



SECTION 23 08 00 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. HVAC Commissioning description.
 2. HVAC Commissioning responsibilities.

1.2 REFERENCES

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
1. ASHRAE Guideline 0 - The Commissioning Process.
 2. ASHRAE Guideline 1.1 - HVAC&R Technical Requirements for the Commissioning Process.

1.3 COMMISSIONING DESCRIPTION

- A. HVAC commissioning process includes the following tasks:
1. Testing and startup of HVAC equipment and systems.
 2. Equipment and system verification checks.
 3. Assistance in functional performance testing to verify testing and balancing, and equipment and system performance.
 4. Provide qualified personnel to assist in commissioning tests, including seasonal testing.
 5. Complete and endorse functional performance test checklists provided by Commissioning Authority to assure equipment and systems are fully operational and ready for functional performance testing.
 6. Provide equipment, materials, and labor necessary to correct deficiencies found during commissioning process to fulfill contract and warranty requirements.
 7. Provide operation and maintenance information and record drawings to Commissioning Authority for review verification and organization, prior to distribution.
 8. Provide assistance to Commissioning Authority to develop, edit, and document system operation descriptions.
 9. Provide training for systems specified in this Section with coordination by Commissioning Authority.
- B. Equipment and Systems to Be Commissioned:
1. Pumps
 2. Piping systems.



3. Ductwork.
4. Variable frequency drives.
5. Packaged roof top air conditioning units.
6. Split system air conditioning units.
7. Humidifiers.
8. Air handling units.
9. Packaged heat pump units.
10. Self-contained air conditioning units.
11. Fan Coil Units.
12. Heat exchangers.
13. Computer room units.
14. Constant volume terminal units.
15. Variable volume terminal units.
16. Fans.
17. Fire dampers.
18. Smoke dampers.
19. Indoor air quality.
20. Equipment sound control – if noted on drawings.
21. Equipment vibration control – if noted on drawings.
22. Automatic temperature control system.
23. Testing, Adjusting and Balancing work.

1.4 COMMISSIONING SUBMITTALS

- A. Draft Forms: Submit draft of system verification form and functional performance test checklist.
- B. Test Reports: Indicate data on system verification form for each piece of equipment and system as specified. Use AABC or NEBB forms.
- C. Field Reports: Indicate deficiencies preventing completion of equipment or system verification checks equipment or system to achieve specified performance.

1.5 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record revisions to equipment and system documentation necessitated by commissioning.
- B. Operation and Maintenance Data: Submit revisions to operation and maintenance manuals when necessary revisions are discovered during commissioning.



1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with ASHRAE Guideline 0.

1.7 COMMISSIONING RESPONSIBILITIES

- A. Equipment or System Installer Commissioning Responsibilities:
 - 1. Attend commissioning meetings.
 - 2. Ensure temperature controls installer performs assigned commissioning responsibilities as specified below.
 - 3. Ensure testing, adjusting, and balancing agency performs assigned commissioning responsibilities as specified.
 - 4. Provide instructions and demonstrations for LAWA's personnel.
 - 5. Ensure subcontractors perform assigned commissioning responsibilities.
 - 6. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
 - 7. Develop startup and initial checkout plan using manufacturer's startup procedures and functional performance checklists for equipment and systems to be commissioned.
 - 8. During verification check and startup process, execute HVAC related portions of checklists for equipment and systems to be commissioned.
 - 9. Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Authority.
 - 10. Provide manufacturer's representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
 - 11. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
 - 12. Provide personnel to assist Commissioning Authority during equipment or system verification checks and functional performance tests.
 - 13. Prior to functional performance tests, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.
 - 14. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.
 - 15. Provide factory supervised startup services for equipment and systems where specified. Coordinate work with manufacturer and Commissioning Authority.
 - 16. Perform verification checks and startup on equipment and systems as specified.
 - 17. Assist Commissioning Authority in performing functional performance tests on equipment and systems as specified.



18. Perform operation and maintenance training sessions scheduled by Commissioning Authority.
 19. Conduct HVAC system orientation and inspection.
- B. Temperature Controls Installer Commissioning Responsibilities:
1. Attend commissioning meetings.
 2. Review design for ability of systems to be controlled including the following:
 - a. Confirm proper hardware requirements exist to perform functional performance testing.
 - b. Confirm proper safeties and interlocks are included in design.
 - c. Confirm proper sizing of system control valves and actuators and control valve operation will result capacity control identified in Contract Documents.
 - d. Confirm proper sizing of system control dampers and actuators and damper operation will result in proper damper positioning.
 - e. Confirm sensors selected are within device ranges.
 - f. Review sequences of operation and obtain clarification from Architect/Engineer.
 - g. Indicate delineation of control between packaged controls and building automation system, listing BAS monitor points and BAS adjustable control points.
 - h. Provide written sequences of operation for packaged controlled equipment. Equipment manufacturers' stock sequences may be included, when accompanied by additional narrative to reflect Project conditions.
 3. Inspect, check, and confirm proper operation and performance of control hardware and software provided in other HVAC sections.
 4. Submit proposed procedures for performing automatic temperature control system point-to-point checks to Commissioning Authority and Architect/Engineer.
 5. Inspect check and confirm correct installation and operation of automatic temperature control system input and output device operation through point-to-point checks.
 6. Perform training sessions to instruct LAWA's personnel in hardware operation, software operation, programming, and application in accordance with commissioning plan.
 7. Demonstrate system performance and operation to Commissioning Authority during functional performance tests including each mode of operation.
 8. Provide control system technician to assist during Commissioning Authority verification check and functional performance testing.
 9. Provide control system technician to assist testing, adjusting, and balancing agency during performance of testing, adjusting, and balancing work.
 10. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.



