrastructure, etc....) capable of auditing shall audit the following: • Successful and unsuccessful logon attempts • Privileged activities or other system level access • Starting and ending time for user access to the system • Concurrent logons from different workstations. • Successful and unsuccessful accesses to objects • All program initiators • All direct access to the information system • All account creations, modifications, disabling, and terminations • All kernel module load, unload, and restart	App	This is policy-related to be provided by Government. See other CCIs for implementation.	Gov	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001571	AU-2(a)	The organization defines the information system auditable events.	DoD has defined the information system auditable events as successful and unsuccessful attempts to access, modify, or delete privileges, security objects, security levels, or categories of information (e.g. classification levels). Successful and unsuccessful logon attempts, Privileged activities or other system level access, Starting and ending time for user access to the system, Concurrent logons from different workstations, Successful and unsuccessful accesses to objects, All program initiations, All direct access to the information system. All account creations, modifications, disabling, and terminations. All kernel module load, unload, and restart.	App	This is policy-related to be provided by Government. See other CCIs for implementation.	Gov	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-000125	AU-2(c)	The organization provides a rationale for why the list of auditable events is deemed to be adequate to support after-the-fact investigations of security incidents.	The organization documents in the audit and accountability policy the list of auditable system events, the organization provides clearly stated rationale for the selection of each system vent. The rationale will support any after-action investigations of security event.	App	This is policy-related to be provided by Government. See other CCIs for implementation.	Gov	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001485	AU-2(d)	The organization defines the events which are to be audited on the information system on an organization-defined frequency of (or situation requiring) auditing for each identified event.	The organization being inspected / assessed defines and documents events which are to be audited on the information system. Events should be selected from the events the information system is capable of auditing as defined in AU-2 (a) and should be based on ongoing risk assessments of current threat information and environment. DoD has determined that the events are not appropriate to define at the Enterprise level. Recommended Compelling Evidence: 1.) Signed and dated audit and accountability policy and / or procedures.	App	This is policy-related to be provided by Government. See other CCIs for implementation.	Gov	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-000130	AU-3	The information system generates audit records containing information that establishes what type of event occurred.	The information system shall be configured to generate audit records containing information that establishes what type of event occurred. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 130. Other IP devices (BPOCs, other field devices) may not be able to generate audit records. Document if these components are incapable of implementing the requirements set forth in policy.	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-000131	AU-3	The information system generates audit records containing information that establishes when an event occurred.	The information system shall be configured to generate audit records containing information that establishes when an event occurred. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000131. Other IP devices (BPOCs, other field devices) may not be able to generate audit records. Document if these components are incapable of implementing the requirements set forth in policy.	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-000132	AU-3	The information system generates audit records containing information that establishes where the event occurred.	The information system shall be configured to generate audit records containing information that establishes where the event occurred. For information system components that have applicable STIGs or SRGs, the organization EING inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000132. Other IP devices (BPOCs, other field devices) may not be able to generate audit records. Document if these components are incapable of implementing the requirements set forth in policy.	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-000133	AU-3	The information system generates audit records containing information that establishes the source of the event.	The information system shall be configured to generate audit records containing information that establishes where the event occurred. For information system components that have applicable STIGs or SRGs, the organization EING inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000133. Other IP devices (BPOCs, other field devices) may not be able to generate audit records. Document if these components are incapable of implementing the requirements set forth in policy.	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-000134	AU-3	The information system generates audit records containing information that establishes the outcome of the event.	The information system shall be configured to generate audit records containing information that establishes where the event occurred. For information system components that have applicable STIGs or SRGs, the organization EING inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000134. Other IP devices (BPOCs, other field devices) may not be able to generate audit records. Document if these components are incapable of implementing the requirements set forth in policy.	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001487	AU-3	The information system generates audit records containing information that establishes the identity of any individuals or subjects associated with the event.	The information system shall be configured to generate audit records containing information that establishes the identity of any individuals or subjects associated with the event. For information system components that have applicable STIGs or SRGs, the organization must comply with the STIG / SRG guidance that pertains to CCI 001487. Other IP devices (BPOCs, other field devices) may not be able to generate audit records. Document if these components are incapable of implementing the requirements set forth in policy.	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001848	AU-4	The organization defines the audit record storage requirements.	Devices that have STIG / SRGs must comply with the requirements of those STIG / SRGs. For BPOCs and field devices (not front end computers) capable of generating audit records, the front end server shall be configured to retrieve audit records from the devices. Provide a secure mechanism of uploading these audit records to a front end PC for storage and review.	App	This is policy to be provided by the Government. See CCI-1849 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-1849 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-1849 for design and implementation.	Gov
L	CCI-001849	AU-4	The organization allocates audit record storage capacity in accordance with organization-defined audit record storage requirements.	The organization allocates, and configures the information system to allocate audit record storage capacity as defined in AU-4, CCI 001848. For information system components that have applicable STIGs or SRGs, the organization must comply with the STIG / SRG guidance that pertains to CCI 001849. Provide a secure mechanism of uploading these audit records to a front end PC for storage and review.	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-000139	AU-5(a)	The information system alerts designated organization - defined personnel or roles in the event of an audit processing failure.	If the front end server can be configured to automatically archive full logs or write audit logs to an audit server (from all connected audit capable devices), then this control shall be considered not-applicable(NA). Otherwise, if email services are available, configure the workstations and servers to alert at a minimum, the system administrator (SA) and or the designated Information System Security Officer / Manager in the event of an audit processing failure. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 139. If email services are not available then the workstations and servers shall configure the system to provide an alert on the screen in the event of an audit processing failure. For BPOCs and other field devices see CCI-001848.	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified. ~~For devices which support audit logs, configure devices as specified for notification and response to audit failure.~~ Apply STIG / SRGs.	N/A	N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001490	AU-5(b)	The organization defines actions to be taken by the information system upon audit failure (e.g., shut down information system, overwrite oldest audit records, stop generating audit records).	The organization being inspected / assessed will define and document actions to be taken by the information system upon audit failure as described in CCI-000139 and CCI-000140.	App	This is policy to be provided by the Government. See CCI-140 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-140 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-140 for design and implementation.	Gov
L	CCI-000140	AU-5(b)	The information system takes organization defined actions upon audit failure (e.g., shut down information system, overwrite oldest audit records, stop generating audit records).	In case of an audit failure, if possible, configure the system to continue to collect audit records by overwriting existing audit records starting with the oldest records first. Ideal configuration would be to configure the system to send audit records directly to an audit server, or automatically archive full logs and document as such with the ISSO. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 00140.	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
X	CCI-000154	AU-06(4)	The information system provides the capability to centrally review and analyze audit records from multiple components within the system.		N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-000159	AU-8(a)	The information system uses internal system clocks to generate time stamps for audit records.	Workstations and servers on the domain shall be configured to synchronize with domain controllers. If an NTP server is configured it should synchronize with a secure, authorized source. If not on a domain or NTP server, workstations, server or other components that generate audit records, the timing requirement inherent in the control system will be sufficient. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 00159.	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001889	AU-8(b)	The information system records time stamps for audit records that meets organization-defined granularity of time measurement.	DoD has defined the granularity of time measurement as one second. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 001889.	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001890	AU-8(b)	The information system records time stamps for audit records that can be mapped to Coordinated Universal Time (UTC) or Greenwich Mean Time (GMT).	All devices which provide audit capabilities, configure them to generate time stamps for audit records that contain time zones or time offsets that can be mapped to Coordinated Universal Time (UTC) or Greenwich Mean Time (GMT). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1890.	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-001459	AU-12(a)	The organization defines information system components that provide audit record generation capability.	DoD has defined the information system components as all information system and network components. Devices which ARE NOT capable of generating an audit log are exempt. System documentation should define which components are capable and are not capable of generating audit logs.	App	This is policy to be provided by the Government. See CCI-169 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-169 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-169 for design and implementation.	Gov
L	CCI-000169	AU-12(a)	The information system provides audit record generation capability for the auditable events defined in AU-2 a at organization defined information system components.	CCI-000123 defines auditable events for an information system. Level 4 devices (workstations, servers, network switches, routers, etc.) shall implement to the extent possible the requirements in CCI-000123 and AU-2(a). Requirements that cannot be implemented must be documented and justification provided. Other devices (non level 4) that provide auditing capabilities shall implement the requirements in CCI-000123 where the capability exists and the ISSM deems relevant. Example, for components. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance.	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-001910	AU-12(b)	The organization defines the personnel or roles allowed select which auditable events are to be audited by specific components of the information system.	DoD has defined the personnel or roles as the ISSM or individuals appointed by the ISSM.	App	This is policy to be provided by the Government. See CCI-171 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-171 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-171 for design and implementation.	Gov
L	CCI-000171	AU-12(b)	The information system allows organization-defined personnel or roles to select which auditable events are to be audited by specific components of the information system.	Configure all capable devices to ensure that only the ISSM or individuals appointed by the ISSM select which auditable events are to be audited by specific components of the information system. DoD has defined the personnel or roles as the ISSM or individuals appointed by the ISSM. System administrator personnel will inherently have the rights associated with their accounts to select auditable events, however, organizational policy shall only authorize the ISSM or individuals appointed by the ISSM to select and make those necessary changes.	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
L	CCI-000172	AU-12(c)	The information system generates audit records for the events defined in AU-2 (d) with the content defined in AU-3.	Audit record requirements are defined in CCI-000130,CCI-000131, CCI-000132, CCI-000133, CCI-000134, CCI-001487 above. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 172.	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
X	CCI-001919	AU-14	The information system provides the capability for authorized users to select a user session to capture/record or view/hear.		N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A
L	CCI-001464	AU-14 (1)	The information system initiates session audits at system start-up.	The organization being inspected/assessed configures the information system to initiate session audits at system start-up. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI-001464. DISA Compelling Evidence 1) audit and accountability policy 2) Applicable STIGs or SRGs	N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A	N/A	There are no requirements to perform auditing at field devices that do not FULLY support accounts.	N/A
X	CCI-001462	AU-14(2)	The information system provides the capability for authorized users to capture/record and log content related to a user session.		N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP) App	LEVEL 2 Designer Text	LEVEL 2 Resp	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP) App	LEVEL 1 Designer Text	LEVEL 1 Resp	LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED) App	LEVEL 0 Designer Text	LEVEL 0 Resp
X	CCI-001920	AU-14(3)	The information system provides the capability for authorized users to remotely view/hear all content related to an established user session in real time.		N/P	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Does not apply to devices at this level.	N/A	N/A	Does not apply to devices at this level.	N/A
L	CCI-000258	CA-3(b)	The organization documents, for each interconnection, the interface characteristics.	Interconnections to other systems WILL NOT be implemented. Front end servers and workstations may reside on the local Network Enterprise Center's (NECs) network allowing a connection into the control system (CS) components.	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-002102	CA-9(a)	The organization defines the information system components or classes of components that that are authorized internal connections to the information system.	Define and document the information system components or classes of components that are authorized internal connections to the information system. (e.g. Network Controllers, switches, routers, etc.…)	App	Contractor will provide a network communication report, per specifications.	Con	App	Contractor will provide a network communication report, per specifications.	Con	N/A	Does not apply to non-networked devices.	N/A
L	CCI-002103	CA-9(b)	The organization documents, for each internal connection, the interface characteristics.	The organization documents, for each internal connection (network controllers, etc.…) the communication protocols used and a general description of what information is communicated over the network. This can be accomplished through a network communication report.	App	Contractor will provide a network communication report, per specifications.	Con	App	Contractor will provide a network communication report, per specifications.	Con	N/A	Does not apply to non-networked devices.	N/A
L	CCI-002104	CA-9(b)	The organization documents, for each internal connection, the security requirements.	The organization documents, for each internal connection, the security requirements.	App	Contractor will provide a network communication report, per specifications.	Con	App	Contractor will provide a network communication report, per specifications.	Con	N/A	Does not apply to non-networked devices.	N/A
L	CCI-002105	CA-9(b)	The organization documents, for each internal connection, the nature of the information communicated.	The organization documents, for each internal connection (network controllers, etc.…) the communication protocols used and a general description of what information is communicated over the network. This can be accomplished through a network communication report.	App	Contractor will provide a network communication report, per specifications.	Con	App	Contractor will provide a network communication report, per specifications.	Con	N/A	Does not apply to non-networked devices.	N/A
X	CCI-001812	CM-11 (2)	The information system prohibits user installation of software without explicit privileged status.	The organization being inspected/assessed must configure the information system to prevent the installation of software by non-privileged users. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI-001812. DISA Compelling Evidence 1) Verify the organization has configured the information system to prevent the installation of software by non-privileged users 2) Demonstrate that installation of software without explicit privileged status is prohibited/that the system is configured properly	App	For devices that have a STIG or SRG, install and configure the device in accordance with that STIG or SRGs. For devices without a STIG and SRG, consult vendor documentation and install and configure with the most restrictive security-related modes consistent with the mission. Apply STIG/SRGs.	Con	App	For devices that have a STIG or SRG, install and configure the device in accordance with that STIG or SRGs. For devices without a STIG and SRG, consult vendor documentation and install and configure with the most restrictive security-related modes consistent with the mission. Apply STIG/SRGs.	Con	App	For devices that have a STIG or SRG, install and configure the device in accordance with that STIG or SRGs. For devices without a STIG and SRG, consult vendor documentation and install and configure with the most restrictive security-related modes consistent with the mission. Apply STIG/SRGs.	Con
L	CCI-000293	CM-2	The organization develops and documents a current baseline configuration of the information system.	Develop and document a current baseline configuration of the information system to include, drawings, software licenses, source code, hardware, etc.…	App	Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.).	Con	App	Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.).	Con	App	Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.).	Con
L	CCI-000363	CM-6(a)	The organization defines security configuration checklists to be used to establish and document configuration settings for the information system technology products employed.	DoD has defined the security configuration checklists as DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.). Document in the security plan, the configuration guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) which apply to their information system components. Field Devices (BPOCs, etc.…) that do not have STIGs, SRGs, etc.…obtain vendor configuration guides.	App	This is policy to be provided by the Government. See CCI-364 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-364 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-364 for design and implementation.	Gov

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-000364	CM-6(a)	The organization establishes configuration settings for information technology products employed within the information system using organization-defined security configuration checklists.	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) meet the DoD requirement for establishing configuration settings. DoD Components are automatically compliant with this control because they are covered by the DoD level security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.).	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con
L	CCI-001588	CM-6(a)	The organization-defined security configuration checklists reflect the most restrictive mode consistent with operational requirements.	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) meet the DoD requirement for ensuring security configuration checklists reflect the most restrictive mode consistent with operational requirements. DoD Components are automatically compliant with this control because they are covered by the DoD level security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.). Vendor should provide secure configuration guides	App	This is policy to be provided by the Government. See CCI-365 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-365 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-365 for design and implementation.	Gov
L	CCI-000365	CM-6(a)	The organization documents configuration settings for information technology products employed within the information system using organization-defined security configuration checklists that reflect the most restrictive mode consistent with operational requirements.	DoD security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.) meet the DoD requirement for documenting configuration settings. DoD Components are automatically compliant with this control because they are covered by the DoD level security configuration or implementation guidance (e.g. STIGs, SRGs, NSA configuration guides, CTOs, DTMs etc.). Vendor should provide secure configuration guides	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con
L	CCI-001755	CM-6(c)	The organization defines the information system components for which any deviation from the established configuration settings are to be identified, documented and approved.	DoD has defined the information system components as all configurable information system components.	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
X	CCI-000388	CM-7 (3)	The organization ensures compliance with organization-defined registration requirements for functions, ports, protocols, and services.	The organization being inspected/assessed implements DoDI 8551.01. DISA Compelling Evidence 1) The organization documents a listing of ports, protocols, and services in use. 2) Reviews a sampling of those ports, protocols, and services to ensure the organization being inspected/assessed is compliant with DoDI 8551.01	App	Systems are implemented with approved ports and protocols as specified. Refer to the specifications for details on ports and protocols that have been approved and procedures for requesting additional.	Con	N/P	Devices at this level do not support IP Network connectivity.	N/A	N/P	Devices at this level do not support IP Network connectivity.	N/A
L	CCI-000381	CM-7(a)	The organization configures the information system to provide only essential capabilities.	Disable all ports, protocols and services not specifically needed by any device or component within the Control system (server, workstations, field devices, BPOCS, switches, etc....) Remove all software not specifically needed for use in the control system.	App	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.) Apply STIG / SRGs.	Con	App	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	App	Specifications require procurement of equipment with least functionality to perform the mission. i.e. do not use a networked actuator unless it is required.	Con
L	CCI-000380	CM-7(b)	The organization defines for the information system prohibited or restricted functions, ports, protocols, and / or services.	Disable all ports, protocols and services not specifically needed by any device or component within the Control system (server, workstations, field devices, BPOCS, switches, etc....) Remove all software not specifically needed for use in the control system.	App	This is policy to be provided by the Government. See CCI-382 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-382 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-382 for design and implementation.	Gov
L	CCI-000382	CM-7(b)	The organization configures the information system to prohibit or restrict the use of organization-defined functions, ports, protocols, and / or services.	Disable all ports, protocols and services not specifically needed by any device or component within the Control system (server, workstations, field devices, BPOCS, switches, etc....) Remove all software not specifically needed for use in the control system.	App	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.) Apply STIG / SRGs.	Con	App	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	App	Specifications require procurement of equipment with least functionality to perform the mission. i.e. do not use a networked actuator unless it is required.	Con
L	CCI-001761	CM-7(1)(b)	The organization defines the functions, ports, protocols and services within the information system that are to be disabled when deemed unnecessary and / or non-secure.	Define and document in the system security plan, the functions, ports, protocols and services within the control system that are to be disabled when deemed unnecessary.	App	This is policy to be provided by the Government. See CCI-1762 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-1762 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-1762 for design and implementation.	Gov
L	CCI-001762	CM-7(1)(b)	The organization disables organization-defined functions, ports, protocols, and services within the information system deemed to be unnecessary and / or non-secure.	Disable functions, ports, protocols, and services within the control system deemed to be unnecessary and / or non-secure, non-secure functions, ports, protocols, and services.	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	App	For devices that have a STIG or SRG related to Requirements for Least Functionality (such as configuration settings and port and device I / O access for least functionality), install and configure the device in accordance with that STIG or SRGs. For Control Systems: Do not provide devices with user interfaces where one was not required. Do not use a networked sensor or actuator where a non-networked sensor or actuator would suffice. Only use and enable ports and protocols specified. Contractor to provide required artifacts through contract submittals (drawings, license turnover, application files, etc.)	Con	N/A	Does not apply to non-networked devices.	N/A

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-000389	CM-8(a)(1)	The organization develops and documents an inventory of information system components that accurately reflects the current information system.	Provide a Control System inventory report covering all networked, including network infrastructure devices. Provide the following information (where applicable): • If the device has (in other project documentation) a unique identifier • Description, make, mode, serial number, location • Software / firmware version Network information: protocol, network address	App	Contactor to provide comprehensive asset inventory (Control System Inventory Report).	Con	App	Contactor to provide comprehensive asset inventory (Control System Inventory Report).	Con	App	Contactor to provide comprehensive asset inventory (Control System Inventory Report).	Con
L	CCI-000392	CM-8(a)(2)	The organization develops and documents an inventory of information system components that includes all components within the authorization boundary of the information system.	Provide a Control System inventory report covering all networked, including network infrastructure devices. Provide the following information (where applicable): • If the device has (in other project documentation) a unique identifier • Description, make, mode, serial number, location • Software / firmware version Network information: protocol, network address	App	Contactor to provide comprehensive asset inventory (Control System Inventory Report).	Con	App	Contactor to provide comprehensive asset inventory (Control System Inventory Report).	Con	App	Contactor to provide comprehensive asset inventory (Control System Inventory Report).	Con
L	CCI-000398	CM-8(a)(4)	The organization defines information deemed necessary to achieve effective information system component accountability.	DoD has defined the information as hardware inventory specifications (manufacturer, type, model, serial number, physical location), software license information, information system / component owner, and for a networked component / device, the machine name.	App	This is policy-related to be provided by Government.	Gov	App	This is policy-related to be provided by Government.	Gov	App	This is policy-related to be provided by Government.	Gov
L	CCI-000550	CP-10	The organization provides for the recovery and reconstitution of the information system to a known state after a disruption.	The organization must develop a contingency plan (CP) addressing recovery and reconstitution of the control system to a known state after a disruption In essence, restoring the system to the appropriate operational state. The CP will be site specific and should be developed in conjunction with stakeholders of the system. Copies of required software, backup data, hardware list and baseline configurations should be identified in the CP. NOTE-known state shall also include the accepted "as-built" documentation and include any custom programming and configuration for controllers or workstations.	App	Contractor to provide recovery and reconstitution images for programmable and / or configurable devices.	Con	App	Contractor to provide recovery and reconstitution images for programmable and / or configurable devices.	Con	App	Contractor to provide recovery and reconstitution images for programmable and / or configurable devices.	Con
L	CCI-000551	CP-10	The organization provides for the recovery and reconstitution of the information system to a known state after a compromise.	The organization shall provide automated mechanisms or manual procedures, or a combination of the two, for the recovery and reconstitution of its information system to a known state after a compromise. The organization must identify the selected method in the contingency plan. See also CCI-000550	App	Contractor to provide recovery and reconstitution images for programmable and / or configurable devices.	Con	App	Contractor to provide recovery and reconstitution images for programmable and / or configurable devices.	Con	App	Contractor to provide recovery and reconstitution images for programmable and / or configurable devices.	Con
L	CCI-000552	CP-10	The organization provides for the recovery and reconstitution of the information system to a known state after a failure.	The organization shall provide automated mechanisms or manual procedures, or a combination of the two, for the recovery and reconstitution of its information system to a known state after a failure. The organization must identify the selected method in the contingency plan. See also CCI-000550	App	Contractor to provide recovery and reconstitution images for programmable and / or configurable devices.	Con	App	Contractor to provide recovery and reconstitution images for programmable and / or configurable devices.	Con	App	Contractor to provide recovery and reconstitution images for programmable and / or configurable devices.	Con
L	CCI-002856	CP-12	The organization defines the conditions, that when detected, the information system enters a safe mode of operation with organization-defined restrictions of safe mode of operation.	When the following conditions are detected, the control system shall enter a safe mode of operation. • Commercial Power Loss • Fire • Water	App	This is policy to be provided by the Government. See CCI-2855 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-2855 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-2855 for design and implementation.	Gov
L	CCI-002857	CP-12	The organization defines the restrictions of safe mode of operation that the information system will enter when organization-defined conditions are detected.	Commercial Power Failure: Upon loss of commercial power, the control system will switch to Generator power and only Mission Critical Infrastructure (deemed by the organization) will received continued control system service. All other infrastructure / areas services will cease until commercial power is restored. Fire: The system shall be integrated with fire detectors. Upon detection of fire, the system will ensure dampers and air handlers are shut down to prevent the propagation of smoke, gasses and fire through the system. The system shall remain in a shutdown / closed state until manually restarted / rebooted by organization personnel. Water: Upon detection of water (sprinkler system), the servers shall perform a graceful shutdown in order to minimize component failure due to water.	App	This is policy to be provided by the Government. See CCI-2855 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-2855 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-2855 for design and implementation.	Gov

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP) App	LEVEL 2 Designer Text	LEVEL 2 Resp	LEVEL 1 FIELD CONTROL SYSTEM (NON-IP) App	LEVEL 1 Designer Text	LEVEL 1 Resp	LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED) App	LEVEL 0 Designer Text	LEVEL 0 Resp
L	CCI-002855	CP-12	The information system, when organization-defined conditions are detected, enters a safe mode of operation with organization-defined restrictions of safe mode of operation.	Configure the information system to enter a safe mode of operation with restrictions of safe mode of operation defined in CP-12, CCI 002857 when conditions defined in CP-12, CCI 2856 are detected. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 2855.	App	Specification requires contractor to coordinate failure responses. Apply requirements contained in specifications. Where no safe state is indicated, configure appropriately and report configuration in documentation. Contractor to provide control system inventory report. Apply STIG / SRGs.	Con	App	Specification requires contractor to coordinate failure responses. Apply requirements contained in specifications. Where no safe state is indicated, configure appropriately and report configuration in documentation. Contractor to provide control system inventory report. Apply STIG / SRGs.	Con	App	Specification requires contractor to coordinate failure responses. Apply requirements contained in specifications. Where no safe state is indicated, configure appropriately and report configuration in documentation. Contractor to provide control system inventory report. Apply STIG / SRGs.	Con
L	CCI-001942	IA-02(9)	The information system implements replay-resistant authentication mechanisms for network access to non-privileged accounts.		App	For devices that have STIG/SRGs related to cryptographic protection, comply with the requirements of those STIG/SRGs.	Con	App	For devices that have STIG/SRGs related to cryptographic protection, comply with the requirements of those STIG/SRGs.	Con	App	For devices that have STIG/SRGs related to cryptographic protection, comply with the requirements of those STIG/SRGs.	Con
X	CCI-002007	IA-05(13)	The information system prohibits the use of cached authenticators after an organization-defined time period.		App	Software running on computers and computer operating systems must manage cached authenticators in accordance with the relevant STIGs. All other devices and software must not use cached authenticators.	Con	App	Software running on computers and computer operating systems must manage cached authenticators in accordance with the relevant STIGs. All other devices and software must not use cached authenticators.	Con	App	Software running on computers and computer operating systems must manage cached authenticators in accordance with the relevant STIGs. All other devices and software must not use cached authenticators.	Con
L	CCI-000764	IA-2	The information system uniquely identifies and authenticates organizational users (or processes acting on behalf of organizational users).	All components capable of user accounts will be configured to uniquely identify and authenticate users (or processes acting on behalf of organizational users). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000764.	App	Devices that FULLY support accounts must uniquely identify and authenticate organizational users. Devices which allow network access to privileged accounts must implement multifactor authentication for network access to privileged accounts. Apply STIG / SRGs.	Con	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-000768	IA-2 (4)	The information system implements multifactor authentication for local access to non-privileged accounts.	The organization being inspected/assessed configures the information system to implement multifactor authentication for local access to non-privileged accounts. For information system components that have applicable STIGs or SRGs, the organization being inspected/assessed must comply with the STIG/SRG guidance that pertains to CCI-000768. DISA Compelling Evidence 1)Provide the Access Control Policy to verify the information system has a implementation of multifactor authentication for local access of non-privileged accounts. Information must be compliant with STIG/SRG guidance that pertains to CCI-000768.	App	User interfaces provided by computer operating systems must implement multifactor authentication via PIV.	Con	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-000765	IA-2(1)	The information system implements multifactor authentication for network access to privileged accounts.	Multifactor authentication shall be implemented for users that require privileged level accounts to servers and workstations residing on the network (not standalone or private VLAN segregated systems). Multifactor authentication can be implemented with through common access card (CAC) authentication. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000765.	App	User interfaces provided by computer operating systems must implement multifactor authentication via PIV.	Con	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-001953	IA-2(12)	The information system accepts Personal Identity Verification (PIV) credentials.	This control enhancement applies to organizations implementing logical access control systems (LACS) and physical access control systems (PACS). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 001953	App	User interfaces provided by computer operating systems must implement multifactor authentication via PIV.	Con	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-001954	IA-2(12)	The information system electronically verifies Personal Identity Verification (PIV) credentials.	This control enhancement applies to organizations implementing logical access control systems (LACS) and physical access control systems (PACS). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 001954.	App	User interfaces provided by computer operating systems must implement multifactor authentication via PIV.	Con	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-000777	IA-3	The organization defines a list of specific and / or types of devices for which identification and authentication is required before establishing a connection to the information system.	All network connected endpoint devices (including but not limited to: workstations, printers, servers) shall be identified and authenticated before establishing a connection to the information system. Any device incapable of being authenticated to the system shall be documented.	N/A	This is policy to be provided by the Government. See CCI-778 and 1958 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-778 and 1958 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-778 and 1958 for design and implementation.	N/A
L	CCI-000778	IA-3	The information system uniquely identifies an organization defined list of specific and / or types of devices before establishing a local, remote, or network connection.	Configure the network infrastructure to identify all network connected endpoint devices (including but not limited to: workstations, printers, servers) before establishing a local, remote, network connection. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 778. See CCI-000777	N/A	Contractor shall provide a network inventory report. ~~All hardware that part of a domain must use 802.1x for authentication.~~ Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-001958	IA-3	The information system authenticates an organization defined list of specific and / or types of devices before establishing a local, remote, or network connection.	Configure the network infrastructure to authenticate all network connected endpoint devices (including but not limited to: workstations, printers, servers) before establishing a local, remote, network connection. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1958. See CCI-000777	N/A	Contractor shall provide a network inventory report. ~~All hardware that part of a domain must use 802.1x for authentication.~~ Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-000176	IA-5(b)	The organization manages information system authenticators by establishing initial authenticator content for authenticators defined by the organization.	The ISSM / O or designee will manage the password generation, issuance, and control process. If used, generate passwords in accordance with the BBP for Army Password Standards. The authenticators (passwords) will follow format and complexity as defined in the BBP for Army Password Standards and be changed immediately upon initial login. Control system component that are not capable of implementing the complexity requirements shall implement password strength to the greatest extent possible. Physical security mechanisms can be implemented as a layered defense to further protect access to non-conforming components. For information system components that have applicable STIGs or SRGs, the organization must comply with the STIG / SRG guidance.	App	Government to define acceptable credential authentication requirements for systems. Apply STIG / SRGs.	Gov	App	Government to define acceptable credential authentication requirements for systems. Apply STIG / SRGs.	Gov	App	Government to define acceptable credential authentication requirements for systems. Apply STIG / SRGs.	Gov
L	CCI-001544	IA-5(c)	The organization manages information system authenticators by ensuring that authenticators have sufficient strength of mechanism for their intended use.	For information system components that have applicable STIGs or SRGs, the organization must comply with the STIG / SRG guidance. Components which do not have an applicable STIG or SRG will configure (to the extent possible) them to comply with the complexity requirements set forth in the BBP for Army Password Standards.	App	Government to define acceptable credential authentication requirements for systems. Apply STIG / SRGs.	Gov	App	Government to define acceptable credential authentication requirements for systems. Apply STIG / SRGs.	Gov	App	Government to define acceptable credential authentication requirements for systems. Apply STIG / SRGs.	Gov
L	CCI-001989	IA-5(e)	The organization manages information system authenticators by changing default content of authenticators prior to information system installation.	Document and implement procedures to change default authenticators (passwords, etc.) or apply authenticators to all capable components prior to system installation.	App	Government to define acceptable credential authentication requirements for systems.	Gov	App	Government to define acceptable credential authentication requirements for systems.	Gov	App	Government to define acceptable credential authentication requirements for systems.	Gov

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-001610	IA-5(g)	The organization defines the time period (by authenticator type) for changing / refreshing authenticators.	DoD has defined the time period as CAC - every 3 years, or 1 year from term of contract. Password: 60 days. Biometrics: every 3 years.	App	This is policy to be provided by the Government. See CCI-182 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-182 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-182 for design and implementation.	Gov
L	CCI-000182	IA-5(g)	The organization manages information system authenticators by changing / refreshing authenticators in accordance with the organization defined time period by authenticator type.	Document and implement procedures for changing / refreshing authenticators.	App	Government to define acceptable credential authentication requirements for systems.	Gov	App	Government to define acceptable credential authentication requirements for systems.	Gov	App	Government to define acceptable credential authentication requirements for systems.	Gov
L	CCI-001612	IA-5(1)(a)	The organization defines the minimum number of upper case characters for password complexity enforcement.	The BBP for Army Password Standards defines the minimum number of upper case characters to be 2.	App	This is policy to be provided by the Government. See CCI-192 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-192 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-192 for design and implementation.	Gov
L	CCI-000192	IA-5(1)(a)	The information system enforces password complexity by the minimum number of upper case characters used.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 192. All other components will be configured to implement and enforce the minimum number of upper case characters used as defined in the BBP for Army Password Standards.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con
L	CCI-001613	IA-5(1)(a)	The organization defines the minimum number of lower case characters for password complexity enforcement.	The BBP for Army Password Standards defines the minimum number of special characters to be 2.	App	This is policy to be provided by the Government. See CCI-193 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-193 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-193 for design and implementation.	Gov
L	CCI-000193	IA-5(1)(a)	The information system enforces password complexity by the minimum number of lower case characters used.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000193. All other components will be configured to implement and enforce the minimum number of lower case characters used as defined in the BBP for Army Password Standards.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con
L	CCI-001614	IA-5(1)(a)	The organization defines the minimum number of numeric characters for password complexity enforcement.	The BBP for Army Password Standards defines the minimum number of numeric characters to be 2.	App	This is policy to be provided by the Government. See CCI-194 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-194 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-194 for design and implementation.	Gov
L	CCI-000194	IA-5(1)(a)	The information system enforces password complexity by the minimum number of numeric characters used.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000192. All other components will be configured to implement and enforce the minimum number of numeric characters used as defined in the BBP for Army Password Standards.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-001611	IA-5(1)(a)	The organization defines the minimum number of special characters for password complexity enforcement.	The BBP for Army Password Standards defines the minimum number of special characters to be 2.	App	This is policy to be provided by the Government. See CCI-1619 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-1619 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-1619 for design and implementation.	Gov
L	CCI-001619	IA-5(1)(a)	The information system enforces password complexity by the minimum number of special characters used.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 1619. All other components will be configured to implement and enforce the minimum password length as defined in the BBP for Army Password Standards.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con
L	CCI-000205	IA-5(1)(a)	The information system enforces minimum password length.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 000205. All other components will be configured to implement and enforce the minimum password length as defined in the BBP for Army Password Standards.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con
L	CCI-001615	IA-5(1)(b)	The organization defines the minimum number of characters that are changed when new passwords are created.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 195. DoD has defined the minimum number of characters as 50% of the minimum password length.	App	This is policy to be provided by the Government. See CCI-195 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-195 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-195 for design and implementation.	Gov
L	CCI-000195	IA-5(1)(b)	The information system, for password-based authentication, when new passwords are created, enforces that at least an organization-defined number of characters are changed.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 195.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con
L	CCI-000196	IA-5(1)(c)	The information system, for password-based authentication, stores only cryptographically-protected passwords.	Configure the information system to store only encrypted representations of passwords. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 196.	App	Passwords must be cryptographically protected during storage and transmission. Apply STIG / SRGs.	Con	App	Passwords must be cryptographically protected during storage and transmission. Apply STIG / SRGs.	Con	App	Passwords must be cryptographically protected during storage and transmission. Apply STIG / SRGs.	Con
L	CCI-000197	IA-5(1)(c)	The information system, for password-based authentication, transmits only cryptographically-protected passwords.	Configure the information system to transmit only encrypted representations of passwords. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 197.	App	Passwords must be cryptographically protected during storage and transmission. Apply STIG / SRGs.	Con	App	Passwords must be cryptographically protected during storage and transmission. Apply STIG / SRGs.	Con	App	Passwords must be cryptographically protected during storage and transmission. Apply STIG / SRGs.	Con
L	CCI-001616	IA-5(1)(d)	The organization defines minimum password lifetime restrictions.	DoD has defined the minimum password lifetime restrictions as 24 hours.	App	This is policy to be provided by the Government. See CCI-198 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-198 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-198 for design and implementation.	Gov

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-000198	IA-5(1)(d)	The information system enforces minimum password lifetime restrictions.	Configure the information system to enforce minimum password lifetime restrictions. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 198.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to apply defined complexity and strength requirements as specified.	Con
L	CCI-001617	IA-5(1)(d)	The organization defines maximum password lifetime restrictions.	DoD has defined the maximum password lifetime restrictions as 60 days and not being "0".	App	This is policy to be provided by the Government. See CCI-199 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-199 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-199 for design and implementation.	Gov
L	CCI-000199	IA-5(1)(d)	The information system enforces maximum password lifetime restrictions.	Configure the information system to enforce maximum password lifetime restrictions. For capable components, set maximum password age to 60 days or less (excluding "0"). For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 199.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to configure based on specification for passwords.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to configure based on specification for passwords.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to configure based on specification for passwords.	Con
L	CCI-001618	IA-5(1)(e)	The organization defines the number of generations for which password reuse is prohibited.	Per the STIGs for Windows based systems, the DOD has defined this to be set at a minimum of 24.	App	This is policy to be provided by the Government. See CCI-200 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-200 for design and implementation.	Gov	App	This is policy to be provided by the Government. See CCI-200 for design and implementation.	Gov
L	CCI-000200	IA-5(1)(e)	The information system prohibits password reuse for the organization defined number of generations.	For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 200. All other components utilizing passwords, the password reuse should be set to 24. If the components are incapable of being set to 24 then implement the maximum possible.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to configure based on specification for passwords.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to configure based on specification for passwords.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to configure based on specification for passwords.	Con
L	CCI-002041	IA-5(1)(f)	The information system allows the use of a temporary password for system logons with an immediate change to a permanent password.	Configure the information system to allow the use of a temporary password for system logons with an immediate change to a permanent password. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 2041. For components that cannot technically require password change upon initial login, document in organizational policy as a requirement for personnel logging in with a temporary password to immediately change the password to the standards defined in the BBP for Army Password Standards.	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to configure based on specification for passwords.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to configure based on specification for passwords.	Con	App	Devices which FULLY support accounts must use password-based authentication. Devices MINIMALLY supporting accounts must use password-based authentication. Contractor to configure based on specification for passwords.	Con
L	CCI-002002	IA-5(11)	The organization defines the token quality requirements to be employed by the information system mechanisms for token-based authentication.	DoDI 8520.03 defines types of authentication credentials that are acceptable for authentication to different systems based on the systems' information sensitivity levels and the users' access environments. The definitions for credential strengths D, E and H found in DoDI 8520.03 Enclosure 3, Section 3 specifically deal with acceptable types of hardware PKI credentials. DoD Components are automatically compliant with this control because they are covered by the DoD-level policy, DoDI 8520.03.	N/P	This is policy to be provided by the Government. See CCI-2003 for design and implementation.	N/A	N/P	This is policy to be provided by the Government. See CCI-2003 for design and implementation.	N/A	N/P	This is policy to be provided by the Government. See CCI-2003 for design and implementation.	N/A

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-002003	IA-5(11)	The information system, for token-based authentication, employs mechanisms that satisfy organization-defined token quality requirements.	The information system performing hardware token-based authentication must be configured to accept only DoD-approved PKI credentials in accordance with DoDI 8520.02 and DoDI 8520.03. For unclassified systems, DoD-approved PKI credentials include DoD PKI credentials, External Certification Authority (ECA) PKI credentials, and DoD-approved external PKI credentials. If the information system accepts DoD-approved external PKI credentials, the information system must be configured to accept only certificates at approved assurance levels, as represented by the Certificate Policy Object Identifiers (OIDs) asserted in the certificate. The current list of DoD-approved external PKIs and acceptable Object Identifiers (OIDs) for each approved external PKI is available at http: / / iase.disa.mil / pki-pke / interoperability Windows based control systems on the network, utilizing CAC authentication and configured with the Army Gold Master (AGM) should automatically be compliant with this.	N/P	~~Contractor to implement security authentication types as stated in specification.~~ ~~Devices which FULLY support accounts must use password-based authentication.~~ ~~Devices MINIMALLY supporting accounts must use password-based authentication.~~ Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/P	~~Contractor to implement security authentication types as stated in specification.~~ ~~Devices which FULLY support accounts must use password-based authentication.~~ ~~Devices MINIMALLY supporting accounts must use password-based authentication.~~ Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/P	~~Contractor to implement security authentication types as stated in specification.~~ ~~Devices which FULLY support accounts must use password-based authentication.~~ ~~Devices MINIMALLY supporting accounts must use password-based authentication.~~ Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A
L	CCI-000206	IA-6	The information system obscures feedback of authentication information during the authentication process to protect the information from possible exploitation / use by unauthorized individuals.	Configure the information system to obscure feedback of authentication information during the authentication process to protect the information from possible exploitation / use by unauthorized individuals. For information system components that have applicable STIGs or SRGs, the organization being inspected / assessed must comply with the STIG / SRG guidance that pertains to CCI 206. Applicable to networked devices. Does not apply to devices that have NO feedback during password / PIN entry. Devices shall never show authentication information, including passwords, on a display. Devices that momentarily display a character as it is entered, and then obscure the character, are acceptable. For devices that have STIGs or SRGs related to CCI-000206, comply with the requirements of those STIGS / SRGs.	App	Contractor to configure devices to never show authentication information on devices which support this feature. Apply STIG / SRGs.	Con	App	Contractor to configure devices to never show authentication information on devices which support this feature. Apply STIG / SRGs.	Con	App	Contractor to configure devices to never show authentication information on devices which support this feature. Apply STIG / SRGs.	Con
L	CCI-000803	IA-7	The information system implements mechanisms for authentication to a cryptographic module that meet the requirements of applicable federal laws, Executive Orders, directives, policies, regulations, standards, and guidance for such authentication.	For devices that have STIG / SRGs related to CCI-000803,comply with the requirements of those STIG / SRGs.	App	Contractor to apply authentication requirements as specified. Apply STIG / SRGs	Con	N/A	Cryptographic functions not available at this level.	N/A	N/A	Cryptographic functions not available at this level.	N/A
L	CCI-003051	PL-2(a)(2)	The organization's security plan for the information system explicitly defines the authorization boundary for the system.	Develop a diagram and explain within the system security plan (SSP) the authorization boundary for the complete control system including all networked devices and controller hardware.	App	Contractor to provide riser diagrams, connectivity diagrams and data flows per specifications. Only isolated control networks or standalone systems planned for this project. No connections to existing networks.	Con	App	Contractor to provide riser diagrams, connectivity diagrams and data flows per specifications. Only isolated control networks or standalone systems planned for this project. No connections to existing networks.	Con	N/A	Does not apply to field devices	N/A
L	CCI-003053	PL-2(a)(4)	The organization's security plan for the information system provides the security categorization of the information system including supporting rationale.	The recommended Security Category = {(confidentiality, Low), (integrity, Low), (availability, Low)} Therefore the system shall be categorized as a LOW-LOW-LOW system.	App	This is policy-related to be provided by Government.	Gov	App	This is policy-related to be provided by Government.	Gov	App	This is policy-related to be provided by Government.	Gov
L	CCI-000207	PM-5	The organization develops and maintains an inventory of its information systems.	Initial inventory is provided by as-built bill of materials. Army requires any system utilizing IT dollars to be registered in the Army Portfolio Management System (APMS). This would be a requirement of the system owner (SO). 1.) Vendor to provide needed information 2.) System Owner responsible for registration in APMS	App	Contractor to provide asset inventory list for all network-capable enabled devices.	Con	App	Contractor to provide asset inventory list for all network-capable enabled devices.	Con	App	Contractor to provide asset inventory list for all network-capable enabled devices.	Con

