

**SECTION 23 05 10
COMMON WORK RESULTS FOR BOILER PLANT AND STEAM GENERATION**

SPEC WRITER NOTES:

1. Delete between // // if not applicable to project. Also delete any other item or paragraph not applicable in the Section and renumber the paragraphs.
2. References to pressure in this section are gauge pressure unless otherwise noted.
3. All references to pneumatic control components have been removed from this section. If working in existing plants where pneumatic systems are still existing and are to be reused, it is the design engineers' responsibility to add to these specifications all required pneumatic components.
4. The spec writer shall review the Physical Security and Resiliency Design Manual for VA Facilities to determine and include in this section any Mission Critical or Life Safety requirements called out.
5. Obtain and review the VHA Boiler Plant Safety Devices Testing Manual and ensure design documents meet all current requirements.

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 23 related to boiler plant and steam generation.
- B. Definitions:
 1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
 2. Exterior: Piping, ductwork, and equipment exposed to weather be it temperature, humidity, precipitation, wind, or solar radiation.
- C. Abbreviations/Acronyms:
 1. ac: Alternating Current
 2. ACR: Air Conditioning and Refrigeration
 3. AI: Analog Input
 4. AISI: American Iron and Steel Institute
 5. AO: Analog Output
 6. ASJ: All Service Jacket
 7. AWG: American Wire Gauge
 8. BACnet: Building Automation and Control Networking Protocol

9. BAg: Silver-Copper-Zinc Brazing Alloy
10. BAS: Building Automation System
11. BCuP: Silver-Copper-Phosphorus Brazing Alloy
12. bhp: Brake Horsepower
13. Btu: British Thermal Unit
14. Btu/h: British Thermal Unit Per Hour
15. CDA: Copper Development Association
16. C: Celsius
17. CD: Compact Disk
18. CFM: Cubic Foot Per Minute
19. CH: Chilled Water Supply
20. CHR: Chilled Water Return
21. CLR: Color
22. CO: Carbon Monoxide
23. COR: Contracting Officer's Representative
24. CPD: Condensate Pump Discharge
25. CPM: Cycles Per Minute
26. CPVC: Chlorinated Polyvinyl Chloride
27. CRS: Corrosion Resistant Steel
28. CTPD: Condensate Transfer Pump Discharge
29. CTPS: Condensate Transfer Pump Suction
30. CW: Cold Water
31. CWP: Cold Working Pressure
32. CxA: Commissioning Agent
33. dB: Decibels
34. dB(A): Decibels (A weighted)
35. DDC: Direct Digital Control
36. DI: Digital Input
37. DO: Digital Output
38. DVD: Digital Video Disc
39. DN: Diameter Nominal
40. DWV: Drainage, Waste and Vent
41. EPDM: Ethylene Propylene Diene Monomer
42. EPT: Ethylene Propylene Terpolymer
43. ETO: Ethylene Oxide
44. F: Fahrenheit
45. FAR: Federal Acquisition Regulations
46. FD: Floor Drain

47.FED: Federal
48.FG: Fiberglass
49.FGR: Flue Gas Recirculation
50.FOS: Fuel Oil Supply
51.FOR: Fuel Oil Return
52.FSK: Foil-Scrim-Kraft facing
53.FWPD: Feedwater Pump Discharge
54.FWPS: Feedwater Pump Suction
55.GC: Chilled Glycol Water Supply
56.GCR: Chilled Glycol Water Return
57.GH: Hot Glycol Water Heating Supply
58.GHR: Hot Glycol Water Heating Return
59.gpm: Gallons Per Minute
60.HDPE: High Density Polyethylene
61.Hg: Mercury
62.HOA: Hands-Off-Automatic
63.hp: Horsepower
64.HPS: High Pressure Steam (equal to/greater than 414 kPa (60 psig))
65.HPR: High Pressure Steam Condensate Return
66.HW: Hot Water
67.HWH: Hot Water Heating Supply
68.HWHR: Hot Water Heating Return
69.Hz: Hertz
70.ID: Inside Diameter
71.IPS: Iron Pipe Size
72.kg: Kilogram
73.klb: 1000 lb
74.kPa: Kilopascal
75.lb: Pound
76.lb/hr: Pounds Per Hour
77.L/s: Liters Per Second
78.L/min: Liters Per Minute
79.LPS: Low Pressure Steam (equal to/less than 103 kPa (15 psig))
80.LPR: Low Pressure Steam Condensate Gravity Return
81.MAWP: Maximum Allowable Working Pressure
82.MAX: Maximum
83.MBtu/h: 1000 Btu/h
84.MBtu: 1000 Btu

85.MED: Medical
86.m: Meter
87.MFG: Manufacturer
88.mg: Milligram
89.mg/L: Milligrams Per Liter
90.MIN: Minimum
91.MJ: Megajoules
92.ml: Milliliter
93.mm: Millimeter
94.MPS: Medium Pressure Steam (110-414 kPa [16-60 psig])
95.MPR: Medium Pressure Steam Condensate Return
96.MW: Megawatt
97.NC: Normally Closed
98.NF: Oil Free Dry (Nitrogen)
99.Nm: Newton Meter
100.NO: Normally Open
101.NOx: Nitrous Oxide
102.NPT: National Pipe Thread
103.NPS: Nominal Pipe Size
104.OD: Outside Diameter
105.OSD: Open Sight Drain
106.OS&Y: Outside Stem and Yoke
107.PC: Pumped Condensate
108.PID: Proportional-Integral-Differential
109.PLC: Programmable Logic Controllers
110.PP: Polypropylene
111.PPE: Personal Protection Equipment
112.ppb: Parts Per Billion
113.ppm: Parts Per Million
114.PRV: Pressure Reducing Valve
115.PSIA: Pounds Per Square Inch Absolute
116.psig: Pounds Per Square Inch Gauge
117.PTFE: Polytetrafluoroethylene
118.PVC: Polyvinyl Chloride
119.PVDC: Polyvinylidene Chloride Vapor Retarder Jacketing, White
120.PVDF: Polyvinylidene Fluoride
121.rad: Radians
122.RH: Relative Humidity

123.RO: Reverse Osmosis
124.rms: Root Mean Square
125.RPM: Revolutions Per Minute
126.RS: Refrigerant Suction
127.RTD: Resistance Temperature Detectors
128.RTRF: Reinforced Thermosetting Resin Fittings
129.RTRP: Reinforced Thermosetting Resin Pipe
130.SCFM: Standard Cubic Feet Per Minute
131.SPEC: Specification
132.SPS: Sterile Processing Services
133.STD: Standard
134.SDR: Standard Dimension Ratio
135.SUS: Saybolt Universal Second
136.SW: Soft water
137.SWP: Steam Working Pressure
138.TAB: Testing, Adjusting, and Balancing
139.TDH: Total Dynamic Head
140.TEFC: Totally Enclosed Fan-Cooled
141.TFE: Tetrafluoroethylene
142.THERM: 100,000 Btu
143.THHN: Thermoplastic High-Heat Resistant Nylon Coated Wire
144.THWN: Thermoplastic Heat & Water-Resistant Nylon Coated Wire
145.T/P: Temperature and Pressure
146.USDA: U.S. Department of Agriculture
147.V: Volt
148.VAC: Vacuum
149.VA: Veterans Administration
150.VAC: Voltage in Alternating Current
151.VA CFM: VA Construction & Facilities Management
152.VA CFM CSS: Consulting Support Service
153.VAMC: Veterans Administration Medical Center
154.VHA OCAMES: Veterans Health Administration - Office of Capital
Asset Management Engineering and Support
155.VR: Vacuum condensate return
156.WCB: Wrought Carbon Steel, Grade B
157.WG: Water Gauge or Water Column
158.WOG: Water, Oil, Gas

