SECTION 15990

TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Testing, adjustment, and balancing of air, hydronic and domestic hot water systems.

B. Measurement of final operating condition of HVAC systems.

C. Sound measurement of equipment operating conditions.

1.2 REFERENCES

A. AABC: National Standards for Total System Balance.

B. ADC: Test Code for Grilles, Registers, and Diffusers.

C. ASHRAE 111: Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.

D. SMACNA: HVAC Systems Testing, Adjusting, and Balancing.

1.3 SUBMITTALS

A. Submit under provisions of Section 01340.

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

C. Field Reports: Submit under provisions of Sections 01340 and 01360.

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

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

F. 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.

G. 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.

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

I. Test reports: Submit data on "AABC National Standards for Total System Balance" forms.

1.4 PROJECT RECORD DOCUMENTS: Submit under provisions of Section 01700. Record actual locations of flow measuring stations balancing valves and rough setting.

1.5 QUALITY ASSURANCE: Perform total system balance in accordance with AABC, National Standards for Field Measurement and Instrumentation.

1.6 QUALIFICATIONS

A. Agency: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum three years documented experience certified by AABC.

B. Perform Work under supervision of AABC Certified Test and Balance Engineer NEBB Certified Testing, Balancing and Adjusting Supervisor at the place where the Project is located.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

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

1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.
9. Access doors are closed and duct end caps are in place.
10. Air outlets are installed and connected.

11. Duct system leakage is minimized.

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

C. Beginning of work means acceptance of existing conditions.

3.2 PREPARATION: Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing. Provide additional balancing devices as required.

3.3 INSTALLATION TOLERANCES

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

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

3.4 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. Correct and reverify any detected disruption.

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 selection of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

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

E. Use volume control devices to regulate air quantities only to 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, return air, and exhaust dampers for design conditions.

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

3.6 WATER SYSTEM PROCEDURE

A. Verify proper charge in compression tanks.

B. Verify air has been eliminated from chilled water systems.

C. Verify pump rotation.

D. Open chilled water control valves to the full open position. Close coil bypass balance valves.

E. Set flow through the chillers to the scheduled values.

F. Set pump flow to scheduled values.

G. Determine pump performance at shut-off, and at full scheduled flow rate and head, and plot results on a performance graph.

H. Set temperature controls to full cooling for balancing chilled water coils to the maximum flow.

I. Set bypass balance valve loss to match the loss of full flow through the coils.

J. Reverify values once balance is complete on a system.

K. Verify proper hot water flow in the hot water recirculating system.

3.7 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing:

Air Coils

Air Handling Units

Fans

Air Filters

Air Inlets and Outlets

B. Report Forms:

1. Title Page
    a. Testing, Adjusting, and Balancing Agency: Name, Address and Telephone Number.
    b. Project name
    c. Project location
    d. Project Architect
    e. Project Contractor
    f. Project altitude
    g. Report date
2. Summary Comments:
    a. Design versus final performance
    b. Notable characteristics of system
    c. Description of systems operation sequence
    d. Summary of outdoor air and exhaust flows to indicate amount of building pressurization.
    e. Nomenclature used throughout report
    f. Test conditions.
3. Instrument List:
    a. Instrument
    b. Manufacturer
    c. Model number
    d. Serial number
    e. Range
    f. Calibration date
4. Electric Motors:
    a. Manufacturer
    b. Model/Frame
    c. HP
    d. Phase, voltage, amperage; nameplate, actual, no load
    e. RPM
    f. Service factor
    g. Starter size, rating, heater elements
    h. Sheave Make/Size/Bore
5. V-Belt Drive:
    a. Identification/location
    b. Required driven RPM

c. Driven sheave, diameter and RPM
d. Belt, size and quantity
e. Motor sheave diameter and RPM
f. Center to center distance, maximum, minimum, and actual

6. Cooling and heating Coil Data:

a. Identification number
b. Location
c. Service
d. Manufacturer
e. Air flow, design and actual
f. Entering air DB temperature, design and actual
g. Entering air WB temperature, design and actual (DX and cooling coils only)
h. Leaving air DB temperature, design and actual
i. Leaving air WB temperature, design and actual (DX and cooling coils only)
j. Water flow, design and actual
k. Water pressure drop, design and actual
l. Entering water temperature, design and actual
m. Leaving water temperature, design and actual
n. Saturated suction temperature, design and actual (DX cooling coils only)
o. Air pressure drop, design and actual.

7. Air Cooled Chiller Data:

a. Identification number
b. Location
c. Manufacturer
d. Ambient condenser air temperature design and actual
f. Entering chilled water temperature, design and actual
g. Leaving chilled water temperature, design and actual
h. Water flow, design and actual
i. Water pressure drop, design and actual
j. Amperage on each leg for each compressor
k. Voltage on each leg for each compressor

8. Air Moving Equipment

a. Location
b. Manufacturer
c. Model number
d. Serial number
e. Arrangement/Class/Discharge
f. Air flow, specified and actual
g. Return air flow, specified and actual
h. Outside air flow, specified and actual.
i. Total static pressure (total external), specified and actual
j. Full static pressure profiles for rooftop units
k. Inlet pressure
k. Discharge pressure

l. Sheave Make/Size/Bore
m. Number of Belts/Make/Size
n. Fan RPM

9. Return Air/Outside Air Data:

a. Identification/location
b. Design air flow
c. Actual air flow
d. Design return air flow
e. Required mixed air temperature
f. Actual mixed air temperature
g. Design outside/return air ratio
h. Actual outside/return air ratio

10. Exhaust Fan Data:

a. Location
b. Manufacturer
c. Model number
d. Serial number
e. Air flow, specified and actual
f. Total static pressure (total external), specified and actual
g. Inlet pressure
h. Discharge pressure
i. Sheave Make/Size/Bore
j. Number of Belts/Make/Size
k. Fan RPM

11. Duct Traverse:

a. System zone/branch
b. Duct size
c. Area
d. Design velocity
e. Design air flow
f. Test velocity
g. Test air flow
h. Duct static pressure
i. Air temperature
j. Air correction factor

12. VAV Box:

a. Location
b. Manufacturer
c. Model number
d. Serial number
e. Inlet size
f. Discharge size
g. Maximum air flow, specified and actual

h. Minimum air flow, specified and actual
i. Outside air flow, specified and actual.
j. Inlet pressure
k. Discharge pressure
l. Fan RPM

13. Air Monitoring Station Data:

a. Identification/location
b. System
c. Size
d. Area
e. Design velocity
f. Design air flow
g. Test velocity
h. Test air flow

14. Flow Measuring Station:

a. Identification number
b. Location
c. Size
d. Manufacturer
e. Model number
f. Serial number
g. Design flow rate
h. Design pressure drop
i. Actual/final pressure drop
j. Actual/final flow rate
k. Station calibrated setting

END OF SECTION