



PRESSURE SOLUTIONS

P202: Pressure Gauge Construction & Use

Construction:

To construct a practical pressure gauge, we need a bourdon tube fitted to a process connection.

The bourdon tube must be made from a material that has good spring qualities, while resisting corrosion by common fluids. This means that spring steel is not a good choice because it will rust. The commonest material used for bourdon tubes is phosphor bronze. Stainless steel is widely available, as are some corrosion resistant materials such as beryllium copper and Monel. Process connections or stems or blocks usually match the bourdon tube, except with bronze bourdon tubes we usually use brass stems.

Brass/bronze combinations are usually joined by silver soldering, and occasionally by silver brazing when a higher joint strength is necessary.

Stainless steel and Monel tubes are joined by TIG (GTAW) welding.

Configuration:

Gauges may be direct mounting or remote mounting. Direct mounting gauges are screwed directly to the pressure source. The pressure connection is usually at the bottom of the gauge (radial 6 o'clock) or at the rear of the gauge (centre back for small gauges, lower rear for larger gauges.) Remote mounting gauges are connected to the pressure source by a length of tubing. Such gauges usually require to be mounted to some structure, and thus are usually built with a mounting flange, either at the back for surface mounting, or at the front for flush panel mounting.

Fluid Quality:

The design of the bourdon tube pressure gauge requires a long stem with a limited size of bore. The fluid should not choke this bore, either through solids content, or high viscosity. In these cases, a chemical seal, or diaphragm seal, or diaphragm design, must be used.

Temperature:

The accuracy of a bourdon tube is usually stated at 20°C. The deflection of a given tube under a given pressure is proportional to the Young's modulus of the material. This is not a constant, but is affected by pressure, at a rate which is about 3% per 100K. (1K is equivalent in magnitude to 1°C). This means that a temperature shift of 30K will take the average pressure gauge out of calibration. Temperature can affect the construction of the gauge as well. A soldered joint will fail if enough heat is applied. Rubber seals used in the gauge construction can perish. Glycerine used for damping can decompose into a black mess.

Dead-end pipes have a high dissipation of temperature, thus remotely mounting the gauge will bring the temperature down. When used on condensing vapours, the gauge should ideally be mounted below the tapping point so that the line fills with condensate, or else protected with a loop or siphon tube which keeps the gauge in contact with condensate only. The most common condensing vapour is steam.

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Products for Pressure Professionals

Pressure gauges are usually rated to 60°C. The old guide is that a pressure gauge is too hot if it cannot be held in the hand comfortably.

Corrosion:

The pressure medium to be measured must be compatible with the materials of construction. In practice bourdon tubes are only available in bronze and stainless steel (some Monel but very expensive). Using a chemical seal allows a very much wider choice of materials to be in contact with the pressure medium.

Choosing and Installing a Pressure Gauge:

Keep it cool, keep it clean, keep it free of corrosion.

Chemical Seals:

Chemical Seals form a barrier between the instrument and the pressure medium. The barrier is typically a thin, flexible metal diaphragm, and the space between the diaphragm and the bourdon tube is solidly filled with a suitable liquid, usually silicone oil. Their main uses are to protect against blockage of the instrument's pressure entry, and to protect against corrosion.

Protection against blockage: The pressure medium may contain solids, or it may be highly viscous. For this application, as large a bore as practical should be used. 50mm Table 1 000 flanges, or 2" threaded connections, make a good choice for conventional seals. Extended nose designs, which protrude into the pipe nozzle and place the diaphragm flush with the tank wall, are expensive, but suitable for the worst tank applications where nozzle blockage is likely. In-line or Donut designs may be used for slurry pipe-line applications.

Protection against corrosion: The diaphragm is typically 75µ thick, and must be highly resistant to corrosion by the pressure medium. The process connection, which is much thicker, can tolerate much heavier corrosive attack. There is no universal offering. Even tantalum, which resists so many boiling acids, is attacked by something as ordinary as caustic soda. If you are unsure of what to use, tell us your conditions, i.e. temperature, concentration, degree of aeration, and we will check for a match against our extensive database