Belimo Pressure Independent Valve Flow Verification and Commissioning

PIVs are very different from pressure dependent control valves (standard control valves). Pressure variations in the system do not affect flow through the PIV. PIVs do not require additional flow regulating devices (e.g. – circuit setters and automatic flow limiting devices). This makes the Testing and Balancing (TAB)/Commissioning process much different from standard control valves. This document details the flow verification and commissioning procedures for a Pressure Independent Valve (PIV). These procedures are not mandatory to ensure proper operation of PIV.

When using PIV, Electronic Pressure Independent Valve (EPIV), or Energy Valve (EV), flow verification can be performed using the valve's built-in flow sensor and a hand-held tool (ZTH US) that connects to the valve. However, if independent verification is required, the use of 3 P/T ports is recommended.

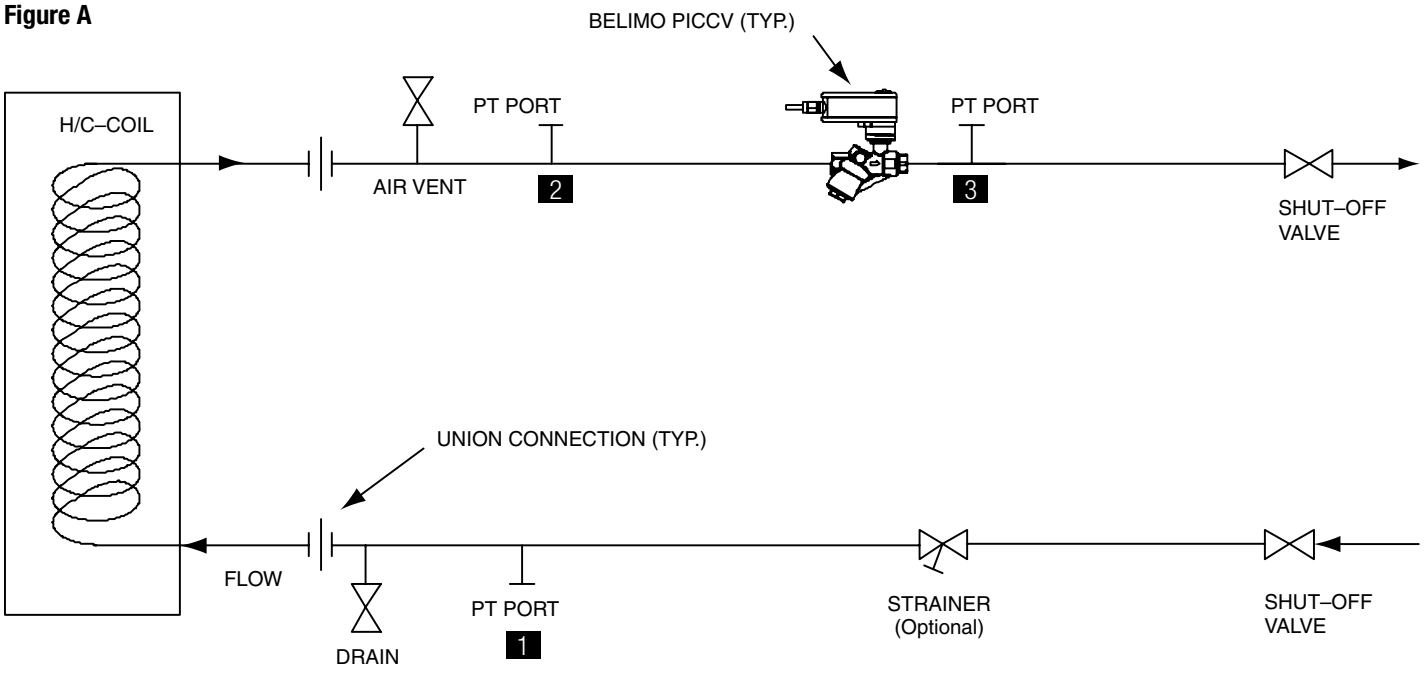
NOTE: When using mechanical PIVs, Pressure Independent Characterized Control Valves (PICCV), it is essential that the mechanical contractor install three (3) independent pressure/ temperature ports (P/T ports) if the PICCV is not supplied with integrated ports. For P/T port locations, refer to Figure A in this document.

External P/T ports allow for independent verification of proper PIV operation and these ports allow for future comprehensive troubleshooting and diagnosis.

For proper and accurate flow verification of mechanical PIV, it is essential that the mechanical contractor install P/T ports as shown in Figure A. Some PIVs may be ordered with integrated P/T ports.

