DIVISION 23

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING (TAB) FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes requirements for provision of testing, adjusting and balancing, including but not limited to the following:

1. Boiler Relief Valve Pressure Tests
2. Motorized Control Dampers and Boiler Room Combustion Air Makeup Units and Exhaust Fans Ventilation System Adjusting, Balancing and Operational Performance Testing
3. Natural Gas Piping Radiographic Tests
4. Natural Gas Piping Pressure Tests
5. Steam, Condensate Return, Feedwater, Blowdown and Cold Makeup Water Piping Hydrostatic Pressure Tests
6. Boiler Emissions Tests
7. Chimney and Breeching Systems Smoke Pressure Tests
10. Vacuum Pump Condensate Return System Tests
11. Reporting results of activities and procedures specified in this Section.
12. Heating control panels and sensors tests
13. Test Schedule and Procedures Plan: Submit time schedule and copy of the step-by-step testing procedures for each system. Isolating valves and flanges, vent fittings and pressure gauges utilized during the testing shall be indicated on the submitted appropriate shop drawings.

B. Related Sections:

1. Section 01 51 23 - Temporary Heating
2. Section 23 05 00 – Common Work Results For HVAC
3. Section 23 05 13 - Common Motor Requirements For HVAC Equipment
4. Section 23 05 23 - General Duty Valves For HVAC Piping
5. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
6. Section 23 05 53 - Identification for HVAC Piping and Equipment
7. Section 23 05 93 - Testing, Adjusting and Balancing for HVAC
8. Section 23 07 00 - HVAC Insulation
9. Section 23 09 13 - Instrumentation and Control for HVAC
10. Section 23 09 14 - Natural Gas and CO Gas Leak Detection Equipment
11. Section 23 09 23 - Control Dampers
12. Section 23 09 24 - Steam Flow Meters
13. Section 23 22 13 - Steam and Condensate Heating Piping
14. Section 23 25 19 - Water Treatment for Steam System Feedwater
15. Section 23 31 13 - Metal Ducts
16. Section 23 33 00 - Air Duct Accessories
17. Section 23 34 16 - Boiler Room Combustion Air Makeup And Ventilation System
18. Section 23 51 00 - Chimney Liner

19. Section 23 51 16 - Prefabricated Breechings and Accessories
20. Section 23 51 23 - Gas Vents
21. Section 23 52 39 - Firetube Boilers
22. Section 23 53 12 - Vacuum Condensate Pumps
23. Section 23 53 13 - Boiler Feedwater Pumps

1.02 SUBMITTALS

A. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 7 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

B. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

C. Warranties specified in this Section.

1.03 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm as specified.

B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard forms from ASME, GAS UTILITY, AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." TAB firm's forms approved by NYCHA Engineer.

D. Regulatory Requirements

1. Perform testing of factory fabricated equipment in accordance with all the City agencies having jurisdiction.

2. Perform field-testing of piping systems in accordance with all the City agencies having jurisdiction and as specified.

E. NYCHA Standard For Steam Quality And Fuel-To-Steam Efficiency Testing:

1. The testing shall be performed by an independent consultant retained by the Contractor explicitly for this purpose.

2. The purpose of these field tests is to ascertain the steam quality, fuel-to-steam efficiency, and gross output of the low pressure Scotch Marine boilers.

3. The testing computation of steam quality shall be in accordance with ASME performance Test Code PTC 19.11, American Boiler Manufacturers Association (ABMA), and the steam calorimeter manufacturer's instructions.

4. The testing and computation of the fuel-to-steam efficiency shall be in accordance to ASME PTC 4.1 and The Hydronics Institute (IBR).

1.04 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, boiler controls installers, and other mechanics to operate boilers and equipment to support and assist TAB activities.

1.05 SEQUENCING AND SCHEDULING

A. Transmit written notification of proposed date and time of all tests to the Authority at least 5 days in advance of such tests.

