

Part 1 General

1.1 RELATED SECTIONS

- .1 Starting of Equipment and Systems: Division 01.
- .2 Mechanical Sub-Contractor Start-Up Report Forms: Division 01.
- .3 Mechanical Equipment Starting and Testing: Section 23 08 23.
- .4 Mechanical System Starting and Testing: Section 23 08 33.
- .5 Balancing and Adjusting of Mechanical Equipment and Systems: Section 23 08 83.
- .6 EMCS Start-up and Testing: Division 25.
- .7 Commissioning: Division 01.
- .8 Testing, Adjusting and Balancing: Division 01.

1.2 DEPARTMENTAL REPRESENTATIVE'S WITNESSING OF TESTS

- .1 The Departmental Representative's Commissioning Facilitator may witness selected starting, testing, adjusting, balancing and cleaning procedures.
- .2 Advise the Commissioning Facilitator in advance that starting, testing, adjusting, balancing or cleaning processes are ready to commence. Consult with the Commissioning Facilitator to determine which procedures he may elect to witness. Provide advanced notice prior to commencement of each procedure or series of procedures to allow Departmental Representative to arrange for witnessing of tests.

1.3 STARTING AND TESTING COSTS

- .1 Pay costs associated with starting, testing, adjusting, balancing and cleaning, including supply of instruments, equipment, supplies, and consumable materials.

1.4 START-UP REPORTS

- .1 Start-Up report forms will be available from the Commissioning Facilitator.
- .2 Where forms are not available from the Commissioning Facilitator for specific systems or equipment, prepare appropriate forms.
- .3 Submit Start-Up reports as part of Operation and Maintenance Manual specified in Section 01 78 23, 01 78 24, and 01 78 25.

1.5 REPORTS

- .1 Submit Contractor Start-Up Report forms in accordance with Section 01 33 35 documenting starting and testing procedures performed, and observed tests results obtained.
- .2 Submit field reports in accordance with Section 01 78 23 and 01 78 24.

1.6 QUALITY ASSURANCE

- .1 Use personnel for starting, testing, adjusting and balancing procedures who have experience in mechanical equipment and systems commissioning, and are able to interpret results of readings and tests and report state of systems in a clear and concise manner.

1.7 MANUFACTURER'S RECOMMENDATIONS

- .1 Prior to starting equipment or systems, obtain and review manufacturer's installation, starting and operating instructions. Read in conjunction with procedures specified herein.
- .2 Use manufacturer's and supplier's trained personnel where necessary to maintain validity of manufacturer's warranty.
- .3 Compare actual installation with manufacturer's recommended installation. Record discrepancies. Correct deviations detrimental to equipment performance prior to starting equipment.

1.8 REGULATORY REQUIREMENTS

- .1 To facilitate expedient turnover of facility at Interim Acceptance of the Work, arrange for regulatory authorities to witness those specified starting procedures that duplicate tests required by regulatory authorities.
- .2 Obtain certificates of approval and for compliance with regulations from authorities having jurisdiction. Include copies of certificates with start-up reports.

Part 2 Products

2.1 TESTING INSTRUMENTS AND EQUIPMENT

- .1 Provide testing instruments and equipment and ancillary equipment such as two-way radios and ladders required to perform starting, testing, adjusting and balancing of mechanical equipment and systems.
- .2 Submit a list of testing instruments and equipment proposed for use to the Commissioning Facilitator for approval.

- .3 Use instruments supplied or calibrated by approved laboratory or manufacturer. Show the Commissioning Facilitator original calibration certificate for each instrument to be used. Include copy of calibration certificates with test reports.
- .4 Recalibrate instruments at frequency recommended by instrument manufacturer or, in absence of manufacturer's recommendations, as required by Associated Air Balance Council (AABC).
- .5 Use testing instruments and equipment which meet following accuracy requirements:

Device	Range	Accuracy
Air Temperature	-40 to 75°C	±0.10°C
Hydronic temperature	-40 to 120°C	±0.10°C
Stack Temperature	-40 to 300°C	±1.00°C
Air Velocity Pressure	0 to 250 Pa	±2% of reading
Air Pressure	0 to 2500 Pa	±12.5 Pa
Hydraulic Pressure	0 to 1400 KPa	±2% of gauge
Air Velocity	0.1 to 20 m/s	±2% of gauge
Sound Meter	35 to 130 dB	ANSI S 1.4 Type 2
Octave Band Filters	63 to 8000 Hz	ANSI S 1.11 Class II
Humidity	10 to 90% RH	±3.0%

