

SECTION 23 08 00
COMMISSIONING OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 23.
- B. This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS. A Commissioning Agent (CxA) appointed by the Department of Veterans Affairs will manage the commissioning process.

1.2 RELATED WORK

- A. Section 01 00 00 GENERAL REQUIREMENTS.
- B. Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- D. Section 23 08 12, VA Boiler Plant Safety Device Testing Manual, Third Edition, 2008 for testing and safety device requirements for natural gas and fuel oil trains.

1.3 SUMMARY

- A. This Section includes requirements for commissioning the HVAC systems, subsystems and equipment. This Section supplements the general requirements specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.
- B. The commissioning activities have been developed to support the VA requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.
- C. The commissioning activities have been developed to support the United States Green Building Council (USGBC) LEED™ rating program and to support delivery of project performance in accordance with the Contract Documents developed with the approval of the VA.
 - 1. Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" prerequisite of "Fundamental Building Systems Commissioning".
 - 2. Commissioning activities and documentation for the LEED™ section on "Energy and Atmosphere" requirements for the "Enhanced Building System Commissioning" credit.
 - 3. Activities and documentation for the LEED™ section on "Measurement and Verification" requirements for the Measurement and Verification credit.

- D. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for more specifics regarding processes and procedures as well as roles and responsibilities for all Commissioning Team members.

1.4 DEFINITIONS

- A. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.5 COMMISSIONED SYSTEMS

- A. Commissioning of a system or systems specified in this Division is part of the construction process. Documentation and testing of these systems, as well as training of the VA's Operation and Maintenance personnel, is required in cooperation with the VA and the Commissioning Agent.
- B. The following HVAC systems will be commissioned:
1. Air Handling Systems (Fans, motors, heating coils and control valves, filters, dampers, safeties such as smoke detectors or freezestats and damper end switches, controls, gages, and vibration isolation).
 2. Condensate Return Systems (condensate transfer pumps, vacuum condensate pump system, deaerator, feedwater pumps motors, controls, pump alternator, alarms and instrumentation, deaerators, boiler feed pumps and motors, safeties).
 3. Steam System (Boilers, boiler controls and boiler plant controls, gages and instrumentation, safety relief valves, combustion burners/fans/motors, fuel delivery pumps and motors, flues, burner controls).
 4. Direct Digital Control System (BACnet or similar Local Area Network (LAN), Operator Work Station hardware and software, building controller hardware and software, terminal unit controller hardware and software, all sequences of operation, system accuracy and response time).
 5. Room Pressurization Equipment (Pressure sensors, controls and alarms).
 6. Boiler Chemical Feed Systems (Closed circuits - including final water analysis, open circuits - including water analysis, chemical/biocide tanks, injection piping, chemical/biocide pumps and motors, controls, water meter, and automatic blowdown).

1.6 SUBMITTALS

- A. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be

reviewed by the Commissioning Agent. This list will be reviewed and approved by the VA prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, and SAMPLES for further details.

- B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 PRE-FUNCTIONAL CHECKLISTS

- A. The Contractor shall complete Pre-Functional Checklists to verify systems, subsystems, and equipment installation is complete and systems are ready for Systems Functional Performance Testing. The Commissioning Agent will prepare Pre-Functional Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the VA and to the Commissioning Agent for review. The Commissioning Agent may spot check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and resubmission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and resubmission. Refer to SECTION 01 91 00 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for Pre-Functional Checklists, Equipment Startup Reports, and other commissioning documents.

3.2 CONTRACTORS TESTS

- A. Contractor tests as required by other sections of Division 23 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. The Commissioning Agent will witness selected Contractor tests. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.3 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

A. The Commissioning Process includes Systems Functional Performance

Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Contracting Officer's Technical Representative (COTR). The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will witness and document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.4 TRAINING OF VA PERSONNEL

A. Training of the VA's operation and maintenance personnel is required in cooperation with the COTR and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the COTR after submission and approval of formal training plans. Refer to Section 01 91 00 GENERAL COMMISSIONING REQUIREMENTS and Division 23 Sections for additional Contractor training requirements.

----- END -----



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Fire-Tube Boilers (Steam L.P.) Pre-Functional Checklist

Equipment ID	[Equipment ID]
Building	[Building]
Location	[Room]

Statement of Readiness

The above equipment and/or systems integral to them are complete and ready for functional testing, except as noted. None of the outstanding items preclude safe and reliable functional tests being performed. This checklist does not take the place of the manufacturer's recommended checkout and startup procedures or report.

