SIGMA-NETICS

WHITE PAPER

Extending the Functionality of Pressure Switches

Customization overcomes design challenges.

Pressure switches are often considered commodity items. But for many mission-critical or demanding applications, including aerospace, pharmaceuticals and chemical processing, your switch may require a custom mechanical design or electrical features that go beyond what commercial off-the-shelf switches can offer. In fact, with a little extra engineering, you can boost the performance of your switch and, in many instances, overcome challenges your pressure system may be experiencing as a result of its operating environment.

In this paper, we'll explore some recent applications that demonstrate how custom-engineering our pressure switches has improved the functionality of the switch—as well as the reliability of the overall system. These additional features include incorporating signal delay, thermal lockout and dual-switch capabilities, as well as outfitting switches with a flush-mount design to better fit tubular structures in processing machines. Let's take a closer look at these applications.

OFF-ROAD VEHICLE SEES SUCCESS IN PRESSURE SWITCH SIGNAL DELAY

If your hydraulic systems suffer from pressure spikes, your pressure switches may not work as expected. The spikes can trigger the switch prematurely even though continuous pressures remain below the set point. The result is a hard-to-control hydraulic system plagued by false switching signals. Fortunately, there's a simple solution to these spike-induced switching errors: just add a time delay to the switch.

In an off-road vehicle, a pressure switch was used as part of a hydraulic monitoring system, which was designed to trigger a warning light in the cabin if it experienced sustained excess pressure. But driving over rough terrain was causing unintended pressure spikes, causing the annunciator light in the crew compartment to constantly switch on and off. (For more on ruggedized pressure switches, see sidebar.) Our engineers incorporated a PC board into the pressure switch that was programmed to delay signal output based on certain adjustable parameters, including the amount of time—down to the millisecond—and whether the signal occurred on the rising or falling pressure. In this case, engineers set the time delay at 3.2 seconds. As a result, the warning light remained off unless a pressure change lasted longer than that.

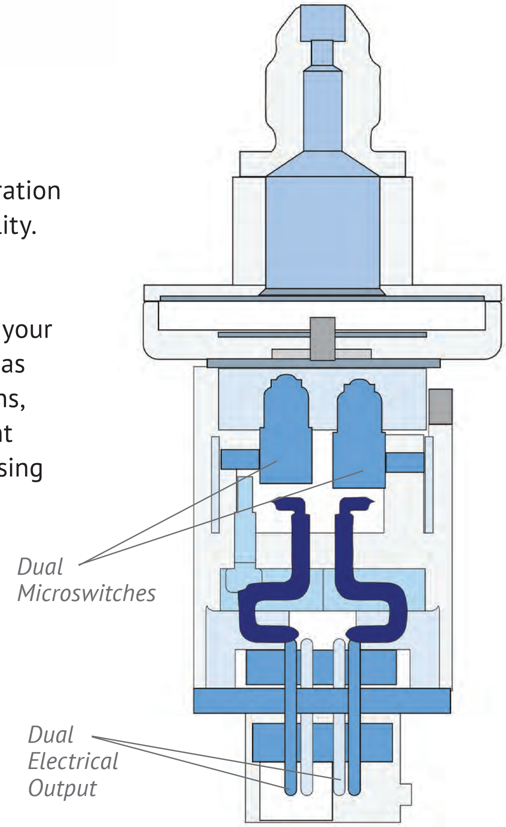
FLUSH-MOUNT PRESSURE SWITCHES—AND TRANSDUCERS TOO

Food, pharmaceutical and chemical processes often use tubular equipment to mix, transport or store materials. In these applications, it's a good idea to keep any internal switches or sensors from protruding too far into the tube where they can create a toehold for material buildup or impede flow. This is where our latest pressure switch design comes into play.

This custom switch's sensing element has been designed and manufactured to match the interior curvature of a specific food processing machine. The only part that protrudes into the flow within the machine is a low-profile, seamless seal that provides no place for materials to hang up during production. While this particular flush-mount switch was designed for a specific use, the same approach can be applied to a wide variety of processing machines. We can alter the design of the switch for tubular structures with internal diameters as small as three inches and have also created a similar design for flush-mount pressure transducers.

DUAL SWITCHING ELEMENT ACCOMMODATES VARIOUS ELECTRICAL SIGNALS

Some applications may benefit from using a single pressure switch with two distinct switching elements. This Double Pole Double Throw (DPDT) configuration saves on installation real estate and provides you with greater design flexibility. With this arrangement, one pressurized system can output to two different electrical circuits, increasing your control options and doubling available amperage. You can also integrate different circuits and contact material into your switching element, including gold contacts for low-level dry circuits, as well as silver contacts for circuits requiring higher amperages. For critical applications, this kind of design also provides redundancy in the event a switching element fails. And finally, this design saves space—enabling you to run two systems using the package size of one pressure switch.



PRESSURE SWITCHES FOR TOUGH ENVIRONMENTS

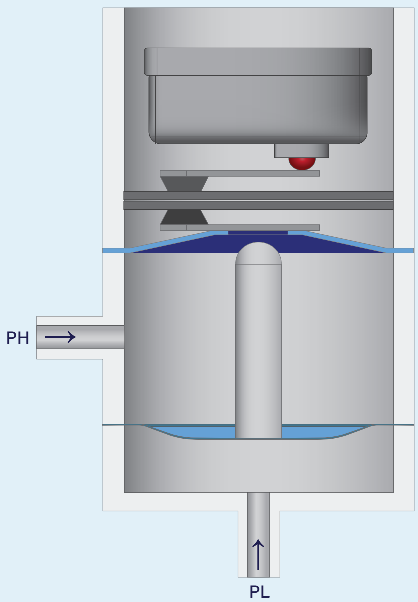
In addition to integrating time delay capabilities, the pressure switch used in the off-road vehicle had to be ruggedized for use in demanding environments. In fact, we design our pressure switches to withstand pressure spikes, leaks, temperature extremes, moisture, chemical exposure, vibration and shock loads. Other ruggedized features include:

- Proof pressures up to 12,000 psig
- Maximum operating pressures up to 7,500 psig
- Wide temperature range of -40 to 250°F
- High overpressure capability
- High shock and vibration survivability
- Snap-action electrical switch tested to 1 million cycles
- IP67 compliance

THERMAL LOCKOUT FOR HERMETIC PRESSURE SWITCHES

In some hydraulic systems, such as those found in aircraft, cold start-ups often cause pressure switching errors that disappear once the system reaches its normal operating temperature. The culprit behind these false high pressure signals is increased fluid viscosity, which temporarily increases the differential pressure across the diaphragm or pressure sensing device. A thermal lockout mechanism based on a snap-acting, temperature-sensitive bimetallic disc can prevent this problem.

