

**PART 1. GENERAL****1.1 DESCRIPTION OF WORK**

- A. Testing, Adjusting and Balancing of air handling systems and hydronic systems.
- B. Hydronic balancing of each device connected to the Hydronic System to the design criteria.
- C. Air balancing of each diffuser, grille and register to the air volumes indicated on the drawings.

**1.2 SUBMITTALS**

- A. Preliminary:
  - 1) Submit electronic copies of documentation to confirm compliance with Quality Assurance provisions:
    - (a) Organizations Certified Professional, Certified Technician, and other trained in the discipline of Testing, Adjusting and Balancing
    - (b) Sample copy of each of the report forms proposed for use
- B. Second: At least fifteen days prior to starting field work submit electronic copies of the following:
  - 1) Set of report forms filled out indicating design flow values and required flow for all air and hydronic devices
  - 2) Complete list of instrumentation proposed for use, organized in appropriate categories, with data sheets for each instrument. Furnish the following information:
    - (a) Manufacturer and model number
    - (b) Description and use when needed to further identify instrument
    - (c) Size or capacity range
    - (d) Latest calibration date
  - 3) The Engineer of Record will review submittals for compliance with Contract Documents and return one set marked to indicate the following:
    - (a) Discrepancies noted between data shown and Contract Documents
    - (b) Additional or more accurate instruments required
    - (c) Requests for re-calibration of specific instruments
- C. Third: At least fifteen days prior to Contractor's request for final inspection, submit an electronic copy of final reports on applicable reporting forms for review.
  - 1) Schedule testing and balancing of parts of systems delayed due to seasonal, climatic, occupancy or other conditions beyond control of Contractor as early as proper conditions will allow, after consultation with Engineer.
  - 2) Submit reports of delayed testing promptly after execution of those services.
  - 3) Form of Final Reports:
    - (a) The final TAB Report must bear the name, signature and NEBB Stamp of the TAB Certified Professional of the TAB Firm.
    - (b) Each individual final reporting form must bear the name of person who recorded the data.
    - (c) When more than one certified organization performs TAB services, the firm having managerial responsibility shall make the submittals.

### 1.3 QUALITY ASSURANCE

- A. Testing, Adjusting and Balancing services shall be performed by a NEBB Certified TAB Firm. The NEBB Certified TAB Firm shall have a proven record of doing TAB work and be in Good Standing with NEBB. At the Owners request, references may be requested from the TAB Firm.
- B. Submit evidence that personnel who perform testing and balancing of project systems are qualified personnel; for review and approval by Owner prior to performing work.
- C. If the design parameters cannot be achieved due to faulty installation, provide a TAB Deficiency Report listing the items that do not meet the design parameters to the Engineer of Record. Upon the TAB Firm receiving a change order for retesting, perform retesting after corrective measures are completed by the installing contractors. Re-test, re-adjust and re-balance systems until satisfactory results are achieved. If the design parameters cannot be achieved, issue the Final TAB Report with the outstanding Deficiencies List.
- D. Qualified personnel are:
  - 1) TAB personnel shall be certified NEBB.
  - 2) TAB Work performed by the NEBB Certified TAB Firm shall be under direct supervision of a NEBB TAB Certified Professional who is a full-time employee of the NEBB Certified TAB Firm. Technicians performing TAB Work must be NEBB Certified Technicians and full-time employees of the NEBB Certified TAB Firm.
- E. Should separate NEBB Certified firms perform services for air and hydronic portions, verify the firm that will have managerial responsibilities for coordination of entire Testing, Adjusting and Balancing process will issue the Final NEBB Certified TAB Report.
- F. Comply with applicable procedures and standards of NEBB, unless more stringent requirements are specified in this Section.
  - 1) Current issue of "Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems" published by NEBB.
- G. Calibrate and maintain test instruments in accordance with requirements of referenced standards. Calibrate instruments used in performance of TAB Work within twelve (12) months preceding date of usage.
- H. Balancing Tolerances:
  - 1) Air Systems: Balance equipment, air outlets and air intakes in accordance with air quantities indicated with permissible tolerances as follows:
    - (a) Supply Return and Exhaust Fans: Plus 10 percent to Minus 10 percent (+/-10%) of system total.
    - (b) Supply, Return, Exhaust to Individual Room: Plus 10 percent to Minus 10 percent (+/-10%) of design flowrate.
  - 2) Hydronic Systems: Balance equipment in accordance with capacities and flow quantities indicated with a permissible tolerance of Minus 10 percent to Plus 10 percent.

