# SECTION 230593 - TESTING, ADJUSTING AND BALANCING

## PART 1 - GENERAL

### 1.1 APPLICABLE REQUIREMENTS

A. All work to be furnished and installed under this section shall comply with all the requirements of General Conditions, Supplemental Conditions, Division 01 - General Requirements, Section 230500 - Basic HVAC Materials and Methods, and other Sections in Division 23 specified herein.

### 1.2 WORK RELATED IN OTHER SECTIONS

A. Section 230500: Basic HVAC Materials and Methods.

B. Section 230900: Building Automation System (BAS) Controls.

C. Section 232113: Hydronic Piping, Valves and Specialties.

D. Section 233113: Air Distribution.

E. Division 26: Electrical.

### 1.3 SUMMARY

A. Scope: Extent of testing, adjusting and balancing work required by this Section is indicated on the drawings, in schedules, and by the requirements of this Section, and Section 230500 -Basic Mechanical Requirements.

B. Systems: Testing, adjusting and balancing specified in this Section shall include, but not be limited to, the following systems:

1. Air handling systems including supply, return and exhaust.
2. Air distribution ductwork including supply, return and exhaust.
3. Dedicated exhaust systems.
4. Building automation system controls.
5. Instruction of Owner's personnel for future balancing of systems.

### 1.4 CODES AND STANDARDS

A. The Contractor is cautioned that code requirements not explicitly detailed in these specifications or drawings, but which may be reasonably inferred or implied from the nature of the project, must be provided as part of the contract.

B. Reference Standards

1. ANSI/ASHRAE Standard 111 - Measurement, Testing, Adjusting and Balancing of Building HVAC Systems (current edition).
2. ASHRAE - HVAC Applications Handbook: Chapter 38 - Testing, Adjusting and Balancing (current edition).
3. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings, Chapter 6 (current edition).
4. AABC - National Standards for Total System Balance.



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5. NEBB - Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.
6. SMACNA - HVAC Systems-Testing, Adjusting and Balancing.
7. SMACNA - HVAC Air Duct Leakage Test Manual.
8. ANSI - American National Standards Institute. Comply with the following:
    a. S1.4: Specifications for Sound Level Meters.
    b. S1.11: Specifications for Electroacoustics - Octave-Band and Fractional-Octave-Band Filters
9. Building Code, with State Amendments, Chapter 9 Fire Protection Systems.
10. Mechanical Code, with State Amendments, Chapter 4 Ventilation Air Supply.
11. Local Nonresidential Energy Code.

1.5 QUALITY ASSURANCE

A. Contractor’s Qualifications: A specialist certified by the National Environmental Balancing Bureau (NEBB) or Associated Air Balance Council (AABC) with at least 5 years of experience in those testing, adjusting and balancing requirements similar to those required for this project, is not the installer of the system to be tested and is otherwise independent of the project. Testing, adjusting, and balancing shall be performed by a certified NEBB technician or a certified AABC technician under direct field supervision of a Certified NEBB Supervisor or a Certified AABC Supervisor. Testing and balancing agency must submit qualifications for review and approval prior to acceptance for work.Penalty: The Contractor shall submit the name of the organization he proposes to employ for approval within 30 days after contract award. If the Contractor fails to submit the name of an acceptable agency within the specified time, a firm may be selected to accomplish the work, and this selection shall be binding upon the Contractor at no additional cost.

C. Retainages: In addition to any other sums retained or withheld pursuant to the provisions of this Contract, the amount of dollars will be withheld from payments to the contractor until such time as the work has been completed and accepted. In no event will this amount be paid to the Contractor prior to 60 days following acceptance of the project; during such time, the Contractor shall investigate and correct any reported deficiencies unless such deficiencies are a result of unauthorized tampering by building occupants.

D. Calibration of Testing Instruments: All measurement instruments used for testing, adjusting, balancing, and commissioning shall be calibrated. The time between the most recent calibration data and the final test report date shall not be over 6 months.

E. Testing and balancing agency, as part of its contract, shall act as authorized inspection agency responsible to Consulting Engineer and Owner, and shall list all items that are installed incorrectly, require correction, or have not been installed in accordance with contract Drawings and Specifications, pertaining to air distribution, cooling and heating systems. The testing and balancing agency is required to provide written reports of all deficiencies and proposed recommendations to the Owner' Representative, Contractor, Architect and Engineer.



