SECTION 23 05 90 - TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

DESCRIPTION

Work Included: After completion of the work of installation, test and regulate all components of the new heating, air conditioning and ventilating systems to verify air volumes and heating-cooling flow rates indicated on the Drawings.

Balancing Organization:

Balancing of the Heating and Air Conditioning Systems: Performed by a firm providing this service established in the State of Oregon.

Balancing Organization: Approval by Architect. Air Balancing Specialties, Neudorfer Engineers, Northwest Engineering Services, Precision Test and Balance, or approved.

Provide all necessary personnel, equipment, and services.

Balancer shall perform work as a Contractor to the General Contractor directly, not through the Mechanical Contractor.

QUALITY ASSURANCE

Balancing of the Heating and Air Conditioning Systems: Agency shall be a current member of NEBB or AABC specializing in the adjusting and balancing of systems specified with a minimum of 10 years documented experience.

Testing, adjusting, and balancing shall be performed under direct field supervision of a Certified NEBB Supervisor or a Certified AABC Supervisor.

See Commissioning Specification for additional requirements.

SUBMITTALS

See Section in Division 1, Administrative Requirements, for submittal procedures.

Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.

Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

Submit under provisions of Section 23 05 00.

Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.

Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.

Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced Drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

Include detailed procedures, agenda, sample report forms, and copy of AABC National Project Performance Guaranty or other certifying agency prior to commencing system balance.

Test Reports: Indicate data on AABC MN-1 forms, forms prepared following ASHRAE 111, NEBB forms, or forms containing information indicated in Schedules.

Include the following on the title page of each report:

Name of testing, adjusting, and balancing agency.

Address of testing, adjusting, and balancing agency.

Telephone number of testing, adjusting, and balancing agency.

Project name.

Project location.

Project Architect and Owner.

Project Engineer.

Project Contractor.

Project altitude.

Report date.

Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.

Provide a list of equipment, air supply, return and exhaust, heating water, and chilled water systems not in compliance with tolerances subsequently specified.

PART 2 - PRODUCTS

-- NOT USED --

PART 3 - EXECUTION

EXAMINATION

Verify that systems are complete and operable before commencing work. Ensure the following conditions:

Systems are started and operating in a safe and normal condition.

Temperature control systems are installed complete and operable.

Proper thermal overload protection is in place for electrical equipment.

Final filters are clean and in place. If required, install temporary media in addition to final filters.

Duct systems are clean of debris.

Fans are rotating correctly.

Fire and volume dampers are in place and open.

Air coil fins are cleaned and combed.

Access doors are closed and duct end caps are in place.

Air outlets are installed and connected.

Duct system leakage is minimized.

Hydronic systems are flushed, filled, and vented.

Pumps are rotating correctly.

Proper strainer baskets are clean and in place.

Service and balance valves are open.

Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

Beginning of work means acceptance of existing conditions.

INSTALLATION TOLERANCES

Air Handling Systems: Adjust to within plus 10 percent or minus 5 percent of design for supply systems and +/- 10 percent of design for return and exhaust systems.

Air Outlets and Inlets: Adjust total to within plus 10 percent or minus 5 percent of design to space. Adjust outlets and inlets in space to within +/- 10 percent of design.

Hydronic Systems: Adjust to within +/- 10 percent of design.

ADJUSTING

Ensure recorded data represents actual measured or observed conditions.

Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

AIR SYSTEM PROCEDURE

Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.

Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

Measure air quantities at air inlets and outlets.

Adjust noise distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.02" (12.5 Pa) positive static pressure near the building entries.

For variable air volume system powered units, set volume controller to air flow setting indicated. Confirm connections are properly made and confirm proper operating for automatic variable air volume temperature control. Adjust drives to maximum airflow for highest static condition (maximum amps of motor). Allow VFD to regulate airflow per specification.

Space pressure Control, Return Fan Speed Endpoints: For variable air volume system with terminal unit zoning, attain return fan speed control endpoints based on the following values for the given operating mode. Coordinate with the HVAC Control Contractor for system setup and provide values when determined.

Return Fan Speed Endpoint Values				
Mode	**Supply Fan Speed Hi/Lo Reset Limits**	**Desired Space Pressure (InH2O)**	**Economizer Position**	**Return Fan Speed**
Full Heating (All terminal units are operating at heating flow setpoints)	TBD – Noted during the full heating condition	**Ideal - 0.02** Acceptable Test Range: 0.01 – 0.03	Min-Min (25% of the minimum ventilation requirement)	Minimum Return Fan Speed-TBD
Full Cooling (All terminal units are operating at cooling flow setpoints)	TBD – Noted during the full cooling condition	**Ideal - 0.02** Acceptable Test Range: 0.01 – 0.03	Min-Max (100% of the minimum ventilation requirement)	Maximum Return Fan Speed-TBD

CO2 controller set points – minimum CO2 setpoint (ppm), maximum CO2 setpoint (ppm)(setting for min OSA at full occupancy).