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT
- D. Section 01 81 13, SUSTAINABLE CONSTRUCTION REQUIREMENTS.
- E. //Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//
- F. //Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.//
- G. Section 03 30 00, CAST-IN-PLACE CONCRETE.
- H. //Section 05 31 00, STEEL DECKING.//
- I. //Section 05 36 00, COMPOSITE METAL DECKING.//
- J. Section 05 50 00, METAL FABRICATIONS.
- K. Section 07 60 00, FLASHING AND SHEET METAL: Flashing for wall and roof penetrations.
- L. Section 07 84 00, FIRESTOPPING.
- M. Section 07 92 00, JOINT SEALANTS.
- N. Section 09 91 00, PAINTING.
- O. //Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//
- P. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT.
- Q. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- R. Section 23 05 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT.
- S. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- T. Section 23 07 11, HVAC AND BOILER PLANT INSULATION.
- U. //Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//
- V. //Section 23 08 11, DEMONSTRATIONS AND TESTS FOR BOILER PLANT.//
- W. Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT.
- X. Section 23 21 11, BOILER PLANT PIPING SYSTEMS.
- Y. Section 23 50 11, BOILER PLANT MECHANICAL EQUIPMENT.
- Z. Section 23 52 25, LOW-PRESSURE WATER HEATING BOILERS.
- AA. Section 23 52 28, LOW-PRESSURE STEAM BOILERS.
- BB. Section 23 52 33, WATER-TUBE BOILERS.
- CC. Section 23 52 39, FIRE-TUBE BOILERS.
- DD. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
- EE. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES.
- FF. Section 26 29 11, MOTOR CONTROLLERS.
- GG. Section 33 63 00, STEAM ENERGY DISTRIBUTION.

- SP-58-2009.....Pipe Hangers and Supports-Materials, Design, Manufacture, Selection, Application, and Installation
- SP-127-2014a.....Bracing for Piping Systems: Seismic-Wind-Dynamic Design, Selection, and Application
- H. Military Specifications (MIL):
 - MIL-P-21035B-2003.....Paint High Zinc Dust Content, Galvanizing Repair (Metric)
- I. National Fire Protection Association (NFPA):
 - 31-2016.....Standard for Installation of Oil-Burning Equipment
 - 54-2015.....National Fuel Gas Code
 - 70-2014.....National Electrical Code (NEC)
 - 85-2015.....Boiler and Combustion Systems Hazards Code
 - 101-2015.....Life Safety Code
- J. Department of Veterans Affairs (VA):
 -VHA Boiler Plant Safety Devices Testing Manual, Third Edition
 - PG-18-10-2016.....Steam, Heating Hot Water, and Outside Distribution Systems Design Manual
 - PG-18-10-2011.....Asbestos Abatement Design Manual
 - PG-18-10-2014.....Sustainable Design Manual
 - PG-18-10-2016.....Physical Security and Resiliency Design Manual

1.4 SUBMITTALS

- A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 23 05 10, COMMON WORK RESULTS FOR BOILER PLANT AND STEAM GENERATION", with applicable paragraph identification.
- C. All submittals in these sections are for equipment and materials that are interdependent parts of the entire systems; therefore, they shall all be submitted at the same time and complete including coordination/shop drawings, installation instructions, structural support, and structural piping calculations so that they may be reviewed as a system. The submittals for each Section shall be covered by one individual transmittal signed by the prime Contractor and containing a statement that the Contractor has fully reviewed all

documents. Deviations from the contract documents, if any, shall be listed on the transmittal.

- D. //If the project is phased submit complete phasing plan/schedule with manpower levels prior to commencing work. The phasing plan shall be detailed enough to provide milestones in the process that can be verified.//
- E. Test Plans: Submit safety test plan for temporary steam plant with temporary steam plant submittals. Submit all other test plans for plant and equipment 45 days prior to start of testing to allow for test modifications prior to start.
- F. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements, and all equipment that requires regular maintenance, calibration, etc, are accessible from the floor or permanent work platform. It is the Contractor's responsibility to ensure all submittals meet the VA specifications and requirements and it is assumed by the VA that all submittals do meet the VA specifications unless the Contractor has requested a variance in writing and approved by COR prior to the submittal. If at any time during the project it is found that any item does not meet the VA specifications and there was no variance approval the Contractor shall correct at no additional cost or time to the Government even if a submittal was approved.
- G. If equipment is submitted which differs in arrangement from that shown, provide documentation proving equivalent performance, design standards and drawings that show the rearrangement of all associated systems. Additionally, any impacts on ancillary equipment or services such as foundations, piping, and electrical shall be the Contractor's responsibility to design, supply, and install at no additional cost or time to the Government. VA approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- H. Prior to submitting shop drawings for approval, Contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed contract documents, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.

- I. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together. Coordinate and properly integrate materials and equipment to provide a completely compatible and efficient installation.

SPEC WRITER NOTE: Include the paragraph below if samples are required for any specified items.

- J. //Samples: Samples will not be required, except for insulation or where materials offered differ from specification requirements. Samples shall be accompanied by full description of characteristics different from specification. The Government, at the Government's expense, will perform evaluation and testing if necessary. The Contractor may submit samples of additional material at the Contractor's option; however, if additional samples of materials are submitted later, pursuant to Government request, adjustment in contract price and time will be made.//

SPEC WRITER NOTE: Include the paragraph below if mock-ups are required for any specified items. Indicate and describe required mock-ups in the submittal paragraph of the individual Division 23 sections.

- K. //Mock-ups: Mock-ups are required for critical items and typical component installations replicated numerous times throughout the project as indicated in the individual Division 23 sections. The COR and VAMC representatives shall review and approve the mock-up prior to installation of additional applicable components.//

- L. Coordination/Shop Drawings:

1. Submit complete consolidated and coordinated shop drawings for all new systems, and for existing systems that are in the same areas.
2. The coordination/shop drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8-inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show locations and adequate clearance for all equipment, piping, valves, control panels and other items. Show the access means for all items requiring access for operations and maintenance. Provide detailed coordination/shop drawings of all piping and duct systems. The drawings should include all lockout/tagout points for all energy/hazard sources for each piece

- of equipment. Coordinate lockout/tagout procedures and practices with local VA requirements.
3. Do not install equipment foundations, equipment or piping until coordination/shop drawings have been approved.
 4. In addition, for HVAC systems, provide details of the following:
 - a. Mechanical equipment rooms.
 - b. Hangers, inserts, supports, and bracing.
 - c. Pipe sleeves.
 - d. Duct or equipment penetrations of floors, walls, ceilings, or roofs.
- M. Manufacturer's Literature and Data: Include full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity. Submit under the pertinent section rather than under this section.
1. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the COR.
 2. Submit electric motor data and variable speed drive data with the driven equipment.
 3. Equipment and materials identification.
 4. Fire-stopping materials.
 5. Hangers, inserts, supports and bracing. Provide complete stress analysis for variable spring and constant support hangers. For boiler plants, refer to Section 23 21 11, BOILER PLANT PIPING SYSTEMS, for additional requirements.
 6. Wall, floor, and ceiling plates.
- N. Rigging Plan: Provide documentation of the capacity and weight of the rigging and equipment intended to be used. The rigging plan shall include the path of travel of the load, the staging area and intended access, and qualifications of the operator and signal person.
- O. Maintenance Data and Operating Instructions:
1. Maintenance and operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS, paragraph, INSTRUCTIONS, for systems and equipment.
 2. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
 - a. Include complete list indicating all components of the systems.