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F. The testing and balancing agency shall provide with their bid a performance guarantee covering all phases of the work as herein specified.

G. The General and Mechanical Contractors shall cooperate with the selected testing and balancing agency in the following manner:

1. Provide sufficient time before final completion dates so that tests and balancing can be accomplished.
2. The various system installers, suppliers and contractors shall provide all required materials, labor and tools to make corrections when required without undue delay. Install balancing dampers and valves as required by testing and balancing agency.
3. The contractor shall put all heating, ventilating and air conditioning systems and equipment into full operation and shall continue the operation of the same during each working day of testing and balancing.
4. Testing and balancing agency shall be kept informed of any major changes made to the system during construction, and shall be provided with a complete set of Record Drawings.
5. The General Contractor shall make space and other facilities available to the testing and balancing agency to enable their work to progress. The General Contractor shall schedule the work of other trades to avoid conflicts with this work.

H. All air balancing work shall be coordinated with other disciplines to comply with the meet or exceed the minimum requirements of the Americans with Disabilities Act (ADA), Building Code, local amendments and State Energy Code.

1.6 SUBMITTALS

A. Conform to the Submittals requirements of Division 01.

B. Forms: The Contractor shall deliver a complete copy of either NEBB or AABC standard forms for testing and balancing work associated with the project. These forms shall serve as specific guidelines for producing final test report. Hybrid or non-standards forms are not acceptable.

C. Test Reports: Provide final certified test report, three (3) certified hard copies and one electronic PDF formatted copy, with signature of the test and balance supervisor responsible for the work. The final reports shall include key plans identifying all inlets and outlets. Final reports to include equipment calibration reports. Final test reports shall be typed. Reports with handwritten data entry are not acceptable.

D. Maintenance Data: Include, in maintenance manuals, copies of certified and approved test and balance reports and identification of instruments.

E. Qualifications: The Test and Balance Agency shall submit qualifications of all persons responsible for supervising and performing the on-site testing and balancing work and the name of the certifying agency, NEBB or AABC. Provide a reference list of five (5) similar size projects with contact person and telephone number.



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1.7 AGENDA

A. Agenda: A preliminary report and agenda shall be submitted and approved prior to the start of testing and balancing work.

1. Review plans and specifications prior to installation of any of the affected systems, and submit a report indicating any deficiencies in the systems that would preclude the proper adjusting, balancing, and testing of the systems.
2. The agenda shall include a general description of each air with its associated equipment and operation cycles for heating and cooling.
3. The agenda shall include a list of all air flows to be performed at all mechanical equipment.
4. The agenda shall incorporate the proposed selection points for sound measurements, including typical spaces as well as sound sensitive areas such as clinic or research rooms.
5. The agenda shall also include specific test procedures and parameters for determining specified quantities (e.g. flow, drafts, sound levels) from the actual field measurements to establish compliance with contract requirements. Samples of forms showing application of procedures and calculations to typical systems shall be submitted.
6. Specific test procedures for measuring air quantities at terminals shall specify type of instrument to be used, method of instrument application (by sketch) and factors for:

    a. Air terminal configuration.
    b. Flow direction (supply or exhaust).
    c. Velocity corrections.
    d. Effective area applicable to each size and type of air terminal.
    e. Density corrections.

7. The agenda shall include identification and types of measurement instruments to be used, and their most recent calibration date.

1.8 JOB CONDITIONS

A. General: Do not proceed with testing, adjusting and balancing work until the following conditions have been met.

1. Installation and start-up work on equipment or systems to be tested has been completed and documented.
2. Work area scheduled for testing, adjusting and balancing is clean and free from debris, dirt and discarded building materials.
3. All architectural openings (doors, windows, and other openings) which may affect the operation of the system to be tested shall be in their completed normal positions and operation.
4. All related mechanical systems which may affect the operation of the system to be tested shall be at their normal operating conditions.
5. Verify accessibility of systems and system components.



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## PART 2 - PRODUCTS

### 2.1 TEST HOLES

A. Test holes and ports shall be provided in ducts, housings and pipes as directed by the Balancing Agency. At each location where ducts or plenums are insulated, test holes shall be provided with an approved extension with plug fitting.

