Guidelines for Mounting Pressure Transmitters and Switches When Process Temperature Exceeds Published Limits

Extend Pressure Measurement into High Temperature Applications

SICK
Sensor Intelligence.

Introduction

Measurement of pressure plays a central role in many areas of a plant, in the manufacturing industry, in machine tooling, in process engineering, and in the manufacture and processing of food and beverages. Pressure measurement in industrial applications typically occurs with the help of pressure transmitters and switches. Pressure transmitters deliver a continuous current or voltage signal proportional to the pressure applied. Pressure switches are used to monitor pressure. Electronic pressure switches are characterized by their digital switching outputs, which are activated or deactivated when the defined, programmable threshold levels have been reached.

Monitoring, measuring, and controlling pressure can be tricky if the process temperature exceeds the limits of the pressure instrumentation, such as pressure transmitters and switches. It is possible to obtain an accurate pressure measurement using standard pressure transmitters in these high temperature applications. The trick is to ensure that the process is cooled before reaching the pressure measuring device.

There are generally two different methods used to protect the pressure transmitter and/or the pressure switch from high temperatures. These two proven methods are done through the use of cooling elements and standoff piping. Provided below are guidelines on how to protect the pressure devices from extreme temperatures using cooling elements and standoff piping.

Cooling Elements

A cooling element is an accessory that puts some distance between the transmitter and the heat of the process. There are often times “fins” that allow for air circulation for better heat dissipation. Cooling elements are designed to cool the process to a temperature that is within the specifications of the pressure transmitter.

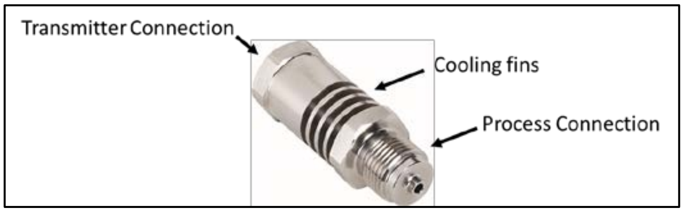

Figure 1: Cooling element.

Figure 2: Cooling element attached to PBS Pressure Transmitter, Switch, and Display.

Cooling elements are a great way to protect the transmitter from high temperature processes. Cooling elements act as a heat sink, which cools the process before it reaches the transmitter.

Cooling elements can extend the maximum process temperature of pressure transmitters from 185 °F (85 °C) up to 392 °F (200 °C).

Cooling elements from SICK provide heat protection as shown in the tables below. For the PBS electronic pressure switch, pressure transmitter and display; cooling elements can protect within the following guidelines:

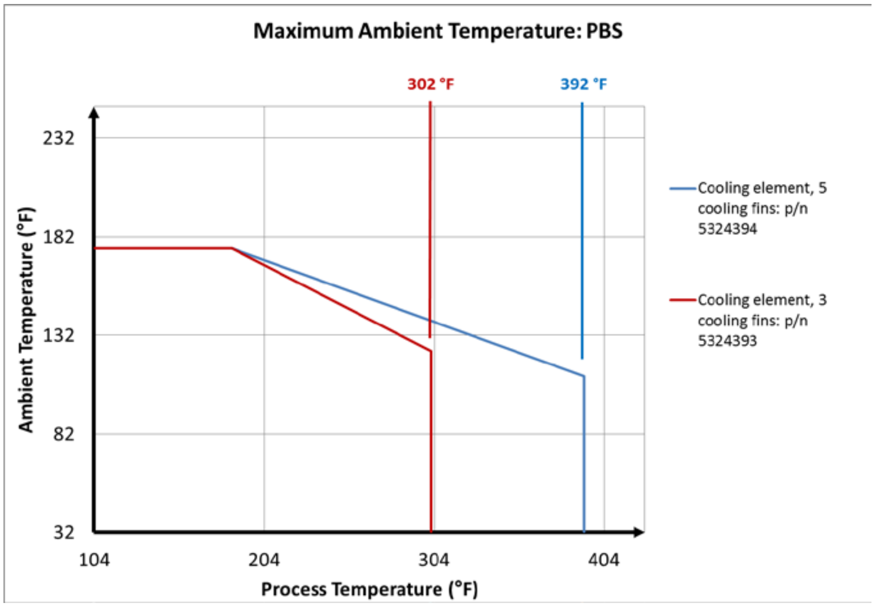

Chart 1: Temperature range of PBS pressure transmitter, switch, and display when installed with a cooling element (°F). PBS maximum process temperature when installed without a cooling element is 185 °F.

