





## NATIONAL BALANCING COUNCIL CERTIFIED AIR AND HYDRONIC BALANCING SPECIFICATION

### SECTION 15990

## AIR AND HYDRONIC TESTING, ADJUSTING, BALANCING AND VERIFICATION

### PART I GENERAL

#### 1.1 GENERAL CONDITIONS AND RELATED DOCUMENTS

- A. The NBC Certified Testing and balancing contractor shall perform the work described in this specification under contract to the owner or the owners representative, but may be under contract with the General or Mechanical Contractor if approved by the owner.
- B. It is acknowledged that the project drawings, plans and documents as well as General Conditions and the content of Section 15 of these specifications are incorporated into the project requirements. Additions or changes to the project documents, as well as all related change order documentation and submittal data, are to be delivered to the balancing contractor prior to the beginning of the balancing work.

#### 1.2 DESCRIPTION OF WORK TO BE PERFORMED

- A. The testing and balancing contractor is to furnish all labor, testing materials and instruments, support equipment, and report materials incidental to their scope of work.
- B. The testing and balancing contractor shall be able to provide evidence that this project is within the companies' expertise and experience for the size and scope of the project.
- C. The National Balancing Council Certification held by this contractor is to be current and be in good standing free from disciplinary action or restrictions.
- D. Testing and balancing of the project may not begin until the mechanical systems are 100% complete. All pumps, piping, valves, tanks, coils, ducting, fans, heating, cooling and ventilation equipment are to be operable and control systems are to be fully functioning.
- E. Effective test and balancing work requires coordination between the mechanical trades to produce effective results. Related contractors may be required to perform additional work to the systems to deliver and the desired final result.

#### 1.3 REFERENCES

- A. ASHRAE Standard 111– Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air Conditioning and Refrigeration Systems.

- B. NBC – Air Balance and HVAC System Diagnostics
- C. SMACNA – HVAC Systems Testing, Adjusting and Balancing
- D. NBC – Practical Standards and Procedures for Air and Hydronic System Balancing.

#### 1.4 BALANCING CONTRACTOR QUALIFICATIONS

- A. Provide to the awarding party a submittal package to be accepted for approval of balancing contractor within 30 days, award of contract to follow within 30 days or prior to commencement of balancing work.
- B. Submittal package to include a cover letter, Bios of balancing company staff, description of NBC certification requirements, a list of completed projects, test instrument documentation and calibration report, and a sampling of typical test report forms and procedures.

#### 1.5 QUALITY ASSURANCE

- A. Perform test and balance of mechanical systems according to plans and specifications in strict accordance with the National Balancing Council Practical Standards, Forms and Procedures.
- B. Invite owner or owner's representative to witness the balancing procedures or to participate in the testing of a system or zone within the project after submitting final report.
- C. Should questions arise as to the credibility of the final test and balance report or accuracy of the test data, Test and balance contractor shall submit reports to the NBC technical committee for review.

#### 1.6 QUALIFICATIONS

Test and balance contractor shall hold a current NBC certification, and be in good standing with the National Balancing Council and must possess accurate and calibrated test and balance instruments. Contractor to issue test and balance reports of data collected implementing NBC Practical Standards, Procedures and Forms.

#### 1.7 STATE OF THE PROJECT AT COMMENCEMENT OF WORK

Prior to commencement of the test and balance work, the mechanical systems are to be started and fully functioning. A *Checklist Prior to Balancing Report* is to be sent to the installing contractor and returned attesting to the readiness of the systems for balancing.

## **PART 2 PRODUCTS**

### 2.1 INSTRUMENTS AND TOOLS

- A. Test and balance contractor shall possess all the required tools and instruments necessary to achieve a full and effective balance of the mechanical systems according to the project specifications and are to be matched to the procedures and tasks required by the systems tested.
- B. Other than adjustments to the systems, additional work required by other trades may be necessary in order to bring the systems into specified operating condition. Installation or performance of the following items required to achieve balance are to be performed by other subcontractors: balancing dampers, strainers, hydronic balancing valves and test ports, and replacement of adjustable pulleys, belts, pumps, impellers, motors, valves, cleaning the systems, or other alterations.

## **PART 3 EXECUTION**

### 3.1 EXAMINATION

- A. Prior to balancing the mechanical system a reviewed copy of the related mechanical submittal shall be provided to the balancing contractor for use in the balancing project. These documents provide critical engineering data for the successful completion of many practical testing procedures.
- B. The air conditioning, heating and ventilations systems including related electrical, plumbing, sheet metal, and controls systems are 100% complete and operable before the balancing is to begin.
  - 1. Fans and pumps are powered and operating freely, rotating in the proper direction with adequate thermal overload protection per plans and specifications. All electrical, plumbing and other mechanical connections are made and tested for safe operation.
  - 2. Controls are to be fully operable and controls contractor is to be available during the balancing process to interpret and manipulate system software and to provide connections, sensor relocation or required hardware.
  - 3. All manual and automatic volume dampers and valves, including smoke and fire dampers are in full open position, with handles and controls accessible.
  - 4. Duct systems, filters, strainers and coils are to be in new or refurbished condition and be free of construction debris or defects. Duct systems are to be completed including end caps and sealed joints and access doors are to be installed and be accessible able to be tightly sealed.
  - 5. All registers and grilles are to be operable and tightly installed.

