SECTION 20 08 00 – Fire Supression/Plumbing/HVAC Systems Commissioning

1. GENERAL
	* + 1. RELATED DOCUMENTS
				1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
				2. Specifications throughout all Divisions of the Project Manual are directly applicable to this Section, and this Section is directly applicable to them.
			2. SUMMARY
				1. The purpose of this Section is to define responsibilities in the Commissioning process. Additional system testing is required within individual Specification Sections.
				2. Ensure that all systems are operating in a manner consistent with the Contract Documents. General Commissioning requirements and coordination are detailed in Division 01. Execute all Commissioning responsibilities assigned and include the cost of Commissioning in the Contract price.
				3. HVAC systems to be commissioned include the following: **[Edit or add to the following scope as appropriate to the Project.]**

Chilled Water Systems

Cooling Tower

Hot Water and Steam PRV Station

Steam Boiler System

Pumps

Heat Exchangers

Air Handling Units

Fans

Piping Systems

Ductwork Systems

Fire, Fire/Smoke and Volume Dampers

Chemical Treatment

Roof Top Packaged DX Units

Split Systems

Fan Coil Units

Terminal Units

Unit Heaters

Building Automation System

* + - * 1. Plumbing Systems to be commissioned include the following **[Edit or add to the following scope as appropriate to the Project.]**:

Sanitary Waste and Vent

Roof and Storm Drainage

Laboratory (Chemical) Waste and Vent

Grease/Oil Laden Waste and Vent

Sump/Ejector Pumps

Domestic Water Booster Pumps

Domestic Water Storage/Break Tank

Water Softeners

Pure Water Production Equipment (R.O., D.I., etc.)

Domestic Water Heaters

Domestic Hot Water Circulating Pumps

Domestic Cold Water Distribution

Domestic Hot Water Distribution

Natural Gas Distribution

Medical Air Compressors and Vacuum Pumps

Laboratory Air Compressors And Vacuum Pumps

Medical Compressed Gas Cylinder Manifolds

Laboratory Compressed Gas Manifolds

Medical Gas and Vacuum System Alarms

Laboratory Gas and Vacuum System Alarms

Medical Gas and Vacuum Distribution

Laboratory Gas and Vacuum Distribution

Plumbing Fixtures

Plumbing Systems/Emergency Power Source Integration

Plumbing Systems/Building Automation System Integration

* + - * 1. Fire Protection Systems to be commissioned include the following **[Edit or add to the following scope as appropriate to the Project.]v**:

Fire Pump

Wet Standpipe

Wet Fire Sprinkler

Dry Fire Sprinkler

Pre-Action Fire Sprinkler

Chemical Fire Suppression

Fire Protection Water Storage/Break Tank

Fire Protection Systems/Emergency Power Source Integration

Fire Protection Systems/Fire Alarm System Integration

Fire Water Tank and piping system including valves, high/low level, over flow, metering, basin and circulation loop.

