

**Part 1            General**

**1.1                SUBMITTALS**

- .1        Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2        Shop drawings to show:
  - .1        Mounting arrangements.
  - .2        Operating and maintenance clearances.
- .3        Shop drawings and product data accompanied by:
  - .1        Detailed drawings of bases, supports, and anchor bolts.
  - .2        Acoustical sound power data, where applicable.
  - .3        Points of operation on performance curves.
  - .4        Manufacturer to certify current model production.
  - .5        Certification of compliance to applicable codes.
- .4        Closeout Submittals:
  - .1        Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
  - .2        Operation and maintenance manual approved by, and final copies deposited with, Departmental Representative before final inspection.
  - .3        Operation data to include:
    - .1        Control schematics for systems including environmental controls.
    - .2        Description of systems and their controls.
    - .3        Description of operation of systems at various loads together with reset schedules and seasonal variances.
    - .4        Operation instruction for systems and component.
    - .5        Description of actions to be taken in event of equipment failure.
    - .6        Valves schedule and flow diagram.
    - .7        Colour coding chart.
  - .4        Maintenance data to include:
    - .1        Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.
    - .2        Data to include schedules of tasks, frequency, tools required and task time.
  - .5        Performance data to include:
    - .1        Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.
    - .2        Equipment performance verification test results.
    - .3        Special performance data as specified.
    - .4        Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

- .6 Approvals:
  - .1 Submit 1 copy of draft Operation and Maintenance Manual to Departmental Representative for approval. Submission of individual data will not be accepted unless directed by Departmental Representative.
  - .2 Make changes as required and re-submit as directed by Departmental Representative.
- .7 Additional data:
  - .1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.
- .8 Site records:
  - .1 Departmental Representative will provide 1 set of reproducible mechanical drawings. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.
  - .2 Transfer information daily to reproducibles, revising reproducibles to show work as actually installed.
  - .3 Use different colour waterproof ink for each service.
  - .4 Make available for reference purposes and inspection.
- .9 As-built drawings:
  - .1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.
  - .2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).
  - .3 Submit to Departmental Representative for approval and make corrections as directed.
  - .4 Perform testing, adjusting and balancing for HVAC using as-built drawings.
  - .5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.
- .10 Submit copies of as-built drawings for inclusion in final TAB report.

## **1.2 QUALITY ASSURANCE**

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 30 - Health and Safety Requirements.

## **1.3 MAINTENANCE**

- .1 Furnish spare parts in accordance with Section 01 78 00 - Closeout Submittals as follows:
  - .1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00 - Closeout Submittals.
- .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

**Part 2 Products**

Not Used.

**Part 3 Execution**

**3.1 PAINTING REPAIRS AND RESTORATION**

- .1 Do painting in accordance with Section 09 91 20 - Painting.
- .2 Prime and touch up marred finished paintwork to match original.
- .3 Restore to new condition, finishes which have been damaged.

**3.2 CLEANING**

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units.

**3.3 FIELD QUALITY CONTROL**

- .1 Manufacturer's Field Services:
  - .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 – SUBMITTALS.
  - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
  - .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

**3.4 DEMONSTRATION**

- .1 Departmental Representative will use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
  - .1 HVAC Systems:
    - .1 Furnace units
    - .2 Air Conditioning
    - .3 Exhaust fans

- .2 Plumbing Systems
  - .1 Plumbing fixtures
  - .2 Water heating systems
- .3 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .4 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Departmental Representative will record these demonstrations on video tape for future reference.

### **3.5 PROTECTION**

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

**END OF SECTION**

**Part 1            General**

**1.1                INTENT**

- .1        This Section specifies commissioning requirements common to all Division 21, 22, 23, and 25 equipment and systems starting and testing, Component Verifications and Systems Performance Verification Testing.
- .2        The Contractor shall expedite required revisions identified during the testing and verification in a cooperative manner to maintain the construction schedule.

**1.2                WORK INCLUDED**

- .1        General inspection and component verification of all mechanical equipment.
- .2        Specific equipment and system performance testing as specified herein or in other sections of the specifications.
- .3        Co-ordination with other trades and testing agencies including local Authority having Jurisdiction.
- .4        Instruction for the Owner's staff in the cleaning, maintenance and operation of the building systems, equipment and finishes.