### 2.2 PATCHING MATERIALS

A. Material: Seal, patch and repair ductwork, piping and equipment drilled or cut for testing purposes.

1. Plastic plugs with retainers may be used to patch drilled holes in ductwork and housings.
2. Insulation shall be neatly hemmed with metal or plastic edging, leaving test points visible for future testing.

### 2.3 TEST INSTRUMENTS

A. Test Instruments: All instruments used for measurements shall be accurate and calibration histories for each instrument shall be available for examination. Each test instrument shall be calibrated by an approved laboratory or by the manufacturer. The Owner’s Representative has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.

B. Additional Instruments: Permanently installed measuring instruments, such as temperature and pressure gauges, shall be checked against Certified Calibrated instruments. Any instrument which does not meet specification requirement shall be replaced or recalibrated.

C. Cone Instruments: The Contractor shall employ manufactured enclosure type cones, capable of air volume direct readings, for all diffuser/grille/register air flow measurements. The readout meters shall meet calibration requirements.

## PART 3 - EXECUTION

### 3.1 PROCEDURES AND INSTRUMENTS, GENERAL

A. Requirements: All systems and components thereof shall be adjusted to perform as required by approved project drawings and specifications.

B. Test Duration: Operating tests of heating and cooling coils, fans, and other equipment shall be of not less than four-hours duration after stabilized operating conditions have been established. Capacities shall be based on temperatures and air quantities measured during such tests.

C. Instrumentation: Method of application of instrumentation shall be in accordance with the approved agenda.

1. All instruments shall be applied in accordance with the manufacturer's certified instructions.



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2. All labor, instruments, and appliances required shall be furnished by the Contractor. Permanently installed instruments used for the tests (e.g., flow meters and Btu meters) shall not be installed until the entire system has been cleaned and ready for operation.

3.2 DUCTWORK AIR LEAKAGE TESTING

A. Dust leakage testing is required on all ductwork constructed to 4” wg class and higher.

B. Test and balance agency shall perform active air flow testing of ductwork systems or sections of ductworks. Agency shall inspect and confirm that all ductwork is sealed per the specification requirements prior to performing any testing. Calculate maximum allowable air leakage by system based on total design air flow rate and/or square footage of ductwork. Maximum allowable system air flow leakage shall not exceed 5% of total air volume, or the maximum allowable per local energy or mechanical codes where the allowable limit is less than 5%.

C. Representative sections totaling 10 percent, or greater, of the total installed duct area shall be tested. Where the tested 10 percent fails to comply with the requirements, then 40 percent of the total installed duct area shall be tested. Where the tested 40 percent fails to comply then 100 percent of the total installed duct area shall be tested and verified to have a leakage rate that does not exceed the maximum allowable limit. Duct sections shall be selected by the Owner’s Representative. Obtain total duct surface area and air flow volumes for each duct section from the installing contractor. Positive pressure leakage testing shall be permitted for negative pressure ductwork.

D. Additional ductwork leakage testing may be required to meet local energy and mechanical code requirements. Refer to local codes for applicability and requirements.

E. Ductwork systems to be leakage tested and procedures shall include:

1. Testing shall be performed at 1.5 times the peak design outlet static pressure (external static pressure) from the air handling unit/fan, but not greater than the maximum SMACNA pressure rating of the ductwork construction classification.
2. Testing is not required of flexible ductwork or ductwork downstream of VAV terminal units.
3. Leakage through manufactured products, such as air handling units, dampers, fire/smoke dampers and terminal units may be excluded from the leakage calculations based on manufacturer stated values, at pressure, or these units may be temporarily sealed with painter’s tape or plastic sheeting during testing to seal any openings and must be removed after testing.
4. Supply air ductwork from the outlet of the air handling unit/fan to inlet side of terminal units or connection to flexible ductwork. Duct leakage testing is not required downstream of terminal units.
5. All supply, return and exhaust air ductwork located outside the building envelope.
6. Return and exhaust air ductwork located in unconditioned spaces from inlet of the air handling unit/fan to the ductwork terminations upstream of each return air grille.

F. Ductwork installer shall prepare ductwork for pressure testing as deemed appropriate to maintain construction schedule. Ductwork may be tested as total systems or in



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sections. Sectional testing will require documentation to prove the totalized system leakage is within allowable range of entire system. Ductwork inlets and outlets may be temporarily sealed airtight with plastic, or other means, to facilitate testing pressures.