* + - 1. REFERENCE STANDARDS
				1. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
				2. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
				3. All materials, installation and workmanship shall comply with all applicable requirements and standards.
			2. definitions
				1. Commissioning: A systematic process confirming that building systems have been installed, properly started, and consistently operated in strict accordance with the Contract Documents, that all systems are complete and functioning in accordance with the Contract Documents at Substantial Completion, and that Contractor has provided Owner adequate system documentation and training. Commissioning includes deferred and/or seasonal tests as approved by Owner.
				2. Commissioning Plan: Document prepared by Contractor and approved by Owner that provides the structure, schedule, and coordination plan for the Commissioning process from the construction phase through the warranty period. The Commissioning Plan must satisfy the Owner’s test requirements.
				3. Commissioning Team: Working group made up of representative(s) from the Architect/Engineer (AE), Contractor, Test, Adjust, and Balance (TAB) Firm, Building Automation System (BAS) provider, specialty manufacturers and suppliers, and Owner. Contractor will provide ad-hoc representation of subcontractors on the Commissioning Team as required for implementation of the Commissioning Plan.
				4. Deferred Tests: Functional Performance or Integrated System Tests performed after Substantial Completion due to partial occupancy, partial equipment acceptance, seasonal requirements, design, or other Site conditions that prohibit the test from being performed prior to Substantial Completion.
				5. Deficiency: Condition of a component, piece of equipment or system that is not in compliance with Contract Documents.
				6. Factory Testing: Testing of equipment at the factory, by factory personnel with an Owner’s representative present if deemed necessary by Owner.
				7. Functional Performance Test Procedures: Commissioning protocols and detailed test procedures and instructions in tabular and script-type format that fully describe system configuration and steps required to determine if the system is performing and functioning properly. Contractor prepares these procedures to document Functional Performance Tests.
				8. Functional Performance Test (FPT): Test of dynamic function and operation of equipment and systems executed by Contractor. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, life safety conditions, power failure, etc. Systems are run through all specified sequences of operation. Components are verified to be responding in accordance with Contract Documents. Functional Performance Tests are executed after Start-ups and Prefunctional Checklists are complete.
				9. Integrated System Test: Test of dynamic interactive function and operation of multiple systems. Integrated System Tests are tested under various modes, such as fire alarm and emergency situations, life safety conditions, power failure, etc. Systems are integrally operated through all specified sequences of operation. Components are verified to be responding in accordance with Contract Documents. Integrated System Tests are executed after Functional Performance Tests are complete and prior to Substantial Completion. Integrated System Tests provide verification that the integrated systems will properly function according to the Contract Documents.
				10. Integrated System Test Procedures: Commissioning protocols and detailed test procedures and instructions in tabular and script-type format fully describe system configurations and steps required to determine if the interacting systems are performing and functioning properly. Contractor prepares these procedures to document Integrated System Tests.
				11. Prefunctional Checklist: A list of static inspections and material or component tests that verify proper installation of equipment (e.g., belt tension, oil levels, labels affixed, gages in place, sensors calibrated, etc.). The word Prefunctional refers to before Functional tests. Prefunctional Checklists must include the manufacturer’s Start-up checklist(s). Contractor shall sign Prefunctional Checklists as complete and submit with the Request for Start-up/Functional Performance Test Form.
				12. Start-up: The activities where equipment is initially energized, tested, and operated. Start-up is completed prior to Functional Performance Tests.
				13. Test Requirements: Requirements specifying what systems, modes and functions, etc. must be tested. Test requirements are not detailed test procedures. Test requirements and acceptance criteria are specified in the Contract Documents.
			3. SUBMITTALS
				1. Contractor shall prepare Prefunctional Checklists and Functional Performance Test (FPT) procedures and execute and document results. All Prefunctional Checklists and tests must be documented using specific, procedural forms in Microsoft Word or Excel software developed for that purpose. Prior to testing, Contractor shall submit those forms to the Owner for review and approval.
				2. Contractor shall provide Owner with documentation required for Commissioning Work. At minimum, documentation shall include: Detailed Start-up procedures, full sequences of operation, Operating and Maintenance data, performance data, Functional Performance Test Procedures, control drawings, and details of Owner-contracted tests.
				3. Contractor shall submit to Owner installation and checkout materials actually shipped inside equipment and actual field checkout sheet forms used by factory or field technicians.
				4. Contractor shall review and approve other relative documentation for impact on FPT’s of the systems:

Shop drawings and product submittal data related to systems or equipment to be commissioned. The Subcontractor responsible for the FPT shall review and incorporate comments from the Owner and AE via the Contractor.

Incorporate manufacturer’s Start-up procedures with Prefunctional checklists.

Draft Test, Adjust and Balance (TAB) Reports: Review and provide comments to Owner.

Factory Performance Test Reports: Review and compile all factory performance data to assure that the data is complete prior to executing the FPT’s.

Completed equipment Start-up certification forms along with the manufacturer’s field or factory performance and Start-up test documentation: Subcontractor performing the test will review the documentation prior to commencing with the scheduled FPT’s. Owner may require that system one-line diagrams and applicable Specification Section(s) be attached to the FPT documentation.

Final TAB Reports: Subcontractor performing the test will review the documentation prior to commencing with the scheduled FPT’s.

Operating and Maintenance (O&M) information per requirements of the Technical Specifications and Division 01 requirements: To validate adequacy and completeness of the FPT, the Contractor shall ensure that the O&M manual content, marked-up record Drawings and Specifications, component submittal drawings, and other pertinent documents are available at the Project Site for review.

1. PRODUCTS
	* + 1. GENERAL
				1. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
			2. TEST EQUIPMENT
				1. Provide all specialized tools, test equipment and instruments required to execute Start-up, checkout, and testing of equipment.
				2. All specialized tools, test equipment, and instruments required to execute Start-up, checkout, and testing of equipment shall be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated test equipment within the previous twelve (12) months. Calibration shall be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer’s recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.
2. EXECUTION
	* + 1. PREPARATION
				1. Construction Phase:

In each purchase order or subcontract that is written for changes in scope, include the following requirements for submittal data, Commissioning documentation, testing assistance, Operating and Maintenance (O&M) data, and training, as a minimum.

Attend Pre-Commissioning Meeting(s), Pre-Installation Meeting(s), and other Project meetings scheduled by the Contractor to facilitate the Commissioning process.