- b. Include complete diagrams of the internal wiring for each item of equipment.
 - c. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
3. Provide a listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment. Include in the listing belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.
- P. Boiler Plant Maintenance Data and Operating Instructions:
1. Provide //4// // // bound copies or 2 electronic versions on CD //DVD//. Deliver to COR not less than 30 days prior to completion of a phase or final inspection.
 2. Include all new and temporary equipment and all elements of each assembly.
 3. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, pump impeller size, other data.
 4. Manufacturer's installation, maintenance, repair, and operation instructions for each device. Include assembly drawings and parts lists. Include operating precautions and reasons for precautions.
 5. Lubrication instructions including type and quantity of lubricant.
 6. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications.
 7. Description of boiler firing and operating sequence including description of relay and interlock positions at each part of the sequence.
 8. Set points of all interlock devices.
 9. Trouble-shooting guide for control systems.
 10. Operation of the combustion control system.
 11. Emergency procedures.
 12. Control system programming information for parameters, such as set points, that do not require services of an experienced technician.
 13. Step-by-Step written instructions that are specific for the system installed on testing all safety devices. The instructions should be in the same format and in compliance and equivalent to the VHA Boiler Plant Safety Devices Testing Manual for each test. All safety devices listed in the manual shall be tested and documentation provided certifying completion.

- Q. Provide copies of approved HVAC equipment submittals to the TAB //and Commissioning// Subcontractor.
- R. //Completed System Readiness Checklist provided by the Commissioning Agent and completed by the Contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//
- S. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

1.5 QUALITY ASSURANCE

- A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. All VA safety device requirements shall be complied with regardless of the size, type, or operating pressure of boiler to include condensing boilers, hot water boilers for heating systems, as defined in the VHA Boiler Plant Safety Devices Testing Manual. The systems shall be comprised of high quality institutional-class and industrial-class products of manufacturers that are experienced specialists in the required product lines. All construction firms and personnel shall be experienced and qualified specialists in industrial and institutional HVAC or steam boiler plant construction, as applicable.
- B. Flow Rate Tolerance for HVAC Equipment: Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- C. Equipment Vibration Tolerance: Refer to Section 23 05 51, NOISE AND VIBRATION CONTROL FOR BOILER PLANT. Equipment shall be factory-balanced to this tolerance and re-balanced on site, as necessary.
- D. Products Criteria:
 - 1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere). The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory

- service record of at least three years. See other specification sections for any exceptions and/or additional requirements.
2. Refer to all other sections for quality assurance requirements for systems and equipment specified therein.
 3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
 4. The products and execution of work specified in Division 33 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments shall be enforced, along with requirements of local utility companies. The most stringent requirements of these specifications, local codes, or utility company requirements shall always apply. Any conflicts shall be brought to the attention of the COR.
 5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be of the same manufacturer and model number, or if different models are required they shall be of the same manufacturer and identical to the greatest extent possible (i.e., same model series).
 6. Assembled Units: Performance and warranty of all components that make up an assembled unit shall be the responsibility of the manufacturer of the completed assembly.
 7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
 8. Use of asbestos products or equipment or materials containing asbestos is prohibited.
- E. Boiler Plant Equipment Service Providers: Service providers shall be authorized and trained by the manufacturers of the equipment supplied. These providers shall be capable of responding onsite and provide acceptable service to restore boiler plant operations within //4// // // hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shutdown of equipment; or within //24// // // hours in a non-emergency. Submit names, mail and e-mail addresses and phone numbers of service personnel and companies providing service under these conditions for (as applicable to the project): burners,

burner control systems, boiler control systems, pumps, critical instrumentation, computer workstation and programming.

- F. Mechanical Systems Welding: Before any welding is performed, Contractor shall submit a certificate certifying that welders comply with the following requirements:
1. Qualify welding processes and operators for piping according to ASME BPVC Section IX. Provide proof of current certification.
 2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
 3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
 4. All welds shall be stamped according to the provisions of the AWS or ASME as required herein and by the associated code.
- G. Boiler Plant and Outside Steam Distribution Welding: Refer to Section 23 21 11, BOILER PLANT PIPING SYSTEMS and Section 33 63 00, STEAM ENERGY DISTRIBUTION.
- H. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the COR with submittals. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material and removal by the Contractor and no additional cost or time to the Government.
- I. Execution (Installation, Construction) Quality:
1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract documents to the COR for resolution. Provide written hard copies and computer files on CD or DVD of manufacturer's installation instructions to the COR with submittals prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received and approved by VA. Failure to furnish these recommendations is a cause for rejection of the material.

SPEC WRITER NOTE: For boiler plant projects, Copy Paragraph 2 below onto the "MP" schedule sheet contract drawing.

2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to: all types of valves, filters and strainers, transmitters, control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to the COR for resolution. Failure of the Contractor to resolve, or point out any issues will result in the Contractor correcting at no additional cost or time to the Government.
 3. Complete coordination/shop drawings shall be required in accordance with paragraph, SUBMITTALS. Construction work shall not start on any system until the coordination/shop drawings have been approved by VA.
 4. Workmanship/craftsmanship will be of the highest quality and standards. The VA reserves the right to reject any work based on poor quality of workmanship this work shall be removed and done again at no additional cost or time to the Government.
- J. Upon request by Government, provide lists of previous installations for selected items of equipment. Include contact persons who will serve as references, with current telephone numbers and e-mail addresses.
- K. Guaranty: Warranty of Construction, FAR Clause 52.246-21.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Protection of Equipment:
1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage or theft.
 2. Large equipment such as boilers, tanks, economizers, heat exchangers, and fans if shipped on open trailer trucks shall be covered with shrink on plastics or water proof tarpaulins that provide protection from exposure to rain, road salts and other transit hazards. Protection shall be kept in place until equipment is moved into a building or installed as designed.
 3. Repair damaged equipment in first class, new operating condition and appearance; or, replace same as determined and directed by the COR.

Such repair or replacement shall be at no additional cost or time to the Government.

4. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.
 5. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.
 6. Protect plastic piping and tanks from ultraviolet light (sunlight).
- B. Cleanliness of Piping and Equipment Systems:
1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
 2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
 3. Clean interior of all tanks prior to delivery for beneficial use by the Government.
 4. Boilers shall be left clean following final internal inspection by Government insurance representative or inspector.
 5. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.7 AS-BUILT DOCUMENTATION

SPEC WRITER NOTE: Coordinate O&M Manual requirements with Section 01 00 00, GENERAL REQUIREMENTS. O&M manuals shall be submitted for content review as part of the close-out documents.

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, VA approved substitutions and construction revisions shall be //in electronic version on CD or DVD// inserted into a three-ring binder. All aspects of system operation and maintenance procedures, including applicable piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A List of

recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

SPEC WRITER NOTE: Select and edit one of the bracketed options after the paragraph below to indicate the format in which the contractor must provide record drawing files. Select the hand-marked option only when the designer has been separately contracted to provide the record drawings from the contractor's mark-ups. Select the BIM option only when a BIM model will be generated, which is typically only performed by the designer on some Design-Bid-Build projects or by the contractor on some Design-Build projects.