6. Hydronic systems are to have been pressure tested, flushed, cleaned, with strainers cleaned or replaced, tanks are to be filled and vented. Impellers are to be trimmed per specifications.
- B. The order to begin balancing is accepted as evidence that the mechanical contractors have reviewed these requirements and acknowledges the systems are completed, in full operation and are operating safely.
- C. Included in the test and balance reports will be comments and test results relating to issues contained in the systems that may prevent the system from delivering optimum balance.

### 3.2 ADJUSTMENT TOLERANCES

- A. Airflow values including fans, registers and grilles, or air terminal boxes are to be adjusted to plus or minus 10% of design flow. If capacities are not obtainable, proportionally balance system and make repair or system modification recommendations. On a hydronic system this step should be completed prior to adjusting hydronic values.
- B. Hydronic values including pump, valve and coil and heat exchanger fluid flows are to be adjusted to plus or minus 10% of design flow.
- C. Since temperature, pressure, fan or pump speed, electrical values and some efficiencies are a result of flows set in the system, any variances of plus or minus 10% of design will be noted on the final reports.
- D. If modifications are minor and do not require a change order, recommendation may be made directly to related subcontractors and the work can proceed immediately. If modifications require a change order recommendations are to be made to the owner or owner's representative.

### 3.3 SYSTEM ADJUSTMENT AND REPORTING

- A. System tested or calculated values are to be entered with accuracy and integrity on the final balancing reports.
- B. Permanently mark and record systems mechanical and control settings once final or proportional balance has been achieved. Mark and fasten mechanical adjustments to assure fixed operation.
- C. Upon completion, assure systems are in proper working order and that all controls have been returned to normal operating conditions or as instructed by owner or owner's representative. Leave systems tidy and ready for continuous operation.

### 3.4 AIR AND WATER SYSTEMS BALANCING PROCEDURE

- A. For hydronic balancing projects use NBC Hydronic Test and Balance Procedures specific to the type and size of system being tested using all applicable NBC testing calculation and reporting procedures including:
  - 1. Hydronic Balancing Preparation Procedure
  - 2. Hydronic Balancing Field Inspection Procedure
  - 3. Initial and Final Pump Test Procedure and Report
  - 4. Hydronic Test and Balance Procedure and Report
  - 5. Balancing Valve Test Procedure and Report
  - 6. Coil Test Procedure and Report
  - 7. Temperature and BTU Measurement Procedures
  - 8. Electrical and RPM Measurement Procedures
  - 9. Hydronic Proportional Balancing Procedure
  - 10. Coil, Cooling Tower and Chiller Reports
  - 11. Other Auxiliary Reports and Procedures as needed
  
- B. For air balancing projects use NBC Air Test and Balance Procedures specific to the type and size of system being tested using all applicable NBC testing calculation and reporting procedures including:
  - 1. Air Test and Balance Procedure
  - 2. Airflow Traverse Procedure
  - 3. Total Static Pressure and Pressure Drop Procedure
  - 4. Temperature and BTU Measurement Procedure
  - 5. Electrical and RPM Measurement Procedure
  - 6. Proportional Balancing Procedure
  - 7. Economizer Settings and Balancing Procedure
  - 8. Exhaust System Balancing Procedure
  - 9. Variable Air Volume Box Balancing Procedure
  - 10. Kitchen Exhaust Balancing Procedure
  - 11. Heat Recovery Ventilator Balancing Procedure
  - 12. HSER™ or CSER™ Installed System Efficiency Rating
  
- C. The work begins by gathering plans, specifications, mechanical submittals, related change orders and as built drawings, if possible.
  
- D. Plans are to be marked, air outlets and inlets, pumps, valves, coils and equipment are to be numbered and design portion of reports prepared prior to arrival at job site.
  
- E. Upon arrival at job site. Follow all initial air or hydronic balancing procedures. Systems are to be walked and inspected and compared to plans and specifications. Systems, equipment and accessories are to be complete and verified operable. Deficiencies are to be noted, if any, and responsible parties are to be notified.