B. Perform Cleaning and Testing Work in the presence of the Authority.

C. Pressure test piping systems inside buildings, at the roughing-in stage of installation, before piping is enclosed by construction work and at other times as directed. Perform test operations in sections as required and directed, to progress the Work in a satisfactory manner and not delay the general construction of the building. Valve or cap-off sections of piping to be tested. Contractor can utilize valves required to be installed in the permanent piping systems, or temporary valves or caps as required to perform the Work. The contractor is responsible to provide all isolation valves/flanges required in order to perform the pressure testing. Testing valves/flanges shall be indicated on the submitted shop drawings. Contractor shall also provide all vents required to vent the air out of the piping prior to performing a hydrostatic test. Fittings for pressure gauges shall be located at the top of the risers. Vent fittings and pressure gauge fittings shall be shown on the submitted shop drawings.

1.06 WARRANTY

A. Provide a guarantee on steam quality and performance tests.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Certified Test Equipment and Instruments: Type and kind shall be as required for the particular system under test. All gauges, instruments and test devices shall be provided with a certificate of calibration and calibration curve or letter indicating that a minimum of five (5) test points have been calibrated. The certificate and letter must show date of last calibration. The calibration date must be within a year of the testing date.

B. Test Media: Provide as specified for the particular piping or system under test.

C. Equipment List For Steam Quality Test:

1. Calibrated hot water meter. The calibration certificates shall be presented to NYCHA's representatives before starting tests.

2. Calibrated temperature gauges or digital thermometers for reading:

   a. the feed water temperature,
   b. flue gas temperature,
   c. the throttling calorimeter temperature,
   d. combustion air temperature,
   e. steam temperature at the boiler nozzle.

3. Calibrated pressure gauges for reading:

   a. the boiler pressure,
   b. feed water pressure,
   c. over fire flue gas pressure,
   d. exhaust gas outlet pressure.

4. Calibrated combustion analyzer to determine the volumetric analysis of exhaust flue gases.

5. Calibrated digital laboratory grade scale to measure the weight of the water collected from the separating calorimeter.

6. Separating and throttling calorimeters for measuring the steam quality. The calorimeter must be connected in tandem and the test port must be located at least seven pipe diameters from the boiler nozzle in the vertical steam lead pipe. The calorimeters must be provided by the independent consultant.

7. The separating calorimeter shall be designed to separate and collect moisture contained in the steam for weighing on a laboratory grade scale.

8. The throttling calorimeter shall be designed to evaporate moisture using superheated steam at atmospheric pressure. The amount of moisture evaporated shall be a function of the quantity of superheat used. The throttling calorimeter shall consist of a 1/8" throttling orifice plate admitting steam into an expansion chamber and a thermometer inserted into the chamber to accurately measure the temperature of the steam. The orifice plate shall be sized appropriately to insure atmospheric pressure in the expansion chamber.

9. Both calorimeters including associated piping and valves shall be insulated so the heat losses due to radiation are negligible.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine the Contract Documents to become familiar with work requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

E. Examine system and equipment test reports.

F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

G. Examine strainers for clean screens and proper perforations.

H. Examine system pumps to ensure absence of entrained air in the suction piping.

I. Examine equipment for installation and for properly operating safety interlocks and controls.

J. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.02 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Steam systems are filled, clean, and free of air.

C. The Contractor shall provide gas, energy, water, air, light and electrical instruments as required for all testing, including testing associated with Special Inspections (unless otherwise noted).

D. Although the Authority will select Special Inspection Firms and pay for all Special Inspection services, the Contractor shall furnish labor, material, and instruments necessary to conduct all acceptance tests at no additional cost to the Authority including testing associated with Special Inspections. Contractor shall provide access for Special Inspections and testing laboratory services.