For the PBS electronic pressure switch, pressure transmitter and display; cooling elements can protect within the following guidelines:

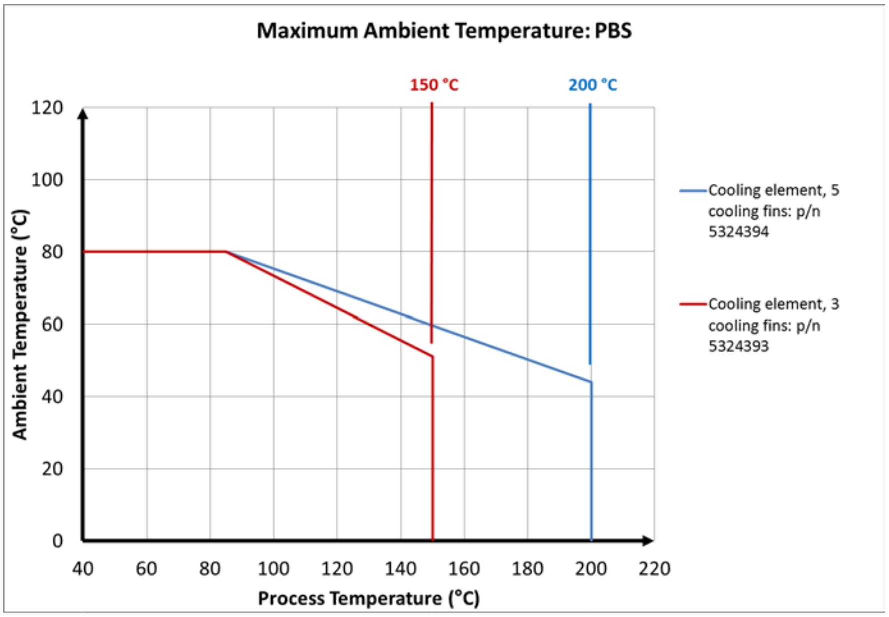

Chart 2: Temperature range of PBS pressure transmitter, switch, and display when installed with a cooling element (°C). PBS maximum process temperature when installed without a cooling element is 85 °C.

For the PFT pressure transmitter; cooling elements can protect within the following guidelines:

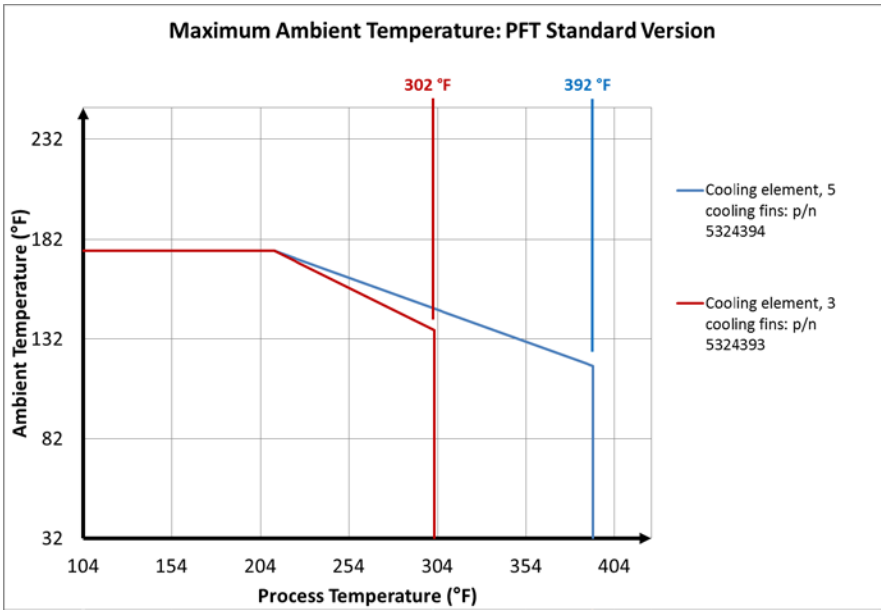

Chart 3: Temperature range of PFT pressure transmitter when installed with a cooling element (°F).
PFT maximum process temperature when installed without a cooling element is 212 °F.