- F. For hydronic systems, inspect systems for completion and compliance according to the Hydronic Inspection Procedure. Inspect pumps, piping, accessories, tanks, heat exchangers, valves locations, equipment locations and accessibility, as well as cleanliness and verify the readiness of the system.
- G. For air systems, inspect systems for completion and compliance according to the Air Inspection Procedure. Inspect air outlet and inlet locations, duct systems, equipment locations and accessibility, as well as damper positions and cleanliness of coils and filters. Drill all required test holes in the system.
- H. Start up equipment to call for full cooling or heating operation, and verify proper fan or pump rotation and air or fluid flow from the manufacturer's fan or pump curve. Verify all control functions.
- I. When system is in full operation and functions have stabilized, test air or fluid flow at appropriate locations.
  - 1. For hydronic systems adjust valves or pump speed to achieve required fluid flow plus or minus 10%, if possible. Follow NBC Hydronic Test and Balance Procedures.
  - 2. For air systems adjust fan speed to achieve required airflow plus 10%, if possible. Follow NBC Air Test and Balance Procedure.
- J. For air systems test, adjust, and verify supply and return air, fresh air, and exhaust air values and record initial readings.
  - 1. Follow NBC Balancing Procedures to obtain a balance of plus or minus 10% of required airflow at each register. Retest and trim dampers to required airflow values.
  - 2. Adjust the system until required airflow is achieved. Avoid excessive noise and velocity.
- K. If required system air or fluid flow cannot be obtained, proportionally balance the system, and record any system deficiencies and make system renovation recommendations.
- L. Mark and record final damper or valve and control settings and record any system deficiencies that exist.
- M. Take and record final system air or fluid pressures. For air systems, include total external static pressure and pressure drops over required components.
- N. Measure and record final temperature readings over system heating and cooling equipment as well as each coil or heat exchanger. For air

systems include the duct system and any fresh air intakes or economizers. Calculate system BTU delivery or removal, if required.

- O. Take and record electrical readings including pump or motor Amp draw and voltage readings.
- P. Measure and record pump and motor speeds. Include pulley and belt sizes as applicable. Record final dimensions and settings.
- Q. If system conditions are subject to constant change due to variable fan or pump speed, VAV terminal boxes, or zoned systems, adjust system operation and measure key system values at minimum and maximum readings as well, if required,

### 3.5 REPORT CONTENT REQUIREMENTS

- A. Test and Balance Reports are to be on NBC forms and are to be an accurate record of the test data collected using corresponding NBC test procedures.
- B. Reports are to include the following minimum information. Additional comments will be required to portray the actual conditions found in the field and are to include a list of recommendations.
- C. A typical test and balance report is to include:
  - 1. Title Page
    - a. Balancing contractor name, address and contact information
    - b. The date the report is issued
    - c. Project name and location
    - d. Project engineer and contact information
    - e. Project Contractors
  - 2. Project Certification
    - a. Certifying Statement
    - b. Name and contact information of balancing contractor
    - c. Certification number
    - d. Certification expiration date
    - e. Certification stamp and authorized signature
  - 3. HVAC System Hydronic Balancing Reports (One or more for each system)
    - a. System identification, location and area served
    - b. Hydronic System Summary
    - c. Pump and motor data summary

- d. Equipment nameplate data
  - e. Test Station Summary – Design and actual
  - f. Valve Sizes and Settings
  - g. Valve Pressure Drops
  - h. Required and actual Flow rates
  - i. Remarks and reference to field forms available
4. HVAC System Air Balancing Reports (One or more for each system)
- a. System identification, location and area served
  - b. Air System Summary
  - c. Fan and motor data summary
  - d. Equipment nameplate data
  - e. Air outlet and inlet values – design and actual
  - f. Outside air CFM
  - g. System temperatures
  - h. Numbered outlets and inlets including location, codes, and grille sizes
  - i. Airflow reading percent of design
  - j. Remarks and reference to field forms available
5. A Marked Corresponding Schematic of Each Zone
- a. Each grille and register marked to correlate with report
  - b. Zone schematic to follow corresponding HVAC system air or hydronic balance report
  - c. Notes and comments may be made on schematic
6. Registers and Grilles Report – air balancing
7. Balancing Flow Station Test Report showing measured flows at each pump balancing valve – hydronic balancing
8. Duct Traverse Forms (Air only)
- a. Round or Rectangular Traverse form
  - b. Completed according to corresponding test procedure
  - c. Identification of system and traverse location
  - d. Required and actual readings
  - e. Traverse point location calculations
  - f. Accurate record of velocity readings
  - g. Airflow calculations
  - h. Remarks and recommendations
9. Pulley Calculation Report (Air only)
- a. Pertinent data extracted from previous reports
  - b. Nameplate data
  - c. Schematic of pulleys and belts
  - d. Fan laws and calculations

- e. Comments and recommendations

10. HSER™ or CSER™ Reports (Optional)

- a. An installed system efficiency rating method
- b. System identification
- c. Current weather conditions
- d. Rated equipment BTU capacity
- e. Fluid flows
- f. Airflow, wet and dry bulb readings
- g. Sensible or Total BTU calculations
- h. HSER or CSER efficiency calculations

11. Other Optional Test Reports Available

- a. These reports must be specified individually
- b. Each report is accompanied by written test procedures
- c. Combustion Efficiency Reports
- d. Total, Sensible and Latent BTU Delivery Reports
- e. Combustion Efficiency Test Reports
- f. Optional Equipment Reports
- g. Various Performance Diagnostic Reports
- h. Air Balancing Reports are also available

12. Test Instrument Report

- a. Test instrument listed by name
- b. Manufacturers and model number
- c. Calibration dates
- d. Description

13. NBC Certification Certificate

- a. Copy of current NBC Certification Certificate
- b. Certification number
- c. Certification expiration date