Outside air intake damper settings at minimum CO_2 and maximum CO_2 setpoint.

WATER SYSTEM PROCEDURE

Adjust water systems to provide required or design quantities. This includes domestic HVAC systems.

Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

Effect system balance with automatic control valves fully open to heat transfer elements.

Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

Where automatic flow control valves are installed (Dynamic devices, not circuit setters) record listed flow rate of device based on field verification. Testing is not required.

Balancing Contractor shall be trained on balancing procedures by certified representative of differential pressure control valves.

SCHEDULES

Equipment Requiring Testing, Adjusting, and Balancing:

- HVAC pumps
- Air coils
- Air handling units
- Fans
- Air filters
- Air terminal units
- Air inlets and outlets

Report:

- Summary Comments:
  - Design versus final performance

Notable characteristics of system

Description of systems operation sequence

Summary of outdoor and exhaust flows to indicate amount of building pressurization

Nomenclature used throughout report

Test conditions

Instrument List:

Instrument

Manufacturer

Model number

Serial number

Range

Calibration date

Electric Motors:

Manufacturer

Model/frame

HP/BHP

Phase, voltage, amperage; nameplate, actual, no load

RPM

Service factor

Starter size, rating, heater elements

Sheave make/size/model

V-Belt Drives:

Identification/location

Required driven RPM

Driven sheave, diameter, and RPM

Belt, size, and quantity

Motor sheave diameter and RPM

Center to center distance, maximum, minimum, and tested

Pumps:

Identification/number

Manufacturer

Size/model

Impeller

Service

Design flow rate, pressure drop, BHP

Actual flow rate, pressure drop, BHP

Discharge pressure

Suction pressure

Total operating head pressure

Shut off, discharge, and suction pressure

Shut off, total head pressure

Refrigerant Cooling Coils:

Identification/number

Location

Service

Manufacturer

Air flow, design and actual

Entering air DB temperature, design and tested

Entering air WB temperature, design and tested

Leaving air DB temperature, design and tested

Leaving air WB temperature, design and tested

Air pressure drop, design and tested

Saturated suction temperature, design and tested

Heating Water Coils:

Identification/number

Location

Service

Manufacturer

Air flow, design and tested

Water flow, design and tested

Water pressure drop, design and tested

Entering water temperature, design and tested

Leaving water temperature, design and tested

Entering air temperature, design and tested

Leaving air temperature, design and tested

Air pressure drop, design and tested

Air Moving Equipment:

Location

Manufacturer

Model number

Serial number

Arrangement/Class/Discharge

Air flow, specified and tested

Return air flow, specified and tested

Outside air flow, specified and tested

Total static pressure (total external), specified and tested

Inlet pressure

Discharge pressure

Sheave make/size/bore

Number of Belts/Make/Size

Fan RPM

Return Air/Outside Air:

Identification/location

Supply air flow, design and tested

Return air flow, design and tested

Outside air flow, design and tested

Return air temperature

Outside air temperature

Mixed air temperature, design and tested

Exhaust Fans:

Location

Manufacturer

Model number

Serial number

Air flow, specified and tested

Total static pressure (total external), specified and tested

Inlet pressure

Discharge pressure

Sheave Make/Size/Bore

Number of Belts/Make/Size

Fan RPM

Duct Traverses:

System zone/branch

Duct size

Area

Design velocity

Design air flow

Test velocity

Test air flow

Duct static pressure

Air temperature

Air correction factor

Terminal Unit Data:

Manufacturer

Type, constant, variable, single, dual duct

Identification/number

Location

Model number

Size

Minimum static pressure

Minimum air flow, design and tested

Maximum air flow, design and tested

Inlet static pressure, design and tested

Air Distribution Tests:

Air terminal number

Room number/location

Terminal type

Terminal size

Area factor

Design velocity

Design air flow

Test (final) velocity

Test (final) air flow

Percent of design air flow

DETAILED REQUIREMENTS

Adjusting and Balancing:

Adjust and balance all portions of the mechanical systems to produce indicated results within limits of minus 5 or plus 10 percent or as subsequently directed by the Architect.

Balancing data may be spot checked with instruments similar to that used by the balancing firm.

If, in the judgment of the Architect, the discrepancies warrant additional adjustment, readjust and rebalance the systems at no additional project cost.

Duct Pressure Test: To be conducted and/or witnessed by balancer.

END OF SECTION 23 05 90