Provide manufacturer’s data sheets and shop drawing submittals of equipment.

Provide additional requested documentation to the Contractor, prior to O&M manual submittals, for development of Prefunctional Checklist and Functional Performance Tests procedures.

Typically, this will include detailed manufacturer’s installation and Start-up, operating, troubleshooting and maintenance procedures, full details of any Owner-contracted tests, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified.

In addition, the installation, Start-up, and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Contractor.

This information and data request may be made prior to normal submittals.

With input from the BAS Provider and AE, Clarify the operation and control of commissioned equipment in areas where the Specifications, BAS control drawings, or equipment documentation are not sufficient for writing detailed test procedures.

Prepare the specific Functional Performance Test procedures specified in Section 20 08 16. Ensure that Functional Performance Test procedures address feasibility, safety, and equipment protection and provide necessary written alarm limits to be used during the tests.

Develop the Commissioning Plan using manufacturer’s Start-up procedures and the Prefunctional Checklists. Submit manufacturer’s detailed Start-up procedures and the Commissioning Plan and procedures and other requested equipment documentation to Owner for review.

During the Start-up and initial checkout process, execute and document related portions of the Prefunctional Checklists for all commissioned equipment.

Perform and clearly document all completed Prefunctional Checklists and Start-up procedures. Provide a copy to the Owner prior to the Functional Performance Test.

Address current AE and Owner punch list items before Functional Performance Tests. Air and water test, adjust and balance shall be completed with discrepancies and problems remedied before Functional Performance Tests of the respective air or water related systems are executed.

Provide skilled technicians to execute starting of equipment and to assist in execution of Functional Performance Tests. Ensure that they are available and present during the agreed-upon schedules and for a sufficient duration to complete the necessary tests, adjustments, and problem solving.

Correct deficiencies (differences between specified and observed performance) as interpreted by the Owner’s Project Manager and AE and retest the system and equipment.

Compile all Commissioning records and documentation to be included in a Commissioning and Closeout Manual.

Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

During construction, maintain as-built marked-up Drawings and Specifications of all Contract Documents and Contractor-generated coordination Drawings. Update after completion of Commissioning activities (include deferred tests). The as-built drawings and specifications shall be delivered to the Owner both in electronic format and hard copies as required by the Owner.

Provide training of the Owner’s operating personnel as specified.

Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

* + - * 1. Warranty Phase:

Execute seasonal or deferred tests, witnessed by the Owner, according to the Specifications.

Complete deferred tests as part of this Contract during the Warranty Period. Schedule this activity with Owner. Perform tests and document and correct deficiencies. Owner may observe the tests and review and approve test documentation and deficiency corrections.

If any check or test cannot be completed prior to Substantial Completion due to the building structure, required occupancy condition, or other condition, execution of such test may be delayed to later in the Warranty Period, upon approval of the Owner. Contractor shall reschedule and conduct these unforeseen deferred tests in the same manner as deferred tests.

Correct deficiencies and make necessary adjustments to O&M manuals, Commissioning documentation, and as-built drawings for applicable issues identified in any seasonal testing.

* + - 1. INSTALLATION
				1. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
				2. All installation shall be in accordance with manufacturer’s published recommendations.
			2. testing
				1. Prefunctional Checklists and Start-up:

Follow the Start-up and initial checkout procedures listed in this Section and in Division 01. Start-up and complete systems and sub-systems so they are fully functional, meeting the requirements of the Contract Documents.

Prefunctional Checklists shall be complete prior to commencement of a Functional Performance test.

* + - * 1. Functional Performance Tests:

Functional Performance Tests are conducted after system Start-up and checkout is satisfactorily completed. Air balancing and water balancing shall be completed before Functional Performance Tests.

* + - * 1. Coordination Between Testing Parties:

Factory Start-ups: Factory Start-ups are specified for certain equipment. Factory Start-ups generally are Start-up related activities that will be reviewed and checked prior to Functional Performance Tests. All costs associated with factory Start-ups shall be included with the contract price unless otherwise noted. Notify the Commissioning Team of the factory Start-up schedule and coordinate these factory Start-ups with witnessing parties. The Commissioning Team members may witness these Start-ups at their discretion.

Independent Testing Agencies: For systems that specify testing by an independent testing agency, the cost of the test shall be included in the Contract price unless otherwise noted. Testing performed by independent agencies may cover aspects required in the Prefunctional Checklists, Start-ups, and Functional Performance Tests. Coordinate with the independent testing agency so that Owner and/or AE can witness the test to ensure that applicable aspects of the test meet requirements.