3.03 REQUIREMENTS AND PROCEDURES FOR TESTING AND BALANCING

A. Natural Gas Piping Pressure Tests:

1. Testing of natural gas piping shall be as required by the Gas Utility and approved by the Authority's Inspector. Testing shall conform to the NYC Building Code.

2. Piping with a maximum operating pressure up to and including 1/2 psig (14" WG) shall be tested with air or inert gas for a minimum of 4 hours at 50 psig.

3. Piping with a maximum operating pressure above 1/2 psi (14" WG) up to and including 3 psig shall be tested with air or inert gas at 50 psig for a minimum of 8 hours.

4. Piping with a maximum operating pressure above 3 psig shall be tested as follows:

   i) For piping with a maximum operating pressure over 3 psig up to 15 psig, the completed line is to be tested at 100 psig for a minimum of 4 hours**.**

   ii) For piping with a maximum operating pressure above 15 psig, the completed line is to be tested to twice the maximum allowable operating pressure, but not less than 100 psig, for a minimum of 4 hours.

   iii) Fresh water shall be used as the test medium only when the required test pressure exceeds 100 psig.

5. Testing of gas piping shall be as required by the Gas Utility and approved by the Authority's Inspector. Testing shall conform to the Building Code.

6. As applicable, piping with a maximum operating pressure up to and including 1/2 psig (14" WG) shall be tested with air or inert gas for a minimum of 4 hours at 50 psig.

7. For pneumatic testing, the piping shall be filled with air or inert gas, and the source of pressure shall be isolated before the pressure readings are taken. All test periods shall be measured after stabilization of testing medium.

8. Buried, Coated or Concealed Piping:

   i) All buried, coated or concealed piping must be installed and tested as per the utility company requirements, including inspection prior to backfilling or closing in the piping.

ii) Notwithstanding the foregoing, all coated or wrapped pipe shall be pressure tested at a minimum of 95 psig for the following times:

Less than 2" diameter - 1 hour
2"- 12" diameter - 4 hours

9. If leaks are indicated by the pressure test, they shall be identified using a method suitable to the Authority. After repair, the pressure test shall be repeated as described above.

10. The Contractor shall submit a report of the gas piping pressure tests to the Authority's Construction Project Manager.

B. Natural Gas Piping Radiographic Tests of Welded Joints:

1. Radiographic test shall be performed on all butt welds in gas meter and gas distribution piping operating at pressures exceeding 3 psig, within buildings, in accordance with API 1104 or ASME Section IX Boiler and Pressure Vessel Code. A report of the radiographic tests shall be submitted to the Authority's Construction Project Manager.

C. Combustion Gas Emissions Tests:

1. The Contractor shall conduct the tests required by the Department of Environmental Conservation to obtain a Certificate of Operation. The contractor shall prepare the necessary test reports and obtain approvals. The Certificate of Operation shall be submitted to the Authority's Construction Project Manager.

D. Steam, Condensate Return, Feedwater, Blowdown and Cold Water Makeup Piping Hydrostatic Pressure Tests:

1. Perform pressure tests as specified below, only for “new” piping systems. Prior to performance of pressure tests, existing piping and existing equipment shall be isolated from subjection to test pressure by means of full-closure of new isolation valves provided at each junction of new and existing piping systems. No work shall be covered or concealed before it is tested. Piping may be concealed after the hydrostatic test and an inspection of the position, pitch and allowance for expansion has been made.

2. Hydrostatic Tests: Per Section MC 1208.1 of the 2014 NYC Mechanical Code, low pressure steam piping, condensate return, feedwater, blowdown and cold makeup water systems, shall be tested at one-and-one-half times the system design operating pressure, but not less than 100 pounds per square inch hydrostatic pressure maintained for at least 2 hours during the progress of installation. All leaks shall be properly eliminated. Caulking of leaky joints is not permitted. For testing purposes, end of piping to be tested shall be plugged or capped. Convectors, thermostatic vacuum traps, float-thermostatic traps, pneumatic valves and other equipment or apparatus which may be damaged by this hydrostatic test shall be excluded from the test. For press fittings, if applicable, pressurize system up to 50 psi maximum using potable water. Allow system pressure to stabilize for a minimum of 2 hours. If system pressure has