G. Testing may occur through ductwork devices such as balancing dampers, smoke fire dampers and coils. Manufacturer provided air leakage allowances for such devices may be excluded from duct leakage measurement but must be documented in final report.

H. The leakage rate shall be confirmed through field verification and diagnostic testing in accordance with procedures defined by Oriflow Air Leakage Test, or equivalent procedure. Perform all testing utilizing a duct leakage testing system, Oriflow Duct Leakage Tester or equal, with calibrated fan, orifice, gauges, ductwork, pressure tips and tubing.

3.3 AIR SYSTEM PROCEDURES

A. Adjustments: Adjust all air handling systems to provide design air quantity to or through, each component, and to maintain stable and comfortable interior temperatures, free of drafts or stagnant air conditions.

B. Equalizers: Equalizing devices shall be adjusted to provide uniform velocity across the inlets (duct side for supply) of terminals prior to measuring flow rates.

C. Balance: Flow adjusting (volume control) devices shall be used to balance air quantities (i.e., proportion flow between various terminals comprising system) to the extent that their adjustments do not create objectionable air motion or sound (i.e., in excess of specified limits).

1. Balancing between runs (submains, branch mains, and branches) generally shall be accomplished by flow regulating devices at, or in, the divided-flow fitting.
2. Restriction imposed by flow regulating devices in or at terminals shall be minimal.
3. Final measurements of air quality shall be made after the air terminal has been adjusted to provide the optimum air pattern of diffusion and as indicated on the air distribution drawings.

D. Fan Adjustment: Total air system quantities, generally, shall be varied by adjustment of fan speeds or axial-flow fan wheel blade pitch. Damper restriction of a system's total flow may be used only for systems with direct-connected fans (without adjustable pitch blades), provided system pressure is less than 0.5” w.g. and sound level criteria are met.

E. Air Measurement: Where air quantity measuring devices are specified in other sections such systems shall be used as a cross-check of portable measuring equipment.

1. Except as specifically indicated herein, pitot tube traverses shall be made of each duct to measure air flow therein. Pitot tubes, associated instruments, traverses, and techniques shall conform to the ASHRAE "Handbook Fundamentals Inch Pound Edition."
2. For ducts serving modular office areas with movable partitions, which are subject to change, pitot tube traverses may be omitted provided the duct serves only a single room or space and its design volume is less than 2000 cfm. In lieu of pitot



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tube traverses, airflow in the duct shall be determined by totaling volume of individual terminals served, measured as described herein.

3. Where duct's design velocity and air quantity are both less than 1000 (fpm/cfm), air quantity may be determined by measurements at terminals served.

F. Test Holes: Test holes shall be in a straight duct, as far as possible downstream from elbows, bends, take-offs, and other turbulence generating devices, to optimize reliability of flow measurements.

G. Air Terminal Balancing: Generally, measurement of flow rates by means of velocity meters applied to individual terminals, with or without cones or other adapters, shall be used only for balancing. Measurement of air quantities at each type of air terminal (inlet and outlet) shall be determined by the method approved for the balancing agenda.

H. Air Motion: Air motion and distribution shall be as specified and indicated on drawings. The Contractor, at no additional cost to the Owner shall, in addition to air motion and direct measurements, perform smoke tests as requested to demonstrate the air distribution and pattern from air terminals and outlets.

I. Air system test and balance procedures shall include, but not be limited to the following requirements:

1. Test and adjust blower RPM to design requirements.
2. Test and record motor full load amperes.
3. Make pitot tube traverse of main supply ducts and obtain design CFM at fans.
4. Test and record system static pressures, suction pressure directly at system fan inlet, and outlet pressure directly at system fan outlet or discharge. Test and record static pressure across each component of air handling system (coils, filters, etc.).
5. Test and adjust system for design CFM recirculated air.
6. Test and adjust system for design CFM outside air.
7. Test and record entering air temperatures.
8. Test and record leaving air temperatures.
9. Adjust all supply, return and exhaust air ducts to proper design CFM.
10. Adjust all zones to proper design CFM, supply and return.
11. Test and adjust duct systems and each diffuser, grille, and/or register to within 10% of design requirements.
12. Each grille, diffuser and register shall be identified as to location and area.
13. Operate each variable frequency drive (VFD) and verify controls installation is complete.
14. Size, type and manufacturer of VAV boxes, diffusers, grilles, registers and all tested equipment shall be identified and listed. Manufacturer's ratings on all equipment shall be used to make required calculations.
15. Readings and tests of diffusers, grilles and registers shall include required FPM velocity and test resultant velocity, required CFM and test resultant CFM after adjustment.
16. In cooperation with the control manufacturer's representative, setting adjustments of automatically operated dampers to operate as specified, indicated, and/or



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noted. Testing agency shall check all controls requiring adjustment by control installers. Room thermostats shall be checked for cooling and heating response.

