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SECTION 15980
TESTING, ADJUSTING, AND BALANCING**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems. TAB includes the following:
1. Planning systematic TAB procedures.
 2. Design Review Report.
 3. Systems Inspection report.
 4. Duct Air Leakage test report.
 5. Systems Readiness Report.
 6. Balancing air and water distribution systems; adjustment of total system to provide design performance; and testing performance of equipment and automatic controls.
 7. Vibration and sound measurements.
 8. Recording and reporting results.
- B. Definitions:
1. Basic TAB used in this Section: Chapter 36, "Testing, Adjusting and Balancing" of ASHRAE Handbook, "HVAC Applications".
 2. TAB: Testing, Adjusting and Balancing; the process of checking and adjusting HVAC systems to meet design objectives.
 3. AABC: Associated Air Balance Council.
 4. NEBB: National Environmental Balancing Bureau.
 5. Air Systems: Includes all outside air, supply air, and exhaust air.
 6. Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

1.2 RELATED WORK

- A. General Mechanical Requirements: Section 15050, BASIC METHODS AND REQUIREMENTS (MECHANICAL).
- B. Noise and Vibration Requirements: Section 15200, NOISE AND VIBRATION CONTROL.
- C. Equipment Insulation: Section 15250, INSULATION.
- D. Unit Heater Performance: Section 15740, TERMINAL UNITS.
- E. Duct Leakage: Section 15840, DUCTWORK AND ACCESSORIES.
- F. Controls and Instrumentation Settings: Section 15902 CONTROLS AND INSTRUMENTATION (DDC).

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1.3 QUALITY ASSURANCE

A. Refer to Articles, Quality Assurance and Submittals, in Section, BASIC METHODS AND REQUIREMENTS (MECHANICAL).

B. Qualifications:

1. TAB Agency: The TAB agency shall be a subcontractor of the General Contractor and shall report to and be paid by the General Contractor.
2. The TAB agency shall be either a certified member of AABC or certified by the NEBB to perform TAB service for HVAC, water balancing and vibrations and sound testing of equipment. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the agency loses subject certification during this period, the General Contractor shall immediately notify the Resident Engineer and submit another TAB firm for approval. Any agency that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any work related to the TAB. All work performed in this Section and in other related Sections by the TAB agency shall be considered invalid if the TAB agency loses its certification prior to Contract completion, and the successor agency's review shows unsatisfactory work performed by the predecessor agency.
3. TAB Specialist: The TAB specialist shall be either a member of AABC or an experienced technician of the Agency certified by NEB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the General Contractor shall immediately notify the Resident Engineer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by an approved successor.

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4. TAB Specialist Responsibilities:

- a. The General Contractor within 60 days after the notice to proceed shall identify TAB specialist who would be responsible for supervising, coordinating, scheduling and reporting all TAB work and related activities and provide necessary information as required by the Resident Engineer.
 - b. All TAB work shall be performed under the direct supervision of the TAB specialist.
 - c. The reports shall be accompanied by report forms and schematic drawings required by the TAB standard, AABC or NEBB. The reports shall be signed by the TAB specialist and shall bear the seal of the TAB standard.
 - d. The TAB Specialist would follow all TAB work through its satisfactory completion.
 - e. Final markings of settings of all HVAC adjustment devices.
 - f. Permanently mark location of duct test ports.
5. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity of this project and must be certified so by the TAB agency in writing.

C. Test Equipment Criteria: The basic instrumentation requirements and accuracy/calibration required by AABC, National Standards or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose.

D. Tab Criteria:

1. One or more of the applicable AABC, NEBB or SMACNA publications, supplemented by ASHRAE Handbook "HVAC Applications" Chapter 36, and requirements stated herein shall be the basis for planning, procedures, and reports.
2. Flow rate tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow ASHRAE Handbook "HVAC Applications", Chapter 36 as a guideline. Air Filter resistance during tests, artificially imposed if necessary, shall be at least 90 percent of final values for pre-filters and after-filters.
 - a. Air handling unit and all other fans, cubic meters/min (cubic feet per minute): Minus 0 percent to plus 10 percent.

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- b. Air terminal units (maximum values): Minus 2 percent to plus 10 percent.
- 3. Systems shall be adjusted for energy efficient operation as described in PART 3.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01340, SAMPLES AND SHOP DRAWINGS.
- B. Submit names and qualifications of TAB agency and TAB specialists within 60 days after the notice to proceed. Submit information on three recently completed projects and a list of proposed test equipment.
- C. For use by the Resident Engineer staff, submit one complete set of applicable AABC or NEBB publications that will be the basis of TAB work.
- D. Submit Following for Review and Approval:
 - 1. Design Review Report within 90 days for conventional design projects after the system layout on air and water side is completed by the Contractor.
 - 2. Systems inspection report on equipment and installation for conformance with design.
 - 3. Duct Air Leakage Test Report.
 - 4. Systems Readiness Report.
 - 5. Intermediate and Final TAB reports covering flow balance and adjustments, performance tests, vibration tests and sound tests.
 - 6. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.

