DIVISION 23 – HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)
23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 QUALITY ASSURANCE

A. The General Contractor shall procure the services of an independent balancing and testing agency, herein after called the Balancing Contractor, which specializes in the balancing and testing of plumbing, heating, ventilating and air conditioning systems, to balance, adjust and test water circulating and air moving equipment and air distribution or exhaust systems as specified herein.

B. Instrument Certification: All instruments used shall be accurately calibrated and certified within six months of balancing and maintained in good working order.

C. Balancing Observance: Balancing shall be subject to regular observation and inspection by the Commissioning Agent and the WSU Construction Manager.

D. Balancing Conferences: The General Contractor, the Balancing Contractor, Commissioning Agent, and WSU Construction Manager shall meet on a regular basis (per the Commissioning Plan) to coordinate balancing and testing activity with all affected subcontractors. The Balancing Contractor shall submit a daily list of system deficiencies to the all parties named in this paragraph, for correction by the affected subcontractors.

E. Balancing Contractor Qualifications:

1. The Balancing Contractor shall guarantee the accuracy and compliance of its material and labor according to the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB).
2. The Balancing Contractor shall be a certified member of the AABC or the NEBB. Balancing Contractor and balancing personnel shall provide proof of having completed at least five projects of similar size and scope.
3. Testing and balancing shall be done under the direct supervision of a certified Test and Balance Engineer or a registered Professional Engineer.

1.02 SUBMITTALS

A. Balancing Report:

1. Contractor shall provide one draft copy of balancing report to the WSU Environmental Controls Shop for approval, prior to completion of the final report.

2. The Contractor shall submit an electronic copy and a paper copy of the approved balancing report. For new construction, submit this in the original Operations and Maintenance (O&M) manuals. For renovations and upgrades, submit copies to the WSU Construction Manager for updating in the existing O&M manuals. The data forms shall be accompanied by a coordinated set of drawings and specifications which show locations of all outlets, dampers, grilles, boxes, test ports, balancing valves, control valves, etc.

1.03 PROJECT CONDITIONS

A. Commencement of Balancing Activities:

1. For renovation and remodeling of existing facilities, the Contractor shall notify the WSU Construction Manager in writing, consistent with the project schedule, when the balancing can be performed. This notice will be given at least 30 days before the work is to be performed.

B. Pre-Balance Checklist:

1. The General Contractor shall examine and verify the following prior to Testing and Balancing activities:
    i. Air Side:
        1) Ductwork is intact and properly sealed.
        2) Ductwork has been leak tested and repaired as required.
        3) Access doors are installed and properly secured.
        4) Ductwork end caps are installed.
        5) Ductwork installed according to drawings and specifications.
        6) Ductwork is free of debris.
        7) All dampers, fire, volume, mixing, splitters are installed, accessible and open.
        8) All terminal boxes, reheat coils, operators and dampers are installed, accessible and operable.
        9) Return air has unobstructed path from each conditioned space back to the unit.
        10) All grilles, registers, diffusers and other devices are installed and functional.
        11) Filters are clean and correctly installed.
        12) Filter frames correctly installed and sealed.

13) Coils clean, properly installed, combed.
14) Drive components installed.
15) Sheaves properly aligned & tight on their shaft.
16) Belts adjusted for correct tension.
17) Belt guard properly installed.
18) Automatic control dampers installed and functional.
19) Fan rotation correct.
20) Fan housing installed and sealed.
21) All flex connections and vibration isolators are installed correctly.
22) Fan wheel aligned with adequate clearance.
23) Fan bearings lubricated.

ii. Water Side:

1) All valves, flow meters, temperature/pressure taps installed correctly, functional and accessible.
2) Strainers & piping, clean, flushed, and free of debris.
3) Construction strainer baskets replaced with permanent baskets.
4) System filled to proper level & pressure reducing valve set.
5) Automatic & manual air vents properly installed & functional.
6) All air purged from system.
7) Water in expansion tanks at proper level.
8) All coils piped correctly and accessible.
9) Correct pump rotation.
10) Pumps properly aligned, grouted, and anchored.
11) Vibration isolators properly installed & adjusted.
12) Service & balance valves are open.

iii. Electrical:

1) Motors are wired and energized.
2) Proper starter and overload protection are installed.
3) Correct fuses are installed.
4) Motor is secured to frame.
5) Motor bearings are lubricated.
6) Fire alarms and duct smoke detectors are fully operational.

iv. Controls:

1) Controls are complete and functional.

