|  |  |
| --- | --- |
| FT: | **23 22 23** |
| **ITEM:** | **HVAC Pumps** |
| **ID:** |  |
| **AREA SERVED:** |  |

Form Filled Out By:

|  |  |  |
| --- | --- | --- |
|  | **Name & Company** | **Date** |
| GC |  |  |
| MC |  |  |
| EC |  |  |
| BC |  |  |
| CC |  |  |
| OR |  |  |
| A/E |  |  |
| CA |  |  |

GC = General Contractor; MC = Mechanical Contractor; EC = Electrical Contractor; BC = Balancing Contractor; CC = Controls Contractor; OR = Owner Representative; A/E = Architect/Engineer; CA = Commissioning Agent

XX = No Initials Required

# TEST PREREQUISITES

The following items have been completed and the equipment is ready for Functional Testing.

Check if OK. Enter note number if deficient.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Item | **GC** | **MC** | **EC** | **BC** | **CC** | **OR** | **A/E** | **CA** |
| Product documentation submitted |  |  |  |  |  |  |  |  |
| Unit startup completed |  |  |  |  |  |  |  |  |
| Start-up report submitted |  |  |  |  |  |  |  |  |
| Test and Balance (TAB) completed |  |  |  |  |  |  |  |  |
| SOO programmed |  |  |  |  |  |  |  |  |
| Prefuctional Checklist completed  |  |  |  |  |  |  |  |  |

# SENSOR CALIBRATION VERIFICATIONS

* Check a representative sample of sensors for calibration and adequate location.
* Test the packaged controls and BAS readings.
* Use the same test instruments as used for the original calibration, if possible.
* Verify that the sensor reading (via the permanent thermostat, gage, packaged control panel or building automation system (BAS)) compared to the test instrument-measured value is within the tolerances specified in the contract requirements. (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_).
	+ “In calibration” means making a reading with a calibrated test instrument within 6 inches of the site sensor.
	+ For items out of calibration or adjustment, fix now if easy, via an offset in the BAS, calibration or replacement of sensor.

| **Sensor &****Location** | **LocationOK1** | **1st Gage / Pkg****& BAS Value** | **Test Inst****Value** | **Final Gage / Pkg****& BAS Value** | **Pass****Y/N?** |
| --- | --- | --- | --- | --- | --- |
|  |  | Pkg:BAS: |  | Pkg:BAS: |  |
|  |  | Pkg:BAS: |  | Pkg:BAS: |  |
|  |  | Pkg:BAS: |  | Pkg:BAS: |  |
|  |  | Pkg:BAS: |  | Pkg:BAS: |  |
|  |  | Pkg:BAS |  | Pkg:BAS |  |

1Sensor location is appropriate and away from causes of erratic operation.

# DEVICE CALIBRATION VERIFICATIONS

* Check a representative sample of actuators and devices for calibration and adequate operation.
	+ “In calibration” means observing readout in the BAS and going to the actuator or controlled device and verifying that the BAS reading is correct.
	+ For items out of calibration or adjustment, fix now if easy, via an offset in the BAS, or a mechanical fix.

| **Device / Actuator &****Location** | **Procedure** | **1st BAS****Value** | **Site****Observation** | **Final BAS****Value** | **Pass****Y/N?** |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |
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# FUNCTIONAL PERFORMANCE VERIFICATIONS

**Demonstrate operation of equipment per Contract Documents including the following:**

A. Record of All Values for Current Setpoints (SP), Control Parameters, Limits, Delays,

 Lockouts, Schedules, Etc. Changed to Accommodate Testing:

| **Parameter** | **Pre-Test Values** | **Returned to Pre-Test Values √** |
| --- | --- | --- |
| Hydronic differential pressure setpoint |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
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|  |  |  |
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 B. The following function / mode testing requirements are in addition to and do not replace any testing requirements elsewhere in the project documents**.**

| **No** | **Function / Mode** | **GC** | **MC** | **EC** | **CC** | **OR** | **A/E** | **CA** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | Test each sequence in the sequence of operations including startup, shutdown, unoccupied & manual modes and power failure.Test functionality of this piece of equipment or system in all control strategies or interlocks that it is associated with. |  |  |  |  |  |  |  |
| 2 | Test the lead/lag staging of pumps.Test VFD operation: modulation to minimum, control system PID, proportional band of speed vs controlling parameter.Verify program settings, alarms, safeties, etc. |  |  |  |  |  |  |  |
| 3 | Verify sensor and actuator calibration on: pressure sensor controlling pump speed and other random checks (EMS readout against hand-held calibrated instrument must be within a tolerance equal to 10 percent of the pressure setpoint, with a test gage) |  |  |  |  |  |  |  |
| 4 | Verify constancy of differential pressure (pump control parameter) |  |  |  |  |  |  |  |
| 5 | Verify schedules and setpoints to be reasonable and appropriate |  |  |  |  |  |  |  |
| 6 | Check for motor overload by taking ampere readings |  |  |  |  |  |  |  |
| 7 | Verify pressure drop across strainer. Verify strainer is clean. Verify pump inlet/outlet pressure reading, compare to test and balance report, pump design conditions, and pump manufacturers performance data. Operate pump(s) at shutoff, 50 percent and 100 percent flow. Plot test readings on pump curve and verify specified flow is obtained. |  |  |  |  |  |  |  |

 C. Record the following: All points listed below which are control system monitored points shall be trended by the controls contractor.

| **Point** | **Time Step****(min.)** | **Minimum****Time Period****of Trend** | **Hard Copy?****(Y/N)** | **CSV File?****(Y/N)** |
| --- | --- | --- | --- | --- |
| For each pump: |  |  |  |
| Pump status | 5 | 5 days incl. weekend | Y | Y |
| Pump speed | 5 | 5 days incl. weekend | Y | Y |
| Pump flow rate | 5 | 5 days incl. weekend | Y | Y |
| Differential pressure | 5 | 5 days incl. weekend | Y | Y |
| Alarms related to pump operations | 5 | 5 days incl. weekend | Y | Y |
| Pump speed controlling parameter value | 5 | 5 days incl. weekend | Y | Y |

Pumping system and controls shall maintain the current desired pressure setpoint to within an amount equal to 10 percent of the setpoint value either side of the deadband without excessive hunting.

| **Sensor & Location** | **Gage reading prior to pump starting** | **BAS Reading** | **Gage reading after pump starting** | **BAS Reading** |
| --- | --- | --- | --- | --- |
|  |   |   |   |   |
|  |  |  |  |  |
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|  |   |   |   |   |
|  |   |   |   |   |

If BAS reading is not within tolerance provide offset in BAS system to match gage readings. If erroneous readings occur, replace sensors.

# OUTSTANDING ITEMS

Note outstanding items in table below. Use numbers referenced above.

|  |  |  |
| --- | --- | --- |
| Resolved(Initial / Date) | **Note** | Description |
|  | **1.** |  |
|  | **2.** |  |
|  | **3.** |  |
|  | **4.** |  |
|  | **5.** |  |
|  | **6.** |  |
|  | **7.** |  |
|  | **8.** |  |
|  | **9.** |  |
|  | **10.** |  |

# FIELD NOTES

Fill in as appropriate.

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| --- |
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|  |

# SIGN OFF

System / Equipment has been installed in accordance with the Contract Documents and is ready for Owner acceptance.

|  |  |  |
| --- | --- | --- |
|  | **Signature** | **Date** |
| **Contractor’s Representative** |  |  |
| **A /E Representative** |  |  |
| **Commissioning Agent** |  |  |
| **Owner’s Representative** |  |  |

## END OF TEST