17. All diffusers, grilles and registers shall be adjusted to minimize drafts in all areas.
18. Adjust overall system balances to allow all self-closing exterior doors to close from any open position. Maximum interior air pressure in all operational modes shall not exceed 0.05" static pressure relative to the outside air pressure. Comply with chapter 10 of the Building Code to assure that self-closing doors will release with a maximum force of 15 pounds.
19. As part of the work of this contract, the HVAC contractor shall make any changes in the pulleys, belts and dampers or the addition of dampers required for correct balance as recommended by air balance agency, at no additional cost to Owner.
20. After air balancing is completed and RPM determined, HVAC Contractor shall provide fixed pitch pulleys.
21. All mixing boxes, VAV air valves, control dampers, smoke dampers and similar devices which operate at 100% shut off shall be tested for leakage.
22. Variable Air Volume Fan Systems: The primary balancing mode is 100% outside air with all terminal boxes on a full call for cooling. Also check and record performance at minimum outside air with all terminal boxes on call for full cooling and at minimum outside air with all terminal boxes on call for full heating and at minimum outside air in the deadband range with no call for heating or cooling. Verify that the systems are operating on a stable part of the fan curves in each mode. Record final duct static controller settings.
23. Space Pressurization Procedure:
    a. Before testing for space pressurization, observe the space to verify the integrity of the space boundaries. Verify that windows and doors are closed and applicable gaskets, and sealants are installed. Report deficiencies and postpone testing until after the reported deficiencies are corrected.
    b. Measure, adjust, and record the pressurization of each room, each zone, and each building by adjusting the supply, return, and exhaust airflows to achieve the indicated conditions.
    c. Measure space pressure differential where pressure is used as the design criteria and measure airflow differential where differential airflow is used as the design criteria for space pressurization.
        1) For pressure measurements, measure and record the pressure difference between the intended spaces at the door with all doors in the space closed. Record the high-pressure side, low-pressure side, and pressure difference between each adjacent space.
        2) For applications with cascading levels of space pressurization, begin in the most critical space and work to the least critical space.
        3) Test room pressurization first, then zones, and finish with building pressurization.
    d. To achieve indicated pressurization, set the supply airflow to the indicated conditions and adjust the exhaust and return airflow to achieve the indicated pressure or airflow difference.



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e. In spaces that employ multiple modes of operation, such as normal mode and emergency mode or occupied mode and unoccupied mode, measure, adjust, and record data for each operating mode.
f. Record indicated conditions and corresponding initial and final measurements. Report deficiencies.

## 3.4 ADA COMPLIANCE

A. All air balancing work shall be coordinated with other disciplines to comply with meeting or exceeding the minimum requirements of the Americans with Disabilities Act (ADA), Building Code, State Energy Code and local amendments. Final air balancing for all systems in each space shall be verified and adjusted as necessary to meet the following requirements during peak ventilation, smoke control mode, partial ventilation and minimum ventilation modes during occupied and non-occupied hours. The following requirements are provided as consolidated list of minimum ADA requirements:

1. The required force for pushing or pulling open a door other than fire doors shall not exceed 5 pounds.
2. At fire doors the required opening force shall not exceed 15 pounds.
3. At fire doors the doors shall be set in motion when subjected to a force not exceeding 30 pounds.
4. At fire doors the doors shall swing to a full open position when subjected to a force not exceeding 15 pounds.
5. The force to operate door latch releases shall not exceed 5 pounds.
6. The differential pressure between the building lobby and outside shall remain positive between 0.01” w.g., minimum, and 0.05” w.g., maximum, during operational hours.