- C. The installing Contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. Should the installing Contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement. Provide record drawings as follows:
1. //Red-lined, hand-marked drawings are to be provided, with one paper copy and a scanned PDF version of the hand-marked drawings provided on CD //DVD//.//
 2. //As-built drawings are to be provided, with a copy of them on AutoCAD version // // provided on CD //DVD//. The CAD drawings shall use multiple line layers with a separate individual layer for each system.//
 3. //As-built drawings are to be provided, with a copy of them in three-dimensional Building Information Modeling (BIM) software version // // provided on CD //DVD//.//
- D. The as-built drawings shall indicate the location and type of all lockout/tagout points for all energy sources for all equipment and pumps to include breaker location and numbers, valve tag numbers, etc. Coordinate lockout/tagout procedures and practices with local VA requirements.
- E. Certification documentation shall be provided to COR 21 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing

work for the testing agency on this project, detailed procedures followed for all tests, and provide documentation/certification that all results of tests were within limits specified. Test results shall contain written sequence of test procedure with written test results annotated at each step along with the expected outcome or setpoint. The results shall include all readings, including but not limited to data on device (make, model and performance characteristics), normal pressures, switch ranges, trip points, amp readings, and calibration data to include equipment serial numbers or individual identifications, etc.

SPEC WRITER NOTE: Keep the following paragraph if the work affects an existing boiler plant, i.e. boiler plant renovation, or if the work affects an existing VAMC, i.e. if the new plant has to service an existing VAMC (replacement of existing heat plant).

1.8 //JOB CONDITIONS - WORK IN EXISTING BOILER PLANT

- A. Plant Operation: Government employees will be continuously operating and managing all plant facilities, including temporary facilities, that serve the steam, condensate, and //hot water// //chilled water// requirements of the VAMC.
- B. Maintenance of Steam Supply and Condensate Return Service: Schedule all work to permit continuous steam and condensate service at pressures and flow rates as required by the VAMC. At all times, there shall be one spare boiler available and one spare pump for each service available, in addition to those required for serving the load demand. The spare boiler and pumps must be capable of handling the loads that may be imposed if the operating boiler or pump fails.
- C. Steam and Condensate Service Interruptions: Limited steam and condensate service interruptions, as required for interconnections of new and existing systems, will be permitted by the COR during periods when the steam demands are not critical to the operation of the VAMC. These non-critical periods are limited to between 8 pm and 5 am during the non-heating season. Provide at least 10 working days advance notice to the COR. The request shall include a detailed plan on the proposed shutdown and the intended work to be done along with manpower levels. All equipment and materials must be onsite and verified with plan //5// // // days prior to the shutdown or it will need to be rescheduled.

- D. //Phasing of Work: Comply with all requirements shown on contract documents. Contractor shall submit a complete detailed phasing plan/schedule with manpower levels prior to commencing work. The phasing plan shall be detailed enough to provide milestones in the process that can be verified.//
- E. Plant Working Environment: Maintain the architectural and structural integrity of the plant building and the working environment at all times. Maintain the interior of plant at 18 degrees C (65 degrees F) minimum. Limit the opening of doors, windows or other access openings to brief periods as necessary for rigging purposes. Storm water or ground water leakage is prohibited. Provide daily clean-up of construction and demolition debris on all floor surfaces and on all equipment being operated by VA. Maintain all egress routes and safety systems/devices.
- F. Acceptance of Work for Government Operation: As new equipment, systems and facilities are made available for operation and these items are deemed of beneficial use to the Government, inspections will be made and tests will be performed. Based on the inspections, a list of contract deficiencies will be issued to the Contractor. No boiler, system, or piece of equipment will be accepted for beneficial use until ALL safety devices have been tested and passed in accordance with the VHA Boiler Plant Safety Devices Testing Manual; all equipment that requires regular maintenance, calibration, etc. are accessible from the floor or permanent work platform; and all control systems are proven to be fully operational without faults or shutdowns for a period not less than 21 days of continuous operation without interaction from any person other than that of normal operational duty. After correction of deficiencies as necessary for beneficial use, the Contracting Officer will process necessary acceptance and the equipment will then be under the control and operation of Government personnel.

SPEC WRITER NOTE: Delete the following paragraph if not applicable to project.

- G. //Temporary Facilities: Refer to paragraph, TEMPORARY PIPING AND EQUIPMENT in this section.// //

PART 2 - PRODUCTS

2.1 FACTORY-ASSEMBLED PRODUCTS

- A. Provide maximum standardization of components to reduce spare part requirements.

- B. Performance and warranty of all components that make up an assembled unit shall be the responsibility of the manufacturer of the completed assembly.
 - 1. All components of an assembled unit need not be products of same manufacturer.
 - 2. Constituent parts that are alike shall be products of a single manufacturer.
 - 3. Components shall be compatible with each other and with the total assembly for intended service.
 - 4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Equipment and components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a nameplate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions must be approved by the VA but may be permitted if performance requirements cannot be met.

2.2 COMPATIBILITY OF RELATED EQUIPMENT

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational plant that conforms to contract requirements.

2.3 BELT DRIVES

- A. Type: ARPM standard V-belts with proper motor pulley and driven sheave. Belts shall be constructed of reinforced cord and rubber.
- B. Dimensions, rating and selection standards: ARPM IP-20 and ARPM IP-21.
- C. Minimum Horsepower Rating: Motor horsepower plus recommended ARPM service factor (not less than 20 percent) in addition to the ARPM allowances for pitch diameter, center distance, and arc of contact.
- D. Maximum Speed: 25 m/s (5000 feet per minute).
- E. Adjustment Provisions: For alignment and ARPM standard allowances for installation and take-up.
- F. Drives may utilize a single V-Belt (any cross section) when it is the manufacturer's standard.

- G. Multiple Belts: Matched to ARPM specified limits by measurement on a belt measuring fixture. Seal matched sets together to prevent mixing or partial loss of sets. Replacement, when necessary, shall be an entire set of new matched belts.
- H. Sheaves and Pulleys:
1. Material: Pressed steel, or close-grained cast iron.
 2. Bore: Fixed or bushing type for securing to shaft with keys.
 3. Balanced: Statically and dynamically.
 4. Groove spacing for driving and driven pulleys shall be the same.
 5. Minimum Diameter of V-Belt Sheaves (ARPM recommendations) in millimeters and inches:
- I. Drive Types, Based on ARI 435:
1. Provide adjustable-pitch //or fixed-pitch// drive as follows:
 - a. Fan speeds up to 1800 RPM: 7.5 kW (10 hp) and smaller.
 - b. Fan speeds over 1800 RPM: 2.2 kW (3 hp) and smaller.
 2. Provide fixed-pitch drives for drives larger than those listed above.
 3. The final fan speeds required to just meet the system CFM and pressure requirements, without throttling the design air flow branch, shall be determined by adjustment of a temporary adjustable-pitch motor sheave or by fan law calculation if a fixed-pitch drive is used initially.
- J. Final Drive Set: If adjustment is required beyond the capabilities of the factory drive set, the final drive set shall be provided as part of this contract at no additional cost or time to the Government.

2.4 DRIVE GUARDS

- A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor to prevent damage to equipment and injury to personnel. Drive guards may be excluded where motors and drives are inside factory-fabricated air handling unit casings.
- B. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gauge sheet steel; all edges shall be hemmed and ends shall be bent into flanges and the flanges drilled and attached to pump base with minimum of four 6 mm (1/4 inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.

- C. V-belt and sheave assemblies shall be totally enclosed, firmly mounted, and non-resonant. Guard shall be an assembly of minimum 22-gauge sheet steel and expanded or perforated metal to permit observation of belts. 25 mm (1 inch) diameter hole shall be provided at each shaft centerline to permit speed measurement.
- D. Materials: Sheet steel, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.
- E. Access for Speed Measurement: 25 mm (1 inch) diameter hole at each shaft center.

2.5 LIFTING ATTACHMENTS

- A. Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

SPEC WRITER NOTE: Verify that special motor requirements when required, such as two-speed or explosion proof, are shown on the drawings in the equipment schedules.