**1.3                OVERVIEW**

- .1        The commissioning process follows a logical sequence, from Contractor equipment startup and testing to Component Verifications through to System Performance Verification Testing and finally Integrated System Testing.
- .2        At completion of the commissioning process, all defined system components, each mode of systems operation, and each control sequence will have been started and tested in accordance with the Manufacturer's requirements and verified operational relative to design intent and operational requirements.
- .3        Equipment and System Starting and Testing:
  - .1        Complete equipment starting and testing procedures as defined in the respective Sections of this specification.
  - .2        All starting, testing, adjusting, balancing and calibration activities are to be documented by the Contractor.
  - .3        All Contractor and Manufacturer startups and testing procedures are to be completed and approved prior to conducting the System Performance Verification Testing defined herein.
  - .4        The Contractor will be responsible for identifying in the commissioning schedule, the required equipment starting and testing, including all Manufacturer's startup and field verifications.
  - .5        Perform and record pressure testing on all piping and ducting systems installed under this Contract.

- .4 Component verification sheets shall be developed by this Contractor for each piece of equipment specified and installed. The Contractor shall be responsible for completion of these sheets.
- .5 System Performance Verification Testing:
  - .1 The System Performance Verification Tests provide a functional demonstration of the system performance during the various modes of operation including, startup, operation, shut down and various disturbance situations such as power failure and fire alarm.
  - .2 The System Performance Verification Tests shall be developed by the Contractor.
  - .3 All Contactor and Manufacturer's startup and proving tests are to be completed and approved prior to conducting the defined System Performance Verification Tests.
  - .4 All Component Verifications and identified testing pre-requisites related to a given system, shall be completed and approved prior to conducting the defined System Performance Verification Testing.
  - .5 The Contractor will be responsible for the scheduling and implementation of the System Performance Verification Testing.
- .6 The commissioning process associated with the component and systems verifications does not negate the need for the normal contractor equipment and system startup and proving and the associated training requirements.

#### **1.4 RELATED REQUIREMENTS**

- .1 Equipment startup and testing procedures, including Manufacturer startups, specified in this and other Sections.

#### **1.5 EQUIPMENT STARTING AND TESTING**

- .1 Prior to starting and testing, ensure all equipment is cleaned and free of dust.
- .2 After testing, protect equipment from dust.
- .3 Do not conceal or cover components or equipment until inspected, tested and approved by the Commissioning Contractor.
- .4 Assume all liabilities associated with the starting and testing.
- .5 Assume all costs associated with the starting, testing, adjusting and balancing, including the supply of testing equipment.

#### **1.6 WITNESSING OF EQUIPMENT STARTING AND TESTING**

- .1 Prior to starting and testing of equipment and systems, prepare a schedule for the required starting and testing.

## **1.7 MANUFACTURER'S STARTING RECOMMENDATIONS**

- .1 Prior to starting components or systems, obtain and review manufacturer's installation, operation and starting instructions. Read in conjunction with the procedures specified herein.
- .2 Use manufacturer's and supplier's starting personnel where required to maintain validity of manufacturer's warranty. Confirm with manufacturer that all testing specified in these specifications will not void any warranties.
- .3 Compare installation to manufacturer's published data and record discrepancies. Modify procedures detrimental to components performance prior to starting equipment.

## **1.8 CO-ORDINATION**

- .1 Co-ordinate all sub-trades, other divisions, manufacturers, suppliers and other specialists as required to ensure all phases of work shall be properly organized prior to commencement of each particular startup, testing and commissioning procedure.
- .2 Where any components or systems require testing prior to starting, ensure that such work has been completed and approved prior to starting of the components and systems.

## **Part 2 Products**

- .1 Provide all instruments, meters, and equipment required to conduct tests during and at the conclusion of the project.

## **Part 3 Execution**

### **3.1 EQUIPMENT STARTING AND TESTING**

- .1 Schedule and complete the equipment startup, run-ins and testing as defined in the respective Sections.
- .2 Submit all startup and test reports, including Manufacturer's reports.
- .3 All startup and testing is to be done in accordance with approved Manufacturer's procedures.