2) Thermostats are calibrated.

3) Program is correct and functional.

v. General:

1) All doors and closures, windows and ceiling tile shall be installed.

PART 2 - EXECUTION

2.01 SCOPE OF WORK

A. The Test and Balance data shall be complete and the Performance Test accepted before the project will be considered substantially complete.

2.02 BALANCING

A. Data to be read and recorded:

1. Data read and recorded shall include, but not be limited to the following:

i. Air Balance at the Fans:

1) Read all fan systems: Supply, exhaust, return, fume hoods, unit heaters, packaged units, cooling towers, etc. Set all systems so that repeatability error is less than 5% of design. Do not change design without written approval from the Prime Consultant and the WSU Project Manager.

2) Record all design fan data listed in drawings, specifications, and submittals (i.e., fan number, CFM, static pressure, O.D. sheave size, shaft diameter, RPM. expected BHP, class, manufacturer & unit size).

3) Record all design motor data (i.e., motor HP, voltage, phase, full load amperage, BHP, frame size, heater size, O.D. sheave size, shaft diameter, RPM).

4) Record all actual fan & motor data (i.e., CFM, fan RPM, BHP, Z, static pressure, motor movement, amperage, center to center of shafts, size & number of belts).

5) Record pressure drop across each coil or filter and total system pressure. Record temperatures (return, mixed, inlet & outlet).

6) Perform a velocity test for total CFM.

7) Balancing contractor shall make vibration and acoustic readings only if required by design specifications. If in the professional

judgment of the Balancing Contractor acoustic and vibration readings are required, a change proposal shall be submitted to the owner.

ii. Air Balance Branch Ducts, Boxes and Outlets:

1) Record zone, branch, mixing box number and outlet number for each grille, register or diffuser, outlet size, free area Ak factor and required velocity to reach design.

2) For TEC systems, record the TEC address, the duct size and coefficient factor (rather than the mixing box number), Ak factor & velocity.

3) Record design CFM for each outlet and actual CFM. Adjust dampers and repeat until design CFM has been obtained.

4) Install test ports and perform a velocity test on major branches or where required.

5) Check calibration and operation of all thermostats.

6) Check position of all manual dampers and fire dampers and the operation of all automatic dampers. Make sure "open" and "closed" positions are clearly marked on quadrant. Mark damper position at design setting.

7) Check operation and tightness of outside air dampers, leakage of more than 5% must be corrected by the Contractor. Check and set percentage of outside air required.

iii. Fume hoods: Balance according to ASHRAE 110.

iv. Water Balance at Pump, Towers or equipment on all Water Systems:

1) Record equipment name and assigned number, manufacturer’s name and model number, size, impeller and the system or service. For cooling towers, record fan size and data in addition to condenser pump data.

2) Record the design and actual test data for the following: GPM, head (in ft.), discharge pressure, suction pressure, operating pressure, EWT, LWT, HP, RPM, amps, volts, BHP, & heater size. Record EAT, LAT, sheaves, belts and shaft sizes if applicable.

v. Water Balance at Box, Convector or Coil:

1) Record room number, device number (box or coil), design BTU, the design and actual GPM, pressure drop, and balancing valve size or Venturi Number.

vi. Damage, Test and Final Setting:

1) The balancing firm shall avoid damage to paint and finishes. Where damage is inevitable to gain access to dampers, valves, or other devices, the General Contractor shall be given prior notice so that appropriate corrections can be made and proper accessibility can be provided.

2) Location of all devices placed within ceiling spaces or hidden from view shall be marked by a color coded identifier pin.

Color	Device
Yellow	Mixing box
Blue	Manual dampers
Red	Fire dampers
Orange	Instruments
Green	BAS
Silver	Valves

3) All final settings shall be clearly marked on each balancing valve, damper, quadrant, etc., with a center punch upon final completion of the balancing work.

2.03 ELECTRIC HEATING EQUIPMENT

A. Test and record voltage and amperage readings at each electric heating device while fully energized and at part load conditions (each step) to verify proper operation.

B. Record data on appropriate forms.

2.04 FINALIZATION

A. Installation deficiencies found by the balancers shall be immediately reported to the General Contractor, Commissioning Agent, and WSU Construction Manager to allow corrective action to be taken by Contractor.

END OF SECTION