Responsible Contractor Signoff

CONTRACTOR	PRINTED NAME	SIGNATURE	DATE
General Contractor (GC)			
Mechanical Contractor (MC)			
Electrical Contractor (EC)			
TAB Contractor (TAB)			
Controls Contractor (CC)			

This statement of readiness has been received by the Commissioning Agent on _____ and will be incorporated as part of the final commissioning report.

Equipment Information

Make		Model Number	
Serial Number		Capacity BTUH	PPH
Volts/Phase		Function	Service Area

Sample Pre-Functional Checklist

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Fire-Tube Boiler

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Notes:

System Readiness Checklist

Yes = Checked and Completed, N/A = Not Applicable

General Installation					
Description	Yes	N/A	Initials	Date	Comments
General appearance good, no apparent damage	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Pipe, fittings and accessories complete	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Pumps and accessories complete	<input type="checkbox"/>	<input type="checkbox"/>			
Pipe, gas, fittings and accessories complete	<input type="checkbox"/>	<input type="checkbox"/>			
Isolation valves and balancing valves installed	<input type="checkbox"/>	<input type="checkbox"/>			
Pipes not supported on boiler	<input type="checkbox"/>	<input type="checkbox"/>			
Steam system flushing complete, strainers cleaned and steam traps operational	<input type="checkbox"/>	<input type="checkbox"/>			
Condensate receiver and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Condensate receiver and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Condensate pipe, fittings and pumps complete	<input type="checkbox"/>	<input type="checkbox"/>			
Boiler temperature control installed	<input type="checkbox"/>	<input type="checkbox"/>			
Pressure gages installed	<input type="checkbox"/>	<input type="checkbox"/>			
Test plugs (P/T) installed near all control sensors and as per spec	<input type="checkbox"/>	<input type="checkbox"/>			
Flow switch installed as specified	<input type="checkbox"/>	<input type="checkbox"/>			
Proper boiler fluid level	<input type="checkbox"/>	<input type="checkbox"/>			
Expansion tanks and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Air removal fitting and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment labels affixed	<input type="checkbox"/>	<input type="checkbox"/>			

Sample Pre-Functional Checklist

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Fire-Tube Boiler

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General Installation					
Description	Yes	N/A	Initials	Date	Comments
Tube pull and access door space adequate and to code	<input type="checkbox"/>	<input type="checkbox"/>			
Combustion air supply installed	<input type="checkbox"/>	<input type="checkbox"/>			
No leaking apparent	<input type="checkbox"/>	<input type="checkbox"/>			
Boiler water condensate pumps and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Boiler safeties, burner controls and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Draft Fan (If Applicable)					
Description	Yes	N/A	Initials	Date	Comments
Fan is installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Casing in good condition; no dents	<input type="checkbox"/>	<input type="checkbox"/>			
Mountings checked and shipping bolts removed	<input type="checkbox"/>	<input type="checkbox"/>			
Vibration isolators installed	<input type="checkbox"/>	<input type="checkbox"/>			
Plenums free of debris	<input type="checkbox"/>	<input type="checkbox"/>			
Fan rotates freely and in correct direction	<input type="checkbox"/>	<input type="checkbox"/>			
Bearings lubricated	<input type="checkbox"/>	<input type="checkbox"/>			
Equipment guards and safety devices installed	<input type="checkbox"/>	<input type="checkbox"/>			
Starter installed and size coordinated with motor	<input type="checkbox"/>	<input type="checkbox"/>			
Motor correctly aligned	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					



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Gas Train					
Description	Yes	N/A	Initials	Date	Comments
Gas train Installed in accordance with NFPA, FM and IRI	<input type="checkbox"/>	<input type="checkbox"/>			
Gas train checked for leaks	<input type="checkbox"/>	<input type="checkbox"/>			
Gas piping installed and tested	<input type="checkbox"/>	<input type="checkbox"/>			
Gas train vents are terminated per code	<input type="checkbox"/>	<input type="checkbox"/>			
Gas train safety devices are operational	<input type="checkbox"/>	<input type="checkbox"/>			
Drip leg provided in gas main	<input type="checkbox"/>	<input type="checkbox"/>			
Gas cock valve orientation per manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>			
Gas cock valve accessible and travels freely	<input type="checkbox"/>	<input type="checkbox"/>			
Gas cock checked for leaks in closed position with the other gas train valves open	<input type="checkbox"/>	<input type="checkbox"/>			
Gas regulator installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Gas regulator properly located in non-turbulent section of pipe	<input type="checkbox"/>	<input type="checkbox"/>			
Gas regulator is properly oriented	<input type="checkbox"/>	<input type="checkbox"/>			
Gas regulator is wired correctly	<input type="checkbox"/>	<input type="checkbox"/>			
Gas regulator is accessible for test and service	<input type="checkbox"/>	<input type="checkbox"/>			
Gas pressure adjusted and verified within acceptable range	<input type="checkbox"/>	<input type="checkbox"/>			
Confirmed gas PRV operation	<input type="checkbox"/>	<input type="checkbox"/>			
Gas pressure sensor limits are appropriate for application	<input type="checkbox"/>	<input type="checkbox"/>			
High gas pressure switch installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
High gas pressure switch is properly wired	<input type="checkbox"/>	<input type="checkbox"/>			
Low gas pressure switch installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Low gas pressure switch is properly wired	<input type="checkbox"/>	<input type="checkbox"/>			
Gas control valve installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			