2.6 ELECTRIC MOTORS

- A. All material and equipment furnished and installation methods shall conform to the requirements of Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT; Section 26 29 11, MOTOR CONTROLLERS; and, Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES. Provide all electrical wiring, conduit, and devices necessary for the proper connection, protection and operation of the systems. Provide special energy efficient premium efficiency type motors as scheduled.

2.7 VARIABLE SPEED MOTOR CONTROLLERS

- A. Refer to Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS and Section 26 29 11, MOTOR CONTROLLERS for specifications.
- B. Coordinate variable speed motor controllers' communication protocol with Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT.

SPEC WRITER NOTE: Verify that drawings indicate "with bypass contactor" or "without bypass contactor" on all variable frequency drives shown.

- C. Provide variable speed motor controllers with or without a bypass contactor as indicated in Contract drawings.
- D. The combination of controller and motor shall be provided by the manufacturer of the driven equipment, such as pumps and fans, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. pumps shall be product of a single manufacturer.
- E. Motors shall be premium efficiency type and be approved by the motor controller manufacturer. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch.
- F. Controller shall not add any current or voltage transients to the input ac power distribution system, DDC controls, sensitive medical equipment, etc., nor shall be affected from other devices on the ac power system.

SPEC WRITER NOTE: Revise and expand, or delete the following paragraph as necessary. Ensure that all requirements are coordinated with other contract documents and with site conditions. Paragraph will be used when project requires a temporary plant to provide service while construction is in progress in the existing plant.

2.8 TEMPORARY BOILER PLANT INSTALLATION

- A. Provide temporary facilities to replace all functions of the existing boiler plant during the construction period. Temporary facilities must remain in operation until all new facilities are accepted for beneficial use. Temporary facilities shall provide same quality and capacity of service as existing facilities.
- B. Refer to contract documents for arrangement and location of temporary facilities and for equipment performance requirements.
- C. Temporary equipment may be new or previously used. Previously used equipment shall show no evidence of wear or deterioration that would affect the safe, reliable operation.
- D. Equipment to be utilized in the new plant shall not be used in the temporary plant.
- E. Remove all temporary facilities from Government property after final use. Provide COR 10 working days advance notice prior to removal.

- F. Equipment must be clean inside and outside.
- G. Boilers and accessories shall have the following:
1. Design pressure exceeding maximum safety valve set pressure.
 2. Construction and accessories in compliance with ASME Boiler and Pressure Vessel Code, Section I.
 3. After installation and prior to operation, provide internal inspection by authorized inspector certified by National Board of Boiler and Pressure Vessel Inspectors. Submit signed report to COR. Inspector must certify boilers as clean and safe for operation. Photographic evidence shall be taken of the condition of the boiler internally of both the water and fire sides at time of delivery and prior to operation and once again when the prior to the temporary boiler leaving the site. This is to ensure the VA is not charged to descale the boilers.
 4. Steam output flow range and pressure as shown on contract documents.
 5. Dual low water cutoffs, dual high steam pressure cutouts, high water alarm.
 6. Calibrated steam pressure gauge, 150 mm (6 inch) minimum diameter.
 7. One set of spares for all gaskets and water column gauge glasses.
 8. Provide N+1 capacity.
 9. Equip with all safety devices defined and tested in accordance with the VHA Boiler Plant Safety Devices Testing Manual at the Contractor's expense.
 10. Emergency power connection for continuous operation during utility outage.
- H. Burners, accessories, and fuel trains shall have the following:
1. Automatic operation over entire firing range. Turndown capability 6/1 or greater.
 2. Comply with NFPA 85 regardless of burner input rating.
 3. All safety devices UL listed for the service and defined in the VHA Boiler Plant Safety Devices Testing Manual.
 4. Dual fuel capability.
 5. Filtration devices at entrance to each fuel train designed to protect all downstream devices from clogging or plugging.
 6. Pressure regulating valves on main gas and igniter (pilot) gas.
 7. Pressure gauges at burners and outlets of pressure regulating valves.
 8. One set of spare drive belts for all belt-driven equipment.

- I. Burner control (Flame Safeguard) system shall have the following:
1. Automatic operation, self-checking circuits.
 2. UL listed, FM approved.
 3. Self-checking ultraviolet flame detectors. Infrared flame detectors with self-checking amplifiers permitted on fire tube boilers.
 4. Provide one spare scanner and control chassis for each type utilized.
- J. Combustion Control System: Automatic control of steam pressure, with provision for manual control.
- K. Feedwater System:
1. Provide system, including feedwater deaerator, to furnish minimum water temperature of 104 degrees C (220 degrees F), pressure and quality recommended by boiler manufacturer. Maximum oxygen content of feedwater from deaerator 12 ppb.
 2. Capacity shall exceed maximum steam flow requirement of VAMC.
 3. Provide automatic feedwater deaerator water level control and high and low-level alarms as defined in the VHA Boiler Plant Safety Devices Testing Manual.
 4. Provide one full size redundant feed pump.
 5. Automatic boiler water level control with three-valve bypass.
 6. Automatic water softener for make-up water.
 7. Prior to operation, provide internal inspection of feedwater deaerator by Authorized Inspector certified by the National Board of Boiler and Pressure Vessel Inspectors. Submit signed report.
Inspector must certify deaerator as clean and safe for operation.
- SPEC WRITER NOTE: Add to this paragraph a list of all safety devices defined in the VHA Boiler Plant Safety Devices Testing Manual and/or provide the manual as part of the documents defining the required test intervals.
- L. Instrumentation:
1. Record steam flow rate and provide totalizer for each boiler.
 2. Pressure gauge for main steam, feedwater header, fuel oil and natural gas headers.
 3. Mount recorders and pressure gauges in painted, reinforced sheet metal panel.
 4. Provide 100 recorder charts of each type and two replacement recorder pens for each pen arm.

- M. Chemical Treatment System: Provide individual pump type systems to deliver proper chemicals to each boiler. Water quality shall be maintained as directed by contractor-retained water treatment firm. All chemicals must be FDA approved for use where steam contacts food or is used for humidification. Provide chemical treatment, or maintain existing chemical treatment, which protects all site coils and condensate lines from corrosion.
- N. Blowoff System: Provide system to collect boiler bottom blowoff and to discharge it to sanitary sewer at temperature not exceeding 65 degrees C (150 degrees F).
- O. Fuel System: Provide systems to furnish sufficient //natural gas// and //No. 2 fuel oil// to generate steam to satisfy maximum steam flow demand of VAMC. Comply with NFPA 31 and NFPA 54. Provide filtration systems to protect pumps, flow meters, and pressure control valves. Fuel oil systems shall operate with no air entrainment or pump cavitation.
- P. Access Platforms and Ladders: Provide for access to all valves, controls and instruments not accessible to personnel standing on floor. Design of platforms and ladders must comply with OSHA requirements.
- Q. Enclosure of Temporary Equipment: Provide clean, dry, ventilated, lighted, heated shelter for all equipment and for operating personnel. Heating system shall maintain 18 degrees C (65 degrees F) under all weather conditions and when boilers are not in operation. Shelter construction must comply with all state and local codes.
- SPEC WRITER NOTE: Ensure other documents and site conditions accommodate the following requirements.
- R. Provisions shall be made for operators control room within the line of sight and adjacent to the temporary equipment to allow 24/7 oversight of the systems. This will include appropriate break and restroom facilities.
- S. Pipe, Stack, and Breeching Supports: Support all hot systems on roller and spring hangers. Anchor and support all systems in compliance with recommendations and requirements of ASME B31.1 and MSS SP-58.
- T. Pipe, Equipment, Boiler Stack and Breeching Insulation: Provide material and thickness as specified for permanent installation, except maximum thickness shall be 50 mm (2 inches) and all pipe insulation may be fiberglass with all-service jackets.