* + - 1. TRAINING
				1. Submit a written training plan to the Owner and Architect/Engineer for review and approval. Contractor’s training plan shall cover the following elements:

Equipment included in training.

Intended audience.

Location of training.

Objectives.

Subjects covered.

Duration of training on each subject.

Instructor for each subject.

Methods (classroom lecture, video, Site walk-through, actual operational demonstrations, written handouts, etc.).

Instructors and qualifications.

* + - * 1. Contractor shall have the following training responsibilities:

Provide a training plan ten (10) calendar days prior to the scheduled training, in accordance with Division 01.

Provide Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned mechanical equipment or system.

Training shall start with classroom sessions, if necessary, followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including Start-up, shutdown, fire/smoke alarm, power failure, etc.

During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This representative may be the Start-up technician for the piece of equipment, the installing contractor, or manufacturer’s representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.

The training sessions shall follow the outline in the Table of Contents of the O&M manual and illustrate whenever possible the use of the O&M manuals for reference.

Training shall include:

Usage of the printed installation, operation and maintenance instruction material included in the O&M manuals.

Review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include Start-up, operation in all modes possible, shutdown, seasonal changeover and any emergency procedures.

Discussion of relevant health and safety issues and concerns.

Discussion of warranties and guarantees.

Common troubleshooting problems and solutions.

Explanation of information included in the O&M manuals and the location of all plans and manuals in the facility.

Discussion of any peculiarities of equipment installation or operation.

Hands-on training shall include Start-up, operation in all modes possible, including manual, shutdown, and any emergency procedures and maintenance of all pieces of equipment

Training shall occur after Functional Performance Tests are complete and shall be scheduled with the Owner’s Project Manager.

* + - * 1. Contractor shall cooperate with Owner and Owner’s Test, Adjust, and Balance Firm for verification testing and final adjustments and balancing as may be indicated in the Contract Documents or as directed by Owner.
				2. Provide training on each system/piece of equipment according to the following schedule: [Edit the following as appropriate for the Project].

 Hours System

 \_\_\_\_\_ Chillers and System

 \_\_\_\_\_ Cooling Towers

 \_\_\_\_\_ Boilers and Heating System and PRV Station

 \_\_\_\_\_ HVAC Piping Systems

 \_\_\_\_\_ HVAC Chemical Water Treatment

 \_\_\_\_\_ Air Compressors and dryers

 \_\_\_\_\_ Air Handler Units

 \_\_\_\_\_ Variable Speed Drives

 \_\_\_\_\_ Supplementary Supply Fans

 \_\_\_\_\_ Return Fan/Relief Fan

 \_\_\_\_\_ Air Terminal Units

 \_\_\_\_\_ Air Handler Units

 \_\_\_\_\_ Packaged Rooftop Units

 \_\_\_\_\_ Computer Room AC Units

 \_\_\_\_\_ Split System AC or Heat Pumps

 \_\_\_\_\_ Elevator Shaft Fans

 \_\_\_\_\_ Stairwell Fans

 \_\_\_\_\_ Specialty Exhaust Fans

 \_\_\_\_\_ Restroom Central Exhaust Fans

 \_\_\_\_\_ Garage Exhaust Fans

 \_\_\_\_\_ Emergency Generator

 \_\_\_\_\_ Domestic Water Heaters

 \_\_\_\_\_ Domestic Hot Water Circulating System

 \_\_\_\_\_ Domestic Water Booster Pumps

 \_\_\_\_\_ Domestic Water Storage/Break Tank

 \_\_\_\_\_ Water Softeners

 \_\_\_\_\_ Pure Water Production Equipment (R.O., D.I., etc.)

 \_\_\_\_\_ Medical Air Compressors and Vacuum Pumps

 \_\_\_\_\_ Laboratory Air Compressors and Vacuum Pumps

 \_\_\_\_\_ Medical Compressed Gas Cylinder Manifolds

 \_\_\_\_\_ Laboratory Compressed Gas Manifolds

 \_\_\_\_\_ Medical Gas and Vacuum System Alarms

 \_\_\_\_\_ Laboratory Gas and Vacuum System Alarms

 \_\_\_\_\_ Sump Pumps

 \_\_\_\_\_ Sewage Ejector

 \_\_\_\_\_ Fire Pump System

 \_\_\_\_\_ Wet Standpipe/Sprinkler Fire Protection System

 \_\_\_\_\_ Dry Fire Sprinkler System

 \_\_\_\_\_ Pre-Action Fire Sprinkler System

 \_\_\_\_\_ Chemical Fire Suppression System

 \_\_\_\_\_ Irrigation System

 \_\_\_\_\_ Ornamental Fountain System

END OF SECTION 20 08 00