dropped, add more water to bring entire system up to 50 psi maximum. If system increases above 50 psi, bleed off excessive pressure to ensure system is at a maximum pressure of 50 psi. If the system pressure continues to drop, inspect all joints for un-pressed fittings. Press fittings, if applicable, will leak in an un-pressed condition. Check all pressure joints for leaking water. Once the system has been confirmed to be leak free, water pressure can be increased to one and one half times the system design operating pressure, but not less than 100 pounds per square inch hydrostatic pressure and maintained for at least 2 hours. All leaks shall be properly eliminated.

E. Field Testing Of Boilers, Apparatus And Appurtenances (Reference: NYC BC 1704.25, NYC MC 1011)

1. Low pressure steam boilers shall be factory hydrostatic pressure tested, fire tested and steam quality tested as specified under Section 23 52 39, and in accordance with the ASME Boiler and Pressure Code. Per Section NYCMC Section 1011.1, upon completion of the assembly and installation of boilers and pressure vessels, acceptance tests shall be conducted in accordance with the requirements of the ASME Boiler and Pressure Vessel Code. Boilers shall not be placed in operation upon completion of construction until they have been inspected and tested and a Certificate of Compliance has been issued by the Commissioner. All final inspections and tests for boilers shall be made by a qualified boiler inspector in the employ of the NYC Building Department or a duly authorized insurance company as provided in Section 204 of the Labor Law of the State of New York. Where field assembly of boilers may be required, if applicable, a copy of the completed low pressure H-2 Data Report required by the ASME Boiler and Pressure Vessel Code, shall be submitted to the NYC Building Department.

3. Relief Valves: Increase pressure in equipment or apparatus to relief valve setting to test opening of valves at required relief pressures.

4. Vacuum Pump: During testing, the vacuum pumps shall be tested as follows:

    1. With the pumps operating, and with steam on the entire system, the pumps shall each maintain a vacuum of at least 5-½ inches-of-mercury (in.-Hg), as indicated by gauge on receiving tank at pumps.

5. Motorized Control Dampers and Boiler Room Combustion Air Makeup Units and Exhaust Fans Ventilation System: The combustion air intake dampers, makeup air units and boiler room exhaust fans and associated items and accessories as specified, shall be tested and adjusted during the balancing of systems work, to confirm the correct operation of the boiler room combustion air makeup and ventilation system in strict conformance with their specified control sequences of operation, as specified under Sections 23 09 13, 23 34 16 and 23 52 39. The Boiler Room combustion and Ventilation Air (MU) makeup air units and associated (EF) exhaust fans shall be final air-flow adjusted and balanced to deliver their design air-flow rate CFM's, balanced to within +/- 10% of their design capacity requirements, as scheduled and shown on the Contract Documents.

6. Test gauges. An indicating test gauge shall be connected directly to the boiler or pressure vessel where it is visible to the operator throughout the duration of the test. The pressure gauge scale shall be graduated over a range of not less than one and one-half times and not greater than four times the maximum test pressure. All gauges utilized for testing shall be calibrated and certified by the test operator. Reference Section MC 1011.2.

7. Upon completion of tests and after reopening all test isolation valves, purge all vents at high points of systems and where applicable, check automatic vents and determine if they are operating properly, and check all steam condensate traps for the proper setting and operation.

L. Chimney And Breeching Pressure Smoke Test: (Reference NYC MC 810, MC 811.1.5, NYC BC 1704.25 And 1704.26):

1. After the completion of a new chimney, or of the stainless steel liner in the existing chimney and associated breeching system, to determine the tightness of both constructions, a Smoke Test shall be made in accordance with the Sections NYC BC 1704.25 and NYC BC 1704.26 of the 2014 NYC Building Code. The Authority shall witness all Smoke Tests. Independent Special Inspector retained by the Authority shall additionally witness the Smoke Test. Isolate the boilers or domestic hot water heaters, during the test. No work shall be covered or concealed before testing.

