PIP PCCPR001
Pressure Measurement Design Criteria
PURPOSE AND USE OF PROCESS INDUSTRY PRACTICES

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# PIP PCCPR001
## Pressure Measurement Design Criteria

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1. **Scope**

This Practice provides requirements criteria for pressure measurement equipment selection and for design of pressure measurement systems.

This Practice describes the design requirements for pressure and differential pressure measurement systems excluding DP level and flow measurements.

2. **References**

Applicable parts of the following Practices, industry codes and standards, and references shall be considered an integral part of this Practice. The edition in effect on the date of contract award shall be used, except as otherwise noted. Short titles are used herein where appropriate.

2.1 **Process Industry Practices (PIP)**

   - PIP PCIDP100 - *Differential Pressure Transmitter Installation Details*
   - PIP PCIPR100 - *Pressure Transmitter Installation Details*

2.2 **Industry Codes and Standards**

   - International Society of Automation (ISA)
     - ISA S20 - *Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves*

3. **Requirements**

3.1 **General**

3.1.1 **Data**

   - 3.1.1.1 A data set shall be provided for each sensor.
   - 3.1.1.2 The data set may be in electronic or hard-copy format.
   - 3.1.1.3 The minimum data set shall be in accordance with *ISA S20* specification forms.

   - 3.1.2 Root (isolation) valves shall be provided for each instrument.

   - 3.1.3 Provision for relieving pressure (vent/drain) between root valve and instrument before removal shall be provided.

   - 3.1.4 Flush-mounted seals may be installed without root (isolation) valves with owner approval.

   - 3.1.5 As a minimum, all pressure devices shall be specified with over-range protection to 1-1/2 times the maximum system operating pressure.

   - 3.1.6 Material selection for pressure device wetted parts shall be stainless steel, unless other materials are required to meet process conditions.
3.1.7 Process tubing between the root (isolation) valve and the pressure device shall be 1/2-inch (12.7 mm), 316 stainless steel tubing, unless other materials or sizes are required to meet process conditions.

3.1.8 Impulse line purging systems, if required, shall be designed and installed such that the purge does not introduce errors to the process measurement. Check valves shall be provided on all purge installations.

Comment: Gas purges should be a maximum of 3 scfh or 0.1 cubic meters per hour. Liquid purges should be a maximum of 3 gallons per hour or 12 liters per hour.

3.1.9 Diaphragm Seals

3.1.9.1 Diaphragm seals shall be considered for prevention of plugging with solids or viscous fluids, freeze protection (thereby eliminating need for winterization), temperature isolation, and additional barrier for corrosive or flammable service, by preventing the process from entering the internal parts of the device.

3.1.9.2 The capillary fill fluid shall be compatible with the process and suitable for the minimum and maximum process operating temperature and pressure as well as ambient temperature.

3.1.9.3 Capillary system shall be designed to minimize errors caused by process and ambient temperature changes for transmitters calibrated for low differential pressure ranges (e.g., boiler drum level).

3.1.9.4 Capillary lengths shall be kept to a minimum standard length for a given installation.

3.1.9.5 Mechanical protection shall be provided for capillaries to prevent physical damage.

3.1.9.6 Flushing connection shall be provided to drain/vent process media from the front of diaphragm seal, allow media to clean/decontaminate the diaphragm seal surface, and facilitate calibration. This requirement does not apply to extended diaphragm installations.

3.1.9.7 Seal connections to process shall follow applicable piping specifications.

3.1.10 All sensors subject to pulsation shall consider pulsation damping devices.

3.1.11 For liquid and heat transfer media services, pressure taps shall be located on the horizontal side of the piping or 45 degrees down from horizontal. The pressure tap sensing lines (impulse lines) shall be sloped down to the instrument (minimum of 1 inch per foot).

3.1.12 For gas and vapor services, pressure taps shall be located on the top of the piping, horizontal, or 45 degrees up from horizontal. The pressure tap sensing lines (impulse lines) shall be sloped up to the instrument (minimum of 1 inch per foot).

