

## **1 General**

### **1.1 RELATED SECTIONS**

- .1 Section 01 91 13 - General Commissioning Requirements.
- .2 Section 22 11 16 - Domestic Water Piping.
- .3 Section 22 05 15 - Plumbing Specialties and Accessories.
- .4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.
- .5 Section 23 08 16 - Cleaning and Start-up of HVAC Piping Systems.
- .6 Section 23 21 13 - Hydronic Piping.

### **1.2 REFERENCES**

- .1 American Society for Testing and Materials International (ASTM)
  - .1 ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

### **1.3 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS**

- .1 In accordance with Section 23 08 16 - Cleaning and Start-up of HVAC Piping Systems..

### **1.4 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)**

- .1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.
- .2 When systems are operational, perform following tests:
  - .1 Conduct full scale tests at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.
  - .2 Verify performance of hydronic system circulating pumps as specified in relevant technical sections, recording system pressures, temperatures, fluctuations by simulating maximum design conditions and varying.
    - .1 Pump operation.
    - .2 Boiler operation.
    - .3 Pressure bypass open/closed.
    - .4 Control pressure failure.
    - .5 Maximum heating demand.
    - .6 Maximum cooling demand.
    - .7 Boiler failure.
    - .8 Outdoor reset. Re-check heat exchanger output supply temperature at 100% and 50% reset, maximum water temperature.

### **1.5 HYDRONIC SYSTEM CAPACITY TEST**

- .1 Perform hydronic system capacity tests after:
    - .1 TAB has been completed
    - .2 Verification of operating, limit, safety controls.
    - .3 Verification of primary and secondary pump flow rates.
    - .4 Verification of accuracy of temperature and pressure sensors and gauges.
  - .2 Calculate system capacity at test conditions.
  - .3 Using manufacturer's published data and calculated capacity at test conditions, extrapolate system capacity at design conditions.
  - .4 When capacity test is completed, return controls and equipment status to normal operating conditions.
  - .5 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.
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- .6 Heating system capacity test:
  - .1 Perform capacity test when ambient temperature is within 10% of design conditions. Simulate design conditions by:
    - .1 Increasing OA flow rates through heating coils (in this case, monitor heating coil discharge temperatures to ensure that coils are not subjected to freezing conditions) or
    - .2 Reducing space temperature by turning of heating system for sufficient period of time before starting testing.
  - .2 Test procedures:
    - .1 Open fully heat exchanger, heating coil and radiation control valves.
    - .2 With boilers on full firing and hot water heating supply temperature stabilized, record flow rates and supply and return temperatures simultaneously.
    - .3 Conduct flue gas analysis test on boilers at full load and at low fire conditions.

## **1.6 REPORTS**

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Reports, supplemented as specified herein.

## **1.7 TRAINING**

- .1 In accordance with Section 01 91 13 - General Commissioning (Cx) Requirements: Training of O&M Personnel, supplemented as specified herein.

**END OF SECTION**

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