- P/T port #1 and P/T port #2 are used to measure the pressure and temperature drop across the cooling or heating coil. This information in combination with the coil flow curves can be used to calculate flow and delta T.
- P/T port #2 and P/T port #3 are used to measure pressure drop across the PIV. PIVs must have 5 – 50 psid (11.5 ft – 115 ft H_2O) (or per manufacturer's specification) pressure drop across the valve only. PIVs must be commanded to design flow position via analog or BMS (Building Management System) signal. Do not manually open the valve with the override handle to check for design flow or pressure. The required operating pressure drop range is necessary to ensure pressure independent operation of the PIV.

Figure A



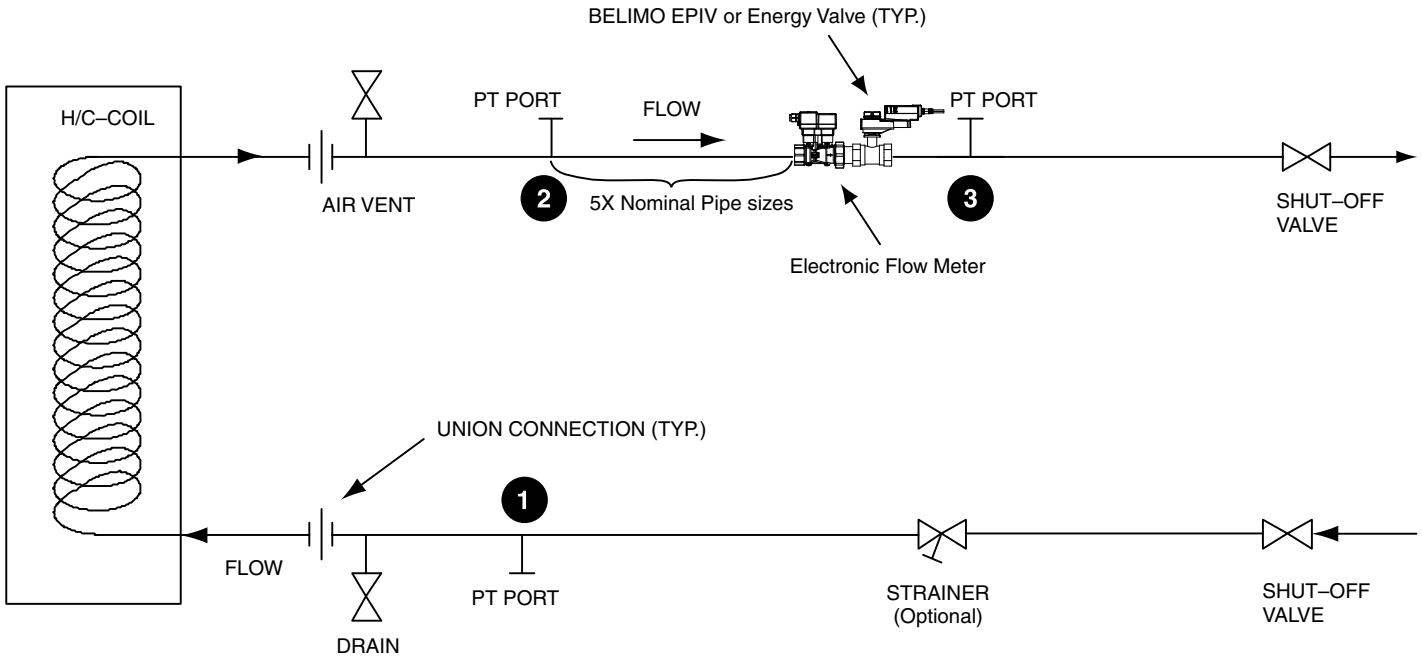
Mechanical PIV Pre-Flow Verification Checklist

- Verify that system is purged of air and filled to proper pressure.
- Verify that each PIV has the manufacturer's required operating pressure drop range across P/T ports 2 and 3 (Figure A).
- Verify proper pump operation per manufacturer's specifications.
- Verify proper supply water temperature is available and is at design temperature.
- Proper air filter maintenance has been completed.
- Fan belts are in proper working order.
- Heat transfer devices (coils) are clean.
- Strainers are clean.
- All manual shutoff valves are open.
- All bypass valves are closed.
- No automatic or manual balancing valves exist. If they do exist, they must be set fully open and locked not interfere with the pressure independency function of the PIV.

Electronic PIV Pre-Flow Verification Checklist

- Verify that system is purged of air and filled to proper pressure.
- Verify that each electronic PIV is set to pressure independent/ flow control mode.
- If the PIV is an Energy Valve, the Delta T Manager™ must be disabled during the flow verification and commissioning procedure.
- Verify that each PIV has the manufacturer's required operating pressure drop range across P/T ports 2 and 3 (Figure B).
- Verify proper pump operation per manufacturer's specifications.
- Verify proper supply water temperature is available and is at design temperature.
- Proper air filter maintenance has been completed.
- Fan belts are in proper working order.
- Heat transfer devices (coils) are clean.
- Strainers are clean.
- All manual shutoff valves are open.
- All bypass valves are closed.
- A flow verification tool is available (ZTH US).
- No automatic or manual balancing valves exist. If they do exist, they must be set fully open and locked to not interfere with the pressure independency function of the PIV.