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Gas Train					
Description	Yes	N/A	Initials	Date	Comments
Gas control valve installed vertical with direction of flow confirmed	<input type="checkbox"/>	<input type="checkbox"/>			
Gas control valve accessible and travels freely	<input type="checkbox"/>	<input type="checkbox"/>			
Gas control valve checked for leaks in closed position with the other gas train valves open	<input type="checkbox"/>	<input type="checkbox"/>			
Gas control valve had no visible damage	<input type="checkbox"/>	<input type="checkbox"/>			
Gas control valve nameplate readings checked against application and is applied correctly	<input type="checkbox"/>	<input type="checkbox"/>			
Drum relief valve setting adequate for application	<input type="checkbox"/>	<input type="checkbox"/>			
Drum relief valve discharge properly piped	<input type="checkbox"/>	<input type="checkbox"/>			
Stop-Check valve pressure rating applicable for duty	<input type="checkbox"/>	<input type="checkbox"/>			
Stop-Check valve installed per manufacturers instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Fuel Oil Piping (If Applicable)					
Description	Yes	N/A	Initials	Date	Comments
Fuel Oil Piping Installed in accordance with NFPA, FM and IRI	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Piping checked for leaks	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Piping installed and tested	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Piping safety devices are operational	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Pumps and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Pumps started up and operational per manufacturers recommendations	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil anamizer and accessories installed	<input type="checkbox"/>	<input type="checkbox"/>			
Gas cock checked for leaks in closed position with the other gas train valves open (manufacturers representative has started up burner with fuel oil)	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil Pressure adjusted and verified within acceptable range	<input type="checkbox"/>	<input type="checkbox"/>			

Sample Pre-Functional Checklist

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Fuel Oil Piping (If Applicable)					
Description	Yes	N/A	Initials	Date	Comments
Confirmed Fuel Oil PRV operation	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil pressure sensor limits are appropriate for application	<input type="checkbox"/>	<input type="checkbox"/>			
High Fuel Oil pressure switch installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
High Fuel Oil pressure switch is properly wired	<input type="checkbox"/>	<input type="checkbox"/>			
Low Fuel Oil pressure switch installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Low Fuel Oil pressure switch is properly wired	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil control valve installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil control valve accessible and travels freely	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil control valve checked for leaks in closed position	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil control valve had no visible damage	<input type="checkbox"/>	<input type="checkbox"/>			
Fuel Oil control valve nameplate readings checked against application and is applied correctly	<input type="checkbox"/>	<input type="checkbox"/>			
Stop-Check valve pressure rating applicable for duty	<input type="checkbox"/>	<input type="checkbox"/>			
Stop-Check valve installed per manufacturers instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Piping					
Description	Yes	N/A	Initials	Date	Comments
Steam piping complete, elbows minimized, pitched back to condensate receiver, makeup water piping and safety reliefs installed	<input type="checkbox"/>	<input type="checkbox"/>			
Piping supported independently of the boiler	<input type="checkbox"/>	<input type="checkbox"/>			
Piping type and flow direction labeled on piping	<input type="checkbox"/>	<input type="checkbox"/>			
Isolation valves, balancing valves and piping specialties installed	<input type="checkbox"/>	<input type="checkbox"/>			