- U. Power Supply: Provide full time power and emergency power to serve full load operation of all equipment in temporary boiler plant.
- V. Repairs and Maintenance: Contractor shall furnish labor and material for all repairs and safety device testing at no additional cost or time to the Government. Malfunctions that reduce the steam supply to the facility shall be repaired within 4 hours of notice. Other repairs shall be accomplished within 24 hours of notice. Routine maintenance requiring standard tools and supplies and less than one man-hour per day will be performed by the Government. Cleaning made necessary by Government operation will be performed by the Government.
- W. //Seismic Anchorage of Equipment and Bracing of Piping, Stacks, Breeching: Conform to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//

2.9 EQUIPMENT AND MATERIALS IDENTIFICATION

SPEC WRITER NOTE: Choose the paragraph "A" below that is appropriate for the project.

- A. //Use symbols, nomenclature and equipment numbers specified, shown on the contract documents and shown in the maintenance manuals. Identification for piping is specified in Section 09 91 00, PAINTING.//
- A. //Use symbols, nomenclature and equipment numbers specified, shown on the contract documents and shown in the maintenance manuals. In addition, provide bar code identification nameplate for all equipment which will allow the equipment identification code to be scanned into the system for maintenance and inventory tracking. Identification for piping is specified in Section 09 91 00, PAINTING.//
- B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 5 mm (3/16 inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING permanently fastened to the equipment. Identify unit components such as coils, filters, fans, etc.
- C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 5 mm (3/16 inch) high riveted or bolted to the equipment.
- D. Control Items: Label all instrumentation, temperature and humidity sensors, controllers and control dampers. Identify and label each item as they appear on the control diagrams.

E. Valve Tags and Lists:

1. Boiler Plant: Provide for all valves.
2. Valve tags: Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 6 mm (1/4 inch) for service designation on 19-gauge 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
3. Valve lists: Typed or printed plastic coated card(s), sized 215 mm (8-1/2 inches) by 275 mm (11 inches) showing tag number, valve function and area of control, for each service or system. Punch sheets for a 3-ring notebook.
4. Provide detailed plan for each floor of the building indicating the location and valve number for each valve. Identify location of each valve with a color-coded thumb tack in ceiling.

2.10 FIRESTOPPING

- A. Section 07 84 00, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping and ductwork. Refer to Section 23 07 11, HVAC AND BOILER PLANT INSULATION, for firestop pipe and duct insulation.

2.11 GALVANIZED REPAIR COMPOUND

- A. Mil-P-21035B, paint form.

2.12 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. Vibration Isolators: Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- B. Pipe Hangers and Supports for Boiler Plant: Refer to Section 23 21 11, BOILER PLANT PIPING SYSTEMS.
- C. Supports for Roof Mounted Items:
 1. Equipment: Equipment rails shall be galvanized steel, minimum 1.3 mm (18 gauge), with integral baseplate, continuous welded corner seams, factory installed 50 by 100 mm (2 by 4 inches) treated wood nailer, 1.3 mm (18 gauge) galvanized steel counter flashing cap with screws, built-in cant strip, (except for gypsum or tectum deck), minimum height 275 mm (11 inches). For surface insulated roof deck, provide raised cant strip to start at the upper surface of the insulation.
 2. Pipe/duct pedestals: Provide a galvanized Unistrut channel welded to U-shaped mounting brackets which are secured to side of rail with galvanized lag bolts.
- D. Pipe Supports: Comply with MSS SP-58. Type Numbers specified refer to this standard. For selection and application comply with MSS SP-58.

Refer to Section 05 50 00, METAL FABRICATIONS, for miscellaneous metal support materials and prime coat painting requirements.

E. Attachment to Concrete Building Construction:

1. Concrete insert: MSS SP-58, Type 18.
2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 100 mm (4 inches) thick when approved by the COR for each job condition.
3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 100 mm (4 inches) thick when approved by the COR for each job condition.

F. Attachment to Steel Building Construction:

1. Welded attachment: MSS SP-58, Type 22.
2. Beam clamps: MSS SP-58, Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23 mm (7/8 inch) outside diameter.

SPEC WRITER NOTE: Include paragraph below for new construction (roof deck) only.

G. //Attachment to Metal Pan or Deck: As required for materials specified in // Section 05 31 00, STEEL DECKING// //Section 05 36 00, COMPOSITE METAL DECKING//.//

SPEC WRITER NOTE: Include paragraph below for renovations of existing facilities.

H. //Attachment to existing structure: Support from existing floor/roof frame.//

I. Attachment to Wood Construction: Wood screws or lag bolts.

J. Hanger Rods: Hot-rolled steel, ASTM A36/A36M or ASTM A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 40 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.

K. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 41 by 41 mm (1-5/8 by 1-5/8 inches), 2.7 mm (12 gauge), designed to accept special spring held, hardened steel nuts. Prohibited for steam supply and condensate piping.

1. Allowable hanger load: Manufacturers rating less 91 kg (200 pounds).
2. Guide individual pipes on the horizontal member of every other trapeze hanger with 6 mm (1/4 inch) U-bolt fabricated from steel

rod. Provide Type 40 insulation shield, secured by two 15 mm (1/2 inch) galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.

L. Supports for Piping Systems:

1. Select hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC AND BOILER PLANT INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.
2. Piping Systems except High and Medium Pressure Steam (MSS SP-58):
 - a. Standard clevis hanger: Type 1; provide locknut.
 - b. Riser clamps: Type 8.
 - c. Wall brackets: Types 31, 32 or 33.
 - d. Roller supports: Type 41, 43, 44 and 46.
 - e. Saddle support: Type 36, 37 or 38.
 - f. Turnbuckle: Types 13 or 15. Preinsulate.
 - g. U-bolt clamp: Type 24.
 - h. Copper Tube:
 - 1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, plastic coated or taped with non-adhesive isolation tape to prevent electrolysis.
 - 2) For vertical runs use epoxy painted or plastic-coated riser clamps.
 - 3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
 - 4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.
 - i. Supports for plastic piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.
3. High and Medium Pressure Steam (MSS SP-58):
 - a. Provide eye rod or Type 17 eye nut near the upper attachment.

- b. Piping 50 mm (2 inches) and larger: Type 43 roller hanger. //For roller hangers requiring seismic bracing provide a Type 1 clevis hanger with Type 41 roller attached by flat side bars.//
- SPEC WRITER NOTE: Verify that variable spring or constant support hangers are shown on the drawings.
- c. //Piping with Vertical Expansion and Contraction:
- 1) Movement up to 20 mm (3/4 inch): Type 51 or 52 variable spring unit with integral turn buckle and load indicator.
 - 2) Movement more than 20 mm (3/4 inch): Type 54 or 55 constant support unit with integral adjusting nut, turn buckle and travel position indicator.//
4. Convertor and Expansion Tank Hangers: May be Type 1 sized for the shell diameter. Insulation where required will cover the hangers.
- SPEC WRITER NOTE: Include below for pipe sizes larger than (50 mm) 2 inches.
- M. //Pre-insulated Calcium Silicate Shields:
1. Provide 360-degree water resistant high density 965 kPa (140 psig) compressive strength calcium silicate shields encased in galvanized metal.
 2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
 3. Shield thickness shall match the pipe insulation.
 4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.
 - a. Shields for supporting chilled or cold water shall have insulation that extends a minimum of 25 mm (1 inch) past the sheet metal. Provide for an adequate vapor barrier in chilled lines.
 - b. The pre-insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS SP-58. To support the load, the shields may have one or more of the following features: structural inserts 4138 kPa (600 psig) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36/A36M) wear plates welded to the bottom sheet metal jacket.
 5. Shields may be used on steel clevis hanger type supports, roller supports or flat surfaces.//

- N. //Seismic Restraint of Piping and Ductwork: Refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS. Comply with MSS SP-127.//

2.13 PIPE PENETRATIONS

- A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.
- B. To prevent accidental liquid spills from passing to a lower level, provide the following:
1. For sleeves: Extend sleeve 25 mm (1 inch) above finished floor and provide sealant for watertight joint.
 2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
 3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
- C. Penetrations through beams or ribs are prohibited, but may be installed in concrete beam flanges. Any deviation from these requirements must receive prior approval of COR.
- D. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- E. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.
- F. Galvanized Steel or an alternate Black Iron Pipe with asphalt coating Sleeves: Provide for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. Provide sleeve for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, connect sleeve with floor plate.
- G. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.
- H. Sleeves are not required for wall hydrants for fire department connections or in drywall construction.
- I. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight

with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.