For the PFT pressure transmitter; cooling elements can protect within the following guidelines:

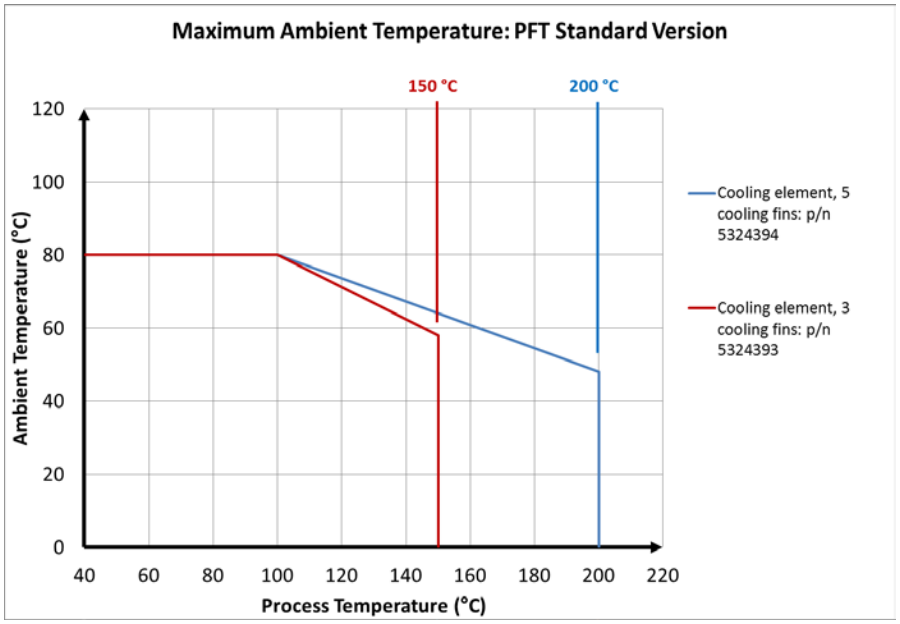

Chart 4: Temperature range of PFT pressure transmitter when installed with a cooling element (°C).
PFT maximum process temperature when installed without a cooling element is 100 °C.

For the PBT pressure transmitter; cooling elements can protect within the following guidelines:

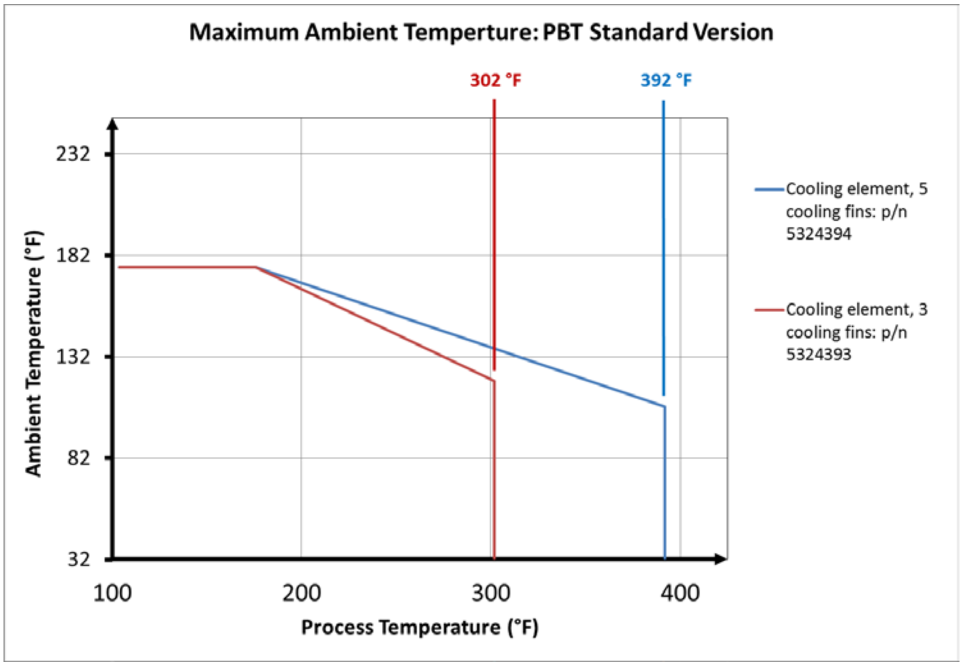

Chart 5: Temperature range of PBT pressure transmitter when installed with a cooling element (°F).
PBT maximum process temperature when installed without a cooling element is 176 °F.

For the PBT pressure transmitter; cooling elements can protect within the following guidelines:

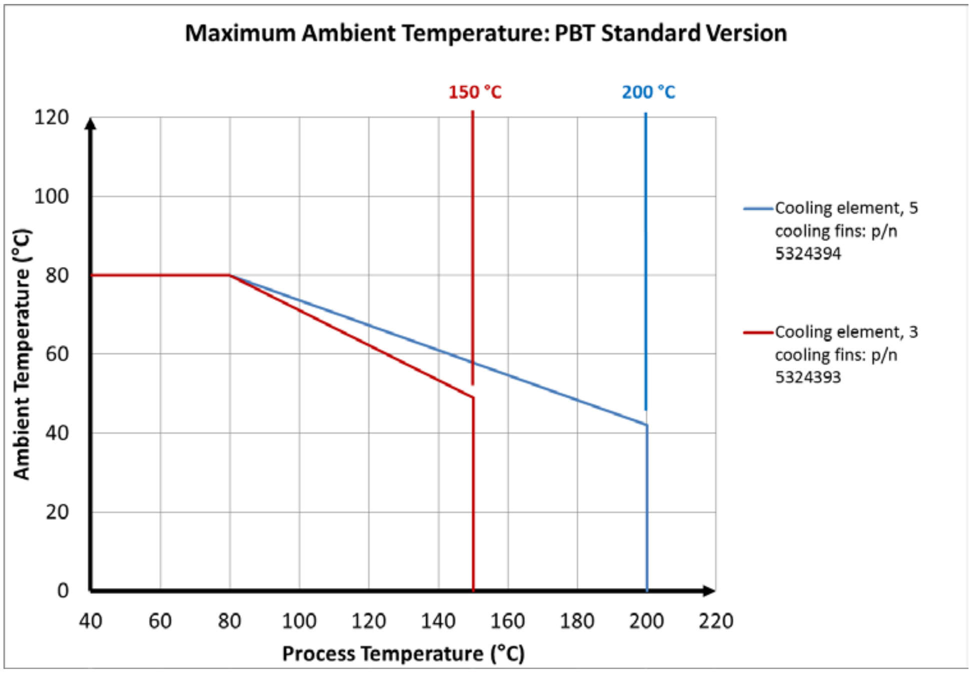

Chart 6: Temperature range of PBT pressure transmitter when installed with a cooling element (°C).
PBT maximum process temperature when installed without a cooling element is 80 °C.

If cooling elements do not provide enough cooling to meet the application, standoff piping / impulse lines may be used.

Standoff Piping

Using standoff piping (otherwise known as impulse lines) cools the process before it comes in contact with the pressure transmitter. Standoff piping may also allow the user to relocate the transmitter to a more convenient location for maintenance.