### 1.4 COORDINATION AND COOPERATION

- A. Installing Contractor responsible for Work under Mechanical: Division 23 provides services described in preparation for Testing and Balancing of Mechanical Systems: Division 23 and as indicated on Drawings.
- B. Enlist aid of Installing Contractor or equipment suppliers, at no additional cost, whenever such aid is required for timely and proper performance of TAB Work.
- C. Cooperate with Installing Contractor to allow smooth coordination of TAB Work with Construction Schedule.
- D. Provide the TAB Firm with a conformed set of contract documents (drawings, specifications, and approved submittals), including all current approved change orders and contract modifications.

Failure to do so may result in a change order for rebuilding of the Pre-TAB Report Forms and TAB marked up drawings.

- E. Develop a project schedule with the input of the TAB Firm that coordinates the work of other disciplines, providing adequate time in the construction process for successful completion of the TAB work.
- F. Notify the TAB Firm of all schedule changes.
- G. Ensure that the building enclosure is complete, including structural components, window and door installation, door hardware, ceilings, stairs, elevator/mechanical shafts and roof systems. All plenums and chases must be sealed.
- H. The Installing Contractors shall ensure that all necessary mechanical and HVAC work is complete and is safe to operate prior to TAB Work. This includes, but is not limited to mechanical, electrical, and control safeties, duct air leakage testing (DALT), hydrostatic testing; piping system flushing, filling, venting, and chemical treating. All strainers should be cleaned, and the correct screens installed. The duct systems and all related equipment should be cleaned, and the specified clean air filters installed. For additional requirements, see Appendix A. Sample Pre-TAB Checklist within the current edition of *NEBB Procedural Standards for the Testing, Adjusting and Balancing of Environmental Systems*.
- I. The Installing Contractors shall ensure permanent electrical power systems serving the HVAC equipment and systems is completed. Such electrical systems should be properly installed in accordance with all applicable codes to ensure the safety of all construction personnel.
- J. The Installing Contractors shall perform startup of all HVAC equipment and systems in accordance with manufacturers' recommendations.
- K. The Installing Contractors shall complete the installation, programming (including design parameters and graphics), calibration and startup of all building control systems. Verify that the building control system provider has commissioned and documented their work before TAB work begins.
- L. The control system firm shall provide access to hardware, software and onsite technical support as required at no cost to the TAB Firm.
- M. The Installing Contractors shall furnish and install all drive changes as required.
- N. The Installing Contractors shall provide TAB Firm with a controlled environment (steady states of flow, pressure, control, temperature) to perform TAB activities. The TAB Firm must be consulted during scheduling to identify what controlled environment is required to provide successful TAB. To create a controlled environment, in addition to mechanical systems being complete and under control, other variables must be considered such as building envelope (i.e.; windows, doors, door sweeps, gaskets, etc.), other trade activities, etc.
- O. The Installing Contractors shall make corrections reported in the TAB Deficiency List in a timely manner and provide written notice when complete.

## **1.5 PROCEDURES**

- A. Review the requirements of the TAB Work from the Engineer of Record before starting any field TAB Work.
- B. When the potential or developing problems are discovered relating to materials, equipment or methods being used in Work, and where such problems may adversely affect TAB Work, immediately report these findings in writing to the Engineer of Record.

## **1.6 WARRANTY AND CONTRACT CLOSEOUT**

- A. Warranty: The Quality Assurance Program guarantee from NEBB applicable for the TAB Work applies to all NEBB Certified TAB Firms
- B. Contract Closeout:

- 1) Submit reports for:
  - (a) Air distribution systems balancing including keyed mechanical drawings.
  - (b) Water systems balancing including keyed mechanical drawings.