3.1.13 For steam media services, pressure taps shall not be located on the bottom of the pipe. The pressure sensing lines (impulse lines) shall be sloped down to the instrument (minimum of 1 inch per foot) if mounted below tap and sloped up to the instrument if mounted above tap with a siphon.
3.1.14 Freeze protection for impulse lines shall be considered.

### 3.2 Pressure Gauges

3.2.1 Pressure gauge movements shall be corrosion resistant.

3.2.2 Dials on process pressure gauges shall be minimum 4-1/2 inches (100 mm) in diameter and shall be white with black numerals unless otherwise approved by owner.

3.2.3 Pressure gauges shall have safety glass or plastic lenses. Lenses shall be compatible with the surrounding environment (temperature limitations and resistance to attack from fluids or vapors).

3.2.4 Pressure gauges shall have solid-front case design with blow-out back and weatherproof, corrosion-resistant cases.

3.2.5 Pressure gauges shall be specified with viscous-liquid-filled cases if applied to reciprocating pump and compressor discharge services and to other services where vibration or pulsations are expected.

3.2.5.1 Fill material shall be compatible with the process.

3.2.5.2 Pulsation dampers should be considered in addition to filled cases.

3.2.6 The process connection for a pressure gauge shall be 1/2 inch MNPT (either bottom or back connected).

3.2.7 Pigtails or siphons shall be specified in steam and other high-temperature condensable vapor services to prevent exceeding the design temperature of the pressure gauge.

3.2.8 Gauges supplied by vendors as part of analyzer sample systems or other devices such as current to pneumatic converters, instrument air supply regulators, valve positioners, piston actuators, and similar devices shall be vendor standard unless otherwise specified.

### 3.3 Pressure Switches

3.3.1 Pressure transmitters are preferred to pressure switches. Pressure switches shall require owner’s approval.

3.3.2 Pressure switches containing electrical contacts shall be in accordance with the specified electrical area classification.

*Comment:* Hermetically sealed contacts are preferred.

3.3.3 Pressure switches shall be selected to operate in a range that allows switch actuation to take place above the midpoint of its range to provide better accuracy.

3.3.4 Pressure switch deadband shall be compatible with the application.

*Comment:* If the process runs close to the switch setting, a large deadband may prevent the switch from resetting after the trip has cleared.

3.3.5 Pressure switches shall not be line mounted in pulsating or vibrating services.

3.3.6 Single Pole Double Throw (SPDT) contact arrangement shall be the minimum configuration.
3.4 Pressure Transmitters

3.4.1 For gas and vapor services, pressure transmitters shall be installed as follows:
   a. Pressure transmitters shall be mounted above and as close to pressure taps as possible while still maintaining accessibility.
   b. Impulse lines shall slope continuously upward from root valve to transmitter (min 1” per foot) such that they are self-draining.

3.4.2 For liquid or condensing services, pressure transmitters shall be installed as follows:
   a. Pressure transmitters shall be mounted below the pressure taps.
   b. Impulse lines shall slope continuously downward from root valve to transmitter (min 1” per foot) such that they are self-venting.
   c. Static head in the impulse line shall be considered in the measurement.

3.4.3 For steam services, pressure transmitters shall be mounted in either of the following ways:
   a. Above the pressure taps with a siphon or pigtail
   b. Below the taps with correction for static head in the impulse line

3.4.4 For process that requires fast response time the data sampling frequency shall be at least twice the inverse of the process response time (e.g., compressor surge control).

3.4.5 A valve manifold shall be considered to isolate a transmitter for maintenance and calibration.

3.5 Differential Pressure

3.5.1 The requirements that apply to pressure measurement shall also apply to differential pressure measurement.

3.5.2 A differential pressure transmitter can be used to measure low gauge pressures by leaving one tap vented to atmosphere.
   3.5.2.1 The vented tap shall be protected from wind velocity changes.
   3.5.2.2 Screens shall be provided on the vented tap for protection from particle and insect intrusion.