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 220500 - Basic Plumbing Materials and Methods, and other Sections in Division 22 specified herein.

1.2 WORK RELATED IN OTHER SECTIONS

A. Section 220500: Basic Plumbing Materials and Methods

B. Section 221000: Plumbing Piping, Valves and Specialties

C. Section 230593: Testing, Adjusting and Balancing (HVAC)

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

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. Domestic hot water recirculation system and branch water flows.
2. Domestic hot water mixing valves.
3. Pressure regulating valves serving domestic systems.
4. Instruction of Owner's personnel for future balancing of systems.

C. Auto flow devices to be utilized to balance system.

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. Local Nonresidential Energy Code.

1.5 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 and water system with its associated equipment and operation cycles for heating and cooling.
   3. The agenda shall include a list of all domestic hot water flows to be performed at all mechanical equipment.
   4. The agenda shall include identification and types of measurement instruments to be used, and their most recent calibration date.

1.6 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 related mechanical systems which may affect the operation of the system to be tested shall be at their normal operating conditions.

PART 2 - PRODUCTS

2.1 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.

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 and water 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.
2. All labor, instruments, and appliances required shall be furnished by the Contractor.

3.2 WATER SYSTEM PROCEDURES

A. Preparation:
1. Open all valves to full open position.
2. Check pump rotation.
3. Check expansion tank(s) to determine they are not air bound and the system is completely full of water.
4. Check all air vents at high points of water systems and determine that all are installed and operating freely.
5. Operate each variable frequency drive (VFD) and verify controls installation is complete.
6. Check that hot water heaters and heat exchangers are fully operational.
7. Check that pressure regulating valves are operational over full range.

B. Metering: Water quantities and pressures shall be measured with calibrated meters.
1. Venturi tubes, orifices, or other metering fittings and pressure gauges shall be used to measure water flow rates and balance systems.
2. Systems shall be adjusted to provide the approved pressure drops through the heat transfer equipment (coils except room units, converters, etc.) prior to the capacity testing.

C. Distribution: Adjustment of distribution shall be effected by means of balancing valves and automatic flow control valves as provided. Manual service valves shall not be used for balancing.
1. Where automatic flow control valves are utilized in lieu of manual balancing valves, only pressure differential need be recorded, provided that the pressure is at least the minimum applicable to the tag rating.

D. Water System Test and Balance Procedure: Perform the following tests, and balance each system in accordance with the following requirements:
1. Set domestic recirculating pumps and associated balancing valves to proper gallons per minute delivery.
2. Set pressure booster pumps and associated balancing valves to proper gallons per minute delivery.
3. Adjust recirculation hot water flow at each branch.
4. Coordinate with recirculation pump control system and record timeclock periods and setpoint.
5. Test and record entering and leaving water temperatures through heat exchangers.
6. Test and record entering and leaving water temperatures through central water distribution mixing valves (does not include fixture mounted mixing valves).
7. Test, verify and record operation of domestic water pressure booster systems.
8. Upon completion of flow readings and adjustments at balancing valves, mark all settings and record data.
9. List all mechanical specifications of pumps.
10. Rated and actual running amperage of pump motor.
11. Adjust each pressure regulating valves and document final setpoint.

3.3 TOLERANCES

A. Set domestic hot water flow rates within plus or minus 10 percent of specified flow rates.

END OF SECTION