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L	CCI-000236	PM-11(b)	The organization determines information protection needs arising from the defined mission / business processes and revises the processes as necessary, until an achievable set of protection needs are obtained.	No additional protection needs are needed aside from what the network provider supplies. Control system components (not including servers and workstations) will be on a private VLAN without public access thereby further segregating the components from the cyber domain.	App	System designed to adhere to the approved CCIs and BOD which are reviewed at each stage of design.	Con	App	System designed to adhere to the approved CCIs and BOD which are reviewed at each stage of design.	Con	App	System designed to adhere to the approved CCIs and BOD which are reviewed at each stage of design.	Con
L	CCI-001048	RA-3(a)	The organization conducts an assessment of risk of the information system and the information it processes, stores, or transmits that includes the likelihood and magnitude of harm from the unauthorized access, use, disclosure, disruption, modification, or destruction.	The conducting of a Risk Assessment will most likely be site specific. The owning organization will need to conduct an assessment of risk of the information system and the information it processes, stores, or transmits that includes the likelihood and magnitude of harm from the unauthorized access, use, disclosure, disruption, modification, or destruction. The Designer can assist in identifying risk to the owing organization in order to complete the risk assessment.	App	Government to complete risk assessments per current policies and procedures. No affect on design and implementation.	Gov	App	Government to complete risk assessments per current policies and procedures. No affect on design and implementation.	Gov	App	Government to complete risk assessments per current policies and procedures. No affect on design and implementation.	Gov
L	CCI-001055	RA-5(a)	The organization defines a frequency for scanning for vulnerabilities in the information system and hosted applications.	DoD has defined the frequency as every 30 days or as directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs).	N/P	This is policy to be provided by the Government. See CCI-1054 for design and implementation.	N/A	N/P	This is policy to be provided by the Government. See CCI-1054 for design and implementation.	N/A	N/P	This is policy to be provided by the Government. See CCI-1054 for design and implementation.	N/A
L	CCI-001054	RA-5(a)	The organization scans for vulnerabilities in the information system and hosted applications on an organization-defined frequency.	Servers, workstations and network infrastructure on the network will be scanned for vulnerabilities by the network provider. All other IP devices associated with the system (whether on the public or private side of the network) must be scannable such that the device can be scanned by industry standard IP network scanning utilities without harm to the device, application or functionality. The owning organization will need a service level agreement (SLA) with the network provider to perform scanning of IP devices on a private VLAN or dark fiber network, or have in-house personnel assigned to perform the vulnerability scanning. DoD has defined the frequency as every 30 days or as directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs).	App	Contractor to provide and configure devices capable of responding to scans as stated in specifications.	Con	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-001641	RA-5(a)	The organization defines the process for conducting random vulnerability scans on the information system and hosted applications.	DoD has defined the requirement for vulnerability scanning periodicity of every 30 days. If the organization has determined a requirement for random scanning they must document that process. DoD has defined the frequency as every 30 days or as directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs).	N/P	This is policy to be provided by the Government. See CCI-1643 for design and implementation.	N/A	N/P	This is policy to be provided by the Government. See CCI-1643 for design and implementation.	N/A	N/P	This is policy to be provided by the Government. See CCI-1643 for design and implementation.	N/A
L	CCI-001643	RA-5(a)	The organization scans for vulnerabilities in the information system and hosted applications in accordance with the organization-defined process for random scans.	Servers, workstations and network infrastructure on the network will follow the process for random scans as defined by the Network Provider. The organization will conduct random vulnerability scans every 30 days or as directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs) for all other control system components on a private VLAN or the portion not scannable by the Network Provider.. The organization will document the vulnerability scans as an audit trail for future reference. The audit trail must be maintained IAW DoD, CYBERCOM, or component policies. DoD has defined the frequency as every 30 days or as directed by an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs).	App	Contractor to provide and configure devices capable of responding to scans as stated in specifications.	Con	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-001056	RA-5(a)	The organization scans for vulnerabilities in the information system and hosted applications when new vulnerabilities potentially affecting the system / applications are identified and reported.	Conduct vulnerability scans of the information system and hosted applications when new vulnerabilities potentially affecting the system / applications are identified and reported via authoritative sources (e.g., IAVM, CTO, DTM, STIG, product vendor).	App	Contractor to provide and configure devices capable of responding to scans as stated in specifications.	Con	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A

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L	CCI-001057	RA-5(b)	The organization employs vulnerability scanning tools and techniques that facilitate interoperability among tools and automate parts of the vulnerability management process by using standards for: enumerating platforms, software flaws, and improper configurations; formatting checklists and test procedures; and measuring vulnerability impact.	The organization whether through the Network Provider or otherwise, employs the DoD Enterprise scanning tool.	App	Contractor to provide and configure devices capable of responding to scans as stated in specifications.	Con	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-001058	RA-5(c)	The organization analyzes vulnerability scan reports and results from security control assessments.	The organization analyzes vulnerability scan reports and security control assessment results with the intent of identifying legitimate vulnerabilities and the relationship between vulnerabilities and security controls.	App	Contractor to provide and configure devices capable of responding to scans as stated in specifications.	Con	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-001059	RA-5(d)	The organization remediates legitimate vulnerabilities in organization-defined response times in accordance with an organizational assessment risk.	The organization being inspected / assessed takes corrective actions as appropriate on legitimate vulnerabilities identified in RA-5, CCI 001058 IAW an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs). Audit records of actions must be maintained IAW applicable DoD, CYBERCOM, and / or component policies. DoD has defined the response times as IAW an authoritative source (e.g. IAVM, CTOs, DTMs, STIGs).	App	Government to inspect / assess vulnerabilities and take corrective action.	Gov	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-003116	SA-4(10)	The organization employs only information technology products on the FIPS 201-approved products list for Personal Identity Verification (PIV) capability implemented within organizational information systems.	Servers and workstations on the network (Network Provider) and configured with the Army Gold Master (AGM) will be compliant with CCI-003116. Devices on the Network Provider will be compliant with FIPS 201-2 approved products list. Components not CAC enabled (those on private side, or private VLAN) will not implement PKI or a PIV capability.	N/P	~~CAC will be required for operator workstations.~~ Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Does not apply to non-IP devices.	N/A	N/A	Does not apply to non-networked devices.	N/A
L	CCI-003124	SA-5(a)(1)	The organization obtains administrator documentation for the information system, system component, or information system services that describes secure configuration of the system, component, or service.	Document within contracts / agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe secure configuration of the system, component, or service. To the extent possible this should also apply to Control System software applications. This generally would not apply to physical servers and workstations on the network since they will be configured to Army requirements.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
L	CCI-003125	SA-5(a)(1)	The organization obtains administrator documentation for the information system, system component, or information system services that describes secure installation of the system, component, or service.	Document within contracts / agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe secure installation of the system, component, or service. To the extent possible this should also apply to Control System software applications. This generally would not apply to physical servers and workstations on the network since they will be configured to Army requirements.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
L	CCI-003126	SA-5(a)(1)	The organization obtains administrator documentation for the information system, system component, or information system services that describes secure operation of the system, component, or service.	Document within contracts / agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe secure operation of the system, component, or service. To the extent possible this should also apply to Control System software applications. This generally would not apply to physical servers and workstations on the network since they will be configured to Army requirements.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con

L	CCI	53 ID	CCI Definition	Default Designer Controls (DC)	LEVEL 2 FIELD CONTROL SYSTEM (IP)			LEVEL 1 FIELD CONTROL SYSTEM (NON-IP)			LEVEL 0 FIELD CONTROL SYSTEM (NON-NETWORKED)		
					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-003127	SA-5(a)(2)	The organization obtains administrator documentation for the information system, system component, or information system services that describes effective use and maintenance of security functions / mechanisms.	Document within contracts / agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe effective use and maintenance of the system, component, or service. To the extent possible this should also apply to Control System software applications.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
L	CCI-003128	SA-5(a)(3)	The organization obtains administrator documentation for the information system, system component, or information system services that describes known vulnerabilities regarding configuration and use of administrative (i.e. privileged) functions.	Document within contracts / agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe known vulnerabilities of the system, component, or service. To the extent possible this should also apply to Control System software applications.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
L	CCI-003129	SA-5(b)(1)	The organization obtains user documentation for the information system, system component, or information system service that describes user-accessible security functions / mechanisms and how to effectively use those security functions / mechanisms.	Document within contracts / agreements, requirements that the developer provide administrator documentation for the information system, system component or information system service that describe user-accessible security functions / mechanisms and how to effectively use those security functions / mechanisms. To the extent possible this should also apply to Control System software applications.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
L	CCI-003130	SA-5(b)(2)	The organization obtains user documentation for the information system, system component or information system service that describes methods for user interaction which enables individuals to use the system, component, or service in a more secure manner.	Document within contracts / agreements, requirements that the developer provide user documentation for the information system, system component or information system service that describes methods for user interaction which enables individuals to use the system, component, or service in a more secure manner. To the extent possible this should also apply to Control System software applications.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
L	CCI-003131	SA-5(b)(3)	The organization obtains user documentation for the information system, system component or information system service that describes user responsibilities in maintaining the security of the system, component, or service.	Document within contracts / agreements, requirements that the developer provide user documentation for the information system, system component or information system service that describes user responsibilities in maintaining the security of the system, component, or service. To the extent possible this should also apply to Control System software applications.	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con	App	Contractor to provide the required information in specification submittals including cybersecurity plan, schematics, configuration, details, etc.	Con
L	CCI-001093	SC-5	The organization defines the types of denial of service attacks (or provides references to sources of current denial of service attacks) that can be addressed by the information system.	Definition of the types of denial of service attacks will be defined at the Network Provider level.	N/A	This is policy to be provided by the Government. See CCI-2385 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-2385 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-2385 for design and implementation.	N/A

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					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
L	CCI-002386	SC-5	The organization defines the security safeguards to be employed to protect the information system against, or limit the effects of, denial of service attacks.	Definition of the security safeguard to be employed to protect the information system will be defined at the Network Provider level for all devices on the Network Provider. To the greatest extent practical, the hardware performs control logic without reliance on the network.	N/A	This is policy to be provided by the Government. See CCI-2385 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-2385 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-2385 for design and implementation.	N/A
L	CCI-002385	SC-5	The information system protects against or limits the effects of organization-defined types of denial of service attacks by employing organization-defined security safeguards.	For information system components that have applicable STIGs or SRGs, the organization must comply with the STIG / SRG guidance that pertains to CCI 2385. To the greatest extent practical, the hardware performs control logic without reliance on the network.	N/P	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Apply STIG / SRGs. Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/P	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/P	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A
X	CCI-001094	SC-05(1)	The information system restricts the ability of individuals to launch organization-defined denial of service attacks against other information systems.		N/P	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Apply STIG / SRGs. Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/P	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/P	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A
X	CCI-001095	SC-05(2)	The information system manages excess capacity, bandwidth, or other redundancy to limit the effects of information flooding types of denial of service attacks.		N/P	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Apply STIG / SRGs. Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/P	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/P	Specifications require procurement of equipment with least functionality to perform the mission and to configure hardware for least privilege required. Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A
L	CCI-001097	SC-7(a)	The information system monitors and controls communications at the external boundary of the system and at key internal boundaries within the system.	Monitoring and the controlling of communications at the external boundary of the system will be the responsibility of the Network Provider. The control system shall not be publicly accessible.	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A
X	CCI-001098	SC-07 (c)	The information system connects to external networks or information systems only through managed interfaces consisting of boundary protection devices arranged in accordance with an organizational security architecture.		N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A
X	CCI-002398	SC-07(9) (a)	The information system detects outgoing communications traffic posing a threat to external information systems.		N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A

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					App	Designer Text	Resp	App	Designer Text	Resp	App	Designer Text	Resp
X	CCI-002399	SC-07(9) (a)	The information system denies outgoing communications traffic posing a threat to external information systems.		N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A
X	CCI-002400	SC-07(9) (b)	The information system audits the identity of internal users associated with denied outgoing communications traffic posing a threat to external information systems.		N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A
X	CCI-002401	SC-07(11)	The organization defines the authorized sources from which the information system will allow incoming communications.		N/A	This is policy to be provided by the Government. See CCI-2403 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-2403 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-2403 for design and implementation.	N/A
X	CCI-002402	SC-07(11)	The organization defines the authorized destinations for routing inbound communications.		N/A	This is policy to be provided by the Government. See CCI-2403 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-2403 for design and implementation.	N/A	N/A	This is policy to be provided by the Government. See CCI-2403 for design and implementation.	N/A
X	CCI-002403	SC-07(11)	The information system only allows incoming communications from organization-defined authorized sources routed to organization-defined authorized destinations.		N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A
X	CCI-001120	SC-07(13)	The organization defines key information security tools, mechanisms, and support components to be isolated.		N/P	This is policy to be provided by the Government. See CCI-1119 for design and implementation.	N/A	N/P	This is policy to be provided by the Government. See CCI-1119 for design and implementation.	N/A	N/P	This is policy to be provided by the Government. See CCI-1119 for design and implementation.	N/A
X	CCI-001119	SC-07(13)	The organization isolates organization-defined information security tools, mechanisms, and support components from other internal information system components by implementing physically separate subnetworks with managed interfaces to other components of the system.		N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A	N/A	Existing control system equipment will be reused. Cybersecurity of the existing control systems not be modified.	N/A

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COMMON WORK RESULTS FOR ELECTRICAL
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PART 1 GENERAL

1.1 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code
IEEE Stds Dictionary	(2009) IEEE Standards Dictionary: Glossary of Terms & Definitions

INTERNATIONAL CODE COUNCIL (ICC)

ICC/ANSI A117.1	(2009) Accessible and Usable Buildings and Facilities

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C80.1	(2005) American National Standard for Electrical Rigid Steel Conduit (ERSC)
ANSI C80.3	(2015) American National Standard for Electrical Metallic Tubing (EMT)
ANSI Z535.1	(2017) Safety Colors
ANSI/NEMA OS 1	(2013) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA 250	(2018) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 3	(2013) Molded Case Circuit Breakers and Their Application
NEMA FB 1	(2014) Standard for Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable
NEMA FU 1	(2012) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements

NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA KS 1	(2013) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA RN 1	(2005; R 2013) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 2	(2020) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2016) Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA WD 1	(1999; R 2015) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2016) Wiring Devices Dimensions Specifications

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 70E	(2021) Standard for Electrical Safety in the Workplace

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jan 2020) UL Standard for Safety Flexible Metal Conduit
UL 5	(2016; Reprint Aug 2020) UL Standard for Safety Surface Metal Raceways and Fittings
UL 6	(2007; Reprint Sep 2019) UL Standard for Safety Electrical Rigid Metal Conduit-Steel
UL 83	(2017; Reprint Mar 2020) UL Standard for Safety Thermoplastic-Insulated Wires and Cables
UL 360	(2013; Reprint Oct 2020) UL Standard for Safety Liquid-Tight Flexible Metal Conduit
UL 486A-486B	(2018) UL Standard for Safety Wire Connectors
UL 486C	(2019) UL Standard for Safety Splicing Wire Connectors
UL 489	(2016) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and

	Circuit-Breaker Enclosures
UL 498	(2017; Reprint Aug 2020) UL Standard for Safety Attachment Plugs and Receptacles
UL 514A	(2013; Reprint Aug 2017) UL Standard for Safety Metallic Outlet Boxes
UL 514B	(2012; Reprint May 2020) Conduit, Tubing and Cable Fittings
UL 514C	(2014; Reprint Feb 2020) UL Standard for Safety Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 651	(2011; Reprint Mar 2020) UL Standard for Safety Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL 797	(2007; Reprint Mar 2017) UL Standard for Safety Electrical Metallic Tubing -- Steel
UL 870	(2016; Reprint Mar 2019) UL Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings
UL 943	(2016; Reprint Feb 2018) UL Standard for Safety Ground-Fault Circuit-Interrupters
UL 1242	(2006; Reprint Aug 2020) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 4248-1	(2017) UL Standard for Safety Fuseholders - Part 1: General Requirements

1.2 DEFINITIONS

a. Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE Stds Dictionary.

b. 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.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Marking Strips; G

SD-03 Product Data

Conduits and Raceways; G

Wire and Cable; G

Splices and Connectors; G

Switches; G

Receptacles; G

Outlet Boxes, Pull Boxes and Junction Boxes; G

Circuit Breakers; G

Device Plates; G

SD-06 Test Reports

Continuity Test; G

Phase-Rotation Tests; G

Insulation Resistance Test; G

600-Volt Wiring Test; G

Ground-Fault Receptacle Test; G

Insulation-Resistance Test; G

SD-08 Manufacturer's Instructions

Manufacturer's Instructions

1.4 QUALITY CONTROL

1.4.1 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. Ensure equipment, materials, installation, and workmanship are in accordance with the mandatory and advisory provisions of NFPA 70, IEEE C2 unless more stringent requirements are specified or indicated.

1.4.2 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. Provide products which have been in satisfactory commercial or industrial use for 2 years prior to bid opening. Ensure the 2-year period includes applications of equipment and materials under similar circumstances and of similar size. Ensure the product has 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 must be products of a single manufacturer.

PART 2 PRODUCTS

2.1 EQUIPMENT

Provide the standard cataloged materials and equipment of manufacturers regularly engaged in the manufacture of the products. For material, equipment, and fixture lists submittals, show manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site.

Provide factory-applied finish on electrical equipment in accordance with the following:

a. NEMA 250 corrosion-resistance test and the additional requirements as specified herein.

b. Interior and exterior steel surfaces of equipment enclosures: thoroughly cleaned followed by a rust-inhibitive phosphatizing or equivalent treatment prior to painting.

c. Exterior surfaces: free from holes, seams, dents, weld marks, loose scale or other imperfections.

d. Interior surfaces: receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice.

e. Exterior surfaces: primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish.

f. Equipment located indoors: ANSI Light Gray, and equipment located outdoors: ANSI Dark Gray.

g. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

2.1.1 Conduits and Raceways

2.1.1.1 Rigid Steel Conduit

Provide hot dipped galvanized rigid steel conduit complying with NEMA RN 1, ANSI C80.1, UL 6 and UL 5 as applicable. Except where installed underground, or in corrosive areas, provide polyvinylchloride (PVC), or protect from corrosion by painting with bitumastic coating or wrapping with corrosion inhibiting tape..

Use threaded fittings for rigid steel conduit.

Use solid gaskets. Ensure conduit fittings with blank covers have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

Provide covers with captive screws and are accessible after the work has been completed.

2.1.1.2 Electrical Metallic Tubing (EMT)

Ensure EMT is in accordance with UL 797, UL 5, and ANSI C80.3 and is zinc coated steel. Provide zinc-coated couplings and connectors that are raintight, gland compression type with insulated throat. Crimp, spring, or setscrew type fittings are not acceptable.

2.1.1.3 Flexible Metallic Conduit

Ensure flexible metallic conduit is galvanized steel and complies with UL 1 and UL 360.

Ensure fittings for flexible metallic conduit are 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.

Ensure fittings for liquidtight flexible metallic conduit are specifically designed for such conduit.

2.1.1.4 Intermediate Metal Conduit

Ensure intermediate metal conduit is galvanized steel and complies with UL 1242, NEMA RN 1, ANSI C80.1, UL 6 and UL 5 as applicable.

2.1.1.5 Rigid Nonmetallic Conduit

Ensure rigid nonmetallic conduit complies with NEMA TC 2, NEMA TC 3, and UL 651 as applicable with a wall thickness not less than Schedule 40.

2.1.2 Wireways

Ensure wireways and auxiliary gutters are a minimum 4 by 4-inch trade size conforming to UL 870.

UL 870. Material: steel galvanized 16 gauge for heights and depths up to 6 by 6 inches, and 14 gauge for heights and depths up to 12 by 12 inches. Provide in length required for the application with hinged- cover NEMA 3R 12 enclosure per NEMA ICS 6.

2.1.3 Outlet Boxes, Pull Boxes and Junction Boxes

Ensure outlet boxes for use with conduit systems are in accordance with NEMA FB 1 UL 514A, UL 514B, UL 514C and ANSI/NEMA OS 1 and are not less than 1-1/2 inches deep. Furnish all pull and junction boxes with screw-fastened covers.

2.1.4 Circuit Breakers

Provide circuit breakers that conform to UL 489 and NEMA AB 3 with frame a trip ratings as indicated.

Provide bolt-on type, molded-case, manually operated, trip-free circuit breakers, with inverse-time thermal-overload protection and instantaneous magnetic short-circuit protection. Completely enclose circuit breakers in a molded case, with a factory-sealed, calibrated sensing element to prevent tampering. Plug-in type, tandem, and half-size circuit breakers

are not permitted.

Provide inverse-time-delay thermal-overload protection and instantaneous magnetic short-circuit protection. Provide an instantaneous solid-state tripping element that is adjustable and accessible from the front of the breaker on frame sizes larger than 100 ampere.

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 10,000 A and that conform to NEMA AB 3. Series rating of circuit breakers or overcurrent protective devices to achieve indicated interrupt rating is permitted.

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 a phenolic-composition breaker body capable of having such accessories as handle-extension, handle-locking, and padlocking devices attached where required to meet lock-out/tag-out requirements of NFPA 70E.

2.2 MATERIALS

2.2.1 Wire And Cable

Provide wires and cables in accordance applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Do not use wires and cables manufactured more than 12 months prior to date of delivery to site.

Provide minimum conductor size in accordance with the following:

a. Branch circuits: No. 12 AWG.

b. Class 1 remote-control and signal circuits: No. 14 AWG.

c. Class 2 low-energy, remote-control and signal circuits: No. 16 AWG.

d. Class 3 low-energy, remote-control, alarm and signal circuits: No. 22 AWG.

Ensure connectors used in wire systems comply with UL 486A-486B and UL 486C as applicable.

Ensure conductors installed in plenums are marked plenum rated.

2.2.1.1 Insulation

Unless specified or indicated otherwise or required by NFPA 70, provide power and lighting wires rated for 600-volts, Type THWN/THHN conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits: Type TW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.2.2 Device Plates

Provide the following:

a. UL listed, one-piece device plates for outlets to suit the devices installed.

b. For metal outlet boxes, plates on unfinished walls: zinc-coated sheet steel or cast metal having round or beveled edges.

c. For nonmetallic boxes and fittings, other suitable plates may be provided.

2.2.3 Switches

2.2.3.1 Safety Switches

Ensure safety switches comply with NEMA KS 1, and are the heavy-duty type with enclosure, voltage, current rating, number of poles, and fusing as indicated on the drawings. Ensure fused switch fuse holders comply with UL 4248-1. Ensure switch construction is such that, when the switch handle in the "ON" position, the cover or door cannot be opened. Cover release device is coinproof and so constructed that an external tool is used to open the cover. Make provisions to lock the handle in the "OFF" position. Ensure the switch is not capable of being locked in the "ON" position.

Provide switches of the quick-make, quick-break type and terminal lugs for use with copper conductors.

Ensure safety color coding for identification of safety switches conforms to ANSI Z535.1.

2.2.4 Fuses

NEMA FU 1. Provide complete set of fuses for each fusible switch. Coordinate time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices for proper operation. Submit coordination data for approval. Provide fuses with a voltage rating not less than circuit voltage.

2.2.5 Receptacles

Provide the following:

a. UL 498, hard use (also designated heavy-duty), grounding-type.

b. Ratings and configurations: as indicated.

c. Bodies: white as per NEMA WD 1.

d. Face and body: thermoplastic supported on a metal mounting strap.

e. Dimensional requirements: per NEMA WD 6.

f. Screw-type, side-wired wiring terminals or of the solderless pressure type having suitable conductor-release arrangement.

g. Grounding pole connected to mounting strap.

h. The receptacle: containing triple-wipe power contacts and double or triple-wipe ground contacts.

2.2.5.1 Weatherproof Receptacles

Provide receptacles, UL listed for use in "wet locations." Include cast metal box with gasketed, hinged, lockable and weatherproof while-in-use, polycarbonate, UV resistant/stabilized cover plate.

2.2.5.2 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Provide device capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A ground-fault circuit interrupter devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

2.2.5.3 Tamper-Resistant Receptacles

Provide duplex receptacle with mechanical sliding shutters that prevent the insertion of small objects into its contact slots.

2.2.6 Manufacturer's Nameplate

Ensure each item of equipment has 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 is not acceptable.

2.2.7 Firestopping Materials

Provide firestopping around electrical penetrations in accordance with Section 07 84 00, FIRESTOPPING.

PART 3 EXECUTION

3.1 PREPARATION

Submit manufacturer's instructions including special provisions required to install equipment components and system packages. Special provisions include impedances, hazards and safety precautions.

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 using approved fittings and treatment. Except where other equivalent protective treatment is specifically approved in writing, provide hot-dip galvanized ferrous metals for items such as, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous items not made of corrosion-resistant steel.

3.2 INSTALLATION

3.2.1 Service Entrance Identification

Service entrance disconnect devices, switches, and enclosures: labeled

and identified as such.

3.2.2 Labels

Wherever work results in service entrance disconnect devices in more than one enclosure, as permitted by NFPA 70, label each enclosure, new and existing, as one of several enclosures containing service entrance disconnect devices. Label, at minimum: indicate number of service disconnect devices housed by enclosure and indicate total number of enclosures that contain service disconnect devices. Provide laminated plastic labels conforming to paragraph FIELD FABRICATED NAMEPLATES. Use lettering of at least 0.25 inch in height, and engrave on black-on-white matte finish. Service entrance disconnect devices in more than one enclosure: provided only as permitted by NFPA 70.

3.2.3 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor: separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Minimum conduit size: 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings: made with metal conduit in fire-rated shafts, with metal conduit extending through shafts for minimum distance of 6 inches. Firestop conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors in accordance with Section 07 84 00, FIRESTOPPING.

3.2.3.1 Pull Wire

Install pull wires in empty conduits. Pull wire: plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.2.4 Conduits, Raceways and Fittings

Ensure that conduit runs between outlet and outlet, between fitting and fitting, or between outlet and fitting does 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 replace conduit.

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).

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. Run conduits in crawl space as if

exposed.

3.2.4.1 Rigid Steel Conduit

Make field-made bends and offsets with approved Hickey bending tool or conduit bending machine. Use long radius conduit for elbows larger than 2-1/2 inches.

Provide a flush coupling for 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, when the floor slab is of sufficient thickness. Otherwise, provide a floor box set flush with the finished floor. For conduits installed for future use, terminate with a coupling and plug; set flush with the floor.

3.2.4.2 Electrical Metallic Tubing (EMT)

Ground EMT in accordance with NFPA 70, using pressure grounding connectors especially designed for EMT.

3.2.4.3 Flexible Metallic Conduit

Use flexible metallic conduit to connect recessed fixtures from outlet boxes in ceilings, transformers, and other approved assemblies.

Use bonding wires in flexible conduit as specified in NFPA 70, for all circuits. Flexible conduit is not considered a ground conductor.

Make electrical connections to vibration-isolated equipment with flexible metallic conduit.

Use liquidtight flexible metallic conduit in wet and oily locations and to complete the connection to motor-driven equipment.

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit to allow 20 percent slack. Minimum flexible steel conduit size: 1/2 inch diameter. Provide liquidtight flexible conduit in wet and damp locations and in fire pump rooms for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections.

3.2.4.4 Intermediate Conduit

Make all field-made bends and offsets with approved Hickey bending tool or conduit bending machine. Use intermediate metal conduit only for indoor installations.

3.2.4.5 Rigid Nonmetallic Conduit

Install a green insulated copper grounding conductor in conduit with conductors and solidly connect to ground at each end. Size grounding wires in accordance with NFPA 70.

3.2.4.6 Underground Conduit

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40; or fiberglass. Convert nonmetallic conduit, other than PVC Schedule 40 or

80, to plastic-coated rigid, or IMC, steel conduit before rising through floor slab. Plastic coating: extend minimum 6 inches above floor.

3.2.4.7 Conduit for Circuits Rated Greater Than 600 Volts

Rigid metal conduit or IMC only.

3.2.4.8 Conduit Installed Under Floor Slabs

Conduit run under floor slab: located a minimum of12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier.

3.2.4.9 Conduit Installed Through Floor Slabs

Where conduits rise through floor slabs, do not allow curved portion of bends to be visible above finished slab.

3.2.4.10 Stub Ups

Provide conduits stubbed up through concrete floor for connection to free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.2.4.11 Conduit Support

Support conduit by pipe straps, wall brackets, threaded rod conduit hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Do not exceed one-fourth proof test load for load applied to fasteners. Provide vibration resistant and shock-resistant fasteners attached to concrete ceiling. Do not cut main reinforcing bars for any holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems: supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Do not share supporting means between electrical raceways and mechanical piping or ducts. Coordinate installation with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Support exposed risers in wire shafts of multistory buildings by U-clamp hangers at each floor level and at 10 foot maximum intervals. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.2.4.12 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.2.4.13 Surface Raceways and Assemblies

Mount surface raceways plumb and level, with the base and cover secured. Minimum circuit run is three-wire, with one wire designated as ground.

3.2.5 Wiring

Color code feeder and branch circuit conductors as follows:

CONDUCTOR	COLOR AC
Phase A	Black (208VAC); Brown (480VAC)
Phase B	Red (208VAC); Orange (480VAC)
Phase C	Blue (208VAC); Yellow (480VAC)
Neutral	White (208VAC); Natural Gray (480VAC)
Equipment Grounds	Green

Use conductors up to and including AWG No. 2 that are manufactured with colored insulating materials. For conductors larger than AWG No. 2, have ends identified with color plastic tape in outlet, pull, or junction boxes.

Splice in accordance with the NFPA 70. Provide conductor identification within each enclosure where a tap, splice, or termination is made and at the equipment terminal of each conductor. Match terminal and conductor identification as indicated.

Where several feeders pass through a common pullbox, tag the feeders to clearly indicate the electrical characteristics, circuit number, and panel designation.

3.2.6 Wiring Devices

3.2.6.1 Wall Switches and Receptacles

Install wall switches and receptacles so that when device plates are applied, the plates are aligned vertically to within 1/16 inch.

Bond ground terminal of each flush-mounted receptacle to the outlet box with an approved green bonding jumper when used with dry wall type construction.

3.2.6.2 Device Plates

Ensure device plates for switches are suitably engraved with a description of the loads when not within sight of the loads controlled.

Mark device plates and receptacle cover plates for receptacles other than 125-volt, single-phase, duplex, convenience outlets. Show the circuit number, voltage, frequency, phasing, and amperage available at the receptacle. Use self-adhesive labels having 1/4 inch embossed letters.

Similarly mark device plates for convenience outlets indicating the supply panel and circuit number.

3.2.7 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 insulated electrical lugs type. Wrap joints with an insulating tape that has an insulation and temperature rating equivalent to that of the conductor.

3.2.8 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, provide color coding by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, provide color coding by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with manufacturer's recommendations.

3.2.8.1 Marking Strips

Provide marking strips in accordance with the following:

a. Provide white or other light-colored plastic marking strips, fastened by screws to each terminal block, for wire designations.

b. Use permanent ink for the wire numbers

c. Provide reversible marking strips to permit marking both sides, or provide two marking strips with each block.

d. Size marking strips to accommodate the two sets of wire numbers.

e. Assign a device designation in accordance with NEMA ICS 1 to each device to which a connection is made. Mark each device terminal to which a connection is made with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams.

f. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, provide additional wire and cable designations for identification of remote (external) circuits for the Government's wire designations.

g. Prints of the marking strips drawings submitted for approval will be

so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.2.9 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 5 feet above floor level, when possible.

3.2.10 Boxes and Fittings

Provide pullboxes where necessary in the conduit system to facilitate conductor installation. For conduit runs longer than 100 feet or with more than three right-angle bends, install a pullbox at a convenient intermediate location.

Securely mount boxes and enclosures to the building structure using supports that are independent of the conduit entering or leaving the boxes.

Select the mounting height of wall-mounted outlet and switch boxes, as measured between the bottom of the box and the finished floor, in accordance with ICC/ANSI A117.1 and as follows, unless otherwise indicated:

LOCATION	MOUNTING HEIGHT (inches)
Receptacles in offices	18
Receptacles in corridors	18
Receptacles in shops and laboratories	48
Receptacles in rest rooms	48
Switches for light control	48

3.2.11 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.2.12 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.2.13 Field Fabricated Nameplates

Ensure nameplates conform to ASTM D709. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device, as specified or as indicated on the drawings. Each nameplate inscription

identifies the function and, when applicable, the position. Provide nameplates that are melamine plastic, 0.125-inch thick, white with black center core and a matte finish surface with square corners. Accurately align lettering and engrave into the core. Minimum size of nameplates is 1 by 2.5 inches. Lettering is a minimum of 0.25-inch high normal block style.

3.2.14 Identification Plates and Warnings

Provide 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. Attach identification plates to process control devices and pilot lights.

Install identification plates for all line voltage enclosed circuit breakers, identifying the equipment served, voltage, phase(s) and power source. For circuits 480 volts and above, install conspicuously located warning signs in accordance with OSHA requirements.

3.3 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.

3.4 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

3.5 FIELD APPLIED MOUNTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria.

3.6 FIELD QUALITY CONTROL

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.

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. Use substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices to isolate the circuits under test.

Perform insulation-resistance test on each field-installed conductor with respect to ground and adjacent conductors. Applied potential is 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 is not less than 25 Megohms for 300 volt rated cable and 100 Megohms for 600 volt rated cable. For circuits with conductor sizes AWG No. 8 and smaller insulation resistance testing is not required.

Perform continuity test to insure correct cable connection end-to-end (i.e correct phase conductor, grounded conductor, and grounding conductor wiring). Repair and verify any damages to existing or new electrical equipment resulting from mis-wiring. Receive approval for all repairs prior to commencement 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 in a clockwise direction, facing the source.

Perform 600-volt wiring test on wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of approximately 500 volts to provide direct reading of resistance. Minimum resistance: 250,000 ohms.

Perform ground-fault receptacle test for ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed.

Submit test reports in accordance with referenced standards in this section.

Final acceptance requires the successful performance of wire and cable under test. Do not energize any conductor until the final test reports are reviewed and approved.

-- End of Section --

SECTION 26 08 00

APPARATUS INSPECTION AND TESTING
11/21

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.

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2021) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM applies to this section with additions and modifications specified herein.

1.3 SUBMITTALS

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

SD-06 Test Reports

Acceptance Tests and Inspections; G

SD-07 Certificates

Qualifications of Organization, and Lead Engineering Technician; G

Acceptance Test and Inspections Procedure; G

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Contractor shall engage the services of a qualified testing organization to provide inspection, testing, calibration, and adjustment of the electrical distribution system and generation equipment listed in paragraph entitled "Acceptance Tests and Inspections" herein. Organization shall be independent of the supplier, manufacturer, and installer of the equipment. The organization shall be a first tier subcontractor. No work required by this section of the specification shall be performed by a second tier subcontractor.

a. Submit name and qualifications of organization. Organization shall have been regularly engaged in the testing of electrical materials,

devices, installations, and systems for a minimum of 5 years. The organization shall have a calibration program, and test instruments used shall be calibrated in accordance with NETA ATS.

b. Submit name and qualifications of the lead engineering technician performing the required testing services. Include a list of three comparable jobs performed by the technician with specific names and telephone numbers for reference. Testing, inspection, calibration, and adjustments shall be performed by an engineering technician, certified by NETA (Level III) or the National Institute for Certification in Engineering Technologies (NICET) with a minimum of 5 years' experience inspecting, testing, and calibrating electrical distribution and generation equipment, systems, and devices.

1.4.2 Acceptance Tests and Inspections Reports

Submit certified copies of inspection reports and test reports. Reports shall include certification of compliance with specified requirements, identify deficiencies, and recommend corrective action when appropriate. Type and neatly bind test reports to form a part of the final record. Submit test reports documenting the results of each test not more than 10 days after test is completed.

1.4.3 Acceptance Test and Inspections Procedure

Submit test procedure reports for each item of equipment to be field tested at least 45 days prior to planned testing date. Do not perform testing until after test procedure has been approved.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 ACCEPTANCE TESTS AND INSPECTIONS

Testing organization shall perform acceptance tests and inspections. Test methods, procedures, and test values shall be performed and evaluated in accordance with NETA ATS, the manufacturer's recommendations, and paragraph entitled "Field Quality Control" of each applicable specification section. Tests identified as optional in NETA ATS are not required unless otherwise specified. Equipment shall be placed in service only after completion of required tests and evaluation of the test results have been completed. Contractor shall supply to the testing organization complete sets of shop drawings, settings of adjustable devices, and other information necessary for an accurate test and inspection of the system prior to the performance of any final testing. Contracting Officer shall be notified at least 14 days in advance of when tests will be conducted by the testing organization. Perform acceptance tests and inspections on applicable equipment and systems specified in the following sections:

3.2 SYSTEM ACCEPTANCE

Final acceptance of the system is contingent upon satisfactory completion of acceptance tests and inspections.

3.3 PLACING EQUIPMENT IN SERVICE

A representative of the approved testing organization shall be present

when equipment tested by the organization is initially energized and placed in service.

