SECTION 23 05 90 - TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 DESCRIPTION

A. 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.

B. Balancing Organization:
   1. Balancing of the Heating and Air Conditioning Systems: Performed by a firm established in the State of Oregon providing this service.
   2. Balancing Organization: Air Balancing Specialty, Pacific Coast Air, Balance, Precision Test & Balance, Inc., Neudorfer Engineering, Northwest Engineering Services, or approval by Engineer.
   3. Provide all necessary personnel, equipment, and services.

1.2 QUALITY ASSURANCE

A. 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.

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

C. Assist with commissioning activities as required by Commissioning Specifications.

1.3 SUBMITTALS

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

B. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
   1. Submit under provisions of Section 230500.
   2. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.
   3. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Engineer and for inclusion in operating and maintenance manuals.
   4. 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.
   5. Include detailed procedures, agenda, sample report forms, and copy of AABC National Project Performance Guaranty prior to commencing system balance.

6. Test Reports: Indicate data on AABC MN-1 forms, forms prepared following ASHRAE 111, NEBB forms, or forms containing information indicated in Schedules.
7. Include the following on the title page of each report:
   a. Name of testing, adjusting, and balancing agency.
   b. Address of testing, adjusting, and balancing agency.
   c. Telephone number of testing, adjusting, and balancing agency.
   d. Project name.
   e. Project location.
   f. Project Engineer.
   g. Project Engineer.
   h. Project Contractor.
   i. Project altitude.
   j. Report date.

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

D. 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

3.1 EXAMINATION

A. Prior to the beginning of construction examine the construction documents and specifications to identify any system design features that may inhibit the ability to successfully balance the Work. Submit a written report to the Engineer outlining any concerns identified.

B. At appropriate points during the construction process, visit the site, observe the installation of the mechanical systems, and identify any construction materials or methods used that could inhibit the ability to successfully balance the Work. Submit a written report to the Engineer confirming the visit and outlining any concerns identified.

C. Verify that systems are complete and operable before commencing balancing work. Ensure the following conditions, as applicable:
1. Systems are started and operating in a safe and normal condition.
2. Temperature and flow control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Hydronic systems are flushed, filled, and vented.
5. Pumps are rotating correctly.
6. Proper strainer baskets are clean and in place.
7. Service and balance valves are open.

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

E. Beginning of work means acceptance of existing conditions.

3.2 INSTALLATION TOLERANCES

A. 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.

B. 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.

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

3.3 ADJUSTING

A. Ensure recorded data represents actual measured or observed conditions.

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

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

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

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

3.4 AIR SYSTEM PROCEDURE

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

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

C. Measure air quantities at air inlets and outlets.

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

E. 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.

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

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

H. 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.

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

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

3.5 WATER SYSTEM PROCEDURE

A. Adjust water systems to provide required or design quantities.

B. 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.

C. 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.

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

E. 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.

F. 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.

G. Coordinate with Control Contractor to test and determine system differential pressure required for proper condensing system and chiller system operation.

3.6 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:
   1. HVAC pumps
   2. Water chillers
   3. Cooling towers
   4. Water filters
   5. Fans
   6. Air inlets and outlets

B. Report:
   1. Summary Comments:
      a. Design versus final performance
      b. Notable characteristics of system
      c. Description of systems operation sequence

d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
e. Nomenclature used throughout report
f. Test conditions

2. Instrument List:
   a. Instrument
   b. Manufacturer
   c. Model number
   d. Serial number
   e. Range
   f. Calibration date

C. Pumps:
1. Identification/number
2. Manufacturer
3. Size/model
4. Impeller
5. Service
6. Design flow rate, pressure drop, BHP
7. Actual flow rate, pressure drop, BHP
8. Discharge pressure
9. Suction pressure
10. Total operating head pressure
11. Shut off, discharge, and suction pressure
12. Shut off, total head pressure

D. Chillers:
1. Identification/number
2. Manufacturer
3. Capacity
4. Model number
5. Serial number
6. Refrigerant type and capacity
7. Evaporator entering water temperature, design and tested
8. Evaporator leaving water temperature, design and tested
9. Evaporator pressure drop, design and tested
10. Evaporator water flow rate, design and tested

E. Cooling Towers:
1. Identification/number
2. Manufacturer
3. Capacity
4. Model number
5. Serial number
6. Entering water temperature, design and tested
7. Leaving water temperature, design and tested
8. Evaporator water flow rate, design and tested

F. Electric Motors:
1. Manufacturer
2. Model/frame
3. HP/BHP
4. Phase, voltage, amperage; nameplate, actual, no load
5. RPM

6. Service factor
7. Starter size, rating, heater elements
8. Sheave make/size/model

G. V-Belt Drives:
1. Identification/location
2. Required driven RPM
3. Driven sheave, diameter, and RPM
4. Belt, size, and quantity
5. Motor sheave diameter and RPM
6. Center to center distance, maximum, minimum, and tested

H. Air Moving Equipment:
1. Location
2. Manufacturer
3. Model number
4. Serial number
5. Arrangement/Class/Discharge
6. Air flow, specified and tested
7. Return air flow, specified and tested
8. Outside air flow, specified and tested
9. Total static pressure (total external), specified and tested
10. Inlet pressure
11. Discharge pressure
12. Sheave make/size/bore
13. Number of Belts/Make/Size
14. Fan RPM

I. Exhaust Fans:
1. Location
2. Manufacturer
3. Model number
4. Serial number
5. Air flow, specified and tested
6. Total static pressure (total external), specified and tested
7. Inlet pressure
8. Discharge pressure
9. Sheave Make/Size/Bore
10. Number of Belts/Make/Size
11. Fan RPM

J. Duct Traverses:
1. System zone/branch
2. Duct size
3. Area
4. Design velocity
5. Design air flow
6. Test velocity
7. Test air flow
8. Duct static pressure
9. Air temperature
10. Air correction factor

K. Air Distribution Tests:
1. Room number/location
2. Terminal type
3. Terminal size
4. Area factor
5. Design velocity
6. Design air flow
7. Test (final) velocity
8. Test (final) air flow
9. Percent of design air flow

3.7 DETAILED REQUIREMENTS

A. Preparation by Contractor:
1. Prior to requesting that the adjusting and balancing be performed, bring the work to a state of readiness for adjusting and balancing.
2. Have all systems in complete operation and all calibrations complete.
3. Furnish a mechanic to assist the balancing firm with the adjusting and balancing.
4. Requests to perform the balancing prematurely and/or requests to perform the balancing in a piece-meal manner at the Contractor's convenience shall be at the Contractor's expense.

B. Adjusting and Balancing:
1. Mechanic's Duties: Include demonstrating that the system is functioning and operable, start and stop the fan, make drive changes, clear system blockages and repair any defective and/or leaking portions of the system which may affect system performance.
2. 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 Engineer.
3. Balancing data may be spot checked with instruments similar to that used by the balancing firm.
4. If, in the judgment of the Engineer, the discrepancies warrant additional adjustment, readjust and rebalance the systems at no additional project cost.

END OF SECTION