Impulse line lengths are calculated using a general rule of thumb. For every 100 °F that the temperature needs to drop, users need to have 1 foot of impulse lines. For instance the maximum process temperature specification of the PBS pressure transmitter, switch, and display is 185 ° F (85 °C). If the process temperature is 585 °F, the process would have to be cooled 400 °F to be within the transmitter specification (585 - 185 = 400). Where 585 is the process temperature in °F, 180 is the maximum process temperature of the PBS, and 400 is the decrease in the temperate required for the transmitter. Dropping the process temperature by 400 °F is easily done using a minimum of 4 feet of impulse lines. This is a general rule of thumb, assuming a 68 °F (20 °C) ambient temperature. For higher ambient temperatures, longer impulse lines are required. For lower ambient temperatures, shorter impulse lines are required. Also, most users add a little more pipe length for added peace of mind.

If the impulse lines are too long, other problems may present themselves:

- Damping of the pressure signal
- Blockage of the pressure signal
- Leakage at couplings

Therefore, a balance between just long enough and too long must be achieved. Piping diameters should be as follows:

Type of measured fluid	Impulse Line Length		
	0-52.5 ft (0-16 m)	52.5-148 ft (16-45 m)	148-295 ft (45-90 m)
Water/steam and dry air/gas	0.27-0.35 in (7-9 mm)	0.4 in (10 mm)	0.51 in (13 mm)
Wet air/wet gas	0.51 in (13 mm)	0.51 in (13 mm)	0.51 in (13 mm)
Oils of low medium viscosity	0.51 in (13 mm)	0.75 in (19 mm)	0.98 in (25 mm)
Very dirty fluids	0.98 in (25 mm)	0.98 in (25 mm)	1.50 in (38 mm)

Table 1: Impulse line diameters from ISO2186:1973

Type of metered fluid	Impulse Line Length	
	0-52.5 ft (0-16 m)	52.5-148 ft (16-45 m)
Water/steam and dry air/gas	0.27-0.35 in (7-9 mm)	0.4 in (10 mm)
Wet air/wet gas	0.51 in (13 mm)	0.51 in (13 mm)
Oils of low medium viscosity	0.51 in (13 mm)	0.75 in (19 mm)
Very dirty fluids	0.98 in (25 mm)	0.98 in (25 mm)

Table 2: Impulse line diameters from ISO/CD 2186:2004

Gas Applications

Mount hardware upward to allow moisture to drain out and not fill the impulse piping:

- Slope impulse piping at least one inch per foot (8 centimeters per meter) downward from the transmitter toward the process connection.

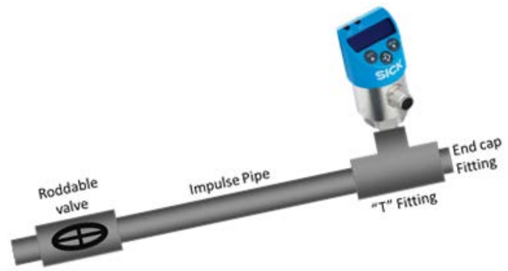

Figure 3: Mounting hardware for gas applications.

Liquid Applications

Mount hardware downward to allow the escape of trapped vapor in the impulse piping:

- Slope impulse piping at least one inch per foot (8 centimeters per meter) upward from the transmitter toward the process connection.
- Vent all gas from the liquid piping legs.
- Prevent sediment deposits in the impulse piping.

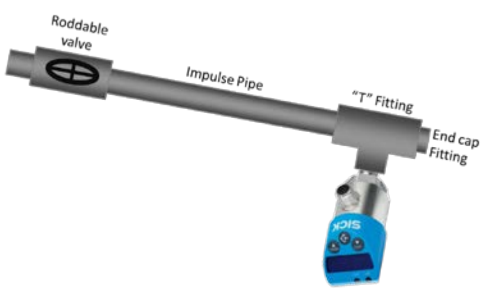

Figure 4: Mounting hardware for liquid applications.

Conclusion

There are generally two different methods used to protect the pressure transmitter and/or the pressure switch from high temperatures. These two proven methods are cooling elements and standoff piping. Some of the time a combination of both methods is used to give the engineer added peace of mind. By using either method, a standard pressure transmitter and/or pressure switch may be used in high temperature applications.