-- End of Section --

SECTION 26 20 00

INTERIOR DISTRIBUTION SYSTEM
08/19, CHG 3: 11/21

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 B1	(2013) Standard Specification for Hard-Drawn Copper Wire
ASTM B8	(2011; R 2017) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D709	(2017) Standard Specification for Laminated Thermosetting Materials

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 81	(2012) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System
IEEE 100	(2000; Archived) The Authoritative Dictionary of IEEE Standards Terms
IEEE C2	(2017; Errata 1-2 2017; INT 1 2017) National Electrical Safety Code

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2021) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION (NECA)

NECA NEIS 1	(2015) Standard for Good Workmanship in Electrical Construction

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C80.1	(2020) American National Standard for Electrical Rigid Steel Conduit (ERSC)
ANSI C80.3	(2020) American National Standard for Electrical Metallic Tubing (EMT)
ANSI C80.5	(2020) American National Standard for Electrical Rigid Aluminum Conduit

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA FU 1	(2012) Low Voltage Cartridge Fuses
NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 2	(2000; R 2020) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V
NEMA ICS 4	(2015) Application Guideline for Terminal Blocks
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA KS 1	(2013) Enclosed and Miscellaneous Distribution Equipment Switches (600 V Maximum)
NEMA MG 1	(2018) Motors and Generators
NEMA MG 10	(2017) Energy Management Guide for Selection and Use of Fixed Frequency Medium AC Squirrel-Cage Polyphase Induction Motors
NEMA MG 11	(1977; R 2012) Energy Management Guide for Selection and Use of Single Phase Motors
NEMA TC 2	(2020) Standard for Electrical Polyvinyl Chloride (PVC) Conduit
NEMA TC 3	(2021) Polyvinyl Chloride (PVC) Fittings for Use With Rigid PVC Conduit and Tubing
NEMA WD 1	(1999; R 2020) Standard for General Color Requirements for Wiring Devices
NEMA WD 6	(2016) Wiring Devices Dimensions Specifications
NEMA Z535.4	(2011; R 2017) Product Safety Signs and Labels

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code
NFPA 70E	(2021) Standard for Electrical Safety in the Workplace
NFPA 780	(2020) Standard for the Installation of Lightning Protection Systems

TELECOMMUNICATIONS INDUSTRY ASSOCIATION (TIA)

TIA-607	(2019d) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

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

29 CFR 1910.147	The Control of Hazardous Energy (Lock Out/Tag Out)
29 CFR 1910.303	Electrical, General

UNDERWRITERS LABORATORIES (UL)

UL 1	(2005; Reprint Jan 2020) UL Standard for Safety Flexible Metal Conduit
UL 4	(2004; Reprint Mar 2021) UL Standard for Safety Armored Cable
UL 5	(2016; Reprint Aug 2020) UL Standard for Safety Surface Metal Raceways and Fittings
UL 5A	(2015; Reprint Aug 2020) Nonmetallic Surface Raceways and Fittings
UL 6	(2007; Reprint Sep 2019) UL Standard for Safety Electrical Rigid Metal Conduit-Steel
UL 6A	(2008; Reprint Mar 2021) UL Standard for Safety Electrical Rigid Metal Conduit - Aluminum, Red Brass, and Stainless Steel
UL 20	(2018; Reprint Jan 2021) UL Standard for Safety General-Use Snap Switches
UL 44	(2018; Reprint May 2021) UL Standard for Safety Thermoset-Insulated Wires and Cables
UL 50	(2015) UL Standard for Safety Enclosures for Electrical Equipment, Non-Environmental Considerations
UL 67	(2018; Reprint Jul 2020) UL Standard for Safety Panelboards
UL 83	(2017; Reprint Mar 2020) UL Standard for Safety Thermoplastic-Insulated Wires and Cables
UL 248-4	(2010; Reprint Apr 2019) Low-Voltage Fuses - Part 4: Class CC Fuses
UL 248-8	(2011; Reprint Aug 2020) Low-Voltage Fuses - Part 8: Class J Fuses
UL 248-10	(2011; Reprint Aug 2020) Low-Voltage Fuses

	- Part 10: Class L Fuses
UL 248-12	(2011; Reprint Aug 2020) Low Voltage Fuses - Part 12: Class R Fuses
UL 248-15	(2018) Low-Voltage Fuses - Part 15: Class T Fuses
UL 360	(2013; Reprint Aug 2021) UL Standard for Safety Liquid-Tight Flexible Metal Conduit
UL 467	(2013; Reprint Jun 2017) UL Standard for Safety Grounding and Bonding Equipment
UL 486A-486B	(2018; Reprint May 2021) UL Standard for Safety Wire Connectors
UL 486C	(2018; Reprint May 2021) UL Standard for Safety Splicing Wire Connectors
UL 489	(2016; Rev 2019) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 498	(2017; Reprint Feb 2021) UL Standard for Safety Attachment Plugs and Receptacles
UL 506	(2017) UL Standard for Safety Specialty Transformers
UL 508	(2018; Reprint Jul 2021) UL Standard for Safety Industrial Control Equipment
UL 510	(2020) UL Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514B	(2012; Reprint May 2020) Conduit, Tubing and Cable Fittings
UL 651	(2011; Reprint Mar 2020) UL Standard for Safety Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings
UL 797	(2007; Reprint Mar 2021) UL Standard for Safety Electrical Metallic Tubing -- Steel
UL 817	(2015; Reprint Jul 2021) UL Standard for Safety Cord Sets and Power-Supply Cords
UL 869A	(2006; Reprint Jun 2020) Reference Standard for Service Equipment
UL 870	(2016; Reprint Mar 2019) UL Standard for Safety Wireways, Auxiliary Gutters, and Associated Fittings
UL 943	(2016; Reprint Feb 2018) UL Standard for Safety Ground-Fault Circuit-Interrupters

UL 984	(1996; Reprint Sep 2005) Hermetic Refrigerant Motor-Compressors
UL 1063	(2017) UL Standard for Safety Machine-Tool Wires and Cables
UL 1242	(2006; Reprint Aug 2020) Standard for Electrical Intermediate Metal Conduit -- Steel
UL 1569	(2018) UL Standard for Safety Metal-Clad Cables
UL 1699	(2017; Reprint Nov 2020) UL Standard for Safety Arc-Fault Circuit-Interrupters
UL 4248-1	(2017) UL Standard for Safety Fuseholders - Part 1: General Requirements
UL 4248-12	(2018) UL Standard for Safety Fuseholders - Part 12: Class R

1.2 DEFINITIONS

Unless otherwise specified or indicated, electrical and electronics terms used in these specifications, and on the drawings, are as defined in IEEE 100.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification 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
Panelboards; G

Wireways; G
Marking Strips Drawings; G

SD-03 Product Data
Receptacles; G
Circuit Breakers; G
Switches; G

Motor Controllers; G
Manual Motor Starters; G

SD-06 Test Reports
600-volt Wiring Test; G

Ground-fault Receptacle Test; G
SD-07 Certificates
Fuses; G

SD-10 Operation and Maintenance Data
Electrical Systems, Data Package 5; G

1.4 QUALITY ASSURANCE

1.4.1 Fuses

Submit coordination data as specified in paragraph, FUSES of this section.

1.4.2 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "must" 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. Provide equipment, materials, installation, and workmanship in accordance with NFPA 70 unless more stringent requirements are specified or indicated. NECA NEIS 1 shall be considered the minimum standard for workmanship.

1.4.3 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship and:

a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.4.3.1 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.

1.4.3.2 Material and Equipment Manufacturing Date

Products manufactured more than 3 years prior to date of delivery to site are not acceptable.

1.5 MAINTENANCE

1.5.1 Electrical Systems

Submit operation and maintenance data in accordance with Section 01 78 23, OPERATION AND MAINTENANCE DATA and as specified herein. Submit operation and maintenance manuals for electrical systems that provide basic data relating to the design, operation, and maintenance of the electrical distribution system for the building. Include the following:

a. Single line diagram of the "as-built" building electrical system.

b. Schematic diagram of electrical control system (other than HVAC, covered elsewhere).

c. Manufacturers' operating and maintenance manuals on active electrical equipment.

1.6 WARRANTY

Provide equipment items supported by service organizations that 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 SEISMIC REQUIREMENTS

Provide seismic details.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

As a minimum, meet requirements of UL, where UL standards are established for those items, and requirements of NFPA 70 for all materials, equipment, and devices.

2.2 CONDUIT AND FITTINGS

Conform to the following:

2.2.1 Rigid Metallic Conduit

2.2.1.1 Rigid, Threaded Zinc-Coated Steel Conduit

ANSI C80.1, UL 6.

2.2.1.2 Rigid Aluminum Conduit

ANSI C80.5, UL 6A.

2.2.2 Rigid Nonmetallic Conduit

PVC Type EPC-40 in accordance with NEMA TC 2,UL 651.

2.2.3 Intermediate Metal Conduit (IMC)

UL 1242, zinc-coated steel only.

2.2.4 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797, ANSI C80.3.

2.2.5 Flexible Metal Conduit

UL 1, limited to 6 feet.

2.2.5.1 Liquid-Tight Flexible Metal Conduit, Steel

UL 360, limited to 6 feet.

2.2.6 Fittings for Metal Conduit, EMT, and Flexible Metal Conduit

UL 514B. Ferrous fittings: cadmium- or zinc-coated in accordance with UL 514B.

2.2.6.1 Fittings for Rigid Metal Conduit and IMC

Threaded-type. Split couplings unacceptable.

2.2.6.2 Fittings for EMT

Steel compression type.

2.2.7 Fittings for Rigid Nonmetallic Conduit

NEMA TC 3 for PVC, and UL 514B.

2.3 SURFACE RACEWAY

2.3.1 Surface Metal Raceway

UL 5, two-piece painted steel, totally enclosed, snap-cover type.

2.3.2 Surface Nonmetallic Raceway

UL 5A, nonmetallic totally enclosed, snap-cover type.

2.4 CABINETS, JUNCTION BOXES, AND PULL BOXES

UL 50; volume greater than 100 cubic inches, NEMA Type 1 enclosure; sheet steel, hot-dip, zinc-coated. Where exposed to wet, damp, or corrosive environments, NEMA Type 4Xas indicated.

2.5 WIRES AND CABLES

Provide wires and cables in accordance applicable requirements of NFPA 70 and UL for type of insulation, jacket, and conductor specified or indicated. Do not use wires and cables manufactured more than 12 months prior to date of delivery to site.

2.5.1 Conductors

Provide the following:

a. Conductor sizes and capacities shown are based on copper, unless indicated otherwise.

b. Conductors No. 8 AWG and larger diameter: stranded.

c. Conductors No. 10 AWG and smaller diameter: solid.

d. Conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3: stranded unless specifically indicated otherwise.

e. All conductors: copper.

2.5.1.1 Minimum Conductor Sizes

Provide minimum conductor size in accordance with the following:

a. Branch circuits: No. 12 AWG.

b. Class 1 remote-control and signal circuits: No. 14 AWG.

c. Class 2 low-energy, remote-control and signal circuits: No. 16 AWG.

d. Class 3 low-energy, remote-control, alarm and signal circuits: No. 22 AWG.

e. Digital low voltage lighting control (DLVLC) system at 24 Volts or less: Category 5 UTP cables in EMT conduit.

2.5.2 Color Coding

Provide color coding for service, feeder, branch, control, and signaling circuit conductors.

2.5.2.1 Ground and Neutral Conductors

Provide color coding of ground and neutral conductors as follows:

a. Grounding conductors: Green.

b. Neutral conductors: White.

c. Exception, where neutrals of more than one system are installed in same raceway or box, other neutrals color coding: white with a different colored (not green) stripe for each.

2.5.2.2 Ungrounded Conductors

Provide color coding of ungrounded conductors in different voltage systems as follows:

a. 208/120 volt, three-phase

(1) Phase A - black

(2) Phase B - red

(3) Phase C - blue

d. On three-phase, four-wire delta system, high leg: orange, as required by NFPA 70.

2.5.3 Insulation

Unless specified or indicated otherwise or required by NFPA 70, provide power and lighting wires rated for 600-volts, Type THWN/THHN conforming to UL 83 conforming to UL 44, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits: Type TW or TF, conforming to UL 83. Where equipment or devices require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.5.4 Bonding Conductors

ASTM B1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.5.5 Metal-Clad Cable

UL 1569; NFPA 70, Type MC cable.

2.5.6 Armored Cable

UL 4; NFPA 70, Type AC cable.

2.5.7 Cable Tray Cable or Power Limited Tray Cable

UL listed; type TC or PLTC.

2.5.8 Cord Sets and Power-Supply Cords

UL 817.

2.6 SPLICES AND TERMINATION COMPONENTS

UL 486A-486B for wire connectors and UL 510 for insulating tapes. Connectors for No. 10 AWG and smaller diameter wires: insulated, pressure-type in accordance with UL 486A-486B or UL 486C (twist-on splicing connector). Provide solderless terminal lugs on stranded conductors.

2.7 DEVICE PLATES

Provide the following:

a. UL listed, one-piece device plates for outlets to suit the devices installed.

b. For metal outlet boxes, plates on unfinished walls: zinc-coated sheet steel or cast metal having round or beveled edges.

c. For nonmetallic boxes and fittings, other suitable plates may be provided.

d. Plates on finished walls: nylon or lexan, minimum 0.03 inch wall thickness and same color as receptacle or toggle switch with which they are mounted.

e. Plates on finished walls: satin finish stainless steel or

brushed-finish aluminum, minimum 0.03 inch thick.

f. Screws: machine-type with countersunk heads in color to match finish of plate.

g. Sectional type device plates are not be permitted.

h. Plates installed in wet locations: gasketed and UL listed for "wet locations."

2.8 SWITCHES2.8.1 Toggle Switches

NEMA WD 1, UL 20, single pole, double pole, totally enclosed with bodies of thermoplastic or thermoset plastic and mounting strap with grounding screw. Include the following:

a. Handles: white thermoplastic.

b. Wiring terminals: screw-type, side-wired or of the solderless pressure type having suitable conductor-release arrangement.

c. Contacts: silver-cadmium and contact arm - one-piece copper alloy.

d. Switches: rated quiet-type ac only, 120/277 volts, with current rating and number of poles indicated.

2.8.2 Breakers Used as Switches

For 120- and 277-Volt fluorescent fixtures, mark breakers "SWD" in accordance with UL 489.

2.8.3 Disconnect Switches

NEMA KS 1. Provide heavy duty-type switches where indicated, where switches are rated higher than 240 volts, and for double-throw switches. Utilize Class R fuseholders and fuses for fused switches, unless indicated otherwise. Provide horsepower rated for switches serving as the motor-disconnect means. Provide switches in NEMA 1 3R 4X Type 304 stainless steel, enclosure as indicated per NEMA ICS 6.

2.9 FUSES

NEMA FU 1. Provide complete set of fuses for each fusible switch panel. Coordinate time-current characteristics curves of fuses serving motors or connected in series with circuit breakers or other circuit protective devices for proper operation. Submit coordination data for approval. Provide fuses with a voltage rating not less than circuit voltage.

2.9.1 Fuseholders

Provide in accordance with UL 4248-1.

2.9.2 Cartridge Fuses, Current Limiting Type (Class R)

UL 248-12, Class RK-1 RK-5 time-delay type. Provide only Class R associated fuseholders in accordance with UL 4248-12.

2.9.3 Cartridge Fuses, High-Interrupting Capacity, Current Limiting Type (Classes J, L, and CC)

UL 248-8, UL 248-10, UL 248-4, Class J for zero to 600 amperes, Class L for 601 to 6,000 amperes, and Class CC for zero to 30 amperes.

2.9.4 Cartridge Fuses, Current Limiting Type (Class T)

UL 248-15, Class T for zero to 1,200 amperes, 300 volts; and zero to 800 amperes, 600 volts.

2.10 RECEPTACLES

Provide the following:

a. UL 498, general purpose specification grade, grounding-type. Residential grade receptacles are not acceptable.

b. Ratings and configurations: as indicated.

c. Bodies: white as per NEMA WD 1.

d. Face and body: thermoplastic supported on a metal mounting strap.

e. Dimensional requirements: per NEMA WD 6.

f. Screw-type, side-wired wiring terminals or of the solderless pressure type having suitable conductor-release arrangement.

g. Grounding pole connected to mounting strap.

h. The receptacle: containing triple-wipe power contacts and double or triple-wipe ground contacts.

2.10.1 Split Duplex Receptacles

Provide separate terminals for each ungrounded pole. One receptacle must be controlled separately.

2.10.2 Weatherproof Receptacles

Provide receptacles, UL listed for use in "wet locations" with integral GFCI protection. Include cast metal box with gasketed, hinged, lockable and weatherproof while-in-use, polycarbonate, UV resistant/stabilized die-cast metal/aluminum cover plate.

2.10.3 Ground-Fault Circuit Interrupter Receptacles

UL 943, duplex type for mounting in standard outlet box. Provide device capable of detecting current leak when the current to ground is 6 milliamperes or higher, and tripping per requirements of UL 943 for Class A ground-fault circuit interrupter devices. Provide screw-type, side-wired wiring terminals or pre-wired (pigtail) leads.

Plugs Provide heavy-duty, rubber-covered three-, four-, or five-wire cord of required size, install plugs thereon, and attach to equipment. Provide UL listed plugs with receptacles, complete with grounding blades. Where equipment is not available, turn over plugs and cord assemblies to the

Government. 2.10.4 Tamper-Resistant Receptacles

Provide duplex receptacle with mechanical sliding shutters that prevent the insertion of small objects into its contact slots.

2.10.5 Arc-Fault Circuit Interrupter Receptacles

UL 1699, duplex type for mounting in standard outlet box. Provide device capable of detecting series arcing current when the current to ground is 5 amperes or higher, and tripping per requirements of UL 1699.

2.11 PANELBOARDS

Provide panelboards in accordance with the following:

a. UL 67 and UL 50 having a short-circuit current rating as indicated .

b. Panelboards for use as service disconnecting means: additionally conform to UL 869A.

c. Panelboards: circuit breaker-equipped.

d. Designed such that individual breakers can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as means of obtaining clearances as required by UL.

e. "Specific breaker placement" is required in panelboards to match the breaker placement indicated in the panelboard schedule on the design drawings. If it is not possible to match "specific breaker placement" during construction, obtain Government approval prior to device installation.

f. Use of "Subfeed Breakers" is not acceptable.

g. Main breaker: "separately" mounted "above" or "below" branch breakers.

h. Where "space only" is indicated, make provisions for future installation of breakers.

i. Directories: indicate load served by each circuit in panelboard.

j. Directories: indicate source of service to panelboard (e.g., Panel PA served from Panel MDP).

k. Provide new directories for existing panels modified by this project as indicated.

l.Type directories and mount in holder behind transparent protective covering.

m. Panelboards: listed and labeled for their intended use.

n. Panelboard nameplates: provided in accordance with paragraph FIELD FABRICATED NAMEPLATES.

2.11.1 Circuit Breakers

UL 489, thermal magnetic-type solid state-type having a minimum

short-circuit current rating equal to the short-circuit current rating of the panelboard in which the circuit breaker will be mounted. Breaker terminals: UL listed as suitable for type of conductor provided. Where indicated on the drawings, provide circuit breakers with shunt trip devices. Series rated circuit breakers and plug-in circuit breakers are unacceptable.

2.11.1.1 Multipole Breakers

Provide common trip-type with single operating handle. Design breaker such that overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phases A, B, and C, respectively.

2.11.1.2 Circuit Breaker With Ground-Fault Circuit Interrupter

UL 943 and NFPA 70. Provide with auto-monitoring (self-test) and lockout features, "push-to-test" button, visible indication of tripped condition, and ability to detect and trip when current imbalance is 6 milliamperes or higher per requirements of UL 943 for Class A ground-fault circuit interrupter devices.

2.12 MOTOR SHORT-CIRCUIT PROTECTOR (MSCP)

Motor short-circuit protectors, also called motor circuit protectors (MCPs): UL 508 and UL 489, and provided as shown. Provide MSCPs that consist of an adjustable instantaneous trip circuit breaker used only in conjunction with a combination motor controller which provides coordinated motor branch-circuit overload and short-circuit protection. Rate MSCPs in accordance with the requirements of NFPA 70.

2.13 MOTORS

Provide motors in accordance with the following:

a. Hermetic-type sealed motor compressors: Also comply with UL 984.

b. Provide the size in terms of HP, or kVA, or full-load current, or a combination of these characteristics, and other characteristics, of each motor as indicated or specified.

c. Determine specific motor characteristics to ensure provision of correctly sized starters and overload heaters.

d. Rate motors for operation on 208-volt, 3-phase circuits with a terminal voltage rating of 200 volts.

e. Use motors designed to operate at full capacity with voltage variation of plus or minus 10 percent of motor voltage rating.

f. Unless otherwise indicated, use continuous duty type motors if rated 1 HP and above.

g. Where fuse protection is specifically recommended by the equipment manufacturer, provide fused switches in lieu of non-fused switches indicated.

h. Use Inverter-Ratedmotors designed to operate with adjustable speed drive (ASD).

2.13.1 High Efficiency Single-Phase Motors

Single-phase fractional-horsepower alternating-current motors: high efficiency types are not acceptable. In exception, for special purpose motors and motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.13.2 Premium Efficiency Polyphase and Single-Phase Motors

Select polyphase and continuous-duty single phase motors based on high efficiency characteristics relative to typical characteristics and applications as listed in NEMA MG 10 and NEMA MG 11. In addition, continuous rated, polyphase squirrel-cage medium induction motors must meet the requirements for premium efficiency electric motors in accordance with NEMA MG 1, including the NEMA full load efficiency ratings. In exception, for motor-driven equipment with a minimum seasonal or overall efficiency rating, such as a SEER rating, provide equipment with motor to meet the overall system rating indicated.

2.13.3 Motor Sizes

Provide size for duty to be performed, not exceeding the full-load nameplate current rating when driven equipment is operated at specified capacity under most severe conditions likely to be encountered. When motor size provided differs from size indicated or specified, make adjustments to wiring, disconnect devices, and branch circuit protection to accommodate equipment actually provided. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage. Provide protection for motors from immediate restart by a time adjustable restart relay.

2.13.4 Wiring and Conduit

Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide power wiring and conduit for field-installed equipment using adjustable speed drive (ASD) manufacturer required wiring type and length, and motor control equipment forming part of motor control centers or switchgear assemblies, the conduit and wiring connecting such centers, assemblies, or other power sources to equipment as specified herein. Power wiring and conduit: conform to the requirements specified herein. Control wiring: provided under, and conform to, the requirements of the section specifying the associated equipment.

2.14 MOTOR CONTROLLERS

Provide motor controllers in accordance with the following:

a. UL 508, NEMA ICS 1, and NEMA ICS 2.

b. Provide controllers with thermal overload protection in each phase, and one spare normally open auxiliary contact, and one spare normally closed auxiliary contact.

c. Provide controllers for motors rated 1-hp and above with electronic phase-voltage monitors designed to protect motors from phase-loss, undervoltage, and overvoltage.

d. Provide protection for motors from immediate restart by a time adjustable restart relay.

e. When used with pressure, float, or similar automatic-type or maintained-contact switch, provide a hand/off/automatic selector switch with the controller.

f. Connections to selector switch: wired such that only normal automatic regulatory control devices are bypassed when switch is in "hand" position.

g. Safety control devices, such as low and high pressure cutouts, high temperature cutouts, and motor overload protective devices: connected in motor control circuit in "hand" and "automatic" positions.

h. Control circuit connections to hand/off/automatic selector switch or to more than one automatic regulatory control device: made in accordance with indicated or manufacturer's approved wiring diagram.

i. Provide selector switch with the means for locking in any position.

j. Provide a disconnecting means, capable of being locked in the open position, for the motor that is located in sight from the motor location and the driven machinery location. As an alternative, provide a motor controller disconnect, capable of being locked in the open position, to serve as the disconnecting means for the motor if it is in sight from the motor location and the driven machinery location.

k. Overload protective devices: provide adequate protection to motor windings; be thermal inverse-time-limit type; and include manual reset-type pushbutton on outside of motor controller case.

l. Cover of combination motor controller and manual switch or circuit breaker: interlocked with operating handle of switch or circuit breaker so that cover cannot be opened unless handle of switch or circuit breaker is in "off" position.

m. Provide controllers in hazardous locations with classifications as indicated.

2.14.1 Control Wiring

Provide control wiring in accordance with the following:

a. All control wire: stranded tinned copper switchboard wire with 600-volt flame-retardant insulation Type SIS meeting UL 44, or Type MTW meeting UL 1063, and passing the VW-1 flame tests included in those standards.

b. Hinge wire: Class K stranding.

c. Current transformer secondary leads: not smaller than No. 10 AWG.

d. Control wire minimum size: No. 14 AWG.

e. Power wiring for 480-volt circuits and below: the same type as control wiring with No. 12 AWG minimum size.

f. Provide wiring and terminal arrangement on the terminal blocks to permit the individual conductors of each external cable to be terminated on adjacent terminal points.

2.14.2 Control Circuit Terminal Blocks

Provide control circuit terminal blocks in accordance with the following:

a. NEMA ICS 4.

b. Control circuit terminal blocks for control wiring: molded or fabricated type with barriers, rated not less than 600 volts.

c. Provide terminals with removable binding, fillister or washer head screw type, or of the stud type with contact and locking nuts.

d. Terminals: not less than No. 10 in size with sufficient length and space for connecting at least two indented terminals for 10 AWG conductors to each terminal.

e. Terminal arrangement: subject to the approval of the Contracting Officer with not less than four spare terminals or 10 percent, whichever is greater, provided on each block or group of blocks.

f. Modular, pull apart, terminal blocks are acceptable provided they are of the channel or rail-mounted type.

g. Submit data showing that any proposed alternate will accommodate the specified number of wires, are of adequate current-carrying capacity, and are constructed to assure positive contact between current-carrying parts.

2.14.2.1 Types of Terminal Blocks

a. Short-Circuiting Type: Short-circuiting type terminal blocks: furnished for all current transformer secondary leads with provision for shorting together all leads from each current transformer without first opening any circuit. Terminal blocks: comply with the requirements of paragraph CONTROL CIRCUIT TERMINAL BLOCKS above.

b. Load Type: Load terminal blocks rated not less than 600 volts and of adequate capacity: provided for the conductors for NEMA Size 3 and smaller motor controllers and for other power circuits, except those for feeder tap units. Provide terminals of either the stud type with contact nuts and locking nuts or of the removable screw type, having length and space for at least two indented terminals of the size required on the conductors to be terminated. For conductors rated more than 50 amperes, provide screws with hexagonal heads. Conducting parts between connected terminals must have adequate contact surface and cross-section to operate without overheating. Provide each connected terminal with the circuit designation or wire number placed on or near the terminal in permanent contrasting color.

2.14.3 Control Circuits

Control circuits: maximum voltage of 120 volts derived from control transformer in same enclosure. Transformers: conform to UL 506, as applicable. Transformers, other than transformers in bridge circuits: provide primaries wound for voltage available and secondaries wound for correct control circuit voltage. Size transformers so that 80 percent of rated capacity equals connected load. Provide disconnect switch on primary side.. Provide one fused secondary lead with the other lead grounded.

Control circuits: maximum voltage of 120 volts derived from a separate control source. Provide terminals and terminal boards. Provide separate control disconnect switch within controller. Provide one fused secondary lead with the other lead grounded.

2.14.4 Enclosures for Motor Controllers

NEMA ICS 6.

2.14.5 Multiple-Speed Motor Controllers and Reversible Motor Controllers

Across-the-line-type, electrically and mechanically interlocked. Multiple-speed controllers: include compelling relays and multiple-button, station-type with pilot lights for each speed.

2.14.6 Pushbutton Stations

Provide with "start/stop" momentary contacts having one normally open and one normally closed set of contacts, and red lights to indicate when motor is running. Stations: heavy duty, oil-tight design.

2.14.7 Pilot and Indicating Lights

Provide LED cluster lamps.Provide transformer, resistor, or diode type.

2.14.8 Reduced-Voltage Controllers

Provide for polyphase motors 1/4 horsepower and larger. Reduced-voltage starters: single-step, closed transition autotransformer, reactor, primary resistor-type, solid state-type, or as indicated, with an adjustable time interval between application of reduced and full voltages to motors. Wye-delta reduced voltage starter or part winding increment starter having adjustable time delay between application of voltage to first and second winding of motor may be used in lieu of the reduced-voltage starters for starting of.

2.15 MANUAL MOTOR STARTERS (MOTOR RATED SWITCHES)

SingleDoubleThree pole designed for surface mounting with overload protection and pilot lights.

2.15.1 Pilot Lights

Provide yoke-mounted, seven element LED cluster light module. Color: in accordance with NEMA ICS 2.Provide yoke-mounted, candelabra-base sockets rated 125 volts and fitted with glass or plastic jewels. Provide clear, 6 watt lamp in each pilot switch. Jewels for use with switches controlling motors: green; jewels for other purposes: amber.

2.16 LOCKOUT REQUIREMENTS

Provide circuit breakers, disconnecting means, and other devices that are electrical energy-isolating capable of being locked out for machines and other equipment to prevent unexpected startup or release of stored energy in accordance with 29 CFR 1910.147, NFPA 70E and 29 CFR 1910.303. Comply with requirements of Division 23, "Mechanical" for mechanical isolation of machines and other equipment.

2.17 GROUNDING AND BONDING EQUIPMENT

2.17.1 Ground Rods

UL 467. Ground rods: cone pointed copper-clad steel, with minimum diameter of 3/4 inch and minimum length 10 feet. Sectional type rods may be used for rods 20 feet or longer.

2.18 MANUFACTURER'S NAMEPLATE

Provide on each item of equipment 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.

2.19 FIELD FABRICATED NAMEPLATES

Provide field fabricated nameplates in accordance with the following:

a. ASTM D709.

b. Provide laminated plastic nameplates for each equipment enclosure, relay, switch, and device; as specified or as indicated on the drawings.

c. Each nameplate inscription: identify the function and, when applicable, the position.

d. Nameplates: melamine plastic, 0.125 inch thick, white with black center core.

e. Provide red laminated plastic label with white center core where indicated.

f. Surface: matte finish. Corners: square. Accurately align lettering and engrave into the core.

g. Minimum size of nameplates: one by 2.5 inches.

h. Lettering size and style: a minimum of 0.25 inch high normal block style.

2.20 WARNING SIGNS

Provide warning signs for flash protection in accordance with NFPA 70E and NEMA Z535.4 for switchboards, panelboards, industrial control panels, and motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized. Provide field installed signs to warn qualified persons of

potential electric arc flash hazards when warning signs are not provided by the manufacturer. Provide marking that is clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

2.21 FIRESTOPPING MATERIALS

Provide firestopping around electrical penetrations in accordance with Section 07 84 00 FIRESTOPPING.

2.22 WIREWAYS

UL 870. Material: steel epoxy painted 16 gauge for heights and depths up to 6 by 6 inches, and 14 gauge for heights and depths up to 12 by 12 inches. Provide in length required for the application with screw- cover NEMA 1 3R enclosure per NEMA ICS 6.

2.23 FACTORY APPLIED FINISH

Provide factory-applied finish on electrical equipment in accordance with the following:

a. NEMA 250 corrosion-resistance test and the additional requirements as specified herein.

b. Interior and exterior steel surfaces of equipment enclosures: thoroughly cleaned followed by a rust-inhibitive phosphatizing or equivalent treatment prior to painting.

c. Exterior surfaces: free from holes, seams, dents, weld marks, loose scale or other imperfections.

d. Interior surfaces: receive not less than one coat of corrosion-resisting paint in accordance with the manufacturer's standard practice.

e. Exterior surfaces: primed, filled where necessary, and given not less than two coats baked enamel with semigloss finish.

f. Equipment located indoors: ANSI Light Gray,and equipment located outdoors: ANSI Dark Gray.

g. Provide manufacturer's coatings for touch-up work and as specified in paragraph FIELD APPLIED PAINTING.

2.24 SOURCE QUALITY CONTROL

PART 3 EXECUTION

3.1 INSTALLATION

Electrical installations, including weatherproof and hazardous locations and ducts, plenums and other air-handling spaces: conform to requirements of NFPA 70 and IEEE C2 and to requirements specified herein.

3.1.1 Wiring Methods

Provide insulated conductors installed in rigid steel conduit, IMC, rigid nonmetallic conduit, or EMT, except where specifically indicated or

specified otherwise or required by NFPA 70 to be installed otherwise. Grounding conductor: separate from electrical system neutral conductor. Provide insulated green equipment grounding conductor for circuit(s) installed in conduit and raceways. Shared neutral, or multi-wire branch circuits, are not permitted with arc-fault circuit interrupters. Minimum conduit size: 1/2 inch in diameter for low voltage lighting and power circuits. Vertical distribution in multiple story buildings: made with metal conduit in fire-rated shafts, with metal conduit extending through shafts for minimum distance of 6 inches. Firestop conduit which penetrates fire-rated walls, fire-rated partitions, or fire-rated floors in accordance with Section 07 84 00 FIRESTOPPING.

3.1.1.1 Pull Wire

Install pull wires in empty conduits. Pull wire: plastic having minimum 200-pound force tensile strength. Leave minimum 36 inches of slack at each end of pull wire.

3.1.1.2 Metal-Clad Cable

Install in accordance with NFPA 70, Type MC cable.

3.1.1.3 Armored Cable

Install in accordance with NFPA 70, Type AC cable.

3.1.2 Conduit Installation

Unless indicated otherwise, conceal conduit under floor slabs and within finished walls, ceilings, and floors. Keep conduit minimum 6 inches away from parallel runs of flues and steam or hot water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project.Run conduitsin crawl space as if exposed.

3.1.2.1 Restrictions Applicable to Aluminum Conduit

a. Do not install underground or encase in concrete or masonry.

b. Do not use brass or bronze fittings.

c. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.2.2 Restrictions Applicable to EMT

a. Do not install underground.

b. Do not encase in concrete, mortar, grout, or other cementitious materials.

c. Do not use in areas subject to physical damage including but not limited to equipment rooms where moving or replacing equipment could physically damage the EMT.

d. Do not use in hazardous areas.

e. Do not use outdoors.

f. Do not use in fire pump rooms.

g. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.2.3 Restrictions Applicable to Nonmetallic Conduit

a. PVC Schedule 40.

(1) Do not use where subject to physical damage, including but not limited to, mechanical equipment rooms, electrical equipment rooms, fire pump rooms, and where restrictions are applying to both PVC Schedule 40 and PVC Schedule 80.

(2) Do not use above grade, except where allowed in this section for rising through floor slab or indicated otherwise.

b. PVC Schedule 40 and Schedule 80.

(1) Do not use where subject to physical damage, including but not limited to, hospitals, power plant, missile magazines, and other such areas.

(2) Do not use in hazardous (classified) areas.

(3) Do not use in penetrating fire-rated walls or partitions, or fire-rated floors.

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3.1.2.4 Restrictions Applicable to Flexible Conduit

Use only as specified in paragraph FLEXIBLE CONNECTIONS. Do not use when the enclosed conductors must be shielded from the effects of High-altitude Electromagnetic Pulse (HEMP).

3.1.2.5 Underground Conduit

Plastic-coated rigid steel; plastic-coated steel IMC; PVC, Type EPC-40; or fiberglass. Convert nonmetallic conduit, other than PVC Schedule 40 or 80, to plastic-coated rigid, or IMC, steel conduit before rising through floor slab. Plastic coating: extend minimum 6 inches above floor.

3.1.2.6 Conduit Installed Under Floor Slabs

Conduit run under floor slab: located a minimum of 12 inches below the vapor barrier. Seal around conduits at penetrations thru vapor barrier. Use NECA NEIS 1 Table 2a (Minimum Raceway Spacing) to determine under floor slab conduit spacing unless greater spacing is required elsewhere in this section.

3.1.2.7 Conduit Through Floor Slabs

Where conduits rise through floor slabs, do not allow curved portion of bends to be visible above finished slab. Where conduit rises through slab-on grade, seal all electrical penetrations to address radon mitigation and prevent infiltration of air, insects, and vermin.

3.1.2.8 Stub-Ups

Provide conduits stubbed up through concrete floor for connection to

free-standing equipment with adjustable top or coupling threaded inside for plugs, set flush with finished floor. Extend conductors to equipment in rigid steel conduit, except that flexible metal conduit may be used 6 inches above floor. Where no equipment connections are made, install screwdriver-operated threaded flush plugs in conduit end.

3.1.2.9 Conduit Support

Support conduit by pipe straps, wall brackets, threaded rod conduit hangers, or ceiling trapeze. Plastic cable ties are not acceptable. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; and by machine screws, welded threaded studs, or spring-tension clamps on steel work. Threaded C-clamps may be used on rigid steel conduit only. Do not weld conduits or pipe straps to steel structures. Do not exceed one-fourth proof test load for load applied to fasteners. Provide vibration resistant and shock-resistant fasteners attached to concrete ceiling. Do not cut main reinforcing bars for any holes cut to depth of more than 1 1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete joints. Fill unused holes. In partitions of light steel construction, use sheet metal screws. In suspended-ceiling construction, run conduit above ceiling. Do not support conduit by ceiling support system. Conduit and box systems: supported independently of both (a) tie wires supporting ceiling grid system, and (b) ceiling grid system into which ceiling panels are placed. Do not share supporting means between electrical raceways and mechanical piping or ducts. Coordinate installation with above-ceiling mechanical systems to assure maximum accessibility to all systems. Spring-steel fasteners may be used for lighting branch circuit conduit supports in suspended ceilings in dry locations. Where conduit crosses building expansion joints, provide suitable watertight expansion fitting that maintains conduit electrical continuity by bonding jumpers or other means. For conduits greater than 2 1/2 inches inside diameter, provide supports to resist forces of 0.5 times the equipment weight in any direction and 1.5 times the equipment weight in the downward direction.

3.1.2.10 Directional Changes in Conduit Runs

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt, or trash from lodging in conduits, boxes, fittings, and equipment during construction. Free clogged conduits of obstructions.

3.1.2.11 Locknuts and Bushings

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by NFPA 70, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least minimum single locknut and bushing. Provide locknuts with sharp edges for digging into wall of metal enclosures. Install bushings on ends of conduits, and provide insulating type where required by NFPA 70.

3.1.2.12 Flexible Connections

Provide flexible steel conduit between 3 and 6 feet in length for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Install flexible conduit

to allow 20 percent slack. Minimum flexible steel conduit size: 1/2 inch diameter. Provide liquid tight flexible conduit in wet and damp locations for equipment subject to vibration, noise transmission, movement or motors. Provide separate ground conductor across flexible connections. Plastic cable ties are not acceptable as a support method.

3.1.3 Boxes, Outlets, and Supports

Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways: cast-metal, hub-type when located in wet locations, when surface mounted on outside of exterior surfaces, when surface mounted on interior walls exposed up to 7 feet above floors and walkways, or when installed in hazardous areas and when specifically indicated. Boxes in other locations: sheet steel, except that aluminum boxes may be used with aluminum conduit, and nonmetallic boxes may be used with nonmetallic conduit system. Provide each box with volume required by NFPA 70 for number of conductors enclosed in box. Boxes for mounting lighting fixtures: minimum 4 inches square, or octagonal, except that smaller boxes may be installed as required by fixture configurations, as approved. Boxes for use in masonry-block or tile walls: square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers. Provide gaskets for cast-metal boxes installed in wet locations and boxes installed flush with outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by fixture terminal operating temperature; provide readily removable fixtures for access to boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of ceiling supports. Fasten boxes and supports with wood screws on wood, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel. In open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from building structure or by bar hangers. Where bar hangers are used, attach bar to raceways on opposite sides of box, and support raceway with approved-type fastener maximum 24 inches from box. When penetrating reinforced concrete members, avoid cutting reinforcing steel.

3.1.3.1 Boxes

Boxes for use with raceway systems: minimum 1 1/2 inches deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting fixture outlets: minimum 4 inches square, except that 4 by 2 inch boxes may be used where only one raceway enters outlet.

3.1.3.2 Pull Boxes

Construct of at least minimum size required by NFPA 7 of code-gauge aluminum or galvanized sheet steel,and compatible with nonmetallic raceway systems, except where cast-metal boxes are required in locations specified herein. Provide boxes with screw-fastened covers. Where several feeders pass through common pull box, tag feeders to indicate clearly electrical characteristics, circuit number, and panel designation.

3.1.4 Mounting Heights

Mount panelboards, enclosed circuit breakers, motor controller and disconnecting switches so height of center of grip of the operating handle

of the switch or circuit breaker at its highest position is maximum 79 inches above floor or working platform or as allowed in Section 404.8 per NFPA 70. Mount lighting switches 48 inches above finished floor. Mount receptacles and telecommunications outlets 18 inches above finished floor, unless otherwise indicated. Mount other devices as indicated.

3.1.5 Conductor Identification

Provide conductor identification within each enclosure where tap, splice, or termination is made. For conductors No. 6 AWG and smaller diameter, provide color coding by factory-applied, color-impregnated insulation. For conductors No. 4 AWG and larger diameter, provide color coding by plastic-coated, self-sticking markers; colored nylon cable ties and plates; or heat shrink-type sleeves. Identify control circuit terminations in accordance with manufacturer's recommendations. Provide telecommunications system conductor identification as specified in Section 27 10 00 BUILDING TELECOMMUNICATIONS CABLING SYSTEMS.

3.1.5.1 Marking Strips

Provide marking strips for identification of power distribution, control, data, and communications cables in accordance with the following:

a. Provide white or other light-colored plastic marking strips, fastened by screws to each terminal block, for wire designations.

b. Use permanent ink for the wire numbers

c. Provide reversible marking strips to permit marking both sides, or provide two marking strips with each block.

d. Size marking strips to accommodate the two sets of wire numbers.

e. Assign a device designation in accordance with NEMA ICS 1 to each device to which a connection is made. Mark each device terminal to which a connection is made with a distinct terminal marking corresponding to the wire designation used on the Contractor's schematic and connection diagrams.

f. The wire (terminal point) designations used on the Contractor's wiring diagrams and printed on terminal block marking strips may be according to the Contractor's standard practice; however, provide additional wire and cable designations for identification of remote (external) circuits for the Government's wire designations.

g. Prints of the marking strips drawings submitted for approval will be so marked and returned to the Contractor for addition of the designations to the terminal strips and tracings, along with any rearrangement of points required.