- J. Sealant and Adhesives: Shall be as specified in Section 07 92 00, JOINT SEALANTS.

2.14 PENETRATIONS

- A. Provide curbs for roof mounted piping, ductwork and equipment. Curbs shall be 457 mm (18 inches) high with continuously welded seams, built-in cant strip, interior baffle with acoustic insulation, curb bottom, hinged curb adapter.
- B. Provide firestopping for openings through fire and smoke barriers, maintaining minimum required rating of floor, ceiling or wall assembly. See section 07 84 00, FIRESTOPPING.

2.15 SPECIAL TOOLS AND LUBRICANTS

- A. Furnish, and turn over to the COR, tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
- B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
- C. Refrigerant Tools: Provide system charging/Evacuation equipment, gauges, fittings, and tools required for maintenance of furnished equipment.
- D. Tool Containers: Hardwood or metal, permanently identified for intended service and mounted, or located, where directed by the COR.
- E. Lubricants: A minimum of 0.95 L (1 quart) of oil, and 0.45 kg (1 pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application.

2.16 WALL, FLOOR AND CEILING PLATES

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025 inch) for up to 75 mm (3-inch pipe), 0.89 mm (0.035 inch) for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Use also where insulation ends on exposed water supply pipe drop from overhead. Provide a

watertight joint in spaces where brass or steel pipe sleeves are specified.

2.17 ASBESTOS

- A. Materials containing asbestos are prohibited.

PART 3 - EXECUTION

3.1 GENERAL

- A. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.

3.2 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. The coordination/shop drawings shall be submitted for review. Locate piping, sleeves, inserts, hangers, ductwork and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Equipment coordination/shop drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review. Follow manufacturer's published recommendations for installation methods not otherwise specified.
- B. Operating Personnel Access and Observation Provisions: Select and arrange all equipment and systems to provide clear view and easy access, without use of portable ladders, for maintenance and operation of all devices including, but not limited to: all equipment items, valves, filters, strainers, transmitters, sensors, control devices. All gauges and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Do not reduce or change maintenance and operating space and access provisions that are shown on the contract documents.
- C. Boiler Control Panel Locations: Locate and orient panels so that operating personnel standing in front of boilers can view the control switches and displays on the panel face for all boilers on the aisle. Panels mounted on the sides near the front of fire tube boilers are prohibited.
- D. Boiler and Economizer Access Platforms: Arrange piping and equipment to allow access by a person standing on the platforms to all valves located above the boilers, to boiler manways located on top of the boilers, and to all economizer valves and access panels.

- E. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- F. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- G. Cutting Holes:
1. Cut holes through concrete and masonry by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill is prohibited, except as permitted by COR where working area space is limited.
 2. Locate holes to avoid interference with structural members such as slabs, columns, ribs, beams or reinforcing. Holes shall be laid out in advance and drilling done only after approval by COR. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to COR for approval.
 3. Do not penetrate membrane waterproofing.
- H. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- I. Electrical Interconnection of Instrumentation or Controls: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, instruments and computer workstations. Devices shall be located so they are easily accessible for testing, maintenance, calibration, etc. The COR has the final determination on what is accessible and what is not. Comply with NFPA 70.
- J. Protection and Cleaning:
1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the COR. Damaged or defective items in the opinion of the COR, shall be replaced.
 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical

- injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- K. Concrete and Grout: Use concrete and non-shrink grout 21 MPa (3000 psig) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE.
- L. Install gauges, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gauges to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- M. Install steam piping expansion joints as per manufacturer's recommendations.
- N. Work in Existing Building:
1. Perform as specified in paragraph, OPERATIONS AND STORAGE AREAS, paragraph, ALTERATIONS, and paragraph, RESTORATION of the Section 01 00 00, GENERAL REQUIREMENTS for relocation of existing equipment, alterations and restoration of existing building(s).
 2. As specified in Section 01 00 00, GENERAL REQUIREMENTS, paragraph, OPERATIONS AND STORAGE AREAS, make alterations to existing service piping at times that will least interfere with normal operation of the facility.
- O. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and data/telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall not be located in the space equal to the width and depth of the equipment and extending from to a height of 1.8 m (6 feet) above the equipment or to ceiling structure, whichever is lower (NFPA 70).
- P. Inaccessible Equipment:
1. Where the Government determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance or inspections, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost or time to the Government.
 2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to motors, fans,

pumps, belt guards, transformers, high voltage lines, conduit and raceways, piping, hot surfaces, and ductwork. The COR has final determination on whether an installation meets this requirement or not.

3.3 TEMPORARY PIPING AND EQUIPMENT

- A. Continuity of operation of existing facilities will generally require temporary installation or relocation of equipment and piping.
- B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of paragraph, ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING apply.
- C. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

3.4 RIGGING

- A. Design is based on application of available equipment. Openings in building structures are planned to accommodate design scheme.
- B. Alternative methods of equipment delivery may be offered by Contractor and will be considered by Government under specified restrictions of phasing and maintenance of service requirements as well as structural integrity of the building.
- C. Close all openings in the building when not required for rigging operations to maintain proper environment in the facility for Government operation and maintenance of service.
- D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility. Upon request, the Government will check structure adequacy and advise Contractor of recommended restrictions.
- E. Contractor shall check all clearances, weight limitations and shall offer a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
- F. Follow approved rigging plan.

G. Restore building to original condition upon completion of rigging work.

SPEC WRITER NOTE: Review the following paragraph with the project structural engineer and confirm that the structural system is adequate for piping and equipment support.

3.5 PIPE AND EQUIPMENT SUPPORTS

A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels designed by a structural engineer, secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the COR.

B. Use of chain pipe supports; wire or strap hangers; wood for blocking, stays and bracing; or, hangers suspended from piping above are prohibited. Replace or thoroughly clean rusty products and paint with zinc primer.

C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 15 mm (1/2 inch) clearance between pipe or piping covering and adjacent work.

D. HVAC Horizontal Pipe Support Spacing: Refer to MSS SP-58. Provide additional supports at valves, strainers, in-line pumps and other heavy components. Provide a support within one foot of each elbow.

E. HVAC Vertical Pipe Supports:

1. Up to 150 mm (6 inch) pipe, 9 m (30 feet) long, bolt riser clamps to the pipe below couplings, or welded to the pipe and rests supports securely on the building structure.

2. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.

F. Overhead Supports:

SPEC WRITER NOTE: Ensure the following has been verified by the A/E structural engineer.

1. //The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.//

2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
3. Tubing and capillary systems shall be supported in channel troughs.