## **PART 2. EXECUTION**

### **2.1 GENERAL**

- A. The Installing Contractor shall examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls are ready for operation, prior to TAB.
- B. The Installing Contractor to examine terminal units, such as variable-air-volume boxes, to verify that they are accessible, and their controls are connected and functioning, prior to TAB.
- C. The Installing Contractor to examine strainers for clean screens and proper perforations, prior to TAB.
- D. Test, Adjust, and Balance to design flowrates. Record pressure drops, operating pressures, temperatures, and heat transfer performance for mechanical systems, including, but not limited to, hydronic water systems, air handling unit systems, supply air, return air, outdoor air, makeup air and exhaust air systems, fans, dampers, diffusers, Airflow Measuring Devices, terminal devices, valves and accessories.
- E. Perform preliminary and final testing and balancing. Following preliminary Testing, Adjusting and Balancing, if balancing or control devices are not operating correctly, report these conditions to Construction Manager who shall coordinate required corrections so that balancing can continue. Send a copy of report to Owner's Representative, Engineer of Record and Construction Manager.
- F. Using controls and devices installed, test and balance air conditioning systems with maximum attainable internal load, including lights and equipment, or simulated maximum load using automatic temperature controls, whichever is closest to design operating conditions.
- G. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are installed per the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation. Report missing devices to the Installing Contractor, so corrections can be made without interrupting construction completion.
- H. Perform final Testing, Adjusting and Balancing of air handling systems with finished ceilings and partitions in place, and doors closed.
- I. Owner's Representative may witness final testing and balancing of systems. Notify Owner's Representative ten (10) working days prior to each system being tested or balanced when possible.
- J. The Installing Contractor shall provide ceiling access to areas and equipment for TAB work. The Installing Contractor shall remove insulation, lagging and any other items as needed to take the TAB Measurements. The Installing Contractor shall repair or replace the insulation and lagging at the conclusion of the TAB Works.

### **2.2 GENERAL PROCEDURES FOR TESTING AND BALANCING**

- A. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- B. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

## **2.3 BALANCING PROCEDURES AND RELATED WORK**

- A. Balancing shall strive to achieve the design air and hydronic flowrates, within specified tolerances at terminal points, including air outlets, inlets air quantities and coil flowrates. Flowrates at fans shall be within indicated tolerances from flows indicated on Drawings, specified or scheduled. Where supply and return air fans of air handling units are of variable air volume (VAV) operation type, adjust both fans for similar control ranges. The TAB Firm will issue a TAB Report Summary of items that do not meet the design flowrates after the TAB Deficiency Report have been corrected or accepted by the Engineer of Record.
- B. Determine the correct fan speed (rpm) and advise mechanical Installing Contractor of correct fan speed (rpm) and required sheave diameter for the mechanical contractor to purchase and install. Final sheaves shall be sized such that, upon final balancing, balancing devices at fan and in highest pressure drop duct run are open. Do not "choke" excess fan capacity to achieve final system balance; instead, decrease fan speed (rpm) as required. Check and verify fan speed (rpm) following installation of fixed sheaves.
- C. Permanently installed flow-measuring elements may be used to accomplish balancing after accuracy has been verified with certified calibrated instruments. Record and report readouts of these instruments for all flows, even if not required for testing and balancing results.
- D. Adjust variable-speed pump/fan controls for proper setting to produce design water/airflow rates.
- E. Direct-flow measurements are acceptable.
- F. Record test data for each motor, fan, pump, terminal equipment and air system. Apply temperature, barometric and other correction factors for non-standard conditions and record in report.

## **2.4 TESTING AND BALANCING REPORTS**

- A. Using the appropriate designations as established in Contract Documents, submit the Final Certified TAB Report in digital format to Owner's Representative and Engineer of Record.
- B. Where actual measurements recorded for final balance show deviation outside of the limits prescribed in this specification, and deviation cannot be corrected by balancing with installed layout and elements, note this deviation in Final TAB Report Summary.
- C. In those cases where recorded data can be reasonably interpreted to be inaccurate, inconsistent or erroneous, Owner's Representative may request additional testing and balancing. Perform such retesting and rebalancing, at no additional cost, as directed by, and in presence of Owner's Representative.

END OF SECTION