3.1.6 Splices

Make splices in accessible locations. Make splices in conductors No. 10 AWG and smaller diameter with insulated, pressure-type connector. Make splices in conductors No. 8 AWG and larger diameter with solderless connector, and cover with insulation material equivalent to conductor insulation.

3.1.7 Covers and Device Plates

Install with edges in continuous contact with finished wall surfaces without use of mats or similar devices. Plaster fillings are not permitted. Install plates with alignment tolerance of 1/16 inch. Use of sectional-type device plates are not permitted. Provide gasket for plates installed in wet locations.

3.1.8 Electrical Penetrations

Seal openings around electrical penetrations through fire resistance-rated walls, partitions, floors, or ceilings in accordance with Section 07 84 00 FIRESTOPPING.

3.1.9 Grounding and Bonding

Provide in accordance with NFPA 70 and NFPA 780. Ground exposed, non-current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductor in metallic and nonmetallic raceways, telecommunications system grounds, and neutral conductor of wiring systems. Interconnect all grounding media in or on the structure to provide a common ground potential. This includes lightning protection, electrical service, telecommunications system grounds, as well as underground metallic piping systems. Make interconnection to the gas line on the customer's side of the meter. Use main size lightning conductors for interconnecting these grounding systems to the lightning protection system. In addition to the requirements specified herein, provide telecommunications grounding in accordance with TIA-607. Where ground fault protection is employed, ensure that connection of ground and neutral does not interfere with correct operation of fault protection.

3.1.9.1 Ground Rods

Provide ground rods and measure the resistance to ground using the fall-of-potential method described in IEEE 81. Do not exceed 25 ohms under normally dry conditions for the maximum resistance of a driven ground. If this resistance cannot be obtained with a single rod, additional rods, spaced on center. Spacing for additional rods must be a minimum of 10 feet. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, notify the Contracting Officer who will decide on the number of ground rods to add.

3.1.9.2 Grounding Connections

Make grounding connections which are buried or otherwise normally inaccessible, excepting specifically those connections for which access for periodic testing is required, by exothermic weld or high compression connector.

a. Make exothermic welds strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces indicating improper cleaning are not acceptable. Mechanical connectors are not required at exothermic welds.

b. Make high compression connections using a hydraulic or electric compression tool to provide the correct circumferential pressure. Provide tools and dies as recommended by the manufacturer. Use an embossing die code or other standard method to provide visible

indication that a connector has been adequately compressed on the ground wire.

3.1.9.3 Ground Bus

Provide a copper ground bus in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of electrical equipment: effectively grounded by bonding to the ground bus. Bond the ground bus to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 4 inches above the floor. Make connections and splices of the brazed, welded, bolted, or pressure-connector type, except use pressure connectors or bolted connections for connections to removable equipment.

3.1.9.4 Resistance

Maximum resistance-to-ground of grounding system: do not exceed 5 ohms under dry conditions. Where resistance obtained exceeds 5 ohms, contact Contracting Officer for further instructions.

3.1.10 Equipment Connections

Provide power wiring for the connection of motors and control equipment under this section of the specification. Except as otherwise specifically noted or specified, automatic control wiring, control devices, and protective devices within the control circuitry are not included in this section of the specifications and are provided under the section specifying the associated equipment.

3.1.11 Government-Furnished Equipment

Contractormake connections to Government-furnished equipment to make equipment operate as intended, including providing miscellaneous items such as plugs, receptacles, wire, cable, conduit, flexible conduit, and outlet boxes or fittings.

3.1.12 Repair of Existing Work

Perform repair of existing work, demolition, and modification of existing electrical distribution systems as follows:

3.1.12.1 Workmanship

Lay out work in advance. Exercise care where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces is necessary for proper installation, support, or anchorage of conduit, raceways, or other electrical work. Repair damage to buildings, piping, and equipment using skilled craftsmen of trades involved.

3.1.12.2 Existing Concealed Wiring to be Removed

Disconnect existing concealed wiring to be removed from its source. Remove conductors; cut conduit flush with floor, underside of floor, and through walls; and seal openings.

3.1.12.3 Removal of Existing Electrical Distribution System3.1.12.4 Continuation of Service

Maintain continuity of existing circuits of equipment to remain. Maintain

existing circuits of equipment energized. Restore circuits wiring and power which are to remain but were disturbed during demolition back to original condition.

3.2 FIELD FABRICATED NAMEPLATE MOUNTING

Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

3.3 WARNING SIGN MOUNTING

Provide the number of signs required to be readable from each accessible side. Space the signs in accordance with NFPA 70E.

3.4 FIELD APPLIED PAINTING

Paint electrical equipment as required to match finish of adjacent surfaces or to meet the indicated or specified safety criteria. Where field painting of enclosures for panelboards, load centers or the like is specified to match adjacent surfaces, to correct damage to the manufacturer's factory applied coatings, or to meet the indicated or specified safety criteria, provide manufacturer's recommended coatings and apply in accordance to manufacturer's instructions.

3.5 FIELD QUALITY CONTROL

Furnish test equipment and personnel and submit written copies of test results. Give Contracting Officer 5 working days notice prior toeach tests. Where applicable, test electrical equipment in accordance with NETA ATS.

3.5.1 Devices Subject to Manual Operation

Operate each device subject to manual operation at least five times, demonstrating satisfactory operation each time.

3.5.2 600-Volt Wiring Test

Test wiring rated 600 volt and less to verify that no short circuits or accidental grounds exist. Perform insulation resistance tests on wiring No. 6 AWG and larger diameter using instrument which applies voltage of 1,000 volts DC for 600 volt rated wiring and 500 volts DC for 300 volt rated wiring per NETA ATS to provide direct reading of resistance. All existing wiring to be reused must also be tested.

3.5.3 Ground-Fault Receptacle Test

Test ground-fault receptacles with a "load" (such as a plug in light) to verify that the "line" and "load" leads are not reversed. Press the TEST button and then the RESET button to verify by LED status that the device is a self-test model as specified in UL 943.

3.5.4 Phase Rotation Test

Perform phase rotation test to ensure proper rotation of service power prior to operation of new or reinstalled equipment using a phase rotation meter. Follow the meter manual directions performing the test.

-- End of Section --

SECTION 26 29 23

ADJUSTABLE SPEED DRIVE (ASD) SYSTEMS UNDER 600 VOLTS
02/20, CHG 1: 05/21

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.

EUROPEAN COMMITTEE FOR STANDARDIZATION (CEN/CENELEC)

EN 61800-3	(2017) Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 519	(2014) 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

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC)

IEC 61000-3-12	(2012) Electromagnetic Compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and </=75 A per phase

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2020) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(2000; R 2015) Standard for Industrial Control and Systems: General Requirements
NEMA ICS 3.1	(2019) Guide for the Application, Handling, Storage, Installation and Maintenance of Medium-Voltage AC Contactors, Controllers and Control Centers
NEMA ICS 6	(1993; R 2016) Industrial Control and Systems: Enclosures
NEMA ICS 7	(2020) Adjustable-Speed Drives

NEMA ICS 7.2	(2015) Application Guide for AC Adjustable Speed Drive Systems
NEMA MG 1	(2018) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2020; ERTA 20-1 2020; ERTA 20-2 2020; TIA 20-1; TIA 20-2; TIA 20-3; TIA 20-4) National Electrical Code

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

47 CFR 15	Radio Frequency Devices

UNDERWRITERS LABORATORIES (UL)

UL 489	(2016; Rev 2019) UL Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
UL 61800-5-1	(2016) Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements - Electrical, Thermal and Energy

1.2 RELATED REQUIREMENTS

Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM applies to this section with additions and modifications specified herein.

1.3 SYSTEM DESCRIPTION

1.3.1 Performance Requirements

1.3.1.1 Electromagnetic Interference Suppression

Computing devices, as defined by 47 CFR 15 and EN 61800-3 rules and regulations, must be certified to comply with the requirements for class A computing devices and labeled.

1.3.1.2 Electromechanical and Electrical Components

Ensure electrical and electromechanical components of the Adjustable Speed Drive (ASD) do 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, IEC 61000-3-12 Control panel must have surge protection, included within the panel to protect the unit from damaging transient voltage surges. Surge protective device must be mounted near the incoming power source and properly wired to all three phases and ground. Fuses must not be used for surge protection.

1.3.2.2 Sensor and Control Wiring Surge Protection

I/O functions as specified must be protected against surges induced on control and sensor wiring installed outdoors and as shown. Test the inputs and outputs 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" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Schematic Diagrams; G

Interconnecting Diagrams; G

Installation Drawings; G

As-Built Drawings; G

SD-03 Product Data

Adjustable Speed Drives; G

Wires and Cables

Equipment Schedule

SD-06 Test Reports

ASD Test

Performance Verification Tests

Endurance Test

SD-07 Certificates

Testing Agency's Field Supervisor NETA Certificate; G

SD-08 Manufacturer's Instructions

Installation instructions

SD-09 Manufacturer's Field Reports

ASD Test Plan; G

Standard Products

SD-10 Operation and Maintenance Data

Adjustable Speed Drives, Data Package 4

1.5 QUALITY ASSURANCE

1.5.1 Schematic Diagrams

Submit diagrams showing 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 ASD's and motors indicated. Indicate ventilation requirements, adequate clearances, and cable routes. Submit drawings for government approval prior to equipment construction or integration. Immediately record modifications to original drawings made during installation for inclusion into the as-built drawings.

1.5.4 Equipment Schedule

Provide schedule of equipment supplied. Schedule must provide a cross reference between manufacturer data and identifiers indicated in shop drawings. Schedule must include the total quantity of each item of equipment supplied and data indicating compatibility with motors being driven. For complete assemblies, such as ASD'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 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 and:

a. Have been in satisfactory commercial or industrial use for 2 years prior to bid opening including applications of equipment and materials under similar circumstances and of similar size.

b. Have been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period.

c. Where two or more items of the same class of equipment are required, provide products of a single manufacturer; however, the component parts of the item need not be the products of the same manufacturer unless stated in this section.

1.6 DELIVERY AND STORAGE

Store delivered equipment to protect from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.7 WARRANTY

The complete system must be warranted by the manufacturer for a period of one year. Repair or replace any component failing to perform its function as specified and documented at no additional cost to the Government. Items repaired or replaced must be warranted for an additional period of at least one year from the date that it becomes functional again, as specified in FAR 52.246-21 Warranty of Construction.

1.8 MAINTENANCE

1.8.1 Spare Parts

Manufacturers provide spare parts in accordance with recommended spare parts list.

Provide one spare ASD of each model provided for HVAC equipment, fully programmed and ready for back-up operation when connected.

1.8.2 Operation and Maintenance Data

Provide in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA. Provide service and maintenance information including preventive maintenance, assembly, and disassembly procedures. Include electrical drawings from electrical general sections. Provide 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.

1.8.3 Maintenance Support

During the warranty period, provide on-site, on-call maintenance services by drive manufacturer's personnel on the following basis: The service must be on a per-call basis with 36 hour response. Contractor is responsible for the maintenance of all hardware and software of the system during the warranty period. Various personnel of different expertise must be sent on-site depending on the nature of the maintenance service required. Costs must 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, must be borne by the Contractor.

1.8.4 Technical Support

Provide the ASDs with manufacturer's technical telephone support in English, readily available during normal working hours.

PART 2 PRODUCTS

2.1 ADJUSTABLE SPEED DRIVES (ASD)

Provide adjustable speed drive to control the speed of induction motor(s). The ASD must include the following minimum functions, features and ratings.

a. Input circuit breaker per UL 489 with a minimum of 10,000 amps symmetrical interrupting capacity and door interlocked external operator.

b. A converter stage per UL 61800-5-1 must change fixed voltage, fixed frequency, ac line power to a fixed dc voltage. The converter must utilize a full wave bridge design incorporating diode rectifiers. Silicon Controlled Rectifiers (SCR) are not acceptable. The converter must be insensitive to three phase rotation of the ac line and must not cause displacement power factor of less than .95 lagging under any speed and load condition.

c. An inverter stage must change fixed dc voltage to variable frequency, variable ac voltage for application to a standard NEMA MG 1 Part 30 motor designed for use with adjustable frequency power supplies. Switch the inverter to produce a sine coded pulse width modulated (PWM) output waveform.

d. The ASD shall be capable of supplying 110 percent of rated full load current for one minute at maximum ambient temperature.

e. The ASD must be designed to operate from a 208/120 volt, plus or minus 10 percent, three phase, 60 Hz supply, and control motors with a corresponding voltage rating.

f. Acceleration and deceleration time must be independently adjustable from one second to 60 seconds.

Required deceleration time may be achieved using not only dynamic braking resistor but with other methods described in NEMA ICS 7.2-2015 paragraph 5.2.5.

g. Adjustable full-time current limiting must limit the current to a preset value which must not exceed 110 percent of the controller rated current. The current limiting action must maintain the V/Hz ratio constant so that variable torque can be maintained. Short time starting override must allow starting current to reach 175 percent of controller rated current to maximum starting torque.

h. The controllers must 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 must be included such that a failure in the controller electronic circuitry must not cause frequency to exceed 110 percent of the maximum controller output frequency selected.

i. Minimum and maximum output frequency must 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 must not be less than 96 percent.

k. The controllers must be capable of being restarted into a motor coasting in the forward direction without tripping.

l. Protection of power semiconductor components must be accomplished without the use of fast acting semiconductor output fuses. Subjecting the controllers to any of the following conditions must 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

n. Include slip compensation circuit that will sense changing motor load conditions and adjust output frequency to provide speed regulation of NEMA MG 1 Part 30 designed for use with adjustable frequency power supplies motors to within plus or minus 0.5 percent of maximum speed without the necessity of a tachometer generator.

o. The ASD must 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 ASD must 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 ASD must include external fault reset capability. All the necessary logic to accept an external fault reset contact must be included.

q. Provide critical speed lockout circuitry to prevent operating at frequencies with critical harmonics that cause resonant vibrations. The ASD must have a minimum of three user selectable bandwidths.

r. Provide properly sized NEMA rated by-pass and isolation contactors to enable operation of motor in the event of ASD failure and for safety transfers motor between power converter output and bypass circuit using a field-selectable automatic and manual bypass mode. Install mechanical and electrical interlocks between the by-pass and isolation contactors. Provide a selector switch and transfer delay timer. Motor overload and short circuit protective features must remain in use during the bypass mode.

s. Each individual ASD must meet the following Total Harmonic Distortion (THD) requirements at the input terminals to the factory assembly of the ASD or at the load disconnecting means serving the ASD and filter assembly. These measurements should be taken with the drive set at 90 percent frequency (rpms) and the motor under a minimum of 50 percent demand.

(1) The Voltage THD should not exceed 2.0 percent THD.

(2) The Current THD should not exceed 15.0 percent THD.

(3) If the standard factory ASD does not meet or exceed these requirements the factory must install appropriate equipment (Harmonic Traps, Filters, different Drive technology, etc.) to mitigate the distortion to assure performance of the VFD is within the limits.

(4) These tests should be performed at the Manufacturers Laboratory facilities and submitted as part of the Product Data Submittals, in order to prevent the necessity of adding mitigation equipment in the field. If the requirements listed above are met, IEEE 519 will also be met.

2.1.1 ASD for HVAC Application

ASDs must have the following features:

a. A local operator control providing the following functions:

(1) Remote/Local operator selection with password access.

(2) Run/Stop and manual speed commands.

(3) All programming functions.

(4) Scrolling through all display functions.

b. A local operator control panel with the following data displayed:

(1) ASD status.

(2) Frequency.

(3) Motor RPM.

(4) Phase current.

(5) Scrolling through all display functions.

(6) Fault diagnostics in descriptive text.

(7) All programmed parameters.

c. Standard PI loop controller with input terminal for controlled variable and parameter settings.

d. User interface terminals for remote control of ASD speed, speed feedback, and an isolated form C SPDT relay, which energizes on a drive fault condition.

e. An isolated form C SPDT auxiliary relay which energizes on a run command.

f. An adjustable carrier frequency with 16 KHz minimum upper limit.

g. A built-in or external line reactor with 3 percent minimum impedance to protect the DC bus capacitors and rectifier section diodes, reduce power line transient voltage, line notching, DC bus over-voltage tripping and improve the inverter over-current and over-voltage conditions.

h. Historical logging information and displays:

(1) Real-time clock with current time and date.

(2) Running log of total power versus time.

(3) Total run time.

(4) Fault log, maintaining last four faults with time and data stamp for each.

i. The ASD must be capable of automatic control by a remote 4-20 mA signal, by BACnet network command, or manually by the ASD control panel.

j. ASDs must include the following operator programmable parameters:

(1) Upper and lower limit frequency.

(2) Acceleration and deceleration rate.

(3) Variable torque volts per Hertz curve.

(4) Starting voltage level.

(5) Starting frequency level.

(6) Display speed scaling.

(7) Enable/disable soft stall feature.

(8) Motor overload level.

(9) Motor stall level.

(10) Jump frequency and hysteresis band.

(11) PWM carrier frequency.

k. ASD must have the following protective features:

(1) An electronic adjustable inverse time current limit with consideration for additional heating of the motor at frequencies below 45Hz, for the protection of the motor.

(2) An electronic adjustable soft stall feature, allowing the ASD to lower the frequency to a point where the motor will not exceed the full-load amperage when an overload ASD will automatically return to the requested frequency when load conditions permit.

(3) A separate electronic stall at 110 percent ASD rated current, and a separate hardware trip at 190 percent current.

(4) The ability to shut down if inadvertently started into a rotating load without damaging the ASD or the motor.

(5) The ability to keep a log of a minimum of four previous fault conditions, indicating the fault type and time of occurrence in descriptive text.

(6) The ability to sustain 110 percent rated current for 60 seconds.

(7) The ability to shutdown safely or protect against and record the following fault conditions:

(a) Over current (and an indication if the over current was during acceleration, deceleration, or running).

(b) Over current internal to the drive.

(c) Motor overload at start-up.

(d) Over voltage from utility power.

(e) Motor running overload.

(f) Over voltage during deceleration.

(g) ASD over heat.

(h) Load and ground fault.

(h) Abnormal parameters or data in ASD EEPROM.

2.2 ENCLOSURES

Provide equipment enclosures conforming to NEMA 250, NEMA ICS 7, and NEMA ICS 6, with a heater if located outdoors. An HMCP device shall provide the disconnecting means. The operating handle shall protrude through the door, but the disconnect shall not be mounted on the door. The handle shall indicate ON, OFF, and tripped conditions. The handle shall have provisions to accommodate a minimum of three padlocks in the OFF position. Interlocks shall prevent unauthorized opening or closing of the ASD door with the disconnect handle in the ON position. The door handle interlock should have provisions to be defeated by qualified maintenance personnel.

2.3 WIRES AND CABLES

All wires and cables must conform to NEMA 250, NEMA ICS 7, NFPA 70.

2.4 NAMEPLATES

Nameplates external to NEMA enclosures must conform with the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide manufacturer's standard, permanent nameplates for internal areas of enclosures.

2.5 SOURCE QUALITY CONTROL

2.5.1 ASD Test Plan

To ensure quality, each ASD must be subject to a series of in-plant quality control inspections before approval for shipment from the manufacturer's facilities. Provide test plans.

2.5.2 ASD Test Report

To ensure quality, each ASD must be subject to a series of in-plant quality control inspections before approval for shipment from the manufacturer's facilities. Provide 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 must supervise the installation of all equipment, and wiring.

3.2 GROUNDING

Per NEMA ICS 7.2, ASD must be solidly grounded to the main distribution.

3.3 FIELD QUALITY CONTROL

Specified products must be tested as a system for conformance to specification requirements prior to scheduling the acceptance tests. Conduct performance verification tests in the presence of Government representative, observing and documenting complete compliance of the system to the specifications. Submit a signed copy of the test results, certifying proper system operation before scheduling tests.

3.3.1 ASD Test

A proposed test plan must be submitted to the contracting officer at least 28 calendar days prior to proposed testing for approval. The tests must 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. Inform the Government at least 14 working days prior to the dates of testing. Perform the ASD test with the assistance of a factory-authorized service representative engaging a qualified testing agency's field supervisor currently certified by NETA to supervise on-site testing.

3.3.2 Performance Verification Tests

"Performance Verification Test" plan must provide the step by step procedure required to establish formal verification of the performance of the ASD. Compliance with the specification requirements must 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. Inform the Government 14 calendar days prior to the date the test is to be conducted.

3.3.3 Endurance Test

Immediately upon completion of the performance verification test, the endurance test must commence. The system must 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. The contractor is not allowed in the building during the endurance test. The system must respond as designed.

3.4 DEMONSTRATION

3.4.1 Training

Coordinate training requirements with the Contracting Officer. Provide video tapes, if available, of all training provided to the Government for subsequent use in training new personnel. Provide 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.

3.4.1.1 Instructions to Government Personnel

Provide the services of competent instructors with minimum two-year field experience with the operation and maintenance of similar ASDs 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 must be thoroughly familiar with the subject matter they are to teach. The number of training days of instruction furnished must 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 must be turned over to the Government at the end of last training session.

3.4.1.2 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

3.4.1.3 Engineering/Maintenance Personnel Training

Accomplish the training program as specified. Training must be conducted on site at a location designated by the Government. Provide a one-day training session to train four engineering personnel in the functional operations of the system. This training must include:

a. System overview

b. General theory of operation

c. System operation

d. System configuration

e. Alarm formats

f. Failure recovery procedures

g. Troubleshooting and repair

h. Maintenance and calibration

i. System programming and configuration

-- End of Section --

SECTION 31 05 20

GEOSYNTHETIC DRAINAGE LAYER
08/08

PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

Measure the total surface area in square feet covered by geosynthetic drainage layer. Base final quantities on as-built conditions. Allowance will be made for geosynthetic drainage layer in anchor and/or drainage trenches but no allowance will be made for waste, overlap, or materials used for the convenience of the Contractor. Geosynthetic drainage layer accepted by the Contracting Officer will be paid for at the respective contract unit price in the bidding schedule.

1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D1505	(2018) Standard Test Method for Density of Plastics by the Density-Gradient Technique
ASTM D1603	(2014) Carbon Black Content in Olefin Plastics
ASTM D4218	(2015) Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
ASTM D4355/D4355M	(2014) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a Xenon-Arc Type Apparatus
ASTM D4491/D4491M	(2017) Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4533/D4533M	(2015) Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4632/D4632M	(2015a) Grab Breaking Load and Elongation of Geotextiles
ASTM D4716/D4716M	(2008; R 2013) Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head
ASTM D4751	(2016) Standard Test Method for Determining Apparent Opening Size of a Geotextile

ASTM D4833/D4833M	(2007; E 2013; R 2013) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D5035	(2011) Breaking Force and Elongation of Textile Fabrics (Strip Method)
ASTM D5199	(2012) Measuring Nominal Thickness of Geosynthetics
ASTM D5261	(2010; R 2018) Standard Test Method for Measuring Mass Per Unit Area of Geotextiles
ASTM D7005	(2003; R 2008) Standard Test Method for Determining the Bond Strength (Ply Adhesion) of Geocomposites

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Sampling and Testing

Penetrations

Geosynthetic Drainage Layer

1.4 DELIVERY, STORAGE, AND HANDLING

The QC inspector shall be present during delivery and unloading of the geosynthetic drainage layer. Ensure the drainage layer material has not been damaged during shipping, storage, or handling. Any drainage layer material found to be damaged shall be repaired or replaced. Accept delivery of material only after the required submittals have been approved. Each roll shall be labeled with the manufacturer's name, product identification, lot number, roll number, and roll dimensions. Rolls that have attached geotextiles shall be individually wrapped in plastic. Store the rolls in a level and dry area.

PART 2 PRODUCTS

2.1 GEOSYNTHETIC DRAINAGE LAYER

The polymer used to manufacture the geonet component of the geosynthetic drainage layer shall be polyethylene which is clean and free of any foreign contaminants. Submit manufacturer's quality control test results. Regrind material which consists of edge trimmings and other scraps may be used to manufacture the geonet; however, post-consumer recycled materials shall not be used. Conform the geosynthetic drainage layer to the property requirements listed in Table 1. Component criteria for the geonet alone and geotextile alone are also listed in Table 1. The geonet shall be covered on both sides with nonwoven geotextile. Create geocomposite by heat bonding geotextile to the geonet. The geotextile shall not be bonded to the drainage net within 6 inches of the edges of the rolls. Where applicable, Table 1 property values represent minimum

average roll values (MARV). The value for AOS represents the maximum average roll value (MaxARV).

TABLE 1 - GEOSYNTHETIC DRAINAGE LAYER PROPERTIES

PROPERTY	TEST METHOD	TEST VALUE	MINIMUM MQC TESTING FREQUENCY
GEONET COMPONENT			
Thickness, minimum avg, Note 1	ASTM D5199	200 mil	100,000 sq ft
Polymer Density, minimum avg	ASTM D1505	0.940 g/cc	100,000 sq ft
Carbon Black Content	ASTM D1603 ASTM D4218	1-3 percent	100,000 sq ft
Tensile Strength, minimum avg, Note 2	ASTM D5035	45 lbs/inch	100,000 sq ft
GEOTEXTILE COMPONENT			
Mass/Unit Area, MARV	ASTM D5261	6.0 oz/SY	100,000 sq ft
Grab Strength, MARV	ASTM D4632/D4632M	157 lbs	100,000 sq ft
Grab Elongation, MARV	ASTM D4632/D4632M	50 percent	100,000 sq ft
Tear Strength, MARV	ASTM D4533/D4533M	55 lbs	100,000 sq ft
Puncture Strength, MARV	ASTM D4833/D4833M	55 lbs	100,000 sq ft
Permittivity, MARV	ASTM D4491/D4491M	.2/sec	500,000 SF
AOS(O95), MaxARV	ASTM D4751	.25 mm	500,000 SF
UV Stability, percent retained (500 hours)	ASTM D4355/D4355M	50 percent	Note 3
GEOCOMPOSITE			
Transmissivity, min, including attached geotextiles, Note 4	ASTM D4716/D4716M	135 gal/min-foot	200,000 sq ft
Geonet/Geotextile Adhesion, minimum avg, Note 5	ASTM D7005	0.5 lbs/inch	100,000 sq ft
Note 1: The diameter of the presser foot shall be 2.22 inches and the pressure shall be 2.9 psi. For other thickness options, see manufacturer's literature.			
Note 2: This is the average peak value for five equally spaced machine direction tests across the roll width.			
Note 3: Manufacturer's historical data.			

TABLE 1 - GEOSYNTHETIC DRAINAGE LAYER PROPERTIES			
PROPERTY	TEST METHOD	TEST VALUE	MINIMUM MQC TESTING FREQUENCY
Note 4: Manufacturing quality control transmissivity tests shall be measured using a gradient of 0.1 under a normal pressure of 14.5 psi. Use a minimum seating period of 15 minutes. Perform the test between rigid end platens.			
Note 5: Average of five tests across the roll width. Discounting the outer 1 foot of each side of the roll, collect samples at the 10, 30, 50, 70, and 90 percent positions across the roll width. Test both sides for double sided geocomposites.			

2.2 SAMPLING AND TESTING

2.2.1 Manufacturing Quality Control Testing

Manufacturing quality control test methods and frequencies shall be in accordance with Table 1 unless otherwise approved. Submit manufacturer's quality control manual and construction quality control test results.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Surface Preparation

Prior to placement of the geosynthetic drainage layer, the subgrade shall be smooth and free of all materials which could damage the drainage layer.

3.1.2 Placement

The geosynthetic drainage layer shall not be damaged during placement. Unroll the drainage layer in the direction of maximum slope, keeping the net flat against the subgrade to minimize wrinkles and folds. The drainage layer shall not be dragged across textured geomembrane if a geotextile is attached to the surface facing the geomembrane. Place adequate ballast (e.g. sandbags) to prevent uplift by wind prior to covering.

3.1.3 Seams and Overlaps

3.1.3.1 Geonet Side Seams

Overlap geonet side seams a minimum of 4 inches. Side seam fastener spacing shall be a maximum of 5 feet. In anchor trenches, fastener spacing shall be a maximum of 1 foot.

3.1.3.2 Geonet End Seams

Overlap geonet end seams a minimum of 1 foot. End seam fastener spacing shall be a maximum of 1 foot. The overlaps shall be in the direction of flow.

3.1.3.3 Geonet Fasteners

Tie geonet rolls together with plastic fasteners. The fasteners shall be a contrasting color from the geonet and attached geotextiles. Metallic fasteners will not be allowed.

3.1.3.4 Geotextile Seams

The geotextile component of the geocomposite shall be overlapped in the direction of flow .

3.1.3.5 Geotextile Cap Strips

Place geotextile cap strips over any exposed edges of geocomposite. Cap strips shall be a minimum of 2 feet in width and shall be thermally bonded to the geotextile component of the geocomposite.

3.1.4 Stacked Geosynthetic Drainage Layers

When geosynthetic drainage layers are to be stacked, stagger roll ends and edges so that joints do not lie above one another.

3.1.5 Corners

In the corners of landfill liner side slopes, install an extra layer of drainage layer material from the top to the bottom of the slope.

3.1.6 Penetrations

Submit penetration details. Mechanically attach a geotextile apron to pipes and other appurtenances penetrating through the drainage layer so that soil is prevented from getting into the drainage layer. The apron of the attached geotextile shall extend out from the pipe or appurtenance a minimum of 2 feet.

3.2 REPAIRS

3.2.1 Geonet Damage

Make repairs by placing a patch of the geosynthetic drainage layer over the damaged area. Extend the patch a minimum of 2 feet beyond the edge of the damage. Use approved fasteners, spaced every 6 inches around the patch, to hold the patch in place. If more than 25 percent of the roll width is damaged, approval must be obtained to repair or replace the damaged roll.

3.2.2 Geotextile Damage

Repair damaged geotextile by placing a patch of geotextile over the damaged area with a minimum of 12 inches of overlap in all directions. The geotextile patch shall be thermally bonded in place.

3.3 PROTECTION AND BACKFILLING

Cover the geosynthetic drainage layer with the specified materials within 4 days of acceptance. Place cover soil from the bottom of the slope upward and shall not be dropped directly onto the drainage layer from a height greater than 3 feet. The cover soil shall be pushed out over the geosynthetic drainage layer in an upward tumbling motion so that wrinkles

in the drainage layer do not fold over. No equipment shall be operated on the top surface of the geosynthetic drainage layer without permission from the Contracting Officer. The initial loose soil lift thickness shall be 12 inches. Use equipment with ground pressures no greater than 7 psi to place the first lift of soil. A minimum of 18 inches of soil shall be maintained between construction equipment with a ground pressure greater than 7 psi and the drainage layer. Cover soil compaction and testing requirements are described in Section 31 23 00.00 20 EXCAVATION AND FILL.

-- End of Section --

SECTION 31 23 00.00 20

EXCAVATION AND FILL
02/11

PART 1 GENERAL

1.1 REFERENCES

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

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C600	(2017) Installation of Ductile-Iron Mains and Their Appurtenances

ASTM INTERNATIONAL (ASTM)

ASTM C136/C136M	(2014) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM D1140	(2017) Standard Test Methods for Determining the Amount of Material Finer than 75-µm (No. 200) Sieve in Soils by Washing
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2216	(2010) Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
ASTM D2321	(2020) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2487	(2017) Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D3786/D3786M	(2018) Standard Test Method for Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method
ASTM D4318	(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D4355/D4355M	(2014) Deterioration of Geotextiles from Exposure to Light, Moisture and Heat in a

	Xenon-Arc Type Apparatus
ASTM D4491/D4491M	(2017) Standard Test Methods for Water Permeability of Geotextiles by Permittivity
ASTM D4533/D4533M	(2015) Standard Test Method for Trapezoid Tearing Strength of Geotextiles
ASTM D4632/D4632M	(2015a) Grab Breaking Load and Elongation of Geotextiles
ASTM D4751	(2016) Standard Test Method for Determining Apparent Opening Size of a Geotextile
ASTM D4759	(2011; R 2018) Standard Practice for Determining the Specification Conformance of Geosynthetics
ASTM D4833/D4833M	(2007; E 2013; R 2013) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D698	(2012; E 2014; E 2015) Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600 kN-m/cu. m.))

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA SW-846.3-3	(1999, Third Edition, Update III-A) Test Methods for Evaluating Solid Waste: Physical/Chemical Methods

1.2 DEFINITIONS

1.2.1 Capillary Water Barrier

A layer of clean, poorly graded crushed rock, stone, or natural sand or gravel having a high porosity which is placed beneath a building slab with or without a vapor barrier to cut off the capillary flow of pore water to the area immediately below a slab.

1.2.2 Degree of Compaction

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D698, for general soil types, abbreviated as percent laboratory maximum density.

1.2.3 Hard Materials

Weathered rock, dense consolidated deposits, or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.

1.2.4 Rock

Solid homogeneous interlocking crystalline material with firmly cemented,

laminated, or foliated masses or conglomerate deposits, neither of which can be removed without systematic drilling and blasting, drilling and the use of expansion jacks or feather wedges, or the use of backhoe-mounted pneumatic hole punchers or rock breakers; also large boulders, buried masonry, or concrete other than pavement exceeding 1 cubic yard in volume. Removal of hard material will not be considered rock excavation because of intermittent drilling and blasting that is performed merely to increase production.

1.2.5 Pile Supported Structure

As used herein, a structure where both the foundation and floor slab are pile supported.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Submit 15 days prior to starting work.

SD-06 Test Reports

Fill and backfill test

Select material test

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

1.4 DELIVERY, STORAGE, AND HANDLING

Perform in a manner to prevent contamination or segregation of materials.

1.5 CRITERIA FOR BIDDING

Base bids on the following criteria:

a. Surface elevations are as indicated.

b. Pipes or other artificial obstructions, except those indicated, will not be encountered.

c. Ground water elevations indicated by the boring log were those existing at the time subsurface investigations were made and do not necessarily represent ground water elevation at the time of construction.

d. Material character is indicated by the boring logs.

h. Blasting will not be permitted. Remove material in an approved manner.

1.6 REQUIREMENTS FOR OFF SITE SOIL

Soils brought in from off site for use as backfill shall be tested for petroleum hydrocarbons, BTEX, PCBs and HW characteristics (including toxicity, ignitability, corrosivity, and reactivity). Backfill shall not

contain concentrations of these analytes above the appropriate State and/or EPA criteria, and shall pass the tests for HW characteristics. Determine petroleum hydrocarbon concentrations by using appropriate State protocols. Determine BTEX concentrations by using EPA SW-846.3-3 Method 5035/8260B. Perform complete TCLP in accordance with EPA SW-846.3-3 Method 1311. Perform HW characteristic tests for ignitability, corrosivity, and reactivity in accordance with accepted standard methods. Perform PCB testing in accordance with accepted standard methods for sampling and analysis of bulk solid samples. Provide borrow site testing for petroleum hydrocarbons and BTEX from a grab sample of material from the area most likely to be contaminated at the borrow site (as indicated by visual or olfactory evidence), with at least one test from each borrow site. For each borrow site, provide borrow site testing for HW characteristics from a composite sample of material, collected in accordance with standard soil sampling techniques. Do not bring material onsite until tests results have been received and approved by the Contracting Officer.

1.7 QUALITY ASSURANCE

1.7.1 Utilities

Movement of construction machinery and equipment over pipes and utilities during construction shall be at the Contractor's risk. Perform work adjacent to non-Government utilities as indicated in accordance with procedures outlined by utility company. Excavation made with power-driven equipment is not permitted within two feet of known Government-owned utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, excavate by hand. Start hand excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines or other existing work affected by the contract excavation until approval for backfill is granted by the Contracting Officer. Report damage to utility lines or subsurface construction immediately to the Contracting Officer.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

2.1.1 Satisfactory Materials

Any materials classified by ASTM D2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, GM-GC, SW, SP, free of debris, roots, wood, scrap material, vegetation, refuse, soft unsound particles, deleterious, or objectionable materials. Unless specified otherwise, the maximum particle diameter shall be one-half the lift thickness at the intended location.

2.1.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, or backfills from previous construction. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 3 inches. The Contracting Officer shall be notified of any contaminated materials.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic (plasticity index equals zero). Materials classified as GM and SM will be identified as cohesive only when the fines have a plasticity index greater than zero.

2.1.4 Expansive Soils

Soils that have a plasticity index equal to or greater than 12 when tested in accordance with ASTM D4318.

2.1.5 Nonfrost Susceptible (NFS) Material

A uniformly graded washed sand with a maximum particle size of 3/16 inch and less than 5 percent passing the No. 200 size sieve, and with not more than 3 percent by weight finer than 0.02 mm grain size.

2.1.6 Common Fill

Approved, unclassified soil material with the characteristics required to compact to the soil density specified for the intended location.

2.1.7 Backfill and Fill Material

ASTM D2487, classification GW, GP, GM, GC, SW, SP, SM, SC with a maximum ASTM D4318 liquid limit of 35 , maximum ASTM D4318 plasticity index of 12 , and a maximum of 25 percent by weight passing ASTM D1140, No. 200 sieve.

2.1.8 Topsoil

Natural, friable soil representative of productive, well-drained soils in the area, free of subsoil, stumps, rocks larger than one inch diameter, brush, weeds, toxic substances, and other material. Amend topsoil pH range to obtain a pH of 5.5 to 7.

2.2 POROUS FILL FOR CAPILLARY WATER BARRIER

ASTM C33/C33M fine aggregate grading with a maximum of 3 percent by weight passing ASTM D1140, No. 200 sieve, and conforming to the general soil material requirements specified in paragraph entitled "Satisfactory Materials."

2.3 UTILITY BEDDING MATERIAL

Except as specified otherwise in the individual piping section, provide bedding for buried piping in accordance with AWWA C600, Type 4, except as specified herein. Backfill to top of pipe shall be compacted to 95 percent of ASTM D698 maximum density. Plastic piping shall have bedding to spring line of pipe. Provide ASTM D2321 materials as follows:

a. Class I: Angular, 0.25 to 1.5 inches, graded stone, including a number of fill materials that have regional significance such as coral, slag, cinders, crushed stone, and crushed shells.

b. Class II: Coarse sands and gravels with maximum particle size of 1.5

inches, including various graded sands and gravels containing small percentages of fines, generally granular and noncohesive, either wet or dry. Soil Types GW, GP, SW, and SP are included in this class as specified in ASTM D2487.

2.3.1 Sand

Clean, coarse-grained sand classified as or SW or SP by ASTM D2487 for bedding and backfill as indicated.

2.3.2 Gravel

Clean, coarsely graded natural gravel, crushed stone or a combination thereof or having a classification of GW and GP in accordance with ASTM D2487 for bedding and backfill. Maximum particle size shall not exceed 3 inches.

2.4 BORROW

Obtain borrow materials required in excess of those furnished from excavations from sources outside of Government property.

2.5 BACKFILL FOR UNDERDRAINAGE SYSTEMS

Clean sand, crushed rock, or gravel meeting the following requirements:

d. Any Type Drain Used With Filter Fabric: Clean gravel or crushed stone or gravel conforming to ASTM C33/C33M coarse aggregate grading size 57, 67, or 7 .

2.6 FILTER FABRIC

Provide a pervious sheet of polyester, nylon, glass or polypropylene , ultraviolet resistant filaments woven, spun bonded, fused, or otherwise manufactured into a nonraveling fabric with uniform thickness and strength. Fabric shall have the following manufacturer certified minimum average roll properties as determined by ASTM D4759:

	Class A	Class B
a. Grab tensile strength (ASTM D4632/D4632M) machine and transversed direction	min. 180	lbs.
b. Grab elongation (ASTM D4632/D4632M) machine and transverse direction	min. 15	15 percent
c. Puncture resistance (ASTM D4833/D4833M)	min. 80	25 lbs.
d. Mullen burst strength (ASTM D3786/D3786M)	min. 290	130 psi
e. Trapezoidal Tear (ASTM D4533/D4533M)	min. 50	25 lbs.

	Class A	Class B
f. Apparent Opening Size (ASTM D4751)	0.25 mm	0.40 mm
g. Permeability (ASTM D4491/D4491M)	k fabric greater than k Soil	
h. Ultraviolet Degradation (ASTM D4355/D4355M)	70 percent Strength retained at 150 hours	

2.7 MATERIAL FOR RIP-RAP

2.7.1 Bedding Material

Consisting of sand, gravel, or crushed rock, well graded, with a maximum particle size of 2 inches. Material shall be composed of tough, durable particles. Fines passing the No. 200 standard sieve shall have a plasticity index less than six.

