

Mechanical Pressure Gauges Installed in Harsh Environments

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Despite the growing use of electronic solutions, mechanical pressure gauges are still present on the market for safe local display of the process pressure without need of external power. The selection and specification of the optimum measuring instrument is difficult for designers and users, in particular if extreme conditions of use are concerned.

Although the use of transmitters in pressure measurement is growing, mechanical pressure gauges are still used on most systems as local pressure display to back up electrical readings. The selection and installation of these gauges can be difficult in certain locations. Harsh conditions that can require special consideration include vibration, pressure pulsation, overpressure, corrosive media and extreme process and ambient temperatures. This article is designed to address harsh conditions with best practice recommendations to extend gauge life and provide for the safest installation possible.

Vibration

Severe vibration can exist in many processes. Vibration can cause pointer flutter, which reduces readability and instrument accuracy. Vibration can cause the breakdown of the internal parts of the gauge, ultimately causing gauge failure.

The best practice for preventing failure due to vibration is filling the gauge with liquid to dampen the effect of vibration on its internal parts. Typical gauge fill is glycerin or silicone; other fills are also available depending on the constraints of the application.

Many manufacturers also offer gauges with dry cases and dampened movement. This option incases viscous grease on the movement of the gauge, which calms the visible pointer flutter, but still allows for stresses on the internal parts. This option will allow for better readability in vibration, but will not extend the gauge's life.

The last option is to remotely mount the gauge via a



Figure 1. Liquid filled mechanical pressure gauge

capillary line, which removes the instrument from the source of vibration entirely.

Pressure Pulsation

Pressure pulsations of dynamic load cycles are quick and repeated rise and fall of pressure, which are extremely common in applications that involve pumps. As the pressure rapidly rises and falls, the elastic element inside that gauge is exercised and eventually fatigued. Wear and premature failure of pressure gauges can result. Several solutions to pressure pulsation in a process exist. The first is to configure the gauge with a restrictor. The orifice size at the socket is shrunk, which slows the speed of pulsation to the gauge. Another solution is to attach a snubber to the gauge, which will further dampen or slow pressure

pulsation. Liquid filling also serves to dampen the pulsation's effect on the gauge's internal parts.

Over Pressure

In some systems, short time pressure spikes, or over pressures, are possible when pressure is much higher than the normal working standard. A common example is a pipeline that is used for different processes that involve various chemicals or gases. Before changing the media, the pipeline is typically cleaned at a pressure much higher than its standard working pressure—causing a temporary over pressure of the gauges in-line. Several options are available to protect gauges susceptible to over pressure conditions.

- Certain diaphragm seal pressure gauges can be built with a membrane capable of tolerating over pressure. Pressure gauges with bourdon tube elements can be manufactured with over pressure protectors or barriers that stop the tube from straightening during over pressure.
- Gauges can be installed into a process with over pressure protectors to guard from damage. Over pressure protectors are valves that can be set to pressure points; when the pressure exceeds the set point, the valve shuts off and protects the gauge.
- Gauges can be installed with shut-off valves. These valves are closed manually when a process is going to see a planned over pressure.

Temperature

Both process media temperature and ambient temperature are critical factors when selecting a pressure gauge. Media temperatures above 140 deg F require a gauge with stainless steel internal parts. Applications with media temperature exceeding 212 deg F require accessories to cool the media or isolate the gauge from these high temperatures. Possibilities include cooling towers, diaphragm seals, capillary line or siphons for gauges exposed to steam service. Ambient temperatures are also critical to pressure gauges. Instruments installed in locations with ambient temperatures



Figure 2. Pressure gauge with cooling



Figure 3. Pressure gauge with overprotector



Figure 4. Pressure gauge with siphon

below 32 deg F should be liquid filled with a glycerin mix or silicone. This prevents icing of the moving internal parts. Pressure gauges should not be applied in environments with ambient temperatures outside of -40 deg F to 140 deg F.

Corrosive Media

Another key factor to consider in gauge selection is the process media to which the gauge will be exposed. If the process media is corrosive, the gauge should be manufactured from a corrosion resistant material or be accessorized with a diaphragm seal that will isolate the gauge's internal parts from the corrosive media. Pressure gauges are available in several corrosion resistant metals including 316SS and Monel; diaphragm elements can be supplied with hastelloy, tantalum and other resistant materials. It is also critical to account for possible corrosive atmospheres that could attack the outside of the pressure gauge. Pressure gauges in these environments can be supplied with a stainless steel case and various corrosion resistant coatings.



Figure 5. Close-up of restrictor

Conclusion

All process and ambient factors should be considered when specifying and installing mechanical pressure gauges. When specifying pressure instrumentation it is advisable to involve the supplier/manufacturer for specific solutions regarding specific processes. A properly specified pressure gauge should provide long life even in harsh process conditions.

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