## 3.5 AIR SYSTEM DATA

A. Report: The certified report shall include for each air handling system the data listed below.

1. Equipment (Fan or Factory Fabricated Station Unit):
    a. Installation data
        1) Manufacturer and model
        2) Size
        3) Arrangement, discharge and class
        4) Motor hp, voltage, phase, cycles, and full load amps
        5) Location and local identification data
    b. Design data
        1) Data listed in schedules on drawings and specifications.
    c. Fan recorded (test) data
        1) CFM
        2) Static pressure (suction and discharge, across each coil and filter set)



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3) RPM
4) Motor operating amps
5) Motor operating bhp

2. Duct Systems:

a. Duct air quantities (maximum and minimum) - main, submains, branches, outdoor (outside) air, total air, and exhaust:

1) Duct size(s)
2) Number of pitot tube (pressure measurements)
3) Sum of velocity measurements (Note: Do not add pressure measurements)
4) Average velocity
5) Recorded (test) cfm
6) Design cfm

b. Individual air terminals

1) Terminal identification supply or exhaust, location and number designation
2) Type size, manufacturer and catalog identification applicable factor for application, velocity, area, etc., and designated area
3) Design and recorded velocities - fpm (state "core," "inlet," etc., as applicable)
4) Design and recorded quantities - cfm (deflector vane or diffusion cone settings)

## 3.6 BALANCING MEASUREMENT TOLERANCES

A. Comply with codes and standards applicable for this project and local AHJ.

B. Comply with maximum tolerance air balance limitations listed in the ASHRAE Handbook – HVAC Applications (latest edition) and as listed in the following guidelines:

1. Air terminal units: -2% to +10% of design air flows.
2. Minimum Outside Air: -2% to +10% of design air flows.
3. For negative pressure rooms: 0% to +10% or design exhaust air flows and balance supply air from -10% percent to 0% of design supply air flows.
4. For positive pressure rooms: 0% to +10% of supply air flows and balance exhaust/return from -10% to 0% of design air flows.
5. For rooms with less than 200 cfm, that are not indicated by plans or code to be positive or negative, balance the supply/return/exhaust from -5% to +5% of design air flows.
6. Supply fans, return fans, exhaust fans and equipment with fans: 0% to +10% of design air flows.
7. Air outlets and inlets: -/+ 5% of design air flows.
8. Reheat heating water flow rate: -/+ 10% of design water flows.
9. Preheat heating water flow rate: 0% to +10% of design water flows.
10. Chilled water flow rate: 0% to +10% of design water flows.
11. Condenser water flow rate: 0% to +10% of design water flows.



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3.7 CERTIFIED REPORTS

A. Submittals: Six (6) copies of the reports described herein, covering air and water system performance, air motion (fpm), and sound pressure levels, shall be submitted prior to final tests and inspection.

B. Instrument Records: Types, serial numbers, and dates of calibration of all instruments shall be included.

C. Reports: Reports shall conspicuously identify items not conforming to contract requirements, or obvious malfunction and design deficiencies.

D. Certification: Certification shall include checking of adherence to agenda, of calculations, of procedures, and evaluation of final summaries.

3.8 FINAL COMMISSIONING TESTS, INSPECTIONS AND ACCEPTANCE

A. Scope: Test shall be made to demonstrate that capacities and performance of air and water systems comply with contract requirements.

1. At the time of final inspection, the Contractor shall recheck, random selection of data (water and air quantities, air motion, and sound levels) recorded in the certified report. In addition, all classrooms and conference rooms shall be rechecked.
2. Points and areas for recheck shall be selected by the commissioning team.
3. Measurement and test procedures shall be the same as approved for work forming basis of certified report.
4. Selections for recheck (specific plus random), in general, will not exceed 25 percent of the total number tabulated in the report, except that special air systems may require a complete recheck for safety reasons.

B. Retests: If random tests elicit a measured flow deviation of 10 percent or more from design, or a sound level greater than 2 db or more than recorded in the certified report listings, as 10 percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, all systems shall be readjusted and tested, new data recorded, new certified reports submitted, and new inspection tests made, all at no additional cost. Retainage time shall be based on the date of the final acceptance of the certified report.

C. Marking of Settings: Following final acceptance of certified reports, the settings of all valves, splitters, dampers, and other adjustment devices shall be permanently marked by the Contractor so that adjustment can be restored if disturbed at any time. Devices shall not be marked until after final acceptance.

END OF SECTION 230593



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