2.8 BURIED WARNING AND IDENTIFICATION TAPE

Polyethylene plastic and metallic core or metallic-faced, acid- and alkali-resistant, polyethylene plastic warning tape manufactured specifically for warning and identification of buried utility lines. Provide tape on rolls, 3 inch minimum width, color coded as specified below for the intended utility with warning and identification imprinted in bold black letters continuously over the entire tape length. Warning and identification to read, "CAUTION, BURIED (intended service) LINE BELOW" or similar wording. Color and printing shall be permanent, unaffected by moisture or soil.

Warning Tape Color Codes	
Red:	Electric
Yellow:	Gas, Oil; Dangerous Materials
Orange:	Telephone and Other Communications
Blue:	Potable Water Systems
Green:	Sewer Systems
White:	Steam Systems
Gray:	Compressed Air
Purple:	Non Potable, Reclaimed Water, Irrigation and Slurry lines

2.8.1 Detectable Warning Tape for Non-Metallic Piping

Polyethylene plastic tape conforming to the width, color, and printing

requirements specified above. Minimum thickness of the tape shall be 0.004 inch. Tape shall have a minimum strength of 1500 psi lengthwise and 1250 psi crosswise. Tape shall be manufactured with integral wires, foil backing, or other means of enabling detection by a metal detector when tape is buried up to 3 feet deep. Encase metallic element of the tape in a protective jacket or provide with other means of corrosion protection.

2.9 DETECTION WIRE FOR NON-METALLIC PIPING

Detection wire shall be insulated single strand, solid copper with a minimum of 12 AWG.

PART 3 EXECUTION

3.1 PROTECTION

3.1.1 Drainage and Dewatering

Provide for the collection and disposal of surface and subsurface water encountered during construction.

3.1.1.1 Drainage

So that construction operations progress successfully, completely drain construction site during periods of construction to keep soil materials sufficiently dry. The Contractor shall establish/construct storm drainage features (ponds/basins) at the earliest stages of site development, and throughout construction grade the construction area to provide positive surface water runoff away from the construction activity and/or provide temporary ditches, swales, and other drainage features and equipment as required to maintain dry soils, prevent erosion and undermining of foundations. When unsuitable working platforms for equipment operation and unsuitable soil support for subsequent construction features develop, remove unsuitable material and provide new soil material as specified herein. It is the responsibility of the Contractor to assess the soil and ground water conditions presented by the plans and specifications and to employ necessary measures to permit construction to proceed. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.1.1.2 Dewatering

Groundwater flowing toward or into excavations shall be controlled to prevent sloughing of excavation slopes and walls, boils, uplift and heave in the excavation and to eliminate interference with orderly progress of construction. French drains, sumps, ditches or trenches will not be permitted within 3 feet of the foundation of any structure, except with specific written approval, and after specific contractual provisions for restoration of the foundation area have been made. Control measures shall be taken by the time the excavation reaches the water level in order to maintain the integrity of the in situ material. While the excavation is open, the water level shall be maintained continuously, at least 1 feet below the working level.

Operate dewatering system continuously until construction work below existing water levels is complete. Submit performance records weekly.

3.1.2 Underground Utilities

Location of the existing utilities indicated is approximate. The Contractor shall physically verify the location and elevation of the existing utilities indicated prior to starting construction. The Contractor shall contact the Public Works Department for assistance in locating existing utilities. The Contractor shall scan the construction site with electromagnetic and sonic equipment and mark the surface of the ground where existing underground utilities are discovered.

3.1.3 Machinery and Equipment

Movement of construction machinery and equipment over pipes during construction shall be at the Contractor's risk. Repair, or remove and provide new pipe for existing or newly installed pipe that has been displaced or damaged.

3.2 SURFACE PREPARATION

3.2.1 Clearing and Grubbing

Unless indicated otherwise, remove trees, stumps, logs, shrubs, brush and vegetation and other items that would interfere with construction operations within the contract limit line. Remove stumps entirely. Grub out matted roots and roots over 2 inches in diameter to at least 18 inches below existing surface.

3.2.2 Unsuitable Material

Remove vegetation, debris, decayed vegetable matter, sod, mulch, and rubbish underneath paved areas or concrete slabs.

3.3 EXCAVATION

Excavate to contours, elevation, and dimensions indicated. Reuse excavated materials that meet the specified requirements for the material type required at the intended location. Keep excavations free from water. Excavate soil disturbed or weakened by Contractor's operations, soils softened or made unsuitable for subsequent construction due to exposure to weather. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed. Refill with satisfactory material and compact to 90 percent of ASTM D698 maximum density. Unless specified otherwise, refill excavations cut below indicated depth with satisfactory material and compact to 95 percent of ASTM D1557 maximum density. Satisfactory material removed below the depths indicated, without specific direction of the Contracting Officer, shall be replaced with satisfactory materials to the indicated excavation grade; except as specified for spread footings. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.3.1 Pipe Trenches

Excavate to the dimension indicated. Grade bottom of trenches to provide uniform support for each section of pipe after pipe bedding placement. Tamp if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported

for the entire length. Rock, where encountered, shall be excavated to a depth of at least 6 inches below the bottom of the pipe.

3.3.2 Hard Material Excavation

Remove hard material to elevations indicated in a manner that will leave foundation material in an unshattered and solid condition. Roughen level surfaces and cut sloped surfaces into benches for bond with concrete. Protect shale from conditions causing decomposition along joints or cleavage planes and other types of erosion. Removal of hard material beyond lines and grades indicated will not be grounds for a claim for additional payment unless previously authorized by the Contracting Officer. Excavation of the material claimed as rock shall not be performed until the material has been cross sectioned by the Contractor and approved by the Contracting Officer. Common excavation shall consist of all excavation not classified as rock excavation.

3.3.3 Excavated Materials

Satisfactory excavated material required for fill or backfill shall be placed in the proper section of the permanent work required or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of as specified in Paragraph "DISPOSITION OF SURPLUS MATERIAL."

3.4 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed and replaced with satisfactory materials as directed by the Contracting Officer. The surface shall be scarified to a depth of 6 inches before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 6 inches, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 12 inches and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified herein.

3.5 SUBGRADE FILTER FABRIC

Place synthetic fiber filter fabric as indicated directly on prepared subgrade free of vegetation, stumps, rocks larger than 2 inches diameter and other debris which may puncture or otherwise damage the fabric. Repair damaged fabric by placing an additional layer of fabric to cover the damaged area a minimum of 3 feet overlap in all directions. Overlap fabric at joints a minimum of 3 feet. Obtain approval of filter fabric installation before placing fill or backfill. Place fill or backfill on fabric in the direction of overlaps and compact as specified herein. Follow manufacturer's recommended installation procedures.

3.6 FILLING AND BACKFILLING

Fill and backfill to contours, elevations, and dimensions indicated. Compact each lift before placing overlaying lift.

3.6.1 Common Fill Placement

Provide for general site .Use satisfactory materials. Place in 6 inch lifts. Compact areas not accessible to rollers or compactors with mechanical hand tampers. Aerate material excessively moistened by rain to a satisfactory moisture content. Finish to a smooth surface by blading, rolling with a smooth roller, or both.

3.6.2 Backfill and Fill Material Placement

Provide for paved areas and under concrete slabs, except where select material is provided. Place in 6 inch lifts. Do not place over wet or frozen areas. Place backfill material adjacent to structures as the structural elements are completed and accepted. Backfill against concrete only when approved. Place and compact material to avoid loading upon or against the structure.

3.6.3 Backfill and Fill Material Placement Over Pipes

Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade . Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 2 feet above sewer lines and 1 foot above other utility lines shall be free from stones larger than 1 inch in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 4 inches in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

3.6.4 Trench Backfilling

Backfill as rapidly as construction, testing, and acceptance of work permits. Place and compact backfill under structures and paved areas in 6 inch lifts to top of trench and in 6 inch lifts to one foot over pipe outside paved areas.

3.7 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved borrow materials shall be obtained as specified herein.

3.8 BURIED WARNING AND IDENTIFICATION TAPE

Provide buried utility lines with utility identification tape. Bury tape 12 inches below finished grade; under pavements and slabs, bury tape 6

inches below top of subgrade.

3.9 BURIED DETECTION WIRE

Bury detection wire directly above non-metallic piping at a distance not to exceed 12 inches above the top of pipe. The wire shall extend continuously and unbroken, from manhole to manhole. The ends of the wire shall terminate inside the manholes at each end of the pipe, with a minimum of 3 feet of wire, coiled, remaining accessible in each manhole. The wire shall remain insulated over it's entire length. The wire shall enter manholes between the top of the corbel and the frame, and extend up through the chimney seal between the frame and the chimney seal. For force mains, the wire shall terminate in the valve pit at the pump station end of the pipe.

3.10 COMPACTION

Determine in-place density of existing subgrade; if required density exists, no compaction of existing subgrade will be required. Density requirements specified herein are for cohesionless materials. When cohesive materials are encountered or used, density requirements may be reduced by 5 percent.

3.10.1 General Site

Compact underneath areas designated for vegetation and areas outside the 5 foot line of the paved area or structure to 85 percent of ASTM D1557.

3.10.2 Paved Areas

Compact top 12 inches of subgrades to 95 percent of ASTM D1557. Compact fill and backfill materials to 95 percent of ASTM D1557.

3.11 SPECIAL EARTHWORK REQUIREMENTS FOR SUBSURFACE DRAINS

3.11.1 Perforated or Slotted Wall Pipes

Wrap one layer of filter fabric around pipe in such a manner that longitudinal overlaps are in unperforated or unslotted quadrants of the pipe. Overlap fabric a minimum of 2 inches. Secure fabric to pipe so that backfill material does not infiltrate through overlaps. Place granular material and extend it for one pipe diameter, minimum of 6 inches on each side of and 18 inches above top of pipe. Place a layer of filter fabric on top of granular filter before continuing with backfill.

3.11.2 Open-Joint Pipe

Wrap one layer of filter fabric around pipe joints overlapping a minimum of 2 inches in the longitudinal direction and extending at least 6 inches on both sides of the joint. Secure fabric to pipe so that backfill material does not infiltrate through overlaps. Place granular material specified and extend it for a minimum of one pipe diameter on each side of and 18 inches above top of pipe. Place a layer of filter fabric on top of granular filter before continuing with backfill.

3.11.3 Blind or French Drains

Install filter cloth in trenches with smoothly graded sides and bottom, free of cavities or projecting rocks. Lay the cloth flat but not

stretched . Place filter cloth so that drain water must pass through the cloth into the specified granular filter material. Overlap ends at least of 12 inches. Place backfill on filter cloth in the direction of overlaps. Where fabric is damaged, place a new piece of filter cloth over damaged area and overlap at least of 12 inches in every direction.

3.12 FINISH OPERATIONS

3.12.1 Grading

Finish grades as indicated within one-tenth of one foot. Grade areas to drain water away from structures. Maintain areas free of trash and debris. For existing grades that will remain but which were disturbed by Contractor's operations, grade as directed.

3.12.2 Topsoil and Seed

Scarify existing subgrade. Provide 4 inches of topsoil for newly graded finish earth surfaces and areas disturbed by the Contractor. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to seeding, planting, or proper grading. If there is insufficient on-site topsoil meeting specified requirements for topsoil, provide topsoil required in excess of that available. Seed shall match existing vegetation. Provide seed at 5 pounds per 1000 square feet. Provide granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

20 percent available nitrogen
20 percent available phosphorus
40 percent available potassium
10 percent sulfur
10 percent iron
Provide mulch and water to establish an acceptable stand of grass.

3.12.3 Protection of Surfaces

Protect newly backfilled, graded, and topsoiled areas from traffic, erosion, and settlements that may occur. Repair or reestablish damaged grades, elevations, or slopes.

3.13 DISPOSITION OF SURPLUS MATERIAL

Waste in Government disposal area Remove from Government property surplus or other soil material not required or suitable for filling or backfilling, and brush, refuse, stumps, roots, and timber.

3.14 FIELD QUALITY CONTROL

3.14.1 Sampling

Take the number and size of samples required to perform the following tests.

3.14.2 Testing

Perform one of each of the following tests for each material used. Provide additional tests for each source change.

3.14.2.1 Fill and Backfill Material Testing

Test fill and backfill material in accordance with ASTM C136/C136M for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D4318 for liquid limit and for plastic limit; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.14.2.2 Select Material Testing

Test select material in accordance with ASTM C136/C136M for conformance to ASTM D2487 gradation limits; ASTM D1140 for material finer than the No. 200 sieve; ASTM D698 or ASTM D1557 for moisture density relations, as applicable.

3.14.2.3 Moisture Content Tests

In the stockpile, excavation or borrow areas, a minimum of two tests per day per type of material or source of materials being placed is required during stable weather conditions. During unstable weather, tests shall be made as dictated by local conditions and approved moisture content shall be tested in accordance with ASTM D2216. Include moisture content test results in daily report.

-- End of Section --

SECTION 32 11 16

BASE COURSE FOR RIGID AND SUBBASES FOR FLEXIBLE PAVING
08/08

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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(2010) Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop
AASHTO T 224	(2010) Standard Method of Test for Correction for Coarse Particles in the Soil Compaction Test

ASTM INTERNATIONAL (ASTM)

ASTM C117	(2013) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D1556	(2007) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D1557	(2012; E 2015) Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2700 kN-m/m3)
ASTM D2167	(2008) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D2487	(2017) Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D422	(1963; R 2007; E 2014; E 2014) Particle-Size Analysis of Soils
ASTM D4318	(2017; E 2018) Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D6938	(2010) Standard Test Method for In-Place Density and Water Content of Soil and

	Soil-Aggregate by Nuclear Methods (Shallow Depth)
ASTM D75/D75M	(2009) Standard Practice for Sampling Aggregates
ASTM E11	(2009; E 2010) Wire Cloth and Sieves for Testing Purposes

1.2 DEFINITION

Degree of compaction required is expressed as a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D1557 abbreviated as a percent of laboratory maximum dry density. One exception is as follows: Since ASTM D1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 3/4 inch sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 3/4 inch sieve will be expressed as a percentage of the laboratory maximum dry density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224.

1.3 SYSTEM DESCRIPTION

All plant and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. Submit a list of proposed equipment, including descriptive data. Provide equipment which is adequate and has the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

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

SD-06 Test Reports

Sampling and Testing

Field Density Tests

1.5 QUALITY ASSURANCE

Sampling and testing are the responsibility of the Contractor, to be performed by an approved testing laboratory in accordance with Section 01 45 00.00 10 QUALITY CONTROL. Perform tests at the specified frequency. No work requiring testing will be permitted until the testing laboratory has been inspected and approved. Test the materials to establish compliance with the specified requirements.

1.5.1 Sampling

Take samples for laboratory testing in conformance with ASTM D75/D75M. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

1.5.2.1 Sieve Analysis

Make sieve analysis in conformance with ASTM C117 and ASTM C136. Complete particle-size analysis of the soils in conformance with ASTM D422. Sieves shall conform to ASTM E11.

1.5.2.2 Liquid Limit and Plasticity Index

Determine liquid limit and plasticity index in accordance with ASTM D4318.

1.5.2.3 Moisture-Density Determinations

Determine the laboratory maximum dry density and optimum moisture in accordance with ASTM D1557 .

1.5.2.4 Field Density Tests

Measure field density in accordance with ASTM D1556, ASTM D2167, or ASTM D6938. For the method presented in ASTM D1556, use the base plate, as shown in the drawing. For the method presented in ASTM D6938, check and adjust the calibration curves, if necessary, using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D6938 result in a wet unit weight of soil and ASTM D6938 will be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D6938. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration, in ASTM D6938, on each different type of material to be tested at the beginning of a job and at intervals as directed.

a. Submit certified copies of test results for approval not less than 30 days before material is required for the work.

b. Submit calibration curves and related test results prior to using the device or equipment being calibrated.

c. Submit copies of field test results within 24 hours after the tests are performed.

1.5.3 Testing Frequency

1.5.3.1 Initial Tests

Perform one of each of the following tests on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements prior to installation.

a. Sieve Analysis

b. Liquid limit and plasticity index

c. Moisture-density relationship

1.5.3.2 In-Place Tests

Perform one of each of the following tests on samples taken from the placed and compacted subbase or rigid pavement base course. Samples shall be taken and tested at the rates indicated.

a. Perform density tests on every lift of material placed and at a frequency of one set of tests for every 500 square yards, or portion thereof, of completed area.

b. Perform sieve analysis on every lift of material placed and at a frequency of one sieve analysis for every 1000 square yards, or portion thereof, of material placed.

c. Perform liquid limit and plasticity index tests at the same frequency as the sieve analysis.

d. Measure the thickness of each course at intervals providing at least one measurement for each 500 square yards or part thereof. The thickness measurement shall be made by test holes, at least 3 inches in diameter through the course.

1.5.4 Approval of Material

Select the source of materials 30 days prior to the time the material will be required in the work. Tentative approval will be based on initial test results. Final approval of the materials will be based on tests for gradation, liquid limit, and plasticity index performed on samples taken from the completed and compacted course.

1.6 ENVIRONMENTAL REQUIREMENTS

Perform construction when the atmospheric temperature is above 35 degrees F. When the temperature falls below 35 degrees F, protect all completed areas by approved methods against detrimental effects of freezing. Correct completed areas damaged by freezing, rainfall, or other weather conditions to meet specified requirements.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Subbase Course

Provide aggregates consisting of crushed stone or gravel processed and blended or naturally combined. Provide aggregates which are durable and sound, free from lumps and balls of clay, organic matter, objectionable coatings, and other foreign material conforming to NYSDOT 304-2.02 Type 2 subbase.

PART 3 EXECUTION

3.1 OPERATION OF AGGREGATE SOURCES

Clearing, stripping and excavating are the responsibility of the Contractor. Operate the aggregate sources to produce the quantity and quality of materials meeting the specified requirements in the specified time limit. Aggregate sources on private lands shall be conditioned in agreement with local laws and authorities.

3.2 STOCKPILING MATERIAL

Prior to stockpiling of material, clear and level storage sites. Stockpile all materials, including approved material available from excavation and grading, in the manner and at the locations designated. Aggregates shall be stockpiled on the cleared and leveled areas designated by the Contracting Officer to prevent segregation. Materials obtained from different sources shall be stockpiled separately.

3.3 PREPARATION OF UNDERLYING MATERIAL

Prior to constructing the subbase or rigid pavement base course, clean the underlying course or subgrade of all foreign substances. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. Correct ruts, or soft yielding spots, in the underlying courses, subgrade areas having inadequate compaction, and deviations of the surface from the specified requirements, by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompacting to specified density requirements. For cohesionless underlying courses or subgrades containing sands or gravels, as defined in ASTM D2487, the surface shall be stabilized prior to placement of the overlying course. Accomplish stabilization by mixing the overlying course material into the underlying course, and compacting by approved methods. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained in a satisfactory condition until the overlying course is placed.

3.4 GRADE CONTROL

The finished and completed course shall conform to the lines, grades, and cross sections shown. The lines, grades, and cross sections shown shall be maintained by means of line and grade stakes placed by the Contractor at the work site.

3.5 MIXING AND PLACING MATERIALS

Mix and place the materials to obtain uniformity of the material at the water content specified. Make such adjustments in mixing or placing procedures or in equipment as may be directed to obtain the true grades, to minimize segregation and degradation, to reduce or accelerate loss or increase of water, and to insure a satisfactory subbase course.

3.6 LAYER THICKNESS

The compacted thickness of the completed course shall be as indicated. When a compacted layer of 6 inches is specified, the material may be placed in a single layer; when a compacted thickness of more than 6 inches is required, no layer shall be thicker than 6 inches nor be thinner than 3 inches when compacted.

3.7 COMPACTION

Compact each layer of the material, as specified, with approved compaction equipment. Maintain water content during the compaction procedure to within plus or minus 2 percent of optimum water content, as determined from laboratory tests, as specified in paragraph SAMPLING AND TESTING. In all places not accessible to the rollers, compact the mixture with

hand-operated power tampers. Compaction of the rigid base course shall continue until each layer is compacted through the full depth to at least 95 percent of laboratory maximum density. Make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory subbase course. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.8 EDGES

Place approved material along the edges of the subbase course in such quantity as will compact to the thickness of the course being constructed. When the course is being constructed in two or more layers, at least a 1 foot width of the shoulder shall be rolled and compacted simultaneously with the rolling and compacting of each layer of the subbase course, as directed.

3.9 SMOOTHNESS TEST

The surface of the top layer shall show no deviations in excess of 3/8 inch when tested with a 12 foot straightedge. Take measurements in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 50 foot intervals. Correct deviations exceeding this amount by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.10 MAINTENANCE

Maintain the completed course in a satisfactory condition until accepted.

-- End of Section --

SECTION 32 12 17

HOT MIX BITUMINOUS PAVEMENT
04/08

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.

ASPHALT INSTITUTE (AI)

AI MS-2	(1997 6th Ed) Mix Design Methods

ASTM INTERNATIONAL (ASTM)

ASTM C117	(2013) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C131	(2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C136	(2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
ASTM D1188	(2007; E 2010) Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
ASTM D1559	(1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D2172/D2172M	(2011) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D2726	(2011) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D4867/D4867M	(2009) Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D546	(2010) Sieve Analysis of Mineral Filler for Bituminous Paving Mixtures
ASTM D75/D75M	(2009) Standard Practice for Sampling Aggregates
ASTM D977	(2019a; E 2019) Standard Specification for Emulsified Asphalt

ASTM D979/D979M	(2012) Sampling Bituminous Paving Mixtures
ASTM D995	(1995b; R 2002) Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures

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-05 Design Data

Job-mix formula

Submit a job-mix formula, prepared specifically for this project, for approval by the Government prior to preparing and placing the bituminous mixture. Design mix using procedures contained in Chapter V, Marshall Method of Mix Design, of AI MS-2. Formulas shall indicate physical properties of the mixes as shown by tests made by a commercial laboratory approved by the Contracting Officer, using materials identical to those to be provided on this project. Submit formulas with material samples. Job-mix formula for each mixture shall be in effect until modified in writing by the Contractor and approved by the Contracting Officer. Provide a new job-mix formula for each source change. Submittal shall include all tests indicated in MIX DESIGN section of this specification.

MIX DESIGN

Aggregates testsBituminous mix tests

Pavement courses

1.3 QUALITY ASSURANCE

1.3.1 Required Data

Job-mix formula shall show the following:

a. Source and proportions, percent by weight, of each ingredient of the mixture;

b. Correct gradation, the percentages passing each size sieve listed in the specifications for the mixture to be used, for the aggregate and mineral filler from each separate source and from each different size to be used in the mixture and for the composite mixture;

c. Amount of material passing the No. 200 sieve determined by dry sieving;

d. Temperature viscosity relationship of the asphalt cement;

e. Stability, flow, percent voids in mineral aggregate, percent air voids, unit weight;

f. Asphalt absorption by the aggregate;

g. Effective asphalt content as percent by weight of total mix;

h. Temperature of the mixture immediately upon completion of mixing;

i. Asphalt performance grade viscosity grade ; and

j. Curves for the leveling binder and wearing course.

1.3.2 Charts

Plot and submit, on a grain size chart, the specified aggregate gradation band, the job-mix gradation and the job-mix tolerance band.

1.3.3 Selection of Optimum Asphalt Content

Base selection on percent of total mix and the average of values at the following points on the curves for each mix:

a. Stability: Peak

b. Unit Weight: Peak

c. Percent Air Voids: Median

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage and store with a minimum of handling. Store aggregates in such a manner as to prevent segregation, contamination, or intermixing of the different aggregate sizes.

1.5 ENVIRONMENTAL CONDITIONS

Place bituminous mixture only during dry weather and on dry surfaces. Place courses only when the surface temperature of the underlying course is greater than 45 degrees F for course thicknesses greater than one inch and 55 degrees F for course thicknesses one inch or less.

1.6 CONSTRUCTION EQUIPMENT

Calibrated equipment, such as scales, batching equipment, spreaders and similar equipment, shall have been recalibrated by a calibration laboratory approved by the Contracting Officer within 12 months of commencing work.

1.6.1 Mixing Plant

Design, coordinate, and operate the mixing plant to produce a mixture within the job-mix formula tolerances and to meet the requirements of ASTM D995, including additional plant requirements specified herein. The plant shall be a batch type, continuous mix type or drum-dryer mixer type, and shall have sufficient capacity to handle the new bituminous construction.

1.6.1.1 Cold Aggregate Feeder

Provide plant with a feeder or feeders capable of delivering the maximum number of aggregate sizes required in their proper proportion. Provide

adjustment for total and proportional feed and feeders capable of being locked in any position. When more than one cold elevator is used, feed each elevator as a separate unit and install individual controls integrated with a master control.

1.6.1.2 Dryer

Provide rotary drum-dryer which continuously agitates the mineral aggregate during the heating and drying process. When one dryer does not dry the aggregate to specified moisture requirements, provide additional dryers.

1.6.1.3 Plant Screens and Bins for Batch and Continuous Mix Plants

Use screen to obtain accurate gradation and allow no bin to contain more than 10 percent oversize or undersize. Inspect screens each day prior to commencing work for plugged, worn, or broken screens. Clean plugged screens and replace worn or broken screens with new screens prior to beginning operations. Divide hot aggregate bins into at least three compartments arranged to ensure separate and adequate storage of appropriate fractions of the aggregate.

1.6.1.4 Testing Laboratory

Provide a testing laboratory for control and acceptance testing functions during periods of mix production, sampling and testing, and whenever materials subject to the provisions of these specifications are being supplied or tested. The laboratory shall provide adequate equipment, space, and utilities as required for the performance of the specified tests.

1.6.1.5 Surge and Storage Bins

Use for temporary storage of hot bituminous mixtures will be permitted under the following conditions:

a. When stored in surge bins for a period of time not to exceed 3 hours.

b. When stored in insulated and heated storage bins for a period of time not to exceed 12 hours. If it is determined by the Contracting Officer that there is an excessive amount of heat loss, segregation and oxidation of the mixture due to temporary storage, discontinue use of surge bins or storage bins.

1.6.1.6 Drum-Dryer Mixer

Do not use drum-dryer mixer if specified requirements of the bituminous mixture or of the completed bituminous pavement course cannot be met. If drum-dryer mixer is prohibited, use either batch or continuous mix plants meeting the specifications and producing a satisfactory mix.

1.6.2 Paving Equipment

1.6.2.1 Spreading Equipment

Self-propelled electronically controlled type, unless other equipment is authorized by the Contracting Officer. Equip spreading equipment of the self-propelled electronically controlled type with hoppers, tamping or vibrating devices, distributing screws, electronically adjustable screeds,

and equalizing devices. Capable of spreading hot bituminous mixtures without tearing, shoving, or gouging and to produce a finished surface of specified grade and smoothness. Operate spreaders, when laying mixture, at variable speeds between 5 and 45 feet per minute. Design spreader with a quick and efficient steering device; a forward and reverse traveling speed; and automatic devices to adjust to grade and confine the edges of the mixture to true lines. The use of a spreader that leaves indented areas or other objectionable irregularities in the fresh laid mix during operations is prohibited.

1.6.2.2 Rolling Equipment

Self-propelled pneumatic-tired rollers supplemented by three-wheel and tandem type steel wheel rollers. The number, type and weight of rollers shall be sufficient to compact the mixture to the required density without detrimentally affecting the compacted material. Rollers shall be suitable for rolling hot-mix bituminous pavements and capable of reversing without backlash. Pneumatic-tired rollers shall be capable of being operated both forward and backward without turning on the mat, and without loosening the surface being rolled. Equip rollers with suitable devices and apparatus to keep the rolling surfaces wet and prevent adherence of bituminous mixture. Vibratory rollers especially designed for bituminous concrete compaction may be used provided rollers do not impair stability of pavement structure and underlying layers. Repair depressions in pavement surfaces resulting from use of vibratory rollers. Rollers shall be self-propelled, single or dual vibrating drums, and steel drive wheels, as applicable; equipped with variable amplitude and separate controls for energy and propulsion.

1.6.2.3 Hand Tampers

Minimum weight of 25 pounds with a tamping face of not more than 50 square inches.

1.6.2.4 Mechanical Hand Tampers

Commercial type, operated by pneumatic pressure or by internal combustion.

PART 2 PRODUCTS

2.1 AGGREGATES

2.1.1 General

Use materials and gradations that have performed satisfactorily in previous installations.

2.1.2 Coarse Aggregate

ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

2.1.3 Fine Aggregate

AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

2.1.3.1 Hot-mix asphalt

For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.

2.1.4 Mineral Filler

AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

2.2.1 Asphalt Binder

AASHTO M 320, PG 64-22.

2.2.2 Asphalt Cement

ASTM D 3381/D 3381M for viscosity-graded material.

2.2.3 Tack Coat

ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting diluted in water, of suitable grade and consistency for application.

2.2.4 Water

Potable.

2.3 AUXILIARY MATERIALS

2.3.1 Herbicide

Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.

2.3.2 Sand

ASTM D 1073, Grade No. 2 or No. 3.

2.4 MIX DESIGN

2.4.1 Hot-Mix Asphalt

Dense-graded, hot-laid, hot-mix asphalt plant mixes, designed according toprocedures in AI MS-2, "Mix Design Methods for Asphalt Concrete and Other Hot-Mix types"; and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.

2. Base Course: NYSDOT Binder Type 3.

3. Surface Course: NYSDOT Binder Type 7F.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Preparation of Asphalt Binder Material

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 160 degrees C 325 degrees F when added to the aggregates. Modified asphalts shall be no more than 174 degrees C 350 degrees F when added to the aggregate.

3.1.2 Preparation of Mineral Aggregates

Store different size aggregate in separate stockpiles so that different sizes will not mix. Stockpile different-sized aggregates in uniform layers by use of a clam shell or other approved method so as to prevent segregation. The use of bulldozers in stockpiling of aggregate or in feeding aggregate to the dryer is prohibited. Feed aggregates into the cold elevator by means of separate mechanical feeders so that aggregates are graded within requirements of the job-mix formulas and tolerances specified. Regulate rates of feed of the aggregates so that moisture content and temperature of aggregates are within tolerances specified herein. Dry and heat aggregates to the temperature necessary to achieve the mixture determined by the job mix formula within the job tolerance specified. Provide adequate dry storage for mineral filler.

3.1.3 Preparation of Bituminous Mixture

Accurately weigh aggregates and dry mineral filler and convey into the mixer in the proportionate amounts of each aggregate size required to meet the job-mix formula. In batch mixing, after aggregates and mineral filler have been introduced into the mixer and mixed for not less than 15 seconds, add asphalt by spraying or other approved methods and continue mixing for a period of not less than 20 seconds, or as long as required to obtain a homogeneous mixture. The time required to add or spray asphalt into the mixer will not be added to the total wet-mixing time provided the operation does not exceed 10 seconds and a homogeneous mixture is obtained. When a continuous mixer is employed, mixing time shall be more than 35 seconds to obtain a homogeneous mixture. Additional mixing time, when required, will be as directed by the Contracting Officer. When mixture is prepared in a twin-pugmill mixer, volume of the aggregates, mineral filler, and asphalt shall not extend above tips of mixer blades when blades are in a vertical position. Overheated and carbonized mixtures, or mixtures that foam or show indication of free moisture, will be rejected. When free moisture is detected in batch or continuous mix plant produced mixtures, waste the mix and withdraw the aggregates in the hot bins immediately and return to the respective stockpiles; for drum-dryer mixer plants, waste the mix, including that in surge or storage bins that is affected by free moisture.

3.1.4 Transportation of Bituminous Mixtures

Transport bituminous material from the mixing plant to the paving site in trucks having tight, clean, smooth beds that have been coated with a minimum amount of concentrated solution of hydrated lime and water or other approved coating to prevent adhesion of the mixture to the truck. Petroleum products will not be permitted for coating truck. If air

temperature is less than 60 degrees F or if haul time is greater than 30 minutes, cover each load with canvas or other approved material of ample size to protect the mixture from the loss of heat. Make deliveries so that the spreading and rolling of all the mixture prepared for one day's run can be completed during daylight, unless adequate approved artificial lighting is provided. Deliver mixture to area to be paved so that the temperature at the time of dumping into the spreader is within the range specified herein. Reject loads that are below minimum temperature, that have crusts of cold unworkable material, or that have been wet excessively by rain. Hauling over freshly laid material is prohibited.

3.1.5 Surface Preparation of Underlying Course

Prior to the laying of the asphalt concrete, clean underlying course of foreign or objectionable matter with power blowers or power brooms, supplemented by hand brooms and other cleaning methods where necessary. During the placement of multiple lifts of bituminous concrete, each succeeding lift of bituminous concrete shall have its underlying lift cleaned and provided with a bituminous tack coat if the time period between the placement of each lift of bituminous concrete exceeds 14 days, or the underlying bituminous concrete has become dirty. Remove grass and other vegetative growth from existing cracks and surfaces.

3.1.6 Spraying of Contact Surfaces

Spray contact surfaces of previously constructed pavement with a thin coat of bituminous materials to act as an anti-stripping agent, conforming to ASTM D977. Paint contact surfaces of structures with a thin coat of emulsion or other approved bituminous material prior to placing the bituminous mixture. Tack coat the previously placed primed coats on base courses when surface has become excessively dirty and cannot be cleaned or when primed surface has cured to the extent that it has lost all bonding effect.

3.2 PLACEMENT

3.2.1 Machine Spreading

The range of temperatures of the mixtures at the time of spreading shall be between 250 degrees F and 300 degrees F. Bituminous concrete having temperatures less than minimum spreading temperature when dumped into the spreader will be rejected. Adjust spreader and regulate speed so that the surface of the course is smooth and continuous without tears and pulling, and of such depth that, when compacted, the surface conforms with the cross section, grade, and contour indicated. Unless otherwise directed, begin the placing along the centerline of areas to be paved on a crowned section or on the high side of areas with a one-way slope. Place mixture in consecutive adjacent strips having a minimum width of 10 feet, except where the edge lanes require strips less than 10 feet to complete the area. Construct longitudinal joints and edges to true line markings. Establish lines parallel to the centerline of the area to be paved, and place string lines coinciding with the established lines for the spreading machine to follow. Provide the number and location of the lines needed to accomplish proper grade control. When specified grade and smoothness requirements can be met for initial lane construction by use of an approved long ski-type device of not less than 30 feet in length and for subsequent lane construction by use of a short ski or shoe, in-place string lines for grade control may be omitted. Place mixture as nearly continuous as possible and adjust the speed of placing as needed to permit

proper rolling.

3.2.2 Shoveling, Raking, and Tamping After Machine-Spreading

Shovelers and rakers shall follow the spreading machine. Add or remove hot mixture and rake the mixture as required to obtain a course that when completed will conform to requirements specified herein. Broadcasting or fanning of mixture over areas being compacted is prohibited. When segregation occurs in the mixture during placing, suspend spreading operation until the cause is determined and corrected. Correct irregularities in alignment left by the spreader by trimming directly behind the machine. Immediately after trimming, compact edges of the course by tamping laterally with a metal lute or by other approved methods. Distortion of the course during tamping is prohibited.

3.2.3 Hand-Spreading in Lieu of Machine-Spreading

In areas where the use of machine spreading is impractical, spread mixture by hand. The range of temperatures of the mixtures when dumped onto the area to be paved shall be between 250 and 300 degrees F. Mixtures having temperatures less than minimum spreading temperature when dumped onto the area to be paved will be rejected. Spread hot mixture with rakes in a uniformly loose layer of a thickness that, when compacted, will conform to the required grade, thickness, and smoothness. During hand spreading, place each shovelful of mixture by turning the shovel over in a manner that will prevent segregation. Do not place mixture by throwing or broadcasting from a shovel. Do not dump loads any faster than can be properly handled by the shovelers and rakers.

3.3 COMPACTION OF MIXTURE

Compact mixture by rolling. Begin rolling as soon as placement of mixture will bear rollers. Delays in rolling freshly spread mixture shall not be permitted. Start rolling longitudinally at the extreme sides of the lanes and proceed toward center of pavement, or toward high side of pavement with a one-way slope. Operate rollers so that each trip overlaps the previous adjacent strip by at least one foot. Alternate trips of the roller shall be of slightly different lengths. Conduct tests for conformity with the specified crown, grade and smoothness immediately after initial rolling. Before continuing rolling, correct variations by removing or adding materials as necessary. If required, subject course to diagonal rolling with the steel wheeled roller crossing the lines of the previous rolling while mixture is hot and in a compactible condition. Speed of the rollers shall be slow enough to avoid displacement of hot mixture. Correct displacement of mixture immediately by use of rakes and fresh mixture, or remove and replace mixture as directed. Continue rolling until roller marks are eliminated and course has a density of at least 96 percent but not more than 100 percent of that attained in a laboratory specimen of the same mixture prepared in accordance with ASTM D1559. During rolling, moisten wheels of the rollers enough to prevent adhesion of mixture to wheels, but excessive water is prohibited. Operation of rollers shall be by competent and experienced operators. Provide sufficient rollers for each spreading machine in operation on the job and to handle plant output. In places not accessible to the rollers, compact mixture thoroughly with hot hand tampers. Skin patching of an area after compaction is prohibited. Remove mixture that becomes mixed with foreign materials or is defective and replace with fresh mixture compacted to the density specified herein. Roller shall pass over unprotected edge of the course only when laying of course is to be

discontinued for such length of time as to permit mixture to become cold.

3.4 JOINTS

Joints shall present the same texture and smoothness as other portions of the course, except permissible density at the joint may be up to 2 percent less than the specified course density. Carefully make joints between old and new pavement or within new pavements in a manner to ensure a thorough and continuous bond between old and new sections of the course. Vertical contact surfaces of previously constructed sections that are coated with dust, sand, or other objectionable material shall be painted with a thin uniform coat of emulsion or other approved bituminous material just before placing fresh mixture.

3.4.1 Transverse

Roller shall pass over unprotected end of freshly laid mixture only when laying of course is to be discontinued. Except when an approved bulkhead is used, cut back the edge of previously laid course to expose an even, vertical surface for the full thickness of the course. When required, rake fresh mixture against joints, thoroughly tamp with hot tampers, smooth with hot smoothers, and roll. Transverse joints in adjacent lanes shall be offset a minimum of 2 feet.

3.4.2 Longitudinal Joints

Space 6 inches apart. Do not allow joints to coincide with joints of existing pavement or previously placed courses. Spreader screed shall overlap previously placed lanes 2 to 3 inches and be of such height to permit compaction to produce a smooth dense joint. With a lute, push back mixture placed on the surface of previous lanes to the joint edge. Do not scatter mix. Remove and waste excess material. When edges of longitudinal joints are irregular, honeycombed, or poorly compacted, cut back unsatisfactory sections of joint and expose an even vertical surface for the full thickness of the course. When required, rake fresh mixture against joint, thoroughly tamp with hot tampers, smooth with hot smoothers, and roll while hot.

3.5 FIELD QUALITY CONTROL

3.5.1 Sampling

3.5.1.1 Aggregates At Source

Prior to production and delivery of aggregates, take at least one initial sample in accordance with ASTM D75/D75M from each stockpile. Collect each sample by taking three incremental samples at random from the source material to make a composite sample of not less than 50 pounds. Repeat the sampling when the material source changes or when testing reveals unacceptable deficiencies or variations from the specified grading of materials.

3.5.1.2 Cold Feed Aggregate Sampling

Take two samples daily from the belt conveying materials from the cold feed. Collect materials in three increments at random to make a representative composite sample of not less than 50 pounds. Take samples in accordance with ASTM D75/D75M.

3.5.1.3 Coarse and Fine Aggregates

Take a 50 pound sample from the cold feed at least once daily for sieve analyses and specific gravity tests. Additional samples may be required to perform more frequent tests when analyses show deficiencies, or unacceptable variances or deviations. The method of sampling is as specified herein for aggregates.

3.5.1.4 Mineral Filler

ASTM D546. Take samples large enough to provide ample material for testing.

3.5.1.5 Pavement and Mixture

Take plant samples for the determination of mix properties and field samples for thickness and density of the completed pavements. Furnish tools, labor and material for samples, and satisfactory replacement of pavement. Take samples and tests at not less than frequency specified hereinafter and at the beginning of plant operations; for each day's work as a minimum; each change in the mix or equipment; and as often as directed. Accomplish sampling in accordance with ASTM D979/D979M.

3.5.2 Testing

3.5.2.1 Aggregates Tests

a. Gradation: ASTM C136.

b. Mineral Filler Content: ASTM D546.

c. Abrasion: ASTM C131 for wear (Los Angeles test). Perform one test initially prior to incorporation into the work and each time the source is changed.