Figure B



Procedure #1 (System Verification) – Total System Flow Method

Verification for PIV Cooling/Heating

1. Verify that the system is in proper working order. Depending on the valves used, check the items listed for PIV Pre-Flow Verification Checklists.
2. If diversity factor = 100%, command open all PIV via the BMS system. Systems with less than 100% diversity need to have a percentage of valves closed to match design diversity.
3. Ensure that pumps are either manually commanded to sufficient speed to provide proper pressure drop across all valves or if pumps are under DDC pressure control ensure ΔP setpoint is sufficient to provide the above conditions.
4. Verify total system flow in main return line is at system design flow rate using one of the following methods:
   - Orifice
   - Venturi
   - Electronic flow meter
   - System-level Flow Device
5. Decrease the pump speed (or decrease ΔP setpoint if under control) until a measureable flow decrease occurs.
6. Increase pump speed (or increase ΔP setpoint if under control) slowly until design flow is reestablished. Make note of the resulting ΔP. This will be the maximum system ΔP operating setpoint.

NOTE: If total flow does not match design flow then troubleshooting must be completed to determine cause. This may involve verifying flows at the terminal level.

Procedure #2 (Terminal Level Verification) – Air Delta T Method

Verification for PIV Heating

1. Verify that the system is in proper working order. Depending on the valves used, check the items listed for PIV Pre-Flow Verification Checklists.
2. Ensure that water is at design temperature.
3. Ensure that terminal airflow is at design airflow rate (cfm).
4. Command open the PIV via analog or BMS control signal to maximum design flow position. Do not manually open the PIV.
5. Reference approved engineering document containing design air temperature drop/rise for design conditions.
6. Measure coil inlet air temperature and coil discharge air temperature.
7. Difference between coil inlet air reading (EAT) and coil discharge air reading (LAT) should equal or exceed design air delta T as shown on the contract documents.

Procedure #3 (Terminal Level Verification) – Water Delta T Method

Verification for PIV Heating

1. Verify that the system is in proper working order. Depending on the valves used, check the items listed for PIV Pre-Flow Verification Checklists.
2. Ensure that water is at design temperature.
3. Ensure that terminal airflow is at design flow rate (cfm).
4. Command open the PIV via analog or BMS control signal to maximum design flow position. Do not manually open the PIV.
5. Reference approved engineering document containing design water temperature drop/rise for design conditions.
6. Measure water temperature differential of coil by using P/T ports #1 and #2 as referenced in Figure A.
7. Measured temperature differential should be equal to designed water temperature differential as shown on the coil manufacturer or engineering documents.

Procedure #4 (Terminal Level Verification) – Coil ΔP (Delta P) Method

Verification for PIV Cooling/Heating

1. Verify that the system is in proper working order. Depending on the valves used, check the items listed for PIV Pre-Flow Verification Checklists.
2. Command open the PIV via analog or BMS control signal to maximum design flow position. Do not manually open the PIV.
3. Reference approved engineering document containing design coil water pressure drop for design flow conditions (usually expressed in ft. of water). This value will be for the heating/cooling coil associated with corresponding PIV.
4. Measure coil ΔP by using P/T ports #1 and #2 as referenced in Figure A.
5. Formula to calculate flow is:

   $$\text{Actual GPM} = \text{Design GPM} \times \sqrt{(\text{Measured Coil } \Delta P / \text{Design Coil } \Delta P)}$$

NOTE: Coil ΔP and design ΔP expressed in feet of water.

Procedure #5 (Terminal Level Verification) – Electronic Coil Flow (EPIV/EV) Method

Verification for electronic PIV Cooling/Heating

1. Verify that System is in proper working order. Depending on the valves used, check the items listed for Electronic PIV Pre-Flow Verification Checklists.
2. Command open the electronic PIV via analog or BMS control signal to maximum design flow position. Do not manually open the electronic PIV.
3. Reference approved engineering document containing design coil water flow in GPM for the coil.
4. Verify flow by connecting the valve to the handheld tool or computer software.

For additional information pertaining to the flow verification and commissioning, visit these organizations websites that promote the certification and continuing education of industry professionals in the Test and Balance discipline.
NEBB - National Environmental Balancing Bureau, http://www.nebb.org
TABB - Testing Adjusting Balancing Bureau, http://www.tabbcertified.org