G. Floor Supports:

1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems shall be anchored and doweled to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
2. Bases and supports shall not be located and installed until equipment mounted thereon has been approved. Bases shall be sized to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Boiler foundations shall have horizontal dimensions that exceed boiler base frame dimensions by at least 150 mm (6 inches) on all sides. Structural contract documents shall be reviewed for additional requirements. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a granular material to permit alignment and realignment.
4. //For seismic anchoring, refer to Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS.//

3.6 MECHANICAL DEMOLITION

- A. Rigging access, other than indicated on the contract documents, shall be provided by the Contractor after approval for structural integrity by the COR. Such access shall be provided without additional cost or time to the Government. Where work is in an operating plant, provide approved protection from dust and debris at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
- B. In an operating facility, maintain the operation, cleanliness and safety. Government personnel will be carrying on their normal duties of operating, cleaning and maintaining equipment and plant operation. Confine the work to the immediate area concerned; maintain cleanliness and wet down demolished materials to eliminate dust. Debris accumulated

in the area to the detriment of plant operation is prohibited. Perform all flame cutting to maintain the fire safety integrity of this plant. Adequate fire extinguishing facilities shall be available at all times. Perform all work in accordance with recognized fire protection standards. Inspection will be made by personnel of the VAMC, and Contractor shall follow all directives of the COR with regard to rigging, safety, fire safety, and maintenance of operations.

- C. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from Government property per Section 01 74 19, CONSTRUCTION WASTE MANAGEMENT. This includes all concrete equipment pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with contract documents where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the contract documents of the other disciplines in the project for additional facilities to be demolished or handled.

SPEC WRITER NOTE: Coordinate and identify salvage equipment to be retained by the Government.

- D. All indicated valves including gate, globe, ball, butterfly and check, all pressure gauges and thermometers with wells shall remain Government property and shall be removed and delivered to COR and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these contract documents. Such material shall be removed from Government property expeditiously and shall not be allowed to accumulate.

SPEC WRITER NOTE: Delete the following paragraph if there is no asbestos removal.

- E. //Asbestos Insulation Removal: Conform to Section 02 82 11, TRADITIONAL ASBESTOS ABATEMENT.//

3.7 CLEANING AND PAINTING

- A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Government, the plant facilities, equipment

and systems shall be thoroughly cleaned and painted. Refer to Section 09 91 00, PAINTING.

- B. In addition, the following special conditions apply:
1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions prior to applying prime and finish coats.
 2. The following material and equipment shall not be painted:
 - a. Motors, controllers, control switches, and safety switches.
 - b. Control and interlock devices.
 - c. Regulators.
 - d. Pressure reducing valves.
 - e. Control valves and thermostatic elements.
 - f. Lubrication devices and grease fittings.
 - g. Copper, brass, aluminum, stainless steel and bronze surfaces.
 - h. Valve stems and rotating shafts.
 - i. Pressure gauges and thermometers.
 - j. Glass.
 - k. Nameplates.
 3. Control and instrument panels shall be cleaned, damaged surfaces repaired, and shall be touched-up with matching paint obtained from panel manufacturer.
 4. Pumps, motors, steel and cast-iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same paint type and color as utilized by the pump manufacturer
 5. Boilers, Burners, Fuel Trains and Accessories: Retain manufacturer's factory finish. Touch up or recoat as necessary to provide smooth, even-colored and even-textured finish.
 6. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats. This may include painting exposed metals where hangers were removed or where equipment was moved or removed.
 7. Paint shall withstand the following temperatures without peeling or discoloration:
 - a. Boiler Stack and Breeching: 65 degrees C (150 degrees F) on insulation jacket surface and 315 degrees C (600 degrees F) on metal surface of stacks and breeching.

- b. Condensate and Feedwater 38 degrees C (100 degrees F) on insulation jacket surface and 121 degrees C (250 degrees F) on metal pipe surface.
 - c. Steam: 52 degrees C (125 degrees F) on insulation jacket surface and 190 degrees C (374 degrees F) on metal pipe surface.
8. Final result shall be smooth, even-colored, even-textured factory finish on all items. Completely repaint the entire piece of equipment if necessary to achieve this.
9. Lead based paints are prohibited.

3.8 IDENTIFICATION SIGNS

- A. Provide laminated plastic signs, with engraved lettering not less than 5 mm (3/16 inch) high, designating functions, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
- B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance.
- C. Boiler Plant Instrumentation Panel: Refer to Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT.
- D. Boiler Control Panels: Refer to Section 23 09 11, INSTRUMENTATION AND CONTROL FOR BOILER PLANT
- E. Pipe Identification: Refer to Section 09 91 00, PAINTING.

3.9 MOTOR AND DRIVE ALIGNMENT

- A. Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.
- B. Direct-Connect Drive: Securely mount motor in accurate alignment so that shafts are per coupling manufacturer's tolerances when both motor and driven machine are operating at normal temperatures.

3.10 LUBRICATION

- A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. Field-check all devices for proper lubrication.
- B. All devices and equipment shall be equipped with required lubrication fittings or devices. A minimum of 0.95 liter (1 quart) of oil and 0.45 kg (1 pound) of grease of manufacturer's recommended grade and type for each different application shall be provided; also provide 12 grease

sticks for lubricated plug valves. All materials shall be delivered to COR in unopened containers that are properly identified as to application.

- C. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.
- D. All lubrication points shall be extended to one side of the equipment.

3.11 STARTUP, TEMPORARY OPERATION AND TESTING

- A. Perform tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- C. //The Commissioning Agent will observe startup and Contractor testing of selected equipment. Coordinate the startup and Contractor testing schedules with COR and Commissioning Agent. Provide a minimum notice of 10 working days prior to startup and testing.//
- D. Startup of equipment shall be performed as described in equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation. Temporary use of equipment is specified in Section 01 00 00, GENERAL REQUIREMENTS, paragraph, TEMPORARY USE OF MECHANICAL AND ELECTRICAL EQUIPMENT.

3.12 OPERATING AND PERFORMANCE TESTS

- A. Prior to the final inspection, perform required tests as specified in Section 01 00 00, GENERAL REQUIREMENTS, paragraph, TESTS; Section 23 08 11, DEMONSTRATIONS AND TESTS FOR BOILER PLANT; and in individual Division 23 specification sections and submit the test reports and records to the COR.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost or time to the Government.
- C. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then conduct such performance tests and finalize control settings for heating systems and for cooling systems respectively during first actual seasonal use of respective systems

following completion of work. Rescheduling of these tests shall be requested in writing to COR for approval.

- D. No adjustments maybe made during the acceptance inspection. All adjustments shall have been made by this point.
- E. //Perform tests as required for commissioning provisions in accordance with Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS and Section 01 91 00, GENERAL COMMISSIONING REQUIREMENTS.//

3.13 DEMONSTRATIONS AND TESTS, TEMPORARY BOILER PLANT EQUIPMENT

- A. Test prior to placing in service.
- B. Demonstrate to COR the proper operation of all equipment, instruments, operating and safety controls, and devices.
- C. Demonstrate to COR the proper operation of burners.
 - 1. Emissions within limits specified for new boilers on this project.
 - 2. Stable flame at all operating points with no pulsations.
 - 3. No flame impingement on the Morrison tube or furnace walls, or water tubes.
 - 4. Smooth flame light off, with no delays, puffs or flashbacks.
 - 5. Turndown capability as specified.
- D. Develop full steam output capacity required.
- E. New boilers installed in temporary location:
 - 1. Perform all tests required by boiler specification.
 - 2. Perform complete retest after boiler is placed in its permanent location.

3.14 //COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

3.15 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for //4//
// // hour//s// to instruct each VA personnel responsible in operation and maintenance of the system.
- B. //Submit training plans and instructor qualifications in accordance with the requirements of Section 23 08 00, COMMISSIONING OF HVAC SYSTEMS.//

- - - E N D - - -