3.5.2.2 Bituminous Mix Tests

Test one sample for each 500 tons, or fraction thereof, of the uncompacted mix for extraction in accordance with ASTM D2172/D2172M; perform a sieve analysis on each extraction sample in accordance with ASTM C136 and ASTM C117. Test one sample for each 500 tons or fraction thereof for stability and flow in accordance with ASTM D1559. Test one sample for each material blend for Tensile Strength Ratio in accordance with ASTM D4867/D4867M.

3.5.2.3 Pavement Courses

Perform the following tests:

a. Density: For each 1000 tons of bituminous mixture placed, determine the representative laboratory density by averaging the density of four laboratory specimens prepared in accordance with ASTM D1559. Samples for laboratory specimens shall be taken from trucks delivering mixture to the site; record in a manner approved by the Contracting Officer the project areas represented by the laboratory densities. From each representative area recorded, determine field density of pavement by averaging densities of 4 inch diameter cores obtained from leveling, binder, and wearing courses; take one core for each 2000 square yards or fraction thereof of course placed. Determine density of laboratory

prepared specimens and cored samples in accordance with ASTM D1188 or ASTM D2726, as applicable. Separate pavement layers by sawing or other approved means. Maximum allowable deficiency at any point, excluding joints, shall not be more than 2 percent less than the specified density for any course. The average density of each course, excluding joints, shall be not less than the specified density. Joint densities shall not be more than 2 percent less than specified course densities and are not included when calculating average course densities. When the deficiency exceeds the specified tolerances, correct each such representative area or areas by removing the deficient pavement and replacing with new pavement.

b. Thickness: Determine thickness of binder and wearing courses from samples taken for the field density test. The maximum allowable deficiency at any point shall not be more than 1/4 inch less than the thickness for the indicated course. Average thickness of course or of combined courses shall be not less than the indicated thickness. Where a deficiency exceeds the specified tolerances, correct each such representative area or areas by removing the deficient pavement and replacing with new pavement.

c. Smoothness: Straightedge test the compacted surface of leveling, binder, and wearing courses as work progresses. Apply straightedge parallel with and at right angles to the centerline after final rolling. Unevenness of leveling and binder courses shall not vary more than 1/4 inch in 10 feet; variations in the wearing course shall not vary more than 1/8 inch in 10 feet. Correct each portion of the pavement showing irregularities greater than that specified.

d. Finish Surface Texture of Wearing Course: Visually check final surface texture for uniformity and reasonable compactness and tightness. Final wearing course with a surface texture having undesirable irregularities such as segregation, cavities, pulls or tears, checking, excessive exposure of coarse aggregates, sand streaks, indentations, ripples, or lack of uniformity shall be removed and replaced with new materials.

3.6 PROTECTION

Do not permit vehicular traffic, including heavy equipment, on pavement until surface temperature has cooled to at least 120 degrees F. Measure surface temperature by approved surface thermometers or other satisfactory methods.

-- End of Section --

SECTION 32 13 13.06

PORTLAND CEMENT CONCRETE PAVEMENT FOR ROADS AND SITE FACILITIES
11/11

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 CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 211.1	(1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete
ACI 301	(2010; Errata 2011) Specifications for Structural Concrete
ACI 305R	(2010) Guide to Hot Weather Concreting
ACI 306.1	(1990; R 2002) Standard Specification for Cold Weather Concreting

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C215	(2010) Extruded Polyolefin Coatings for the Exterior of Steel Water Pipelines

ASTM INTERNATIONAL (ASTM)

ASTM A615/A615M	(2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM C1077	(2013) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C1157/C1157M	(2011) Standard Specification for Hydraulic Cement
ASTM C143/C143M	(2020) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150/C150M	(2012) Standard Specification for Portland Cement
ASTM C1602/C1602M	(2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete
ASTM C171	(2020) Standard Specification for Sheet Materials for Curing Concrete

ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260/C260M	(2010a) Standard Specification for Air-Entraining Admixtures for Concrete
ASTM C309	(2019) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C31/C31M	(2021a) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C33/C33M	(2018) Standard Specification for Concrete Aggregates
ASTM C494/C494M	(2021b) Standard Specification for Chemical Admixtures for Concrete
ASTM C595/C595M	(2013) Standard Specification for Blended Hydraulic Cements
ASTM C618	(2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C78/C78M	(2012; E 2013) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C94/C94M	(2021b) Standard Specification for Ready-Mixed Concrete
ASTM C989/C989M	(2012a) Standard Specification for Slag Cement for Use in Concrete and Mortars

1.2 RELATED SECTIONS

Portland cement concrete pavement shall use Section 32 11 16 BASE COURSE FOR RIGID AND SUBBASE COURSE FOR FLEXIBLE PAVING, in addition to this section.

1.3 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; G

Curing materials

Admixtures

Dowel

Submit a complete list of materials including type, brand and applicable reference specifications.

SD-05 Design Data

Concrete mix design

Thirty days minimum prior to concrete placement, submit a mix design, with applicable tests, for each strength and type of concrete for approval. Submit a complete list of materials including type; brand; source and amount of cement, fly ash, 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 will produce a range of strength encompassing those required for each class and type of concrete required. Submittal shall clearly indicate where each mix design will be used when more than one mix design is submitted. Obtain acknowledgement of approvals prior to concrete placement. Submit a new mix design for each material source change.

SD-06 Test Reports

Aggregate tests

Concrete slump tests

Air content tests

Flexural strength tests

Cementitious materials

SD-07 Certificates

Ready-mixed concrete plant

Batch tickets

Cementitious materials

SD-11 Closeout Submittals

1.4 DELIVERY, STORAGE, AND HANDLING

ASTM C94/C94M.

1.5 QUALITY ASSURANCE

1.5.1 Ready-mixed Concrete Plant Certification

Unless otherwise approved by the Contracting Officer, ready mixed concrete shall be produced and provided by a National Ready-Mix Concrete Association (NRMCA) certified plant. If a volumetric mobile mixer is used to produce the concrete, rather than ready-mixed concrete, the mixer(s) must conform to the standards of the Volumetric Mixer Manufacturers Bureau

(VMMB). Verification shall be made by a current VMMB conformance plate affixed to the volumetric mixer equipment.

1.5.2 Contractor Qualifications

Unless waived by the Contracting Officer, the Contractor shall meet one of the following criteria:

a. Contractor shall have at least one National Ready Mixed Concrete Association (NMRCA) certified concrete craftsman on site, overseeing each placement crew during all concrete placement.

b. Contractor shall have no less than three NRMCA certified concrete installers, who shall be on site working as members of each placement crew during all concrete placement.

1.5.3 Required Information

Submit copies of laboratory test reports showing that the mix has been successfully tested to produce concrete with the properties specified and that mix will be suitable for the job conditions. The laboratory test reports shall include mill test and all other test for cementitious materials, aggregates, and admixtures. Provide maximum nominal aggregate size, combined aggregate gradation analysis, percentage retained and passing sieve, and a graph of percentage retained verses sieve size. Test reports shall be submitted along with the concrete mix design. Sampling and testing of materials, concrete mix design, sampling and testing in the field shall be performed by a commercial testing laboratory which conforms to ASTM C1077. The laboratory shall be approved in writing by the Government.

1.5.4 Batch Tickets

ASTM C94/C94M. Submit mandatory batch ticket information for each load of ready-mixed concrete.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Cementitious Materials

Cementitious materials in concrete mix shall be 20 to 50 percent non-portland cement pozzolanic materials by weight.

2.1.1.1 Cement

ASTM C150/C150M, Type I or II or ASTM C595/C595M, Type IS, IP, or P or ASTM C1157/C1157M MS HS R.

2.1.1.2 Fly Ash and Pozzolan

ASTM C618, Type C, F, or N. Fly ash certificates shall include test results in accordance with ASTM C618.

2.1.1.2 Slag

ASTM C989/C989M, Slag Cement (formerly Ground Granulated Blast Furnace Slag) Grade 100 or 120. Certificates shall include test results in

accordance with ASTM C989/C989M.

2.1.2 Water

Water shall conform to ASTM C1602/C1602M. Hot water shall not be used unless approved by the Contracting Officer.

2.1.2 Aggregate

Coarse aggregate shall consist of crushed or uncrushed gravel, crushed stone, or a combination thereof. Aggregates, as delivered to the mixers, shall consist of clean, hard, uncoated particles. Coarse aggregate shall be washed. Washing shall be sufficient to remove dust and other coatings. Fine aggregate shall consist of natural sand, manufactured sand, or a combination of the two, and shall be composed of clean, hard, durable particles. Both coarse and fine aggregates shall meet the requirements of ASTM C33/C33M.

2.1.2.1 Fine Aggregates

ASTM C33/C33M.

2.1.2.2 Coarse Aggregates

ASTM C33/C33M.

2.1.3 Admixtures

ASTM C494/C494M: Type A, water reducing; Type B, retarding; Type C, accelerating; Type D, water-reducing and retarding; and Type E, water-reducing and accelerating admixture. Do not use calcium chloride admixtures. Where not shown or specified, the use of admixtures is subject to written approval of the Contracting Officer.

ASTM C260/C260M: Air-entraining.

2.1.4 Reinforcement

2.1.4.1 Dowel Bars

Bars shall conform to ASTM A615/A615M, Grade 40 for plain billet-steel bars of the size and length indicated. Remove all burrs and projections from the bars.

2.1.4.2 Coated Dowel Bars

Bars shall conform to ASTM A615/A615M, Grade 40 for plain billet-steel bars of the size and length indicated. Remove all burrs or projections from the dowel bars. Coating system shall conform to AWWA C215, Type 2. Coat the bars with a double coat system or an epoxy coating system for resistance to penetration of oil and salt solutions. The systems shall be in accordance with manufacturer's recommendation for coatings which are not bondable to concrete. Bond the coating to the dowel bar to resist laps or folds during movement of the joint. Coating thickness shall be 7 mils minimum and 20 mils maximum.

2.1.5 Curing Materials

2.1.5.1 White-Burlap-Polyethylene Sheet

ASTM C171, 0.004 inch thick white opaque polyethylene bonded to 10 oz/linear yard (40 inch) wide burlap.

2.1.5.2 Liquid Membrane-Forming Compound

ASTM C309, white pigmented, Type 2, Class B, free of paraffin or petroleum.

2.1.6 Joint Fillers and Sealants

Provide as specified in Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.

2.2 CONTRACTOR-FURNISHED MIX DESIGN

Contractor-furnished mix design concrete shall be designed in accordance with ACI 211.1 except as modified herein, and the mix design shall be as specified herein under paragraph entitled "Submittals." The concrete shall have a minimum flexural strength of 650 pounds per square inch at 28 days. The concrete may be air entrained. If air entrainment is used the air content shall be 6.0 plus or minus 1.5 percent. Maximum size aggregate for slip forming shall be 1.5 inches. The minimum cementitious factor is 564 lbs per cubic yard and slump shall be 2 to 4 inches.

If the cementitious material is not sufficient to produce concrete of the flexural strength required it shall be increased as necessary, without additional compensation under the contract. The cementitious factor shall be calculated using cement, Class F fly ash, and or GGBF slag. The mix shall use a cement replacement (by weight) of 25 percent - 35 percent Class F fly ash, or 40 percent - 50 percent GGBF slag, or a combination of the two. In the combination, each 5 percent of Class F fly ash shall be replaced by 8 percent GGBF slag.

PART 3 EXECUTION

3.1 FORMS

3.1.1 Construction

Construct forms to be removable without damaging the concrete.

3.1.2 Coating

Before placing the concrete, coat the contact surfaces of forms with a non-staining mineral oil, non-staining form coating compound, or two coats of nitro-cellulose lacquer.

3.1.3 Grade and Alignment

Check and correct grade elevations and alignment of the forms immediately before placing the concrete.

3.2 REINFORCEMENT

3.2.1 Dowel Bars

Install bars accurately aligned, vertically and horizontally, at indicated locations and to the dimensions and tolerances indicated. Before installation thoroughly grease the sliding portion of each dowel. Dowels must remain in position during concrete placement and curing.

3.2.2 Coated Dowel Bars

Install bars, accurately aligned vertically and horizontally, at indicated locations and to the dimensions and tolerances indicated. Reject coatings which are perforated, cracked or otherwise damaged. While handling avoid scuffing or gouging of the coatings.

3.3 MEASURING, MIXING, CONVEYING, AND PLACING CONCRETE

3.3.1 Measuring

ASTM C94/C94M.

3.3.2 Mixing

ASTM C94/C94M, except as modified herein. Begin mixing within 30 minutes after cement has been added to aggregates. When the air temperature is greater than 85 degrees F, place concrete within 60 minutes. With the approval of the Contracting Officer, a hydration stabilizer admixture meeting the requirements of ASTM C494/C494M Type D, may be used to extend the placement time to 90 minutes. Additional water may be added to bring slump within required limits as specified in Section 11.7 of ASTM C94/C94M, provided that the specified water-cement ratio is not exceeded.

3.3.3 Conveying

ASTM C94/C94M.

3.3.4 Placing

Follow guidance of ACI 301, except as modified herein. Do not exceed a free vertical drop of 5 feet from the point of discharge. Deposit concrete either directly from the transporting equipment or by conveyor on to the pre-wetted subgrade or subbase, unless otherwise specified. Do not place concrete on frozen subgrade or subbase. Deposit the concrete between the forms to an approximately uniform height. Place concrete continuously at a uniform rate, with minimum amount of segregation, without damage to the grade and without unscheduled stops except for equipment failure or other emergencies. If this occurs within 10 feet of a previously placed expansion joint, remove concrete back to joint, repair any damage to grade, install a construction joint and continue placing concrete only after cause of the stop has been corrected.

3.3.5 Vibration

Immediately after spreading concrete, consolidate concrete with internal type vibrating equipment along the boundaries of all slabs regardless of slab thickness, and interior of all concrete slabs 6 inches or more in thickness. Limit duration of vibration to that necessary to produce consolidation of concrete. Excessive vibration will not be permitted.

Vibrators shall not be operated in concrete at one location for more than 15 seconds. At the option of the Contractor, vibrating equipment of a type approved by the Contracting Officer may be used to consolidate concrete in unreinforced pavement slabs less than 6 inches thick.

3.3.5.1 Vibrating Equipment

Operate equipment, except hand-manipulated equipment, ahead of the finishing machine. Select the number of vibrating units and power of each unit to properly consolidate the concrete. Mount units on a frame that is capable of vertical movement and, when necessary, radial movement, so vibrators may be operated at any desired depth within the slab or be completely withdrawn from the concrete. Clear distance between frame-mounted vibrating units that have spuds that extend into the slab at intervals across the paving lane shall not exceed 30 inches. Distance between end of vibrating tube and side form shall not exceed 2 inches. For pavements less than 10 inches thick, operate vibrators at mid-depth parallel with or at a slight angle to the subbase. For thicker pavements, angle vibrators toward the vertical, with vibrator tip preferably about 2 inches from subbase, and top of vibrator a few inches below pavement surface. Vibrators may be pneumatic, gas driven, or electric, and shall be operated at frequencies within the concrete of not less than 8,000 vibrations per minute. Amplitude of vibration shall be such that noticeable vibrations occur at 1.5 foot radius when the vibrator is inserted in the concrete to the depth specified.

3.3.6 Cold Weather

Except with authorization, do not place concrete when ambient temperature is below 40 degrees F or when concrete is likely to be subjected to freezing temperatures within 24 hours. When authorized, when concrete is likely to be subjected to freezing within 24 hours after placing, heat concrete materials so that temperature of concrete when deposited is between 65 and 80 degrees F. Methods of heating materials are subject to approval of the Contracting Officer. Do not heat mixing water above 165 degrees F. Remove lumps of frozen material and ice from aggregates before placing aggregates in mixer. Follow practices found in ACI 306.1.

3.3.7 Hot Weather

Maintain required concrete temperature in accordance with Figure 2.1.5 in ACI 305R to prevent 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. After placement, use fog spray, apply monomolecular film, or use other suitable means to reduce the evaporation rate. Start curing when surface of fresh concrete is sufficiently hard to permit curing without damage. Cool underlying material by sprinkling lightly with water before placing concrete. Follow practices found in ACI 305R.

3.4 PAVING

Pavement shall be constructed with paving and finishing equipment utilizing fixed forms.

3.4.1 Consolidation

The vibrators shall be inserted into the concrete not closer to the

underlying material than 2 inches. The vibrators or any tamping units in front of the paver shall be automatically controlled so that they shall be stopped immediately as forward motion ceases. Excessive vibration shall not be permitted. Concrete in small, odd-shaped slabs or in locations inaccessible to the paver mounted vibration equipment shall be vibrated with a hand-operated immersion vibrator. Vibrators shall not be used to transport or spread the concrete.

3.4.2 Required Results

The finisher shall be operated to produce a thoroughly consolidated slab throughout, true to line and grade within specified tolerances. The finishing operation shall produce a surface finish free of irregularities, tears, voids of any kind, and any other discontinuities. It shall produce only a very minimum of paste at the surface. No water, other than true fog sprays (mist), shall be applied to the concrete surface during finishing.

3.4.3 Fixed Form Paving

Forms shall be steel, except that wood forms may be used for curves having a radius of 150 feet or less, and for fillets. Forms may be built up with metal or wood, added only to the base, to provide an increase in depth of not more than 25 percent. The base width of the form shall be not less than eight-tenths of the vertical height of the form, except that forms 8 inches or less in vertical height shall have a base width not less than the vertical height of the form. Wood forms for curves and fillets shall be adequate in strength and rigidly braced. Forms shall be set on firm material cut true to grade so that each form section when placed will be firmly in contact with the underlying layer for its entire base. Forms shall not be set on blocks or on built-up spots of underlying material. Forms shall remain in place at least 12 hours after the concrete has been placed. Forms shall be removed without injuring the concrete.

3.4.4 Placing Reinforcing Steel

Reinforcement shall be positioned on suitable chairs securely fastened to the subgrade prior to concrete placement.

3.4.5 Placing Dowels

Dowels shall be installed with alignment not greater than 1/8 inch per ft. Except as otherwise specified below, location of dowels shall be within a horizontal tolerance of plus or minus 5/8 inch and a vertical tolerance of plus or minus 3/16 inch. The portion of each dowel intended to move within the concrete or expansion cap shall be painted with one coat of rust inhibiting primer paint, and then oiled just prior to placement. Dowels in joints shall be omitted when the center of the dowel is located within a horizontal distance from an intersecting joint equal to or less than one-fourth of the slab thickness.

3.4.5.1 Contraction Joints

Dowels in longitudinal and transverse contraction joints within the paving lane shall be held securely in place by means of rigid metal basket assemblies. The dowels shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent them from becoming distorted during paving operations. The basket assemblies shall be held securely in the proper location by means of suitable anchors.

3.4.5.2 Construction Joints-Fixed Form Paving

Installation of dowels shall be by the bonded-in-place method, supported by means of devices fastened to the forms. Installation by removing and replacing in preformed holes will not be permitted.

3.4.5.3 Dowels Installed in Hardened Concrete

Installation shall be by bonding the dowels into holes drilled into the hardened concrete. Holes approximately 1/8 inch greater in diameter than the dowels shall be drilled into the hardened concrete. Dowels shall be bonded in the drilled holes using epoxy resin injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel shall not be permitted. The dowels shall be held in alignment at the collar of the hole, after insertion and before the grout hardens, by means of a suitable metal or plastic collar fitted around the dowel. The vertical alignment of the dowels shall be checked by placing the straightedge on the surface of the pavement over the top of the dowel and measuring the vertical distance between the straightedge and the beginning and ending point of the exposed part of the dowel.

3.5 FINISHING CONCRETE

Start finishing operations immediately after placement of concrete. Finish pavement surface on both sides of a joint to the same grade. Finish formed joints from a securely supported transverse bridge. Provide hand finishing equipment for use at all times. Transverse and longitudinal surface tolerances shall be 1/4 inch in 10 feet.

3.5.1 Side Form Finishing

Strike off and screed concrete to the required slope and cross-section by a power-driven transverse finishing machine. Transverse rotating tube or pipe shall not be permitted unless approved by the Contracting Officer. Elevation of concrete shall be such that, when consolidated and finished, pavement surface will be adequately consolidated and at the required grade. Equip finishing machine with two screeds which are readily and accurately adjustable for changes in pavement slope and compensation for wear and other causes. Make as many passes over each area of pavement and at such intervals as necessary to give proper compaction, retention of coarse aggregate near the finished surface, and a surface of uniform texture, true to grade and slope. Do not permit excessive operation over an area, which will result in an excess of mortar and water being brought to the surface.

3.5.1.1 Equipment Operation

Maintain the travel of machine on the forms without lifting, wobbling, or other variation of the machine which tend to affect the precision of concrete finish. Keep the tops of the forms clean by a device attached to the machine. During the first pass of the finishing machine, maintain a uniform ridge of concrete ahead of the front screed for its entire length.

3.5.1.2 Joint Finish

Before concrete is hardened, correct edge slump of pavement, exclusive of

edge rounding, in excess of 0.02 foot. Finish concrete surface on each side of construction joints to the same plane, and correct deviations before newly placed concrete has hardened.

3.5.1.3 Hand Finishing

Strike-off and screed surface of concrete to elevations slightly above finish grade so that when concrete is consolidated and finished pavement surface is at the indicated elevation. Vibrate entire surface until required compaction and reduction of surface voids is secured with a strike-off template.

3.5.1.4 Longitudinal Floating

After initial finishing, further smooth and consolidate concrete by means of hand-operated longitudinal floats. Use floats that are not less than 12 feet long and 6 inches wide and stiffened to prevent flexing and warping.

3.5.2 Texturing

Before the surface sheen has disappeared and before the concrete hardens, the surface of the pavement shall be given a texture as described herein. After curing is complete, all textured surfaces shall be thoroughly power broomed to remove all debris.

3.5.2.1 Brooming

Finish the surface of the slab by brooming the surface with a new wire broom at least 18 inches wide. Gently pull the broom over the surface of the pavement from edge to edge just before the concrete becomes non-plastic. Slightly overlap adjacent strokes of the broom. Broom perpendicular to centerline of pavement so that corrugations produced will be uniform in character and width, and not more than 1/16 inch in depth. Broomed surface shall be free from porous spots, irregularities, depressions, and small pockets or rough spots such as may be caused by accidentally disturbing particles of coarse aggregate embedded near the surface.

3.5.3 Edging

At the time the concrete has attained a degree of hardness suitable for edging, carefully finish slab edges, including edges at formed joints, with an edge having a maximum radius of one-eighth inch. When brooming is specified for the final surface finish, edge transverse joints before starting brooming, then operate broom to obliterate as much as possible the mark left by the edging tool without disturbing the rounded corner left by the edger. Clean by removing loose fragments and soupy mortar from corners or edges of slabs which have crumbled and areas which lack sufficient mortar for proper finishing. Refill voids solidly with a mixture of suitable proportions and consistency and refinish. Remove unnecessary tool marks and edges. Remaining edges shall be smooth and true to line.

3.5.4 Repair of Surface Defects

Follow guidance of ACI 301.

3.6 CURING AND PROTECTION

Protect concrete adequately from injurious action by sun, rain, flowing water, frost, mechanical injury, tire marks and oil stains, and do not allow it to dry out from the time it is placed until the expiration of the minimum curing periods specified herein. Use White-Burlap-Polyethylene Sheet or liquid membrane-forming compound, except as specified otherwise herein. Do not use membrane-forming compound on surfaces where its appearance would be objectionable, on surfaces to be painted, where coverings are to be bonded to concrete, or on concrete to which other concrete is to be bonded. Maintain temperature of air next to concrete above 40 degrees F for the full curing periods.

3.6.1 White-Burlap-Polyethylene Sheet

Wet entire exposed surface thoroughly with a fine spray of water, saturate burlap but do not have excessive water dripping off the burlap and then cover concrete with White-Burlap-Polyethylene Sheet, burlap side down. Lay sheets directly on concrete surface and overlap 12 inches. Make sheeting not less than 18 inches wider than concrete surface to be cured, and weight down on the edges and over the transverse laps to form closed joints. Repair or replace sheets when damaged during curing. Check daily to assure burlap has not lost all moisture. If moisture evaporates, resaturate burlap and re-place on pavement (re-saturation and re-placing shall take no longer than 10 minutes per sheet). Leave sheeting on concrete surface to be cured for at least 7 days.

3.6.2 Liquid Membrane-Forming Compound Curing

Apply compound immediately after surface loses its water sheen and has a dull appearance and before joints are sawed. Agitate curing compound thoroughly by mechanical means during use and apply uniformly in a two-coat continuous operation by suitable power-spraying equipment. Total coverage for the two coats shall be at least one gallon of undiluted compound per 200 square feet. Compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. Apply an additional coat of compound immediately to areas where film is defective. Respray concrete surfaces that are subject to heavy rainfall within 3 hours after curing compound has been applied in the same manner.

3.6.2.1 Protection of Treated Surfaces

Keep concrete surfaces to which liquid membrane-forming compounds have been applied free from vehicular traffic and other sources of abrasion for not less than 72 hours. Foot traffic is allowed after 24 hours for inspection purposes. Maintain continuity of coating for entire curing period and repair damage to coating immediately.

3.7 FIELD QUALITY CONTROL

3.7.1 Sampling

The Contractor's approved laboratory shall collect samples of fresh concrete in accordance with ASTM C172/C172M during each working day as required to perform tests specified herein. Make test specimens in accordance with ASTM C31/C31M.

3.7.2 Consistency Tests

The Contractor's approved laboratory shall perform concrete slump tests in accordance with ASTM C143/C143M. Take samples for slump determination from concrete during placement. Perform tests at the beginning of a concrete placement operation and and for each batch (minimum) or every 20 cubic yards (maximum) of concrete to ensure that specification requirements are met. In addition, perform tests each time test beams and cylinders are made.

3.7.3 Flexural Strength Tests

The Contractor's approved laboratory shall test for flexural strength in accordance with ASTM C78/C78M. Make four test specimens for each set of tests. Test two specimens at 7 days, and the other two at 28 days. Concrete strength will be considered satisfactory when the minimum of the 28-day test results equals or exceeds the specified 28-day flexural strength, and no individual strength test is less than 550 pounds per square inch. If the ratio of the 28-day strength test to the specified 28 -day strength is less than 65 percent, make necessary adjustments for conformance. Frequency of flexural tests on concrete beams shall be not less than four test beams for each 50 cubic yards of concrete, or fraction thereof, placed. Concrete which is determined to be defective, based on the strength acceptance criteria therein, shall be removed and replaced with acceptable concrete.

3.7.4 Air Content Tests

Test air-entrained concrete for air content at the same frequency as specified for slump tests. Determine percentage of air in accordance with ASTM C231/C231M on samples taken during placement of concrete in forms.

3.7.5 Surface Testing

Surface testing for surface smoothness and plan grade shall be performed as indicated below by the Testing Laboratory.

3.7.5.1 Surface Smoothness Requirements

The finished surfaces of the pavements shall have no abrupt change of 1/8 inch or more, and all pavements shall be within the tolerances specified when checked with a 12 foot straightedge: 1/4 inch transverse directions for roads and streets and 1/4 inch for both directions for all concrete surfaces.

3.7.5.2 Surface Smoothness Testing Method

The surface of the pavement shall be tested with the straightedge to identify all surface irregularities exceeding the tolerances specified above. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines approximately 15 feet apart. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length and measuring the maximum gap between the straightedge and the pavement surface, in the area between these two high points.

3.7.6 Plan Grade Testing and Conformance

The surfaces shall vary not more than 0.06 foot above or below the plan grade line or elevation indicated.

3.7.7 Test for Pavement Thickness

Measure during concrete placement to determine in-place thickness of concrete pavement.

3.7.8 Dowels

Inspect dowel placement prior to placing concrete to assure that dowels are of the size indicated, and are spaced, aligned and painted and oiled as specified. Dowels shall not deviate from vertical or horizontal alignment after concrete has been placed by more than 1/8 inch per foot.

3.8 WASTE MANAGEMENT

In accordance with the Waste Management Plan.

-- End of Section --

SECTION 32 13 73

COMPRESSION JOINT SEALS FOR CONCRETE PAVEMENTS
04/08

PART 1 GENERAL

1.1 UNIT PRICES

1.1.1 Measurement

The quantity of each sealing item to be paid for will be determined by measuring the length of in-place material that has been approved.

1.1.2 Payment

Payment will be made at the contract unit bid prices per unit length for the sealing items scheduled, including approved trail joint installation. Include in the unit bid prices the cost of all labor, materials, the use of all equipment, and tools required to complete the work.

1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D2628	(1991; R 2016) Standard Specification for Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D2835	(1989; R 2017) Standard Specification for Lubricant for Installation of Preformed Compression Seals in Concrete Pavements

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturer's Instructions

SD-04, Samples

Compression Seals; G

SD-06 Test Reports

Test Requirements

1.4 QUALITY ASSURANCE

1.4.1 Safety

Donot place compression joint seals within 25 feet of liquid oxygen (LOX) equipment, LOX storage, or LOX piping.

1.5 DELIVERY, STORAGE, AND HANDLING

Materials delivered to the jobsite shall be inspected for defects, unloaded, and stored with a minimum of handling to avoid damage. Provide storage facilities that protect materials from weather and maintain materials at temperatures recommended by the manufacturer.

1.6 ENVIRONMENTAL REQUIREMENTS

The ambient temperature and the pavement temperature within the joint wall shall be at least 35 degrees F and rising at the time of installation of the materials. Sealant installation will not be allowed if moisture or foreign material is observed in the joint.

PART 2 PRODUCTS

2.1 SYSTEM EQUIPMENT

2.1.1 Joint Cleaning Equipment

2.1.1.1 Concrete Saw

Provide a self-propelled power saw with water-cooled diamond saw blades for cutting joints to the depths and widths specified and for removing filler, existing old joint seal, or other material embedded in the joints or adhered to the joint faces.

2.1.2 Sealing Equipment

Equipment used to install the compression seal shall place the compression seal to the prescribed depths within the specified tolerances without cutting, nicking, twisting, or otherwise damaging the seal. The equipment shall be capable of placing the seal with not more than two percent longitudinal stretch or compression of the seal during installation. The machine shall be an automatic self-propelled joint seal application equipment and engine powered. The machine shall include a reservoir for the lubricant/adhesive, a device for conveying the lubricant/adhesive in the proper quantities to the sides of the compression seal or the sidewalls of the joints, a reel capable of holding one full spool of compression seal, and a power-driven apparatus for feeding the joint seal through a compression device and inserting the seal into the joint. The equipment shall also include a guide to maintain the proper course along the joint being sealed. The machine shall at all times be operated by an experienced operator.

2.1.3 Test Requirements

Submit certified copies of test results, 10 days prior to use of material on the project. Each lot of compression joint seal and lubricant/adhesive shall be sampled, identified, and tested for conformance with the applicable material specification.

a. A lot of compression seal shall consist of 1 day's production or 20,000 linear feet for each cross section, whichever is less. A lot of lubricant/adhesive shall consist of 1 day's production. Samples of the compression joint seal and lubricant/adhesive material shall be submitted and will be tested by the Government. No material shall be used at the project prior to receipt of written notice that the materials meet the laboratory requirements.

b. Samples of each lot of material shall also be submitted and will be retained by the Government for possible future testing should the materials appear defective during or after application. Furnish additional samples of materials, in sufficient quantity to be tested, upon request. Final acceptance will be based on conformance to the specified test requirements and the performance of the in-place materials.

2.2 COMPRESSION SEALS

Regardless of testing responsibility, submit 9 foot long samples of the materials, 60 days prior to use on the project. Printed directions from the manufacturer on recommended installation criteria shall be furnished with the samples plus the manufacturer's certification that the selected seal is recommended for the installation on this project.Compression joint seal materials shall be a vulcanized elastomeric compound using polychloroprene as the only base polymer. The material and manufactured seal shall conform to ASTM D2628 . The joint seal shall be a labyrinth type seal. The uncompressed depth of the face of the compression seal (that is to be bonded to the joint wall) shall be greater than the uncompressed width of the seal, except that for seals 1 inch or greater in width, the depth need be only 1 inch or greater. The actual width of the uncompressed seal for construction and contraction joints shall be 0.75 or 1 inches. The tolerance on the seal shall be 1/16 inch.

2.3 LUBRICANT/ADHESIVE

Lubricant/adhesive used for the compression elastomeric joint seal shall be a one-component compound conforming to ASTM D2835.

PART 3 EXECUTION

3.1 PREPARATION OF JOINTS

Immediately before installation of the compression joint seal, thoroughly clean the joints to remove laitance, filler, existing sealer, foreign material and protrusions of hardened concrete from the sides and upper edges of the joint space to be sealed. Cleaning shall be by sandblasting or waterblasting and shall extend along pavement surfaces at least 1/2 inch on either side of the joint. After final cleaning and immediately prior to sealing, the joints shall be blown out with compressed air and left completely free of debris and water. Demonstrate that the selected cleaning operation meets the cleanliness requirements. Correct any irregularity in the joint face which would prevent uniform contact between the joint seal and the joint face prior to the installation of the joint seal.

3.1.1 Sawing

Clean and open joints to the specified width and depth by sawing. Immediately following the sawing operation, thoroughly clean the joint

faces and opening using a water jet to remove saw cuttings or debris remaining on the faces or in the joint opening. Install compression seal within 3 calendar days of the time the joint cavity is sawed. Depth of the joint cavity shall be in accordance with manufacturer's instructions. Where installation procedures are required in accordance with the manufacturer's recommendations, submit printed copies of manufacturers' instructions, 30 days prior to use on the project. The saw cut for the joint seal cavity shall be centered over the joint line.

3.1.2 Sandblast Cleaning

Use a multiple pass sandblasting technique until the surfaces are free of dust, dirt, curing compound, or any residue that might prevent ready insertion or uniform contact of the seal and bonding of the lubricant/adhesive to the concrete.

3.1.3 Waterblast Cleaning

Use a multiple pass waterblast technique until the surfaces are free of dust, dirt, curing compound, or any residue that might prevent ready insertion or uniform contact of the seal and bonding of the lubricant/adhesive to the concrete.

3.1.4 Rate of Progress

Limit sandblasting or waterblasting of joint faces to the length of joint that can be sealed during the same workday.

3.2 INSTALLATION OF THE COMPRESSION SEAL

A representative of the joint seal manufacturer shall be present at the trial joint installation to correct any installation issues prior to full installation.

3.2.1 Time of Installation

Seal joints immediately within 3 calendar days of sawing the joint seal cavity and following concrete cure and the final cleaning of the joint walls. Provide open joints, ready for sealing that cannot be sealed under the specified conditions, with an approved temporary seal to prevent infiltration of foreign material. When rain interrupts the sealing operations, the joints shall be washed, air pressure cleaned, and allowed to dry prior to installing the lubricant/adhesive and compression seal.

3.2.2 Sequence of Installation

Seal first longitudinal joints, followed by transverse joints. Install seals in longitudinal joints so that all transverse joint seals will be intact from edge to edge of the pavement. Intersections shall be made monolithic by use of joint seal adhesive and care in fitting the intersection parts together. Extender pieces of seal shall not be used at intersections. Any seal falling short at the intersection shall be removed and replaced with new seal at no additional cost to the Government. Seals that are required to change direction by more than 20 degrees, may require a poured sealant at the intersection. Poured sealant shall be in accordance with compression seal manufacturer's instructions.

3.3 SEALING OF JOINTS

The sides of the joint seal or the sides of the joint shall be covered with a coating of lubricant/adhesive and the seal installed as specified. Butt joints and seal intersections shall be coated with liberal applications of lubricant/adhesive. Lubricant/adhesive spilled on the pavement shall be removed immediately to prevent setting on the pavement. The in-place joint seal shall be in an upright position and free from twisting, distortion, and cuts. Adjustments shall be made to the installation equipment and procedure, if the stretch exceeds 1 percent. Any seal exceeding 2 percent stretch shall be removed and replaced. The joint seal shall be placed at a uniform depth within the tolerances specified. In-place joint seal which fails to meet the specified requirements shall be removed and replaced with new joint seal at no cost to the Government. The compression joint seal shall be placed to a depth of 1/4 inch, plus or minus 1/8 inch, below the pavement surface except when the joint is beveled or has a radius at the surface, or unless otherwise directed. For beveled joints or joints with a radius at the surface, the compression joint seal shall be installed at a depth of 1/8 inch, plus or minus 1/8 inch, below the bottom of the edge of the bevel or radius. No part of the seal shall be allowed to project above the surface of the pavement or above the edge of the bevel or radius. The seal shall be installed in the longest practicable lengths in longitudinal joints and shall be cut at the joint intersections to provide continuous installation of the seal in the transverse joints. The lubricant/adhesive in the longitudinal joints shall be allowed to set for 1 hour prior to cutting at the joint intersections to reduce the possibility of shrinkage. For all transverse joints, the minimum length of the compression joint seal shall be the pavement width from edge to edge.

3.4 CLEAN-UP

Upon completion of the project, remove all unused materials from the site, remove any lubricant/adhesive on the pavement surface, and leave the pavement in clean condition.

3.5 QUALITY CONTROL PROVISIONS

3.5.1 Application Equipment

Inspect the application equipment to assure uniform application of lubricant/adhesive to the sides of the compression joint seal or the walls of the joint. If any equipment causes cutting, twisting, nicking, excessive stretching or compressing of the seal, or improper application of the lubricant/adhesive, suspend the operation until causes of the deficiencies are determined and corrected.

3.5.2 Procedures

3.5.2.1 Quality Control Inspection

Provide quality control provisions during the joint cleaning process to prevent or correct improper equipment and cleaning techniques that damage the concrete in any manner. Cleaned joints shall be approved by the Government prior to installation of the lubricant/adhesive and compression joint seal.

3.5.2.2 Conformance to Stretching and Compression Limitations

Determine conformance to stretching and compression limitations. Mark the top surface of the compression seal at 1 foot intervals in a manner clear and durable to enable length determinations of the seal. After installation, measure the distance between the marks on the seal. If the stretching or compression exceeds 2 percent, remove the seal and replace it with new joint at no additional cost to the Government. The seal shall be removed up to the last correct measurement. The seal shall be inspected a minimum of once per 100 feet of seal for compliance to the shrinkage or compression requirements. Measurements shall also be made at the same interval to determine conformance with depth and width of installation requirements. Remove and replace compression seal that is not in conformance with specification requirements with new joint seal at no additional cost to the Government.

3.5.2.3 Pavement Temperature

Determine the pavement temperature by placing a thermometer in the initial saw cut for the joint and record the reading. The thermometer shall remain in the joint for an adequate time to provide a control reading.

3.5.3 Final Inspection

Inspect the joint sealing system (compression seal and lubricant/adhesive) for proper rate of cure and bonding to the concrete, cuts, twists, nicks and other deficiencies. Seals exhibiting any defects, at any time prior to final acceptance of the project, shall be removed from the joint, wasted, and replaced in a satisfactory manner.

-- End of Section --

SECTION 32 16 19

CONCRETE CURBS, GUTTERS AND SIDEWALKS
05/18

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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(2005; R 2017) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

ASTM INTERNATIONAL (ASTM)

ASTM A615/A615M	(2020) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A1064/A1064M	(2017) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
ASTM C31/C31M	(2021a) Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C94/C94M	(2021b) Standard Specification for Ready-Mixed Concrete
ASTM C143/C143M	(2020) Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C171	(2020) Standard Specification for Sheet Materials for Curing Concrete
ASTM C172/C172M	(2017) Standard Practice for Sampling Freshly Mixed Concrete
ASTM C173/C173M	(2016) Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C231/C231M	(2017a) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C309	(2019) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

ASTM C920	(2018) Standard Specification for Elastomeric Joint Sealants
ASTM D1751	(2018) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D1752	(2018) Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D5893/D5893M	(2016) Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1	(2017) Standard And Commentary Accessible and Usable Buildings and Facilities

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete

Biodegradable Form Release Agent

SD-06 Test Reports

Field Quality Control

1.3 EQUIPMENT, TOOLS, AND MACHINES

1.3.1 General Requirements

Plant, equipment, machines, and tools used in the work will be subject to approval and must be maintained in a satisfactory working condition at all times. Use equipment capable of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Discontinue using equipment that produces unsatisfactory results. Allow the Contracting Officer access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.4 ENVIRONMENTAL REQUIREMENTS

1.4.1 Placing During Cold Weather

Do not place concrete when the air temperature reaches 40 degrees F and is falling, or is already below that point. Placement may begin when the air temperature reaches 35 degrees F and is rising, or is already above 40 degrees F. Make provisions to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 35 degrees F, placement and protection must be approved in writing. Approval will be contingent upon full conformance with the following provisions. Prepare and protect the underlying material so that it is entirely free of frost when the concrete is deposited. Heat mixing water and aggregates as necessary to result in the temperature of the in-place concrete being between 50 and 85 degrees F. Methods and equipment for heating must be approved. Use only aggregates that are free of ice, snow, and frozen lumps before entering the mixer. Provide covering or other means as needed to maintain the concrete at a temperature of at least 50 degrees F for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.4.2 Placing During Warm Weather

The temperature of the concrete as placed must not exceed 85 degrees F except where an approved retarder is used. Cool the mixing water and aggregates as necessary to maintain a satisfactory placing temperature. The placing temperature must not exceed 95 degrees F at any time.