.6 Following testing instruments and equipment makes and models are also acceptable:

Equipment	Make	Model
Sound Level Meter	Quest	2700
Octave Band Filters	Quest	OB-50
Flue Gas Analyzer	Kane May	KM 9002
Stack Thermometer	Bacharach	12-7018
Tachometer (contact)	Ono-Sokki	HT-331
Tachometer (strobe)	Ono-Sokki	HT 441
Ammeter	Amprobe	ACD-2
CO Detector	G.C.Industries	GC 401
Sling Psychrometer	Bacharach	12-7018
Digital Humidity Sensor	Vaisala	HM 131 with HMP 31UT probe
Belt Tension Tester	Woods	
Inclined Manometer	Dwyer	400-10
Air Pressure Gauge	Magnahelic	
	-125 to 125 Pa	2300-250 Pa
	0 to 250 Pa	2000-250 Pa
	0 to 1000 Pa	2000-1 KPa
	0 to 1500 Pa	2000-1.5 KPa
Fluid Pressure Gauge	Marsh	0 to 60 psi
	Marsh	0 to 160 psi
	Marsh	30"Hg - 60 psi
Thermometer	Palmer	MS-13
Digital Thermometer	Fluke Multi-meter	8062A with 80T-150 surface probe 80PK-5 piercing probe
Digital Anemometer	ITM Instruments	DA 4000
Micromanometer	Shortridge	8420
Flow Hood	Shortridge	8400 with 8420 meter
Air Quality Monitor	Armstrong	AMC-1013P

Part 3 Execution

3.1 USE OF INSTRUMENTS SUPPLIED UNDER CONTRACT

- .1 Instruments for testing, adjusting and balancing supplied under this contract may be used provided the Departmental Representative is satisfied that instrument accuracy complies with requirements specified above and calibration certificate has been provided with each instrument.

- .2 Use "Calibrated Air Flow Measuring Stations" to measure air flow during system balancing and coil performance testing.
- .3 Use balancing valve pressure tapings, orifice plates, pitot tube fittings, etc. to measure fluid flow rates.
- .4 Calibrated EMCS temperature, humidity and pressure sensors may be used to gather Mechanical Sub-Contractor Start-up Program system performance data provided the Commissioning Facilitator confirms that EMCS sensor calibrations have been completed and approved.

3.2 INSPECTION

- .1 Do not conceal or cover equipment or systems until inspected, tested and approved by Commissioning Facilitator.

3.3 COMPLIANCE WITH DEFINED PROCEDURES

- .1 Failure to follow specified instructions pertaining to correct starting procedures may result in re-evaluation of equipment by independent testing agency selected by the Commissioning Facilitator at Mechanical Sub-Contractor's expense. Should results reveal equipment has not been started in accordance with specified requirements, equipment may be rejected. If rejected, remove equipment from site and replace. Replacement equipment will also be subject to full starting procedures, using same procedures specified for originally installed equipment.

3.4 CHECK SHEETS, FIELD REPORTS AND DATA

- .1 Record all data gathered on site on start-up report forms.
- .2 Make copies of all starting and testing data before equipment and system start-up personnel leave site. Maintain one copy of all data taken during starting on site.
- .3 Maintain one copy of all final starting, testing, adjusting and balancing reports on site up to Interim Acceptance of the Work for reference purposes.

3.5 COORDINATION

- .1 Prior to commencement of each particular testing procedure, coordinate all sub-trades, manufacturers, suppliers and other specialties to ensure all phases of work are properly completed. Establish necessary manpower requirements.

3.6 STARTING AND TESTING PHASES

- .1 Starting and testing program generally consists of following five distinct phases:
 - .1 Pre-Starting: visual inspection
 - .2 Starting: actual starting procedure.

- .3 Post-Starting: operational testing, adjusting or balancing and equipment run-in phase.
- .4 Pre-Interim Acceptance of the Work: final cleaning, re-testing, balancing and adjusting and maintenance.
- .5 Post-Interim Acceptance of the Work: retesting and fine-tuning of system to prove all deficiencies have been corrected.
- .2 After each distinct phase of work has been completed, correct deficiencies before commencing the next phase.

3.7 SPECIALTY AGENCIES AND TESTING LABORATORIES

- .1 Arrange for reports prepared by special testing agencies and testing laboratories to be submitted directly to the Commissioning Agency. Include a copy of each report in Mechanical Sub-Contractor Start-Up Program report.
- .2 Agencies and testing laboratories shall have facilities and qualifications acceptable to the Departmental Representative.

END OF SECTION