2. As per Section NYC MC 810.1 and Section NYC MC 811.1.5, all new chimneys shall be test run under operating conditions to demonstrate fire safety and the complete exhausting of smoke and the products of combustion to the outer air. The test run shall be witnessed by a registered design professional overseeing the test (i.e. Special Inspector), and the results of such test run shall be certified as correct by such professional and submitted in writing to the NYC Building Department.

3. As per Sections NYC MC 810 and NYC MC 811, a smoke test shall be made as outlined below in Section NYC MC 810.3. Any faults or leaks found shall be corrected by the Contractor. Such smoke test shall be witnessed by a representative of the Commissioner. In lieu thereof, the Commissioner may accept the test report of a registered design professional responsible for the test (Special Inspector) which shall be submitted in writing to the NYC Building Department.

4. As per Section NYC MC 810.3 and NYC MC 811.1.5, to determine the tightness of chimney construction, a smoke test shall be made in accordance with the following conditions and requirements:

   a. The equipment, materials, power and labor necessary for such test shall be furnished by, and at the expense of the Contractor who is the holder of the work permit. The Authority will select HVAC Special Inspection Firm and pay for all Special Inspection services.

b. If the test shows any evidence of leakage or other defects, such defects shall be corrected by the Contractor and the test shall be repeated until the results are satisfactory.

c. The Contractor shall fill the breeching/chimney with a thick penetrating smoke produced by one or more smoke machines, or smoke bombs, or other equivalent method. As the smoke appears at the stack opening termination above the roof, such opening shall be tightly closed and a pressure equivalent to ½-inch WG column of water measured at the base of the stack, shall be applied. The test shall be applied for a length of time sufficient to permit the inspection of the chimney and breeching system.

M. Final Operating Tests:

1. Before final acceptance, the contractor shall conduct an operating test of the entire boiler plant including the fuel changeover system to demonstrate that all components of the boilers and their associated equipment are operating properly. The tests shall be conducted in the presence of the Authority's Inspector. Should any component of the plant fail the test, the contractor shall make corrections and repeat the test until the Authority is satisfied that the plant is operating properly. The contractor shall submit a report of the operating test to the Authority's Construction Project Manager.

N. Heating Plant Control Panels and Sensors Tests:

1. The boiler plant control panels and control instrumentation shall be field tested to demonstrate operation in conformance with both the manufacturers' published specifications and operating instructions, and operation in conformance with the specified requirements of the Contract Documents, including all of the specified interfaces with the NYCHA CHAS system and interfaces/junctions with the future BMS system that is to be provided as specified under a separate Contract by Others. Upon completion of the heating plant systems installation, the TAB Contractor shall submit a complete Test Report verifying, attesting to and signing-off on the satisfactory operation of each heating plant control panel and control instrumentation system in strict accordance with the specified requirements of the Contract Documents.

O. Upon completion of the installation, the Contractor shall give 24 hours advanced notice to the Authority's Inspector for performing the test of the new system. The Contractor shall provide all labor and materials for performing the test.

P. Testing of a building or a group of buildings shall be coordinated with NYCHA inspector.

Q. The following results must be achieved to consider the system to be working:

1. Test the features mentioned in the zone valve local controller description.

2. Zone valve opening and closing and % valve opening.

3. All the components of the system, sensors, zone valve and CHAS system shall be tested as a whole system.

R. The Contractor at no additional cost to the Authority shall immediately repair any and all components installed under this contract.

S. The Contractor shall submit a report to the Authority's Inspector indicating location of any defects in installed equipment, existing controls, and all installed and existing valves including piping and fittings.

END OF SECTION

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