PART 2 PRODUCTS

2.1 CONCRETE

Provide concrete conforming to the applicable requirements of ASTM C94/C94M except as otherwise specified. Concrete must have a minimum compressive strength of 3500 psi at 28 days. Size of aggregate must not exceed 1-1/2 inches. Submit copies of certified delivery tickets for all concrete used in the construction.

2.1.1 Air Content

Use concrete mixtures that have an air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

Use concrete with a slump of 3 inches plus or minus 1 inch for hand placed concrete or 1 inch plus or minus 1/2 inch for slipformed concrete as determined in accordance with ASTM C143/C143M.

2.1.2.1 Fiber Reinforcement

Synthetic Fiber: Fibrillated polypropylene fibers engineered and designed for use in concrete paving, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches (13 to 38 mm) long. Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd. (0.60 kg/cu. m).

2.1.3 Reinforcement Steel

Use reinforcement bars conforming to ASTM A615/A615M. Use wire mesh reinforcement conforming to ASTM A1064/A1064M.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Use impervious sheet materials conforming to ASTM C171, type optional, except that polyethylene film, if used, must be white opaque.

2.2.2 Burlap

Use burlap conforming to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

Use white pigmented membrane-forming curing compound conforming to ASTM C309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Use concrete protection materials consisting of a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the Contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Use hard-pressed fiberboard contraction joint filler for curb and gutter.

2.4.2 Expansion Joint Filler, Premolded

Onless otherwise indicated, use 1/2 inch thick premolded expansion joint filler conforming to ASTM D1751 or ASTM D1752.

2.5 JOINT SEALANTS

Use cold-applied joint sealant conforming to ASTM C920 or ASTM D5893/D5893M.

2.6 FORM WORK

Design and construct form work to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Use wood or steel forms that are straight and of sufficient strength to resist springing during depositing and consolidating concrete.

2.6.1 Wood Forms

Use forms that are surfaced plank, 2 inches nominal thickness, straight and free from warp, twist, loose knots, splits or other defects. Use forms with a nominal length of 10 feet. Radius bends may be formed with 3/4 inch boards, laminated to the required thickness.

2.6.2 Steel Forms

Use channel-formed sections with a flat top surface and welded braces at each end and at not less than two intermediate points. Use forms with interlocking and self-aligning ends. Provide flexible forms for radius forming, corner forms, form spreaders, and fillers as needed. Use forms with a nominal length of 10 feet and that have a minimum of 3 welded stake pockets per form. Use stake pins consisting of solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.3 Sidewalk Forms

Use sidewalk forms that are of a height equal to the full depth of the finished sidewalk.

2.6.4 Curb and Gutter Forms

Use curb and gutter outside forms that have a height equal to the full depth of the curb or gutter. Use rigid forms for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 10 feet or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 1-1/2 inch benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

2.6.5 Biodegradable Form Release Agent

Use form release agent that is colorless and biodegradableand that is composed of at least 87 percent biobased material. Provide product that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces. Provide form release agent that does not contain diesel fuel, petroleum-based lubricating oils, waxes, or kerosene.

2.7 Detectable Warning System

Detectable Warning Systems shown on the Contract plans are to meet requirements of ICC A117.1 - Section 705.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

Construct subgrade to the specified grade and cross section prior to concrete placement.

3.1.1 Sidewalk Subgrade

Place and compact the subgrade in accordance with Section 32 11 16. Test the subgrade for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

Place and compact the subgrade in accordance with Section 32 11 16. Test the subgrade for grade and cross section by means of a template extending

the full width of the curb and gutter. Use subgrade materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

Maintain subgrade in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade must be in a moist condition when concrete is placed. Prepare and protect subgrade so that it is free from frost when the concrete is deposited.

3.2 FORM SETTING

Set forms to the indicated alignment, grade and dimensions. Hold forms rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 4 feet. Use additional stakes and braces at corners, deep sections, and radius bends, as required. Use clamps, spreaders, and braces where required to ensure rigidity in the forms. Remove forms in a manner that will not injure the concrete. Do not use bars or heavy tools against the concrete when removing the forms. Promptly and satisfactorily repair concrete found to be defective after form removal. Clean forms and coat with form oil or biodegradable form release agent each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Set forms for sidewalks with the upper edge true to line and grade with an allowable tolerance of 1/8 inch in any 10 foot long section. After forms are set, grade and alignment must be checked with a 10 foot straightedge. Sidewalks must have a transverse slope as indicated. Do not remove side forms less than 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

Remove forms used along the front of the curb not less than 2 hours nor more than 6 hours after the concrete has been placed. Do not remove forms used along the back of curb until the face and top of the curb have been finished, as specified for concrete finishing. Do not remove gutter forms while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Place concrete in the forms in one layer. When consolidated and finished, the sidewalks must be of the thickness indicated. Use a strike-off guided by side forms after concrete has been placed in the forms to bring the surface to proper section to be compacted. Consolidate concrete by tamping and spading or with an approved vibrator. Finish the surface to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, finish the surface with a wood or magnesium float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. Produce a scored

surface by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

Finish all slab edges, including those at formed joints, with an edger having a radius of 1/8 inch. Edge transverse joints before brooming. Eliminate the flat surface left by the surface face of the edger with brooming. Clean and solidly fill corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing with a properly proportioned mortar mixture and then finish.

3.3.4 Surface and Thickness Tolerances

Finished surfaces must not vary more than 5/16 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Place concrete to the required section in a single lift. Consolidate concrete using approved mechanical vibrators. Curve shaped gutters must be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Float and finish exposed surfaces with a smooth wood float until true to grade and section and uniform in texture. Brush floated surfaces with a fine-hair brush using longitudinal strokes. Round the edges of the gutter and top of the curb with an edging tool to a radius of 1/2 inch. Immediately after removing the front curb form, rub the face of the curb with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. Brush the front curb surface, while still wet, in the same manner as the gutter and curb top. Finish the top surface of gutter to grade with a wood float.

3.4.4 Joint Finishing

Finish curb edges at formed joints as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces must not vary more than 1/4 inch from the testing edge of a 10-foot straightedge. Permissible deficiency in section thickness will be up to 1/4 inch.

3.5 SIDEWALK JOINTS

Construct sidewalk joints to divide the surface into rectangular areas. Space transverse contraction joints at a distance equal to the sidewalk width or 5 feet on centers, whichever is less, and continuous across the slab. Construct longitudinal contraction joints along the centerline of

all sidewalks 10 feet or more in width. Construct transverse expansion joints at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, install transverse expansion joints as indicated. Form expansion joints around structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated. Expansion joints are not required between sidewalks and curb that abut the sidewalk longitudinally.

3.5.1 Sidewalk Contraction Joints

Form contraction joints in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness. Unless otherwise approved or indicated, either use a jointer to cut the groove or saw a groove in the hardened concrete with a power-driven saw. Construct sawed joints by sawing a groove in the concrete with a 1/8 inch blade. Provide an ample supply of saw blades on the jobsite before concrete placement is started. Provide at least one standby sawing unit in good working order at the jobsite at all times during the sawing operations.

3.5.2 Sidewalk Expansion Joints

Form expansion joints using 1/2 inch joint filler strips. Joint filler in expansion joints surrounding structures and features within the sidewalk may consist of preformed filler material conforming to ASTM D1752 or building paper. Hold joint filler in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, round joint edges using an edging tool having a radius of 1/8 inch. Remove any concrete over the joint filler. At the end of the curing period, clean the top of expansion joints and fill with cold-applied joint sealant. Use joint sealant that is gray or stone in color. Thoroughly clean the joint opening before the sealing material is placed. Do not spill sealing material on exposed surfaces of the concrete. Apply joint sealing material only when the concrete at the joint is surface dry and atmospheric and concrete temperatures are above 50 degrees F. Immediately remove any excess material on exposed surfaces of the concrete and clean the concrete surfaces.

3.6 CURB AND GUTTER JOINTS

Construct curb and gutter joints at right angles to the line of curb and gutter.

3.6.1 Contraction Joints

Construct contraction joints directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 5 feet nor greater than 15 feet in length.

a. Construct contraction joints (except for slip forming) by means of 1/8 inch thick separators and of a section conforming to the cross section of the curb and gutter. Remove separators as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

b. When slip forming is used, cut the contraction joints in the top

portion of the gutter/curb hardened concrete in a continuous cut across the curb and gutter, using a power-driven saw. Cut the contraction joint to a depth of at least one-fourth of the gutter/curb depth using a 1/8 inch saw blade.

3.6.2 Expansion Joints

Form expansion joints by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Construct expansion joints in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement using the same type and thickness of joints as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, provide expansion joints at least 1/2 inch in width at intervals not less than 30 feet nor greater than 120 feet. Seal expansion joints immediately following curing of the concrete or as soon thereafter as weather conditions permit. Seal expansion joints and the top 1 inch depth of curb and gutter contraction-joints with joint sealant. Thoroughly clean the joint opening before the sealing material is placed. Do not spill sealing material on exposed surfaces of the concrete. Concrete at the joint must be surface dry and atmospheric and concrete temperatures must be above 50 degrees F at the time of application of joint sealing material. Immediately remove excess material on exposed surfaces of the concrete and clean concrete surfaces.

3.7 CURING AND PROTECTION

3.7.1 General Requirements

Protect concrete against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Protect unhardened concrete from rain and flowing water. All equipment needed for adequate curing and protection of the concrete must be on hand and ready for use before actual concrete placement begins. Protect concrete as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.7.1.1 Mat Method

Cover the entire exposed surface with two or more layers of burlap. Overlap mats at least 6 inches. Thoroughly wet the mat with water prior to placing on concrete surface and keep the mat continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.7.1.2 Impervious Sheeting Method

Wet the entire exposed surface with a fine spray of water and then cover with impervious sheeting material. Lay sheets directly on the concrete surface with the light-colored side up and overlapped 12 inches when a continuous sheet is not used. Use sheeting that is not less than 18-inches wider than the concrete surface to be cured. Secure sheeting using heavy wood planks or a bank of moist earth placed along edges and laps in the sheets. Satisfactorily repair or replace sheets that are torn or otherwise damaged during curing. Sheeting must remain on the concrete surface to be cured for not less than 7 days.

3.7.2 Backfilling

After curing, remove debris and backfill, grade, and compact the area adjoining the concrete to conform to the surrounding area in accordance with lines and grades indicated.

3.7.3 Protection

Protect completed concrete from damage until accepted. Repair damaged concrete and clean concrete discolored during construction. Remove and reconstruct concrete that is damaged for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Dispose of removed material as directed.

3.7.4 Protective Coating

Apply a protective coating of linseed oil mixture to the exposed-to-view concrete surface after the curing period, if concrete will be exposed to de-icing chemicals within 6 weeks after placement. Moist cure concrete to receive a protective coating.

3.7.4.1 Application

Complete curing and backfilling operation prior to applying two coats of protective coating. Concrete must be surface dry and clean before each application. Spray apply at a rate of not more than 50 square yards/gallon for first application and not more than 70 square yards/gallon for second application, except that the number of applications and coverage for each application for commercially prepared mixture must be in accordance with the manufacturer's instructions. Protect coated surfaces from vehicular and pedestrian traffic until dry.

3.7.4.2 Precautions

Do not heat protective coating by direct application of flame or electrical heaters and protect the coating from exposure to open flame, sparks, and fire adjacent to open containers or applicators. Do not apply material at ambient or material temperatures lower than 50 degrees F.

3.8 FIELD QUALITY CONTROL

Submit copies of all test reports within 24 hours of completion of the test.

3.8.1 General Requirements

Perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, take the action and submit reports as required below, and additional tests to ensure that the requirements of these specifications are met.

3.8.2 Concrete Testing

3.8.2.1 Strength Testing

Take concrete samples in accordance with ASTM C172/C172M not less than once a day nor less than once for every 250 cubic yards of concrete placed. Mold cylinders in accordance with ASTM C31/C31M for strength

testing by an approved laboratory. Each strength test result must be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 500 psi.

3.8.2.2 Air Content

Determine air content in accordance with ASTM C173/C173M or ASTM C231/C231M. Use ASTM C231/C231M with concretes and mortars made with relatively dense natural aggregates. Make two tests for air content on randomly selected batches of each class of concrete placed during each shift. Make additional tests when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. Notify the placing foreman if results are out of tolerance. The placing foreman must take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.8.2.3 Slump Test

Perform two slump tests on randomly selected batches of each class of concrete for every 250 cubic yards, or fraction thereof, of concrete placed during each shift. Perform additional tests when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.8.3 Thickness Evaluation

Determine the anticipated thickness of the concrete prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, construct the subgrade true to grade prior to concrete placement. The thickness will be determined by measuring each edge of the completed slab.

3.8.4 Surface Evaluation

Provide finished surfaces for each category of the completed work that are uniform in color and free of blemishes and form or tool marks.

3.9 SURFACE DEFICIENCIES AND CORRECTIONS

3.9.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 1/4 inch the deficient section will be removed, between regularly scheduled joints, and replaced.

3.9.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, reduce high areas either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by

grinding the surface of the hardened concrete must not exceed 5 percent of the area of any integral slab, and the depth of grinding must not exceed 1/4 inch. Remove and replace pavement areas requiring grade or surface smoothness corrections in excess of the limits specified.

3.9.3 Appearance

Exposed surfaces of the finished work will be inspected by the Contracting Officer and deficiencies in appearance will be identified. Remove and replace areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work.

3.10 DETECTABLE WARNING SYSTEM

Install Detectable Warning Systems required by Contract plans in accordance with ICC A117.1, Section 705, and by manufacturers' installation instructions.

-- End of Section --

SECTION 32 17 23

PAVEMENT MARKINGS
08/16

PART 1 GENERAL

1.1 UNIT PRICES

1.1.1 Measurement

1.1.1.1 Surface Preparation

The unit of measurement for surface preparation (cleaning) is the number of square feet of pavement surface prepared for marking and accepted by the Contracting Officer.

1.1.1.2 Pavement Striping and Markings

The unit of measurement for pavement markings is the number of square feet of reflective and/or nonreflective striping or markings actually completed and accepted by the Contracting Officer.

1.1.1.3 Raised Pavement Markers

The unit of measurement for raised pavement markers is the number actually placed as specified and approved by the Contracting Officer.

1.1.1.4 Removal of Pavement Markings on Roads and Automotive Parking Areas

The unit of measurement for removal of pavement markings is the number of square feet of pavement markings removed as specified and accepted by the Contracting Officer.

1.1.2 Payment

The quantities of surface preparation, pavement striping or markings, raised pavement markers, and removal of pavement markings determined as specified in paragraph Measurement, will be paid for at the contract unit price. The payment constitutes full compensation for furnishing all labor, materials, tools, equipment, appliances, and doing all work involved in preparing and marking the pavements as shown on the drawings. Remove and replace any striping or markings which required reflective media, but are placed without it, do not meet the stated minimum retro-reflective requirements, or with other defects, at no cost to the Government. Remove and replace striping or markings which do not conform to the required physical characteristics, alignment or location required at no cost to the Government.

1.2 REFERENCES

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

ASTM INTERNATIONAL (ASTM)

ASTM D471 (2016a) Standard Test Method for Rubber Property - Effect of Liquids

ASTM D522/D522M	(2014) Mandrel Bend Test of Attached Organic Coatings
ASTM D711	(2010; R 2015) No-Pick-Up Time of Traffic Paint
ASTM D823	(2018) Standard Practices for Producing Films of Uniform Thickness of Paint, Coatings, and Related Products on Test Panels
ASTM D2240	(2015; E 2017) Standard Test Method for Rubber Property - Durometer Hardness
ASTM D2621	(1987; R 2016) Standard Test Method for Infrared Identification of Vehicle Solids from Solvent-Reducible Paints
ASTM D2697	(2003; R 2014) Volume Nonvolatile Matter in Clear or Pigmented Coatings
ASTM D3335	(1985a; R 2014) Low Concentrations of Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy
ASTM D3718	(1985a; R 2015) Low Concentrations of Chromium in Paint by Atomic Absorption Spectroscopy
ASTM D3924	(2016) Standard Specification for Environment for Conditioning and Testing Paint, Varnish, Lacquer, and Related Materials
ASTM D3960	(2005; R 2013) Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
ASTM D4061	(2013) Standard Test Method for Retroreflectance of Horizontal Coatings
ASTM D4541	(2017) Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
ASTM D6628	(2003; R 2015) Standard Specification for Color of Pavement Marking Materials
ASTM E1710	(2011) Standard Test Method for Measurement of Retroreflective Pavement Marking Materials with CEN-Prescribed Geometry Using a Portable Retroreflectometer
ASTM E2177	(2011) Standard Test Method for Measuring the Coefficient of Retroreflected Luminance (RL) of Pavement Markings in a Standard Condition of Wetness

ASTM E2302	(2003; R 2016) Standard Test Method for Measurement of the Luminance Coefficient Under Diffuse Illumination of Pavement Marking Materials Using a Portable Reflectometer
ASTM G154	(2016) Standard Practice for Operating Fluorescent Light Apparatus for UV Exposure of Nonmetallic Materials

INTERNATIONAL CONCRETE REPAIR INSTITUTE (ICRI)

ICRI 03732	(1997) Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE AMS-STD-595A	(2017) Colors used in Government Procurement

U.S. FEDERAL HIGHWAY ADMINISTRATION (FHWA)

MUTCD	(2015) Manual on Uniform Traffic Control Devices

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

SD-06 Test Reports

High Build Acrylic Coating (HBAC); G

SD-07 Certificates

Qualifications; G

Volatile Organic Compound, (VOC); G

1.4 QUALITY ASSURANCE

1.4.1 Qualifications

Submit documentation certifying that pertinent personnel are qualified for equipment operation and handling of applicable chemicals. The documentation should include experience on five projects of similar size and scope with references for all personnel.

1.5 DELIVERY AND STORAGE

Deliver paint materials, thermoplastic compound materials, and reflective media in original sealed containers that plainly show the designated name, specification number, batch number, color, date of manufacture, manufacturer's directions, and name of manufacturer.

Provide storage facilities at the job site, only in areas approved by the Contracting Officer, for maintaining materials at temperatures recommended by the manufacturer. Make available paint stored at the project site or segregated at the source for sampling not less than 30 days prior to date of required approval for use to allow sufficient time for testing. Notify the Contracting Officer when paint is available for sampling.

1.6 PROJECT/SITE CONDITIONS

1.6.1 Environmental Requirements

1.6.1.1 Weather Limitations for Application

Apply pavement markings to clean, dry surfaces, and unless otherwise approved, only when the air and pavement surface temperature is at least 5 degrees F above the dew point and the air and pavement temperatures are within the limits recommended by the pavement marking manufacturer. Allow pavement surfaces to dry after water has been used for cleaning or rainfall has occurred prior to striping or marking. Test the pavement surface for moisture before beginning work each day and after cleaning. Do not commence marking until the pavement is sufficiently dry and the pavement condition has been approved by the Contracting Officer. Employ the "plastic wrap method" to test the pavement for moisture as specified in paragraph TESTING FOR MOISTURE.

1.6.1.2 Weather Limitations for Removal of Pavement Markings on Roads and Automotive Parking Areas

Pavement surface must be free of snow, ice, or slush; with a surface temperature of at least 40 degrees F and rising at the beginning of operations, except those involving shot or sand blasting or grinding. Cease operation during thunderstorms, or during rainfall, except for waterblasting and removal of previously applied chemicals. Cease waterblasting where surface water accumulation alters the effectiveness of material removal.

1.6.2 Traffic Controls

Place warning signs conforming to MUTCD near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Place small markers along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Mark painting equipment with large warning signs indicating slow-moving painting equipment in operation.

When traffic must be rerouted or controlled to accomplish the work, provide necessary warning signs, flag persons, and related equipment for the safe passage of vehicles.

1.6.3 Lighting

When night operations are necessary, provide all necessary lighting and equipment. The Government reserves the right to accept or reject night work on the day following night activities by the Contractor.

PART 2 PRODUCTS

2.1 MATERIALS

Use high build acrylic for roads and parking. The maximum allowable VOC content of pavement markings is 150 grams per liter. Color of markings are indicated on the drawings and must conform to ASTM D6628 for roads and automotive parking areas and SAE AMS-STD-595A for airfields. Provide materials conforming to the requirements specified herein.

2.1.1 High Build Acrylic Coating (HBAC)

Formulate High Build Acrylic Coating (HBAC) to meet the requirements of Table II.

TABLE II - REQUIREMENTS FOR HIGH BUILD ACRYLIC COATINGS (HBAC)

TEST	MINIMUM REQUIREMENT (AND MAXIMUM WHERE INDICATED)
Resin System (ASTM D2621)	Waterborne 100 percent Acrylic
Percent Volume Solids (ASTM D2697)	58 percent
Volatile Organic Compound, max. (ASTM D3960)	1.25 lbs/gal
White (SAE AMS-STD-595A)	37925
Yellow (SAE AMS-STD-595A)	33538
Shore D Hardness (ASTM D2240)	45
1/8 inch Mandrel Bend at 5 mils Dry Film Thickness (DFT, one-week cure (ASTM D522/D522M, Method B)	No visual defects at bend (Conditions at ASTM D3924)
Adhesion to Concrete and Asphaltic Pavements (ASTM D4541)	140 psi or 100 percent cohesive failure in pavement
Accelerated Weathering, Yellow, 2500 Hours UV Exposure (ASTM G154: see note 1)	Max. color loss to 33655 (SAE AMS-STD-595A)
Water Absorption at 168 Hours Immersion Tap Water (ASTM D471)	9.0 percent max. weight increase (conditions at ASTM D3924)

TABLE II - REQUIREMENTS FOR HIGH BUILD ACRYLIC COATINGS (HBAC)	
TEST	MINIMUM REQUIREMENT (AND MAXIMUM WHERE INDICATED)
Application at 65 mils Wet,One Coat, One-week Cure, (see note 2)	No visual cracking or curling (conditions at ASTM D3924)
No Pick-Up at 25 mils (ASTM D711)	Wet 10 minutes max.
Lead (ASTM D3335)	0.06 percent max.
Cadmium (ASTM D3335)	0.06 percent max.
Chromium (ASTM D3718)	0.00 percent

Notes:

(1) Properly mix and apply yellow paint at 10 mils plus or minus 2 mils DFT over a suitably sized, clean aluminum substrate (ASTM D823), and cure for a minimum of 48 hours: prepare four individual yellow samples. Expose three samples to continuous Ultraviolet (UV) light for 2500 hours, without cycles condensation, in accordance to ASTM G154: use UVA-340 lamps in the testing apparatus. Following exposure, compare the three exposed samples to the "one" non-exposed sample using SAE AMS-STD-595A colors 33538 and 33655 as visual references: evaluate exposed samples for degree of visual color loss. Yellow paint is rated as passing if each exposed sample appears equivalent to the non-exposed sample, and in addition, displays color loss no greater than SAE AMS-STD-595A color 33655.

(2) Using double-stick, foam mounting tape (or equal) with a nominal thickness of 65 mils, apply a rectangular mold with inner dimensions of 3 in by 10 in to a clean aluminum sample approximately sized at 6 in by 12 in by 1/8 in. Do not remove the tape's plastic backing. Mix and apply excess paint into mold. Remove excess paint, by squeegee or other appropriate draw down technique, to a uniform thickness equal to the tape's height. Perform paint application and draw down within a period of no more than 60 seconds. Approximately one to two minutes following the draw down, remove tape from sample and allow coating to cure for a minimum period of one week ASTM D3924. Using a micrometer or other appropriate device, measure cured coating thickness (less sample thickness) to confirm resulting coating application was at or above 38 mils DFT. Inspect coating for visual signs of cracking and curling. Following a one week cure, the coating is rated as passing if applied greater than 38 mils DFT and visually free of both cracking and curling.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Testing for Moisture

Test the pavement surface for moisture before beginning pavement marking after each period of rainfall, fog, high humidity, or cleaning, or when the ambient temperature has fallen below the dew point. Do not commence marking until the pavement is sufficiently dry and the pavement condition has been approved by the Contracting Officer or authorized representative.

Employ the "plastic wrap method" to test the pavement for moisture as follows: Cover the pavement with a 12 inch by 12 inch section of clear plastic wrap and seal the edges with tape. After 15 minutes, examine the plastic wrap for any visible moisture accumulation inside the plastic. Do not begin marking operations until the test can be performed with no visible moisture accumulation inside the plastic wrap. Re-test surfaces when work has been stopped due to rain.

3.1.2 Test Stripe Demonstration

Prior to paint application, demonstrate test stripe application within the work area using the proposed materials and equipment. Apply separate test stripes in each of the line widths and configurations required herein using the proposed equipment. Make the test stripes long enough to determine the proper speed and operating pressures for the vehicle(s) and machinery, but not less than 50 feet long.

3.1.3 Application Rate Demonstration

During the Test Stripe Demonstration, demonstrate compliance with the application rates specified herein. Document the equipment speed and operating pressures required to meet the specified rates in each configuration of the equipment and provide a copy of the documentation to the Contracting Officer prior to proceeding with the work.

3.1.4 Retroreflective Value Demonstration

After the test stripes have cured to a "no-track" condition, demonstrate compliance with the average retroreflective values specified herein. Take a minimum of ten readings on each test stripe with a Retroreflectometer with a direct readout in millicandelas per square meter per lux (mcd/m2/lx). Perform testing in accordance with ASTM D4061, ASTM E1710, ASTM E2177, and ASTM E2302.

3.1.5 Level of Performance Demonstration

The Contracting Officer will be present at the application demonstrations to observe the results obtained and to validate the operating parameters of the vehicle(s) and equipment. If accepted by the Contracting Officer, the test stripe is the measure of performance required for this project. Do not proceed with the work until the demonstration results are satisfactory to the Contracting Officer.

3.2 EXTERIOR SURFACE PREPARATION

Allow new pavement surfaces to cure for a period of not less than 30 days before application of marking materials. Thoroughly clean surfaces to be

marked before application of the paint. Remove dust, dirt, and other granular surface deposits by sweeping, blowing with compressed air, rinsing with water, or a combination of these methods as required. Remove rubber deposits, existing paint markings, residual curing compounds, and other coatings adhering to the pavement by water blastingapproved chemical removal method.

a. For Portland Cement Concrete pavement, grinding, light shot blasting, or light scarification, to a resulting profile equal to ICRI 03732 CSP 2, CSP 3, and CSP 4, respectively, can be used in addition to water blasting on most pavements, to either remove existing coatings, or for surface preparation.

b. Do not use shot blasting on airfield pavements due to the potential of Foreign Object Damage (FOD) to aircraft. Scrub affected areas, where oil or grease is present on old pavements to be marked, with several applications of trisodium phosphate solution or other approved detergent or degreaser and rinse thoroughly after each application. After cleaning oil-soaked areas, seal with shellac or primer recommended by the manufacturer to prevent bleeding through the new paint. Do not commence painting in any area until pavement surfaces are dry and clean.

3.2.1 Early Painting of Rigid Pavements

Pretreat rigid pavements that require early painting with an aqueous solution containing 3 percent phosphoric acid and 2 percent zinc chloride. Apply the solution to the areas to be marked.

3.2.2 Early Painting of Asphalt Pavements

For asphalt pavement systems requiring painting application at less than 30 days, apply the paint and beads at half the normal application rate, followed by a second application at the normal rate after 30 days.

3.3 APPLICATION

Apply pavement markings to dry pavements only.

3.3.1 Paint

Apply paint with approved equipment at rate of coverage specified herein. Provide guidelines and templates as necessary to control paint application. Take special precautions in marking numbers, letters, and symbols. Manually paint numbers, letters, and symbols. Sharply outline all edges of markings. The maximum drying time requirements of the paint specifications will be strictly enforced, to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a deficiency in drying of the markings, painting operations must cease until the cause of the slow drying is determined and corrected.

3.3.1.1 High Build Acrylic Coating

Apply High Build Acrylic Coating (HBAC) at a rate of 50 square feet per gallon. Apply Type IV (Gradation A) beads at a minimum rate of 16 pounds of glass spheres per gallon.

3.3.2 Cleanup and Waste Disposal

Keep the worksite clean and free of debris and waste from the removal and application operations. Dispose of debris at approved sites.

3.4 FIELD QUALITY CONTROL

3.4.1 Material Inspection

Examine material at the job site to determine that it is the material referenced in the report of test results or certificate of compliance. Provide test results substantiating conformance to the specified requirements with each certificate of compliance.

3.4.2 Dimensional Tolerances

Apply all markings in the standard dimensions provide in the drawings. New markings may deviate a maximum of 10 percent larger than the standard dimension. The maximum deviation allowed when painting over an old marking is up to 20 percent larger than the standard dimensions.

3.4.3 Bond Failure Verification

Inspect newly applied markings for signs of bond failure based on visual inspection and comparison to results from Test Stripe Demonstration paragraph.

3.4.4 Reflective Media and Coating Application Verification

Use a wet film thickness gauge to measure the application of wet paint. Use a microscope or magnifying glass to evaluate the embedment of glass beads in the paint. Verify the glass bead embedment with approximately 50 percent of the individual bead spheres embedded and 50 percent of the individual bead spheres exposed.

3.4.5 Retroreflective Markings

Collect and record readings for white and yellow retroreflective markings at the rate of one reading per 1000 linear feet. The minimum acceptable average for white markings is 200 millicandelas per square meter per lux (mcd/m2/lx) (measured with Retroreflectometer). The minimum acceptable average for yellow markings is 175 millicandelas per square meter per lux (mcd/m2/lx). Compute readings by averaging a minimum of 10 readings taken within the area at random locations. Re-mark areas not meeting the retroreflective requirements stated above.

-- End of Section --

SECTION 32 92 19

SEEDING
08/17

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 D4427	(2018) Standard Classification of Peat Samples by Laboratory Testing
ASTM D4972	(2018) Standard Test Methods for pH of Soils

U.S. DEPARTMENT OF AGRICULTURE (USDA)

AMS Seed Act	(1940; R 1988; R 1998) Federal Seed Act
DOA SSIR 42	(1996) Soil Survey Investigation Report No. 42, Soil Survey Laboratory Methods Manual, Version 3.0

1.2 DEFINITIONS

1.2.1 Stand of Turf

95 percent ground cover of the established species.

1.3 RELATED REQUIREMENTS

Section 31 23 00.00 20 EXCAVATION AND FILL applies to this section for pesticide use and plant establishment requirements, with additions and modifications herein.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Wood Cellulose Fiber Mulch

Fertilizer

Include physical characteristics, and recommendations.

SD-06 Test Reports

Topsoil Composition Tests (reports and recommendations).

SD-07 Certificates

State Certification and Approval for Seed

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Seed Protection

Protect from drying out and from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer Gypsum Sulfur Iron and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer gypsum sulphur iron and lime may be furnished in bulk with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Seed, Fertilizer Gypsum Sulfur Iron and Lime Storage

Store in cool, dry locations away from contaminants.

1.5.2.2 Topsoil

Prior to stockpiling topsoil, treat growing vegetation with application of appropriate specified non-selective herbicide. Clear and grub existing vegetation three to four weeks prior to stockpiling topsoil.

1.5.2.3 Handling

Do not drop or dump materials from vehicles.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 TIME LIMITATIONS

1.7.1 Seed

Apply seed within twenty four hours after seed bed preparation.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Classification

Provide State-certified seed of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for

percentages of mixtures, purity, germination, weedseed content, and inert material. Label in conformance with AMS Seed Act and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected.

2.1.2 Planting Dates

Planting Season: Spring - April 15 to June 15.

Planting Season: Fall - September 15 to October 30.

2.1.3 Grass Seed Mix

Botanical Name	Common Name	Minimum Percent Pure Seed
Poa pratensis	Kentucky bluegrass	50
Festuca rubra variety	Chewings red fescue	30
Lolium perenne	Perennial ryegrass	10
Agrostis alba	redtop	10

2.2 TOPSOIL

2.2.1 Off-Site Topsoil

Conform to requirements specified in paragraph COMPOSITION. Additional topsoil must be furnished by the Contractor.

2.2.2 Composition

Containing from 5 to 10 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR 42. Maximum particle size, 3/4 inch, with maximum 3 percent retained on 1/4 inch screen. The pH must be tested in accordance with ASTM D4972. Topsoil must be free of sticks, stones, roots, and other debris and objectionable materials. Other components must conform to the following limits:

Silt	25-50 percent
Clay	10-30 percent
Sand	20-35 percent
pH	5.5 to 7.0
Soluble Salts	600 ppm maximum

2.3 SOIL CONDITIONERS

Add conditioners to topsoil as required to bring into compliance with

"composition" standard for topsoil as specified herein.

2.3.1 Lime

Commercial grade.

2.3.2 Aluminum Sulfate

Commercial grade.

2.3.3 Sulfur

100 percent elemental

2.3.4 Iron

100 percent elemental

2.3.5 Peat

Natural product of peat moss derived from a freshwater site and conforming to ASTM D4427. Shred and granulate peat to pass a 1/2 inch mesh screen and condition in storage pile for minimum 6 months after excavation.

2.3.6 Sand

Clean and free of materials harmful to plants.

2.3.7 Perlite

Horticultural grade.

2.3.8 Composted Derivatives

Ground bark, nitrolized sawdust, humus or other green wood waste material free of stones, sticks, and soil stabilized with nitrogen and having the following properties:

2.3.8.1 Particle Size

Minimum percent by weight passing:

No. 4 mesh screen	95
No. 8 mesh screen	80

2.3.8.2 Nitrogen Content

Minimum percent based on dry weight:

Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.3.9 Gypsum

Coarsely ground gypsum comprised of calcium sulfate dihydrate 80 percent, calcium 18 percent, sulfur 14 percent; minimum 96 percent passing through 20 mesh screen, 100 percent passing thru 16 mesh screen.

2.3.10 Calcined Clay

Calcined clay must be granular particles produced from montmorillonite clay calcined to a minimum temperature of 1200 degrees F. Gradation: A minimum 90 percent must pass a No. 8 sieve; a minimum 99 percent must be retained on a No. 60 sieve; and material passing a No. 100 sieve must not exceed 2 percent. Bulk density: A maximum 40 pounds per cubic foot.

2.4 FERTILIZER

2.4.1 Granular Fertilizer

synthetic, granular controlled release fertilizer containing the following minimum percentages, by weight, of plant food nutrients:

25 percent available nitrogen
25 percent available phosphorus
40 percent available potassium
5 percent sulfur
5 percent iron

2.4.2 Hydroseeding Fertilizer

Controlled release fertilizer, to use with hydroseeding and composed of pills coated with plastic resin to provide a continuous release of nutrients for at least 6 months and containing the following minimum percentages, by weight, of plant food nutrients.

25 percent available nitrogen
25 percent available phosphorus
40 percent available potassium
5 percent sulfur
5 percent iron

2.5 MULCH

Mulch must be free from noxious weeds, mold, and other deleterious materials.

2.5.1 Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Straw must contain no fertile seed.

2.5.2 Hay

Air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Hay must be sterile, containing no fertile seed.

2.5.3 Wood Cellulose Fiber Mulch

Use recovered materials of either paper-based (100 percent post-consumer content) or wood-based (100 percent total recovered content) hydraulic mulch. Processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of materials application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 5.5 to 8.2. Use with hydraulic application of grass seed and fertilizer.

2.6 WATER

Source of water must be approved by Contracting Officer and of suitable quality for irrigation, containing no elements toxic to plant life.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 EXTENT OF WORK

Provide soil preparation prior to planting (including soil conditioners as required), fertilizing, seeding, and surface topdressing of all newly graded finished earth surfaces, unless indicated otherwise, and at all areas inside or outside the limits of construction that are disturbed by the Contractor's operations.

3.1.1.1 Topsoil

Provide 4 inches of off-site topsoil to meet indicated finish grade. After areas have been brought to indicated finish grade, incorporate fertilizer, pH adjusters, soil conditioners into soil a minimum depth of 4 inches by disking, harrowing, tilling or other method approved by the Contracting Officer. Remove debris and stones larger than 3/4 inch in any dimension remaining on the surface after finish grading. Correct irregularities in finish surfaces to eliminate depressions. Protect finished topsoil areas from damage by vehicular or pedestrian traffic.

3.1.1.2 Soil Conditioner Application Rates

Apply soil conditioners at rates as determined by laboratory soil analysis of the soils at the job site.

3.2 SEEDING

3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade. Do not seed when ground is muddy frozen, snow covered or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to the Contracting Officer stating the special conditions and proposed variance. Apply seed within twenty four hours after seedbed preparation. Sow seed by approved sowing equipment. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing.

3.2.2 Seed Application Method

Seeding method must be broadcasted and drop seeding, hydroseeding.

3.2.2.1 Broadcast and Drop Seeding

Seed must be uniformly broadcast at the rate of 5 pounds per 1000 square feet. Use broadcast or drop seeders. Sow one-half the seed in one direction, and sow remainder at right angles to the first sowing. Cover seed uniformly to a maximum depth of 1/4 inch in clay soils and 1/2 inch in sandy soils by means of spike-tooth harrow, cultipacker, raking or other approved devices.

3.2.2.2 Hydroseeding

First, mix water and fiber. Wood cellulose fiber, paper fiber, or recycled paper must be applied as part of the hydroseeding operation. Fiber must be added at 1,000 pounds, dry weight, per acre. Then add and mix seed and fertilizer to produce a homogeneous slurry. Seed must be mixed to ensure broadcasting at the rate of 5-7 pounds per 1000 square feet. When hydraulically sprayed on the ground, material must form a blotter like cover impregnated uniformly with grass seed. Spread with one application with no second application of mulch.

3.2.3 Mulching

3.2.3.1 Hay or Straw Mulch

Hay or straw mulch must be spread uniformly at the rate of 2 tons per acre. Mulch must be spread by hand, blower-type mulch spreader, or other approved method. Mulching must be started on the windward side of relatively flat areas or on the upper part of steep slopes, and continued uniformly until the area is covered. The mulch must not be bunched or clumped. Sunlight must not be completely excluded from penetrating to the ground surface. All areas installed with seed must be mulched on the same day as the seeding. Mulch must be anchored immediately following spreading.

3.2.3.2 Mechanical Anchor

Mechanical anchor must be a V-type-wheel land packer; a scalloped-disk land packer designed to force mulch into the soil surface; or other suitable equipment.

3.2.3.3 Asphalt Adhesive Tackifier

Asphalt adhesive tackifier must be sprayed at a rate between 10 to 13 gallons per 1000 square feet. Sunlight must not be completely excluded from penetrating to the ground surface.

3.2.3.4 Non-Asphaltic Tackifier

Hydrophilic colloid must be applied at the rate recommended by the manufacturer, using hydraulic equipment suitable for thoroughly mixing with water. A uniform mixture must be applied over the area.

3.2.3.5 Asphalt Adhesive Coated Mulch

Hay or straw mulch may be spread simultaneously with asphalt adhesive applied at a rate between 10 to 13 gallons per 1000 square feet, using power mulch equipment which must be equipped with suitable asphalt pump and nozzle. The adhesive-coated mulch must be applied evenly over the surface. Sunlight must not be completely excluded from penetrating to the ground surface.

3.2.4 Rolling

Immediately after seeding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width.

3.2.5 Watering

Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 2 inches without run off. During the germination process, seed is to be kept actively growing and not allowed to dry out.

3.3 PROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 RESTORATION

Restore to original condition existing turf areas which have been damaged during turf installation operations at the Contractor's expense. Keep clean at all times at least one paved pedestrian access route and one paved vehicular access route to each building. Clean other paving when work in adjacent areas is complete.