### **3.2 COMPONENT VERIFICATIONS**

- .1 Complete Component Verifications in accordance with this Section.
- .2 In addition to the starting and testing requirements identified for each piece of equipment, as defined in the respective Sections, the Component Verifications sheets identified in this Section are to be complete by the Contractor.
- .3 The Component Verification sheets are used to track individual pieces of equipment and provide a 'Submittal Verification' and a 'Field Verification' of equipment.

The 'Submittal Verification' includes verifying and confirming the specified requirements against the shop drawing submittal data and the 'Field Verification' includes confirming that the installed parameters meet the specified requirements.

- .4 The Component Verification sheets shall be completed as follows:
  - .1 The 'Specified' fields on the sheet shall be completed by the Engineer.
  - .2 The 'Shop Drawing' fields on the sheets shall be completed by the Contractor.
  - .3 The 'Installed' fields on the sheets shall be completed by the Contractor.
- .5 A Component Verification sheet is to be completed for each specified piece of equipment.

### 3.3 EQUIPMENT START-UP AND OPERATIONAL TESTING

- .1 Control Systems
  - .1 General
    - .1 Review documentation to ensure all system components and operation are recorded in detail.
    - .2 Check installation for orderly component and conduit mounting with all portions secured to building structure. Ensure installations of control systems do not impede access to building spaces or equipment.
    - .3 Check installations in secure areas are hidden or covered and secured in an acceptable manner.
  - .2 Furnace/Air Conditioning
    - .1 Check control systems installations are secured to building or equipment and do not impede access.
    - .2 Check stroke of all dampers.
    - .3 Check installation of all devices to ensure correct location/orientation.
    - .4 Check operation of all devices for limits and operating points.
    - .5 Check manual overrides for operation.
    - .6 Simulate component failure to check reaction of remaining components and systems.
- .2 Fire Protection
  - .1 Fire Extinguishers
    - .1 Check all fire extinguishers in place according to Drawings.
    - .2 Check all fire extinguishers firmly mounted in place.
    - .3 Check all fire extinguishers carry current certification tag signed and dated.
- .3 Plumbing Systems
  - .1 Plumbing Fixtures
    - .1 All
      - .1 Check fixtures firmly attached to supporting surfaces.
      - .2 Operate local water isolation valves, ensure full shut off of water flow.
      - .3 Operate fixture, check hot/cold flows, general performance, measure water flow on representative quantity of each fixture type.
  - .2 Piping Systems
    - .1 Perform regulatory testing as required by specifications, Codes and Authority Having Jurisdiction.
    - .2 Operate all zone isolation valves.

- .4 Heating Systems
  - .1 Furnaces
    - .1 Perform regulatory testing as required by specifications, Codes and Authority Having Jurisdiction.
    - .2 Check air temperature rise through furnaces at maximum fire and design flow.
    - .3 Check operation of all safety and operating controls.
  
- .5 Ventilation Systems
  - .1 Exhaust Systems
    - .1 Verify fan rotation direction.
    - .2 Monitor operation of fans for abnormal vibration.
  - .2 Duct Systems
    - .1 Check duct sealing.
    - .2 Check duct identification.
    - .3 Check all manual balance dampers are secured and marked at balance point.
    - .4 Check mounting of all grilles, registers and diffusers.
  - .3 Heat Recovery Ventilator
    - .1 Check operation of all motorized dampers for extend of opening, shut off, and smooth non-binding operation.

**3.4 PRESSURE TESTING OF PIPING**

- .1 Test all piping prior to concealment and completion of system.
- .2 Record test results by section. Records to be included in Operation and Maintenance Manuals. Show section designation on As-Built Record Drawings.
- .3 Test as noted below. For systems not included below, refer to appropriate specification section. Notify Engineer where test requirement is not shown. Include for testing all piping to minimum of 690 kPa hydrostatic for minimum 1 hour unless lower pressure is warranted.