- C. Testing, Adjusting, and Balancing Agency Commissioning Responsibilities:
 - 1. Attend commissioning meetings.
 - 2. Participate in verification of testing, adjusting, and balancing report for verification or diagnostic purposes. Repeat sample of percent of measurements contained in testing, adjusting, and balancing report as indicated in commissioning plan.
 - 3. Assist in performing operation and maintenance training sessions scheduled by Commissioning Authority.

1.8 COMMISSIONING MEETINGS

- A. Attend initial commissioning meeting and progress commissioning meetings as required by Commissioning Authority.

1.9 SCHEDULING

- A. Prepare schedule indicating anticipated start dates for the following:
 - 1. Piping system pressure testing.
 - 2. Piping system flushing and cleaning.
 - 3. Ductwork cleaning.
 - 4. Ductwork pressure testing.
 - 5. Equipment and system startups.
 - 6. Automatic temperature control system checkout.
 - 7. Testing, adjusting, and balancing.
 - 8. HVAC system orientation and inspections.
 - 9. Operation and maintenance manual submittals.
 - 10. Training sessions.
- B. Schedule seasonal tests of equipment and systems during peak weather conditions to observe full-load performance.
- C. Schedule occupancy sensitive tests of equipment and systems during conditions of both minimum and maximum occupancy or use.

1.10 COORDINATION

- A. Notify Commissioning Authority minimum of four weeks in advance of the following:
 - 1. Scheduled equipment and system startups.
 - 2. Scheduled automatic temperature control system checkout.
 - 3. Scheduled start of testing, adjusting, and balancing work.



- B. Coordinate programming of automatic temperature control system with construction and commissioning schedules.

PART 2 - PRODUCTS

2.1 DESIGN DOCUMENT AND SUBMITTAL REVIEWS

- A. General:
 - 1. Review the Owner Project Requirements (OPR) and relevant design documents.

2.2 SEQUENCE OF OPERATIONS OF HVAC SYSTEM

- A. General:
 - 1. Sequences of Operation submitted shall describe in detail the operation of the building control system and its components. The sequences provided in the contract drawings and specifications provide a good overview, but they shall be supplemented by finalized sequences used to program the system. Sequences of operation should address all critical system interactions in detail to enable their verification and troubleshooting.
 - 2. Control system architecture, components and hardware.

2.3 START-UP AND TESTING, ADJUSTING AND BALANCING (TAB) REPORTS

- A. Start-up and testing reports shall be generated by the installing contractor for all equipment/systems and submitted to Contractor who provides a copy to the Commissioning Authority (CxA).
- B. TAB reports shall be created for designated systems by a certified TAB provider and submitted to Contractor who provides a copy to the CxA.

2.4 FUNCTIONAL PERFORMANCE TESTS

- A. General:
 - 1. Submit Functional Performance Test forms for owner approvals.
 - 2. Submit Functional Performance Test results for each system.

2.5 OPERATION & MAINTENANCE MANUAL AND PERSONNEL TRAINING REVIEWS

- A. Submit O&M Manuals and Personnel Training Reviews.

2.6 SYSTEMS MANUAL

- A. Submit Systems Manual.



PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install additional balancing dampers, balancing valves, access doors, test ports, and pressure and temperature taps required by Commissioning Authority or commissioning plan.
- B. Place HVAC systems and equipment into full operation and continue operation during each working day of commissioning.
- C. Install replacement sheaves and belts to obtain system performance, as requested by Commissioning Authority.
- D. Install test holes in ductwork and plenums as requested by Commissioning Authority for taking air measurements.
- E. Prior to start of functional performance test, install replacement filters in equipment.

3.2 COMMISSIONING

- A. Seasonal Sensitive Functional Performance Tests (as far as possible and in consultation with LAWA):
 - 1. Test heating equipment at winter design temperatures.
 - 2. Test cooling equipment at summer design temperatures.
- B. Be responsible to participate in initial and alternate peak season test of systems required to demonstrate performance.
- C. Occupancy Sensitive Functional Performance Tests:
 - 1. Test equipment and systems affected by occupancy variations at minimum and peak loads to observe system performance.
 - 2. Participate in testing delayed beyond Final Completion to test performance with actual occupancy conditions.

END OF SECTION 23 08 00