-- End of Section --

SECTION 33 40 00

STORMWATER UTILITIES
11/21

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 ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO HB-17	(2002; Errata 2003; Errata 2005, 17th Edition) Standard Specifications for Highway Bridges

ASTM INTERNATIONAL (ASTM)

ASTM A48/A48M	(2003; R 2021) Standard Specification for Gray Iron Castings
ASTM D2321	(2020) Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
ASTM D2564	(2020) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D3212	(2020) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F477	(2014; R 2021) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F679	(2016) Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F714	(2021a) Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
ASTM F2764/F2764M	(2019) Standard Specification for 6 to 60 in. 150 to 1500 mm Polypropylene (PP) Corrugated Double and Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications
ASTM F2881/F2881M	(2021) Standard Specification for 12 to 60 in. (300 to 1500 mm) Polypropylene (PP)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Leakage Test; G

SD-07 Certificates

Hydrostatic Test on Watertight Joints; G

Frame and Cover or Gratings; G

SD-08 Manufacturer's Instructions

Placing Pipe; G

1.3 DELIVERY, STORAGE, AND HANDLING

1.3.1 Delivery and Storage

Inspect materials delivered to site for damage and unload and store materials with minimumal handling. Do not store materials directly on the ground. Keep the inside of pipes and fittings free of dirt and debris. Before, during, and after installation, protect plastic pipe and fittings from any environment that would result in damage or deterioration to the material. Keep a copy of the manufacturer's instructions available at the construction site at all times and follow these instructions unless directed otherwise by the Contracting Officer. Store solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe in accordance with the manufacturer's recommendations and discard if the storage period exceeds the recommended shelf life. Discard solvents in use when the recommended pot life is exceeded.

1.3.2 Handling

Handle materials in a manner that ensures delivery to the trench in sound, undamaged condition. Carry pipe to the trench.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe sizes for culverts and storm drains are indicated on the drawings.

2.1.1 Poly Vinyl Chloride (PVC) Pipe

2.1.1.1 Smooth Wall PVC Pipe

ASTM F679.

2.1.2 Polyethylene (PE) Pipe

2.1.2.1 Smooth Wall PE Pipe

ASTM F714, maximum DR of 21 for pipes 3 to 24 inches in diameter and maximum DR of 26 for pipes 26 to 48 inches in diameter. Polyethylene compound material designation PE3608.

2.1.3 Polypropylene(PP) Pipe

Provide double wall and triple wall pipe meeting the requirements of ASTM F2764/F2764M or ASTM F2881/F2881M, Class I, II.

2.2 PIPE JOINTS

Provide joints that have been tested for and meet the requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.

2.2.1 PVC Plastic Pipe

Provide solvent cement or elastomeric gasket type joints in accordance with the specification for the pipe and as recommended by the pipe manufacturer. Use solvent cement conforming to ASTM D2564. Provide gaskets for elastomeric joints conforming to ASTM F477.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Frame and Cover or Gratings

Submit certification on the ability of frame and cover or gratings to carry the imposed live load indicated on the drawings. Stamp or cast the word "Storm Sewer" into covers so that it is plainly visible.

2.3.2 Downspout Boots

Use boots conforming to ASTM A48/A48M, Class 30B or 35B of the size and shape indicated for connecting exterior downspouts to the storm-drainage system.

2.4 TESTS, INSPECTIONS, AND VERIFICATIONS

2.4.1 Hydrostatic Test on Watertight Joints

Perform a hydrostatic test on the watertight joint types as proposed. This test will be conducted at the plant or by an independent laboratory. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested.

2.4.1.1 Concrete, Clay, PVC, PE, SRPE and PP Pipe

Provide joints in PVC, PE, SRPE, and PP plastic pipe meeting the test requirements in ASTM D3212.

PART 3 EXECUTION

3.1 BEDDING AND INITIAL BACKFILL

3.1.1 Concrete Pipe

3.1.1.1 Trenches

After the pipe has been properly bedded and haunch material placed to the midpoint (springline) of the pipe, backfill and compact the remainder of the trench by spreading and rolling or compacting by mechanical rammers or tampers in layers not exceeding 6 inches. Test for density as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Leave untreated sheeting in place beneath structures or pavements.

3.1.2 Plastic Pipe

Provide bedding for PVC, PE, SRPE and PP pipe meeting the requirements of ASTM D2321. Use Class IB or II material for PVC, PE, SRPE pipe bedding, haunching, and initial backfill. Use Class I, II, or III material for PP pipe bedding, haunching and initial backfill.

3.2 PLACING PIPE AND BOX CULVERT

3.2.1 Concrete, Clay, PVC, Ribbed PVC, Ductile Iron Pipe

Lay pipe proceeding upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.2.2 PE, SRPE, and Dual Wall and Triple Wall PP Pipe

Lay on a bed shaped to line and grade and joint sections together in accordance with manufacturer's guidelines.

3.3 INSTALLATION OF TRACER WIRE AND WARNING TAPE

Install warning tap 31 23 00.00 20 EXCAVATION AND FILL.

3.4 FINAL BACKFILL

Backfill trenches with satisfactory material deposited in layers of a maximum of 8 inches loose thickness and compacted to 90 percent of maximum density for cohesive soils and 95 percent of maximum density for cohesionless soils in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL. Testing is the responsibility of the Contractor and will be performed at no additional cost to the Government. Unless otherwise specified, determine field in-place density of final backfill at a frequency of one test per 50 linear feet, or fraction thereof, of each lift of backfill. Submit test results in accordance with Section 31 23 00.00 20 EXCAVATION AND FILL. Do not displace or damage pipe or box when compacting final backfill by rolling or operating heavy equipment parallel with the pipe or box. Movement of construction machinery over a culvert or storm drain at any stage of construction will be at the Contractor's risk. Repair or replace any damaged pipe. Protect concrete

pipes with a minimum of 3 feet of cover prior to permitting heavy construction equipment to pass over them during construction. Provide the minimum cover for construction loads over corrugated steel pipes as specified in Section 26, Division II of AASHTO HB-17. Provide minimum cover for construction loads over plastic pipes as specified in ASTM D2321.

3.5 FIELD QUALITY CONTROL

3.5.1 Tests

Testing is the responsibility of the Contractor. Perform all testing and retesting at no additional cost to the Government.

3.5.1.1 Leakage Test

Test pipe lines for leakage prior to completing backfill by performing either an exfiltration test, low pressure air pipeline test or by individual pipe joint testing. Submit leakage test results to the Contracting Officer.

3.5.1.2 Tracer Wire Continuity

Test tracer wire for continuity after initial and final backfilling of pipes. Verify that tracer wire is locatable with electronic utility location equipement. Repair breaks or separations and re-test for continuity.

3.5.2 Repair of Defects

3.5.2.1 Leakage Test

When leakage exceeds the maximum amount specified, correct source of excess leakage by replacing damaged pipe and gaskets and retest.

3.5.2.2 Inspection

3.5.2.2.1 Flexible Pipe

Replace pipes having cracks or splits.

3.6 PROTECTION

Protect storm drainage piping and adjacent areas from superimposed and external loads during construction.

3.7 WARRANTY PERIOD

Pipe segments found to have defects during the warranty period must be replaced with new pipe and retested.

-- End of Section --

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		01 11 00	SD-01 Preconstruction Submittals															
			Dig Safe Permit	1.9.1	G	RO												
		01 20 00	SD-01 Preconstruction Submittals															
			Schedule of Values	1.2	G													
		01 30 00	SD-01 Preconstruction Submittals															
			View Location Map	1.4	G	RO												
			Progress and Completion	1.5	G	RO												
			Pictures															
			Preconstruction Video Recording	1.5.5.2														
			Preconstruction Digital	1.5.4.2														
			Photographs															
			Work To Be Performed By The	1.10	G	RO												
			Contractor															
			Eng Form 93	1.21	G	RO												
			Eng Form 93	1.21	G	RO												
			Eng Form 93	1.21	G	RO												
			SD-04 Samples															
			Color Boards	1.3	G	RO												
			SD-05 Design Data															
			Periodic Construction Video	1.5.5.3														
			Recordings															
			Periodic Construction Digital	1.5.4.3														
			Photographs															
			Final Completion Construction	1.5.5.4														
			Video Recordings															
			SD-07 Certificates															

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		01 30 00	Eng Form 93	1.21	G	RO												
			Eng Form 93	1.21	G	RO												
			Eng Form 93	1.21	G	RO												
			SD-11 Closeout Submittals															
			Final Completion Construction	1.5.4.4														
			Digital Photographs															
		01 32 01.00 10	SD-01 Preconstruction Submittals															
			Project Scheduler Qualifications	1.3	G	RO												
			Preliminary Project Schedule	3.4.1	G	RO												
			Initial Baseline Project Schedule	3.4.2	G	RO												
			Periodic Schedule Update	3.6.2	G	RO												
			Narrative Report	3.5.2	G	RO												
		01 33 00	SD-01 Preconstruction Submittals															
			Submittal Register	1.9	G													
		01 33 29	SD-01 Preconstruction Submittals															
			Preliminary High Performance	1.5.3.2	G	RO												
			and Sustainable Building Checklist															
			Sustainability Action Plan	1.4.1	G	RO												
			Preliminary Sustainability	1.5.3.2	G	RO												
			eNotebook															
			SD-11 Closeout Submittals															
			Final High Performance and	1.5.3.2	G	RO												
			Sustainable Building Checklist															
			Final Sustainability eNotebook	1.5.3.2	G	RO												
			Amended Final Sustainability	1.5.3.2	G	RO												
			eNotebook															

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		01 33 29	Amended Final High	1.5.3.2	G	RO												
			Performance and Sustainable															
			Building Checklist															
			Third Party Certification	3.2	G	RO												
			Certificate, Assessment, or															
			Validation and Compliance Report															
		01 45 00.00 10	SD-01 Preconstruction Submittals															
			Contractor Quality Control (CQC)	3.2	G	RO												
			Plan															
			SD-06 Test Reports															
			Verification Statement	3.9.2														
			SD-07 Certificates															
			QCR Report		G	RO												
		01 50 00	SD-01 Preconstruction Submittals															
			Construction Site Plan	1.4	G	RO												
			Traffic Control Plan	3.4.1	G	RO												
			Haul Road Plan	2.2.1	G	RO												
			Contractor Computer	1.7.1.4	G	RO												
			Cybersecurity Compliance															
			Statements															
			Contractor Temporary Network	1.7.6	G	RO												
			Cybersecurity Compliance															
			Statements															
			SD-06 Test Reports															
			Backflow Preventer Tests	3.5														
			SD-07 Certificates															

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		01 50 00	Backflow Tester	1.5.1														
			Backflow Preventers	1.5														
		01 57 19	SD-01 Preconstruction Submittals															
			Environmental Control Plan	1.3	G													
		01 58 00	SD-02 Shop Drawings															
			Sign Legend Orders	1.3.1	G	RO												
		01 78 23	SD-10 Operation and Maintenance															
			Data															
			O&M Database	1.3	G	RO												
			Training Plan	3.1.1	G	RO												
			Training Outline	3.1.3	G	RO												
			Training Content	3.1.2	G	RO												
			SD-11 Closeout Submittals															
			Training Video Recording	3.1.4	G	RO												
			Validation of Training Completion	3.1.6	G	RO												
		01 78 24.00 10	SD-01 Preconstruction Submittals															
			Facility Data Project Execution	1.4.1														
			Plan															
			SD-10 Operation and Maintenance															
			Data															
			Facility Data Workbook,	3.1	G	RO												
			Construction Progress															
			Facility Document Set,	3.1	G	RO												
			Construction Progress															
			SD-11 Closeout Submittals															

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		01 78 24.00 10	Facility Data Workbook,	3.2	G	RO												
			Construction Final															
			Facility Document Set,	1.4.3	G	RO												
			Construction Final															
			Facility Document Set,	3.2	G	RO												
			Construction Final															
		02 41 00	SD-01 Preconstruction Submittals															
			Demolition Plan	1.2.2	G													
			Existing Conditions	1.10														
			SD-07 Certificates															
			Notification	1.7	G													
			SD-11 Closeout Submittals															
			Receipts	3.2.3														
		07 60 00	SD-02 Shop Drawings															
			Gutters	3.1.6	G													
			Downspouts	3.1.7	G													
			Recycled Content	2.1	S													
			SD-03 Product Data															
			Factory fabricated	1.4.1														
			SD-04 Samples															
			Finish Samples	1.4.2	G													
		07 84 00	SD-02 Shop Drawings															
			Firestopping System	2.1	G													
			SD-03 Product Data															
			Firestopping Materials	2.2	G													
			SD-07 Certificates															

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		07 84 00	Firestopping Materials	2.2															
			Installer Qualifications	1.5.1	G														
		07 92 00	SD-03 Product Data																
			Sealants	2.1	G														
			Primers	2.2	G														
			Bond Breakers	2.3	G														
			Backstops	2.4	G														
			Field Adhesion	3.1	G														
			SD-07 Certificates																
			Indoor Air Quality For Interior	2.1.1	S														
			Sealants																
		08 91 00	SD-02 Shop Drawings																
			Wall Louvers	1.4															
			SD-03 Product Data																
			Metal Wall Louvers	2.2															
		09 51 00	SD-03 Product Data																
			Acoustical Ceiling Systems	2.1	G														
			SD-04 Samples																
			Acoustical Units	2.2	G														
		23 05 15	SD-01 Preconstruction Submittals																
			Material, Equipment, and Fixture	1.2	G														
			Lists																
			SD-02 Shop Drawings																
			Record Drawings	1.2	G														
			Connection Diagrams	1.2	G														
			Coordination Drawings	1.2	G														

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		23 05 15	Fabrication Drawings	1.2	G														
			Installation Drawings	3.1	G														
			SD-03 Product Data																
			Pipe and Fittings	2.2	G														
			Piping Specialties	2.3	G														
			Valves	2.4	G														
			Miscellaneous Materials	2.5	G														
			Supporting Elements	2.6	G														
			Equipment Foundation Data	1.2	G														
			SD-04 Samples																
			Manufacturer's Standard Color	1.2	G														
			Charts																
			SD-05 Design Data																
			Pipe and Fittings	2.2	G														
			Piping Specialties	2.3	G														
			Valves	2.4	G														
			SD-06 Test Reports																
			Hydrostatic Tests	3.1	G														
			Air Tests	3.1	G														
			Valve-Operating Tests	3.1	G														
			Drainage Tests	3.1	G														
			Pneumatic Tests	3.1	G														
			Non-Destructive Electric Tests	3.1	G														
			System Operation Tests	3.1	G														
			SD-07 Certificates																

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		23 05 15	Record of Satisfactory Field	1.4.2	G													
			Operation															
			List of Qualified Permanent	1.4.3	G													
			Service Organizations															
			Listing of Product Installations	1.2	G													
			Records of Existing Conditions	1.2	G													
			Surface Resistance	3.1	G													
			Shear and Tensile Strengths	3.1	G													
			Temperature Ratings	3.1	G													
			Bending Tests	3.1	G													
			Flattening Tests	3.1	G													
			Transverse Guided Weld Bend	3.1	G													
			Tests															
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.11	G													
			Manuals															
		23 05 93	SD-01 Preconstruction Submittals															
			Records of Existing Conditions	1.3.3	G													
			TAB Firm	1.5.3.1	G													
			TAB Team Assistants	1.2	G													
			TAB Team Engineer	1.2	G													
			TAB Specialist	1.5.3.2	G	AE												
			TAB Team Field Leader	1.2	G													
			SD-02 Shop Drawings															

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		23 05 93	TAB Schematic Drawings and	1.3.3	G													
			Report Forms															
			SD-03 Product Data															
			Equipment and Performance	1.3	G													
			Data															
			TAB Related HVAC Submittals	1.5.3.4	G													
			TAB Procedures	1.5.2	G													
			Calibration	1.5.2	G													
			Systems Readiness Check	1.3.3	G													
			TAB Execution	1.5.4	G													
			TAB Verification	1.5.4.3	G													
			SD-06 Test Reports															
			Certified Final DALT Report	3.3.6	G													
			TAB Design Review Report	1.7.2.1	GG-AE													
			TAB Report for Season 1	1.5.5.2	G													
			TAB Report for Season 2	1.5.5.2	G													
			SD-07 Certificates															
			Independent TAB Agency and	1.5.1	G													
			Personnel Qualifications															
			DALT and TAB Submittal and	1.7.2	G													
			Work Schedule															
			TAB Pre-Field Engineering	1.7.2.3	G													
			Report															
			TAB Firm	1.5.3.1	G													
			Design Review Report	1.3.3	G													

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		23 05 93	Pre-field DALT Preliminary	1.7.2.2	G														
			Notification																
			Prerequisite HVAC Work Check	1.7.2	G														
			Out List For Season 1																
		23 07 00	SD-02 Shop Drawings																
			MICA Plates	3.2.2.4	G														
			Pipe Insulation Systems	2.3															
			Pipe Insulation Systems	3.2															
			Duct Insulation Systems	3.3															
			Equipment Insulation Systems	3.4															
			Recycled content for insulation	2.3.1	S														
			materials																
			SD-03 Product Data																
			Pipe Insulation Systems	2.3	G														
			Pipe Insulation Systems	3.2	G														
			Duct Insulation Systems	3.3	G														
			Equipment Insulation Systems	3.4	G														
			SD-04 Samples																
			Thermal Insulation	2.2.1.3	G														
			Display Samples	3.1.1	G														
			SD-07 Certificates																
			Indoor air quality for adhesives	2.2.1	S														
			SD-08 Manufacturer’s Instructions																
			Pipe Insulation Systems	2.3	G														
			Pipe Insulation Systems	3.2	G														
			Duct Insulation Systems	3.3	G														

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		23 07 00	Equipment Insulation Systems	3.4	G													
		23 09 00	SD-02 Shop Drawings															
			DDC Contractor Design Drawings	3.3	G													
			Draft As-Built Drawings	3.3	G													
			Final As-Built Drawings	3.3	G													
			SD-03 Product Data															
			Certificate of Networthiness	1.8.1	G													
			Documentation															
			Programming Software	1.8	G													
			Proprietary Multi-Split	1.1.1.3	G													
			Engineering Tool Software															
			Manufacturer's Product Data	2.2	G													
			SD-05 Design Data															
			Boiler Or Chiller Plant Gateway	1.9														
			Request															
			SD-06 Test Reports															
			Existing Conditions Report	3.1.1														
			Start-Up Testing Report	3.5.2	G													
			PVT Procedures	3.6.1	G													
			PVT Report	3.6.3	G													
			Pre-Construction Quality Control	1.10.1	G													
			(QC) Checklist															
			Post-Construction Quality Control	1.10.2	G													
			(QC) Checklist															
			SD-10 Operation and Maintenance															
			Data															

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ACTIVITY NO	TRANSMITTAL NO	SPEC SECT	DESCRIPTION ITEM SUBMITTED	PARAG # RAPH	CLASSIFICATION	GOVT OR A/E REVWR	CONTRACTOR: SCHEDULE DATES			CONTRACTOR ACTION			APPROVING AUTHORITY					MAILED TO CONTR/ DATE RCD FRM APPR AUTH	REMARKS
							SUBMIT	APPROVAL NEEDED BY	MATERIAL NEEDED BY	ACTION CODE	DATE OF ACTION	DATE FWD TO APPR AUTH/ DATE RCD FROM CONTR	DATE FWD TO OTHER REVIEWER	DATE RCD FROM OTH REVIEWER	ACTION CODE	DATE OF ACTION		
(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)		(q)	(r)
		23 09 00	Operation and Maintenance	3.7	G														
			(O&M) Instructions																
			Training Documentation	3.9.1	G														
			SD-11 Closeout Submittals																
			Enclosure Keys	2.5	G														
			Password Summary Report	3.2.6.1	G														
			Closeout Quality Control (QC)	1.10.3	G														
			Checklist																
		23 21 23	SD-02 Shop Drawings																
			System Coordination	2.1.2	G AE														
			SD-03 Product Data																
			Instructions	2.2.2	G AE														
			Equipment Data	2.2.5	G AE														
			Training Period	3.5.2	G AE														
			SD-06 Test Reports																
			Factory Tests	2.8															
			Field Quality Control	3.3															
			SD-07 Certificates																
			Manufacturer's Representative	1.3.1															
			SD-10 Operation and Maintenance																
			Data																
			Operation and Maintenance	3.5.1	G AE														
			Manuals																
			Training	3.5.2	G AE														
		23 25 00	SD-03 Product Data																
			Water Treatment System	2.6.4.1	G														

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		23 25 00	Water Analysis	2.5	G													
			Spare Parts	1.6														
			Field Instructions	3.4														
			Tests	3.5	G													
			Training Course	3.4	G													
			SD-06 Test Reports															
			Condenser Water QA Tests	3.5.5.1														
			Steam Boiler Water QA Tests	3.5.5.4														
			SD-10 Operation and Maintenance															
			Data															
			Water Treatment System	2.6.4.1														
		23 30 00	SD-02 Shop Drawings															
			Detail Drawings	1.4.4	G													
			SD-03 Product Data															
			Metallic Flexible Duct	2.9.1.1														
			Insulated Nonmetallic Flexible	2.9.1.2														
			Duct Runouts															
			Duct Connectors	2.9.1.2														
			Duct Access Doors	2.9.2	G													
			Fire Dampers	2.9.3														
			Manual Balancing Dampers	2.9.4	G													
			Sound Attenuation Equipment	2.9.8														
			Acoustical Duct Liner	2.9.8.3														
			Diffusers	2.9.9.1														
			Registers and Grilles	2.9.9.2														
			Louvers	2.9.10														

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		23 30 00	Air Vents, Penthouses, and	2.9.11														
			Goosenecks															
			Centrifugal Fans	2.10.1.1														
			In-Line Centrifugal Fans	2.10.1.2														
			Axial Flow Fans	2.10.1.3														
			Panel Type Power Wall	2.10.1.4														
			Ventilators															
			Centrifugal Type Power Wall	2.10.1.5														
			Ventilators															
			Centrifugal Type Power Roof	2.10.1.6														
			Ventilators															
			Propeller Type Power Roof	2.10.1.7														
			Ventilators															
			Air-Curtain Fans	2.10.1.8														
			Ceiling Exhaust Fans	2.10.1.9														
			PL-109-58 label for ceiling	2.10.1.9	S													
			exhaust fan product															
			Air Handling Units	2.11	G													
			Room Fan-Coil Units	2.12.1	G													
			Coil Induction Units	2.12.2	G													
			Constant Volume, Single Duct	2.12.3.1	G													
			Terminal Units															
			Variable Volume, Single Duct	2.12.3.2	G													
			Terminal Units															
			Variable Volume, Single Duct,	2.12.3.3	G													
			Fan-Powered Terminal Units															

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		23 30 00	Dual Duct Terminal Units	2.12.3.4	G													
			Ceiling Induction Terminal Units	2.12.3.5	G													
			Reheat Units	2.12.3.7	G													
			Unit Ventilators	2.12.4														
			Energy Recovery Devices	2.13	G													
			Hydronic Modular Panels	2.16.1	G													
			Prefabricated Radiant-Heating	2.16.3	G													
			Electric Panels															
			Test Procedures	1.4.5														
			Diagrams	1.2.1.2	G													
			Indoor Air Quality for Duct	2.9.1	S													
			Sealants															
			SD-06 Test Reports															
			Performance Tests	3.12	G													
			Damper Acceptance Test	3.10	G													
			SD-07 Certificates															
			Ozone Depleting Substances	1.4.3														
			Technician Certification															
			SD-08 Manufacturer’s Instructions															
			Manufacturer's Installation	3.2														
			Instructions															
			Operation and Maintenance	3.15.2														
			Training															
			SD-10 Operation and Maintenance															
			Data															

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		23 30 00	Operation and Maintenance	3.15.1	G													
			Manuals															
			Fire Dampers	2.9.3	G													
			Manual Balancing Dampers	2.9.4	G													
			Centrifugal Fans	2.10.1.1	G													
			In-Line Centrifugal Fans	2.10.1.2	G													
			Axial Flow Fans	2.10.1.3	G													
			Panel Type Power Wall	2.10.1.4	G													
			Ventilators															
			Centrifugal Type Power Wall	2.10.1.5	G													
			Ventilators															
			Centrifugal Type Power Roof	2.10.1.6	G													
			Ventilators															
			Propeller Type Power Roof	2.10.1.7	G													
			Ventilators															
			Air-Curtain Fans	2.10.1.8	G													
			Ceiling Exhaust Fans	2.10.1.9	G													
			Air Handling Units	2.11	G													
			Room Fan-Coil Units	2.12.1	G													
			Coil Induction Units	2.12.2	G													
			Constant Volume, Single Duct	2.12.3.1	G													
			Terminal Units															
			Variable Volume, Single Duct	2.12.3.2	G													
			Terminal Units															
			Variable Volume, Single Duct,	2.12.3.3	G													
			Fan-Powered Terminal Units															

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		23 30 00	Dual Duct Terminal Units	2.12.3.4	G													
			Ceiling Induction Terminal Units	2.12.3.5	G													
			Reheat Units	2.12.3.7	G													
			Unit Ventilators	2.12.4	G													
			Energy Recovery Devices	2.13	G													
			Hydronic Modular Panels	2.16.1	G													
			Prefabricated Radiant-Heating	2.16.3	G													
			Electric Panels															
			SD-11 Closeout Submittals															
			Indoor Air Quality During	3.13	S													
			Construction															
		23 36 00.00 40	SD-01 Preconstruction Submittals															
			Records of Existing Conditions	1.2.1														
			SD-02 Shop Drawings															
			Bypass Single-Duct Air Terminal	2.1.2	G													
			Units															
			Dual-Duct Air Terminal Units	2.1.3	G													
			Fan-Powered Air Terminal Units	2.1.4	G													
			Induction Air Terminal Units	2.1.5	G													
			Shutoff Single-Duct Air Terminal	2.1.6	G													
			Units															
			Integral-Diffuser Air Terminal	2.1.7	G													
			Units															
			High-Pressure Dual-Duct Mixing	2.1.8	G													
			Boxes															

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		23 36 00.00 40	Low-Pressure Dual-Duct Mixing Boxes	2.1.9	G														
			SD-03 Product Data																
			Bypass Single-Duct Air Terminal Units	2.1.2	G														
			Dual-Duct Air Terminal Units	2.1.3	G														
			Fan-Powered Air Terminal Units	2.1.4	G														
			Induction Air Terminal Units	2.1.5	G														
			Shutoff Single-Duct Air Terminal Units	2.1.6	G														
			Integral-Diffuser Air Terminal Units	2.1.7	G														
			High-Pressure Dual-Duct Mixing Boxes	2.1.8	G														
			Low-Pressure Dual-Duct Mixing Boxes	2.1.9	G														
			SD-06 Test Reports																
			Test Report	3.2															
			SD-07 Certificates																
			List of Spare Parts	1.2.1															
			SD-10 Operation and Maintenance Data																
			Operation and Maintenance Manuals	3.4.1															
			SD-11 Closeout Submittals																
			Record Drawings	3.4.1															

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		23 37 13.00 40	SD-01 Preconstruction Submittals															
			Material, Equipment, and Fixture	2.2.1	G													
			Lists															
			Records of Existing Conditions	2.2.1	G													
			SD-02 Shop Drawings															
			Fabrication Drawings	2.2.1	G													
			Installation Drawings	3.1	G													
			SD-03 Product Data															
			Equipment and Performance	2.1	G													
			Data															
			SD-04 Samples															
			Manufacturer's Standard Color	2.2.1	G													
			Chart															
		23 52 00	SD-02 Shop Drawings															
			Detail Drawings	1.5														
			SD-03 Product Data															
			Materials and Equipment	2.1.1	G													
			Spare Parts	1.5														
			Water Treatment System	2.10														
			Boiler Water Treatment	2.10														
			Heating System Tests	3.8														
			Fuel System Tests	3.11														
			Welding	1.3														
			Qualifications	3.8														
			Field Instructions	3.10														
			Tests	3.4														

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		23 52 00	SD-06 Test Reports																
			Heating System Tests	3.8	G														
			Fuel System Tests	3.11	G														
			SD-07 Certificates																
			Bolts	2.6.8.3															
			SD-10 Operation and Maintenance																
			Data																
			Operation and Maintenance	3.10	G														
			Instructions																
			Water Treatment System	2.10	G														
			SD-11 Closeout Submittals																
			Indoor Air Quality During	3.9.2	S														
			Construction																
		23 64 00	SD-02 Shop Drawings																
			Drawings	1.5.2	G														
			SD-03 Product Data																
			Posted Instructions	3.1.3	G														
			Verification of Dimensions	1.5.1	G														
			System Performance Tests	3.5	G														
			Demonstrations	3.6															
			SD-06 Test Reports																
			Field Acceptance Testing	3.4	G														
			System Performance Tests	3.5	G														
			SD-08 Manufacturer's Instructions																
			Water Chiller - Installation	3.1	G														
			Instructions																

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		23 64 00	SD-10 Operation and Maintenance																
			Data																
			Operation and Maintenance	3.6															
			Manuals																
			SD-11 Closeout Submittals																
			Indoor Air Quality During	3.3	S														
			Construction																
		23 64 10	SD-03 Product Data																
			Posted Instructions	3.1.3															
			Verification of Dimensions	1.6.1															
			Factory Tests	2.8															
			System Performance Tests	3.6															
			Demonstrations	3.7															
			Refrigerant	2.5.1															
			Water Chiller - Field Acceptance	3.5.1															
			Test Plan																
			SD-06 Test Reports																
			Field Acceptance Testing	3.5															
			Factory Tests	2.8															
			System Performance Tests	3.6															
			SD-07 Certificates																
			Refrigeration System	3.1.9	G														
			Ozone Depleting Substances	1.3.1															
			Technician Certification																
			SD-11 Closeout Submittals																

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		23 64 10	Indoor Air Quality During	3.4	S														
			Construction																
		23 73 13.00 40	SD-02 Shop Drawings																
			Installation Drawings	3.2	G														
			Fabrication and Connection	2.1	G														
			Drawings																
			SD-03 Product Data																
			Equipment and Performance	2.1	G														
			Data																
			Sample Warranty	1.3.2	G														
			Air Filter Gauges	2.2.11.5	G														
			Coating Specimen	2.2.2.3	G														
			Final Test Reports	3.3.3	G														
			SD-07 Certificates																
			List of Product Installations	1.3															
			Certificates of Conformance	1.3.1	G														
			Unit Cabinet	2.2.2															
			Fan	2.2.3															
			Drain Pans	2.2.4															
			Insulation	2.2.5															
			Plenums	2.2.6															
			Multizone AHU	2.2.7															
			Blow-Through AHU	2.2.8															
			Spare Parts	2.1															
			SD-10 Operation and Maintenance																
			Data																

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(a)	(b)	(c)	(d)	(e)	(f)		(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)
		23 73 13.00 40	Operation and Maintenance	3.4.1														
			Manuals															
			SD-11 Closeout Submittals															
			Warranty	1.5														
		23 80 20.00 10	SD-02 Shop Drawings															
			Detail Drawings	1.3														
			Installation	3.2														
			SD-03 Product Data															
			Spare Parts	1.5														
			SD-06 Test Reports															
			Testing, Adjusting, and Balancing	3.4														
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.3														
			Instructions															
		23 82 19.00 40	SD-02 Shop Drawings															
			Fabrication Drawings	2.2	G													
			Installation Drawings	3.1	G													
			SD-03 Product Data															
			Equipment and Performance	2.2	G													
			Data															
			Coils	2.2	G													
			Casing	2.2	G													
			Enclosure	2.2	G													
			Motors	2.2	G													
			Fan	2.2	G													

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		23 82 19.00 40	Drain Pans	2.2	G													
			Filters	2.2	G													
			Controls	2.2	G													
			Vibration Isolation	2.2	G													
			SD-04 Samples															
			Manufacturer's Standard Color	2.2	G													
			Chart															
			SD-07 Certificates															
			List of Product Installations	1.3														
			Certificates of Conformance	2.2														
			SD-10 Operation and Maintenance															
			Data															
			Operation and Maintenance	3.3														
			Manuals															
			SD-11 Closeout Submittals															
			Warranty	3.3														
		25 05 11.01	SD-01 Preconstruction Submittals															
			Qualifications	1.7.1	G	AE												
			Wireless and Wired Broadcast	3.2.1.3	G	AE												
			Communication Request															
			Device Account Lock Exception	3.3.2	G	AE												
			Request															
			Multiple Ethernet Connection	3.2.3.3	G	AE												
			Device Request															

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		25 05 11.01	Contractor Computer	1.9.1.6	G	AE												
			Cybersecurity Compliance															
			Statements															
			Contractor Temporary Network	1.9.6	G	AE												
			Cybersecurity Compliance															
			Statements															
			Cybersecurity Interconnection	1.8.2	G	AE												
			Schedule															
			Proposed STIG and SRG	1.8.1	G	AE												
			Applicability Report															
			SD-02 Shop Drawings															
			Network Communication Report	1.8.3	G	AE												
			Cybersecurity Riser Diagram	1.8.6	G	AE												
			SD-03 Product Data															
			Control System Cybersecurity	1.8.8	G	AE												
			Documentation															
			SD-06 Test Reports															
			Control System Cybersecurity	3.10.1	G	AE												
			Testing Procedures															
			Control System Cybersecurity	3.10.3	G	AE												
			Testing Report															
			SD-11 Closeout Submittals															
			Confidential Password Report	3.4.5.4	G	AE												
			Confidential Password Report	3.4.5.4	G	AE												
			Confidential Password Report	3.4.5.4	G	AE												

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		25 05 11.01	Password Change Summary Report	3.4.5.4	G	AE												
			Password Change Summary Report	3.4.5.4	G	AE												
			Enclosure Keys	3.3.5	G	AE												
			Software and Configuration Backups	1.8.5	G	AE												
			STIG, SRG and Vendor Guide Compliance Result Report	1.8.7	G	AE												
			Control System Inventory Report	1.8.4	G	AE												
		25 05 11.02	SD-01 Preconstruction Submittals															
			Device Account Lock Exception Request	3.3.2	G	AE												
			Multiple Ethernet Connection Device Request	3.2.3.3	G	AE												
			Contractor Computer Cybersecurity Compliance Statements	1.9.1.6	G	AE												
			Contractor Temporary Network Cybersecurity Compliance Statements	1.9.6	G	AE												
			Proposed STIG and SRG Applicability Report	1.8.1	G	AE												
			Qualifications	1.7.1	G	AE												
			SD-02 Shop Drawings															
			Network Communication Report	1.8.2	G	AE												

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		25 05 11.02	Cybersecurity Riser Diagram	1.8.5	G	AE												
			SD-03 Product Data															
			Control System Cybersecurity	1.8.7	G	AE												
			Documentation															
			SD-06 Test Reports															
			Control System Cybersecurity	3.10.1	G	AE												
			Testing Procedures															
			Control System Cybersecurity	3.10.3	G	AE												
			Testing Report															
			SD-11 Closeout Submittals															
			Confidential Password Report	3.4.5.4	G	AE												
			Confidential Password Report	3.4.5.4	G	AE												
			Confidential Password Report	3.4.5.4	G	AE												
			Password Change Summary	3.4.5.4	G	AE												
			Report															
			Password Change Summary	3.4.5.4	G	AE												
			Report															
			Enclosure Keys	3.3.7	G	AE												
			Software and Configuration	1.8.4	G	AE												
			Backups															
			STIG, SRG and Vendor Guide	1.8.6	G	AE												
			Compliance Result Report															
			Control System Inventory Report	1.8.3	G	AE												
			Integrity Verification Software	3.9.1	G	AE												
		26 05 00.00 40	SD-02 Shop Drawings															
			Marking Strips	3.2.8.1	G													

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		26 05 00.00 40	SD-03 Product Data																
			Conduits and Raceways	2.1.1	G														
			Wire and Cable	2.2.1	G														
			Splices and Connectors	3.2.7	G														
			Switches	2.2.3	G														
			Receptacles	2.2.5	G														
			Outlet Boxes, Pull Boxes and	2.1.3	G														
			Junction Boxes																
			Circuit Breakers	2.1.4	G														
			Device Plates	2.2.2	G														
			SD-06 Test Reports																
			Continuity Test	3.6	G														
			Phase-Rotation Tests	3.6	G														
			Insulation Resistance Test	3.6	G														
			600-Volt Wiring Test	3.6	G														
			Ground-Fault Receptacle Test	3.6	G														
			Insulation-Resistance Test	3.6	G														
			SD-08 Manufacturer’s Instructions																
			Manufacturer's Instructions	3.1															
		26 08 00	SD-06 Test Reports																
			Acceptance Tests and	3.1	G														
			Inspections																
			SD-07 Certificates																
			Qualifications	1.4.1	G														
			Acceptance Test and Inspections	1.4.3	G														
			Procedure																

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		26 20 00	SD-02 Shop Drawings																
			Panelboards	2.11	G														
			Wireways	2.22	G														
			Marking Strips	3.1.5.1	G														
			SD-03 Product Data																
			Receptacles	2.10	G														
			Circuit Breakers	2.11.1	G														
			Switches	2.8	G														
			Motor Controllers	2.14	G														
			Manual Motor Starters	2.15	G														
			SD-06 Test Reports																
			600-volt Wiring Test	3.5.2	G														
			Ground-fault Receptacle Test	3.5.3	G														
			SD-07 Certificates																
			Fuses	2.9	G														
			SD-10 Operation and Maintenance																
			Data																
			Electrical Systems	1.5.1	G														
		26 29 23	SD-02 Shop Drawings																
			Schematic Diagrams	1.5.1	G														
			Interconnecting Diagrams	1.5.2	G														
			Installation Drawings	1.5.3	G														
			As-Built Drawings	1.5.3	G														
			SD-03 Product Data																
			Adjustable Speed Drives	2.1	G														
			Wires and Cables	2.3															

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		26 29 23	Equipment Schedule	1.5.4															
			SD-06 Test Reports																
			ASD Test	3.3.1															
			Performance Verification Tests	3.3.2															
			Endurance Test	3.3.3															
			SD-07 Certificates																
			Testing Agency's Field	3.3.1	G														
			Supervisor																
			SD-08 Manufacturer’s Instructions																
			Installation instructions	1.5.5															
			SD-09 Manufacturer’s Field																
			Reports																
			ASD Test Plan	2.5.1	G														
			Standard Products	1.5.6															
			SD-10 Operation and Maintenance																
			Data																
			Adjustable Speed Drives	2.1															
		31 05 20	SD-03 Product Data																
			Sampling and Testing	2.2															
			Penetrations	3.1.6															
			Geosynthetic Drainage Layer	2.1															
		31 23 00.00 20	SD-06 Test Reports																
			Fill and backfill	3.14.2.1															
			Select material	3.14.2.2															
		32 11 16	SD-06 Test Reports																
			Sampling and Testing	1.5															

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		32 11 16	Field Density Tests	1.5.2.4														
		32 12 17	SD-05 Design Data															
			Job-mix formula	1.3.1														
			MIX DESIGN	2.4														
			Aggregates tests	3.5.2.1														
			Bituminous mix tests	3.5.2.2														
			Pavement courses	3.5.2.3														
		32 13 13.06	SD-03 Product Data															
			Curing materials	2.1.5														
			Admixtures	2.1.3														
			Dowel	2.1.4.1														
			SD-05 Design Data															
			mix design	2.2														
			SD-06 Test Reports															
			Aggregate	2.1.2														
			Concrete slump tests	3.7.2														
			Air content tests	3.7.4														
			Flexural strength tests	3.7.3														
			Cementitious materials	2.1.1														
			SD-07 Certificates															
			Ready-mixed concrete plant	1.5.1														
			Batch tickets	1.5.4														
			Cementitious materials	2.1.1														
		32 13 73	SD-03 Product Data															
			Manufacturer's Instructions	3.1.1														
			SD-04 Samples															

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		32 13 73	Compression Seals	2.2	G														
			SD-06 Test Reports																
			Test Requirements	2.1.3															
		32 16 19	SD-03 Product Data																
			Concrete	2.1															
			Biodegradable Form Release Agent	2.6.5															
			Biodegradable Form Release Agent	3.2															
			SD-06 Test Reports																
			Field Quality Control	3.8															
		32 17 23	SD-06 Test Reports																
			High Build Acrylic Coating (HBAC)	2.1.1	G														
			SD-07 Certificates																
			Qualifications	1.4.1	G														
			Volatile Organic Compound	2.1.1	G														
		32 92 19	SD-03 Product Data																
			Wood Cellulose Fiber Mulch	2.5.3															
			Fertilizer	2.4															
			SD-06 Test Reports																
			Topsoil Composition Tests	2.2.2															
			SD-07 Certificates																
			Seed	2.1															
		33 40 00	SD-06 Test Reports																
			Leakage Test	3.5.1.1	G														

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		33 40 00	SD-07 Certificates															
			Hydrostatic Test on Watertight	2.4.1	G													
			Joints															
			Frame and Cover or Gratings	2.3.1	G													
			SD-08 Manufacturer’s Instructions															
			Placing Pipe	3.2	G													