System	Media (Note 1)	Pressure (Note 2)	Duration
<b>Plumbing</b>			
- DCW, DHW	Water	690 kPa	4 hr
- Nat Gas or Propane Gas (Note 3)	Air	340 kPa	3 hr
- San Sewer/Vent (Note 4, 5)	Water	3 m w.c.	30 min

Note 1	Where possibility of freezing exists, compressed air may be substituted with written permission of the Engineer
Note 2	Pressure test to 1.5 times operating pressure of system. Minimum test pressure is shown. Protect or remove all components which may be damaged by test pressure.
Note 3	Test as required by: Gas Code
Note 4	Test as required by: Plumbing Code
Note 5	Test water closet installations with 25 mm W.C. for 15 min after fixture has been set.

**END OF SECTION**

**SYSTEM PERFORMANCE VERIFICATION FORM**

.1 AIR MOVING EQUIPMENT

Date: \_\_\_\_\_

Equipment ID \_\_\_\_\_

Equipment Data:	Location Data
Manufacturer: _____	Building: _____
Model Number: _____	Area: _____
Serial Number: _____	Floor: _____
	Room: _____

Operation

		Specified	Shop Drawings	Installed	Verified By:
Airflow Rate	Supply				
	Return				
External Static Pressure	Supply				
	Return				
Volts/Amps/Phase	Supply				
	Return				
Rotation Direction	Supply				
	Return				

Inspection Check List:

Filters

- |   |              |  |       |   |               |   |
|---|--------------|--|-------|---|---------------|---|
| - | Size         | <input type="text"/> x <input type="text"/> x <input type="text"/> | Coils | - | Size          | <input type="text"/> x <input type="text"/> |
| - | Quantity     | <input type="text"/>   |       | - | FFV           | <input type="text"/>                        |
| - | Baffles      | <input type="text"/>   |       | - | Rows          | <input type="text"/>                        |
| - | Clean Filter | <input type="text"/>   |       | - | Fin Condition | <input type="text"/>                        |

Belts

- |   |           |                      |         |   |                   |   |
|---|-----------|----------------------|---------|---|-------------------|---|
| - | Size      | <input type="text"/> | Dampers | - | Size              | <input type="text"/> x <input type="text"/> |
| - | Quantity  | <input type="text"/> |         | - | Seals             | <input type="text"/>                        |
| - | Tensioned | <input type="text"/> |         | - | Operation – close | <input type="text"/>                        |
| - | Alignment | <input type="text"/> |         | - | – open            | <input type="text"/>                        |

Operating Controls

- Start /Stop from \_\_\_\_\_
- Test  \_\_\_\_\_

Clean External

Clean Internal

Not Damaged

Service Space

Lubricated   
 Product \_\_\_\_\_

Comments


Sign Off

\_\_\_\_\_  
Contractor

\_\_\_\_\_  
Engineer

\_\_\_\_\_  
Owner

Sample



**Part 1            General**

**1.1                SHOP DRAWINGS AND PRODUCT DATA**

- .1        Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

**1.2                CLOSEOUT SUBMITTALS**

- .1        Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

**Part 2            Products**

**2.1                MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS**

- .1        Stored pressure rechargeable type with hose and shut-off nozzle, ULC labelled for A, B and C class protection. Sizes as indicated.
  - .1        Acceptable product: Ansul Sentry, Pyrene, Flag.

**2.2                EXTINGUISHER BRACKETS**

- .1        Type recommended by extinguisher manufacturer.

**2.3                CABINETS**

- .1        Flush surface or semi-recessed type as indicated, constructed of 1.6 mm thick steel, 180° opening door of 2.5 mm thick steel with latching device.
- .2        Cabinet door: with 6 mm full plexiglass panel. All metal door latch.
- .3        Finish:
  - .1        Tub: prime coated.
  - .2        Door and frame: primer finish ready for final finish.
- .4        Acceptable product: National Fire Equipment CE-950-1, Pyrene, Flag.

**2.4                IDENTIFICATION**

- .1        Identify extinguishers in accordance with recommendations of ANSI/NFPA 10.
- .2        Attach tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

**Part 3          Execution**

**3.1              INSTALLATION**

- .1      Install or mount extinguishers in cabinets or on brackets as indicated.
- .2      Provide initial inspection signature and date on inspection tag.

**END OF SECTION**