1.5 APPLICABLE PUBLICATIONS

- A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the initials of the organization.
- B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):
 - 1999 HVAC Applications ASHRAE Handbook, Chapter 36, Testing, Adjusting, and Balancing and Chapter 46, Sound and Vibration Control
- C. Associated Air Balance Council (AABC):
 - 2002 AABC National Standards for Total System Balance
- D. National Environmental Balancing Bureau (NEBB):
 - 6th Edition 1998 Procedural Standards for Testing, Adjusting, Balancing

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of Environmental Systems

3rd Edition 2001 Procedural Standards for the Measurement and
Assessment

of Sound and Vibration

E. Sheet Metal and Air Conditioning Contractors National Association
(SMACNA):

2nd Edition 1993 HVAC SYSTEMS-Testing, Adjusting and Balancing

PART 2 - PRODUCTS

2.1 PLUGS

Provide plastic plugs to seal holes drilled in ductwork for test purposes.

2.2 INSULATION REPAIR MATERIAL

See Section 15250, INSULATION. Provide for repair of insulation removed or damaged for TAB work.

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to TAB Criteria in Article, Quality Assurance.
- B. Obtain applicable contract documents and copies of approved submittals for HVAC equipment and automatic control systems.

3.2 DESIGN REVIEW REPORT

The TAB Specialist shall review the Contract Plans and specifications and advise the Resident Engineer of any design deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3.3 SYSTEM INSPECTION REPORT

- A. Inspect equipment and installation for conformance with design.
- B. The inspection and report is to be done after air distribution equipment is on site and duct installation has begun, but well in advance of performance testing and balancing work. The purpose of the inspection is to identify and report deviations from design and ensure that systems will be ready for TAB at the appropriate time.
- C. Reports: Follow check list format developed by AABC, NEBB or SMACNA, supplemented by narrative comments, with emphasis on air handling units and fans. Check for conformance with submittals. Verify that diffuser

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and register sizes are correct. Check air terminal unit installation including flexible duct sizes and routing.

3.4 DUCT AIR LEAKAGE TEST REPORT

See paragraphs "Duct leakage Tests and Repairs" in Section 15840, DUCTWORK AND ACCESSORIES for TAB agency's role and responsibilities in witnessing recording and reporting of deficiencies.

3.5 SYSTEM READINESS REPORT

- a. Inspect each System to ensure that it is complete including installation and operation of controls.
- b. Verify that all items such as ductwork piping, ports, terminals, connectors etc. required for TAB are installed and provide a report to the Resident Engineer.

3.6 TAB REPORTS

- A. Submit an intermediate report for 50 percent of systems and equipment tested and balanced to establish satisfactory test results.
- B. The TAB contractor shall provide raw data immediately in writing to the Resident Engineer if there is a problem in achieving intended results before submitting a formal report.
- C. If over 20 percent of readings in the intermediate report fall outside the acceptable range, the TAB report shall be considered invalid and all contract TAB work shall be repeated and re-submitted for approval.
- D. Do not proceed with the remaining systems until intermediate report is approved by the Resident Engineer.

3.7 TAB PROCEDURES

- A. Tab shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC or NEBB.

CB. General: During TAB all related system components shall be in full operation parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.

DC. Coordinate TAB procedures with any phased construction completion requirements for the project. Provide TAB reports for each phase of the project prior to partial final inspections of each phase of the project.

ED. Allow sufficient time in construction schedule for TAB and submission of all reports for an organized and timely correction of deficiencies.

E. Air Balance and Equipment Test: Include unit heater, and exhaust fan.

1. Adjust fan speeds to provide design air flow. V-belt drives, including fixed pitch pulley requirements, are specified in Section 15050, BASIC METHODS AND REQUIREMENTS (MECHANICAL).
2. Record final measurements for air handling equipment performance data sheets.

3.8 VIBRATION TESTING

A. Furnish instruments and perform vibration measurements as specified in Section 15200, NOISE AND VIBRATION CONTROL. Field vibration balancing is specified in Section 15050, BASIC METHODS AND REQUIREMENTS (MECHANICAL). To include fans and motors.

B. Record initial measurements for each unit of equipment on test forms and submit a report to the Resident Engineer. Where vibration readings exceed the allowable tolerance Contractor shall correct the problem, the TAB agency shall verify after the corrections are done and submit a final report to the Resident Engineer.

3.9 SOUND TESTING

A. Perform and record required sound measurements in accordance with Paragraph, QUALITY ASSURANCE in Section 15200, NOISE AND VIBRATION CONTROL.

B. Take measurements with a calibrated sound level meter and octave band analyzer of the accuracy required by AABC or NEBB.

C. Sound reference levels, formulae and coefficients shall be according to ASHRAE Handbook, "HVAC Applications", Chapter 46, SOUND AND VIBRATION CONTROL.

D. Where measure sound levels exceed specified level, the installing contractor or equipment manufacturer shall take remedial action

approved by the Resident Engineer and the necessary sound tests shall be repeated.

3.10 MARKING OF SETTINGS

Following approval of Tab final Report, the setting of all HVAC adjustment devices including valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time. Style and colors used for markings shall be coordinated with the Resident Engineer.

3.11 identification of test ports

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

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