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Piping					
Description	Yes	N/A	Initials	Date	Comments
Steam system flushing complete and strainers cleaned	<input type="checkbox"/>	<input type="checkbox"/>			
Chemical treatment system or plan installed	<input type="checkbox"/>	<input type="checkbox"/>			
Unions installed to allow for easy removal of control valves	<input type="checkbox"/>	<input type="checkbox"/>			
Steam supply functional (preference is to have the steam system VTP complete and satisfactory).	<input type="checkbox"/>	<input type="checkbox"/>			
Pressure gauges have been installed	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Electrical and Controls					
Description	Yes	N/A	Initials	Date	Comments
Power disconnect is located within site of the unit it controls and labeled	<input type="checkbox"/>	<input type="checkbox"/>			
All electric connections tight and installed properly	<input type="checkbox"/>	<input type="checkbox"/>			
Grounding installed for components and unit	<input type="checkbox"/>	<input type="checkbox"/>			
Safeties installed and operational	<input type="checkbox"/>	<input type="checkbox"/>			
Starter overload breakers installed and correct size	<input type="checkbox"/>	<input type="checkbox"/>			
All control devices, pneumatic tubing and wiring complete	<input type="checkbox"/>	<input type="checkbox"/>			
Control system interlocks connected and functional	<input type="checkbox"/>	<input type="checkbox"/>			
Size of over current heater in motor starter correct (where applicable)	<input type="checkbox"/>	<input type="checkbox"/>			
HOA Switch installed per manufacturer's instructions (if applicable)	<input type="checkbox"/>	<input type="checkbox"/>			
Operation of HOA switch checked in all positions	<input type="checkbox"/>	<input type="checkbox"/>			
Proper safeties in control when HOA switch in Hand position	<input type="checkbox"/>	<input type="checkbox"/>			
Sensors calibrated (see calibration section below)	<input type="checkbox"/>	<input type="checkbox"/>			
Multiple boiler interlocks completed	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

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Flue					
Description	Yes	N/A	Initials	Date	Comments
Installed per manufacturers instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Sloped toward boiler	<input type="checkbox"/>	<input type="checkbox"/>			
Clearance to combustibles per code	<input type="checkbox"/>	<input type="checkbox"/>			
Protection in place to prevent burning hazard	<input type="checkbox"/>	<input type="checkbox"/>			
Discharge is protected from rain and blockage	<input type="checkbox"/>	<input type="checkbox"/>			
Provisions in place for expansion compensation	<input type="checkbox"/>	<input type="checkbox"/>			
Discharge is located to preclude re-entrainment back into the building	<input type="checkbox"/>	<input type="checkbox"/>			
Draft checked and meets minimum requirements of boiler manufacturer	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

Low Pressure Cutoff					
Description	Yes	N/A	Initials	Date	Comments
Installed per manufacturer's instructions	<input type="checkbox"/>	<input type="checkbox"/>			
Wire terminations checked and correct	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					

TAB					
Description	Yes	N/A	Initials	Date	Comments
Installation of system and balancing devices is completed following NEBB or AABC procedures and contract documents	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					



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Operational Checks					
Description	Yes	N/A	Initials	Date	Comments
Measure line to line voltage phase imbalance for all three-phase motors: (%Imbalance = 100 x (avg. - lowest) / avg.) Record imbalance of compressor. Imbalance less than 2%?	<input type="checkbox"/>	<input type="checkbox"/>			
Record full load running amps for all three-phase motors. _____ rated FL amps x _____ srvc factor = _____ (Max amps). Running less than max?	<input type="checkbox"/>	<input type="checkbox"/>			
No unusual noise and vibration when running	<input type="checkbox"/>	<input type="checkbox"/>			
Boiler safeties energized and tested	<input type="checkbox"/>	<input type="checkbox"/>			
Specified sequences of operation and operating schedules have been implemented with all variations documented	<input type="checkbox"/>	<input type="checkbox"/>			
Specified point-to-point checks have been completed and documentation record submitted for this system	<input type="checkbox"/>	<input type="checkbox"/>			
Startup report completed with this checklist attached. (Includes full listing of all internal settings with notes as to which settings are BAS controlled or monitored and which are integral	<input type="checkbox"/>	<input type="checkbox"/>			
Startup report includes written certification from boiler manufacturer that all specified features, controls and safeties have been installed and are functioning properly and that the installation and application comply with the manufacturer's recommendations	<input type="checkbox"/>	<input type="checkbox"/>			
Startup report includes optimal and actual percent CO ₂ , CO, O ₂ , stack temperature; combustion efficiency	<input type="checkbox"/>	<input type="checkbox"/>			
Piping gages, BAS and boiler panel temperature and pressure readouts match (see calibration section below)	<input type="checkbox"/>	<input type="checkbox"/>			
Notes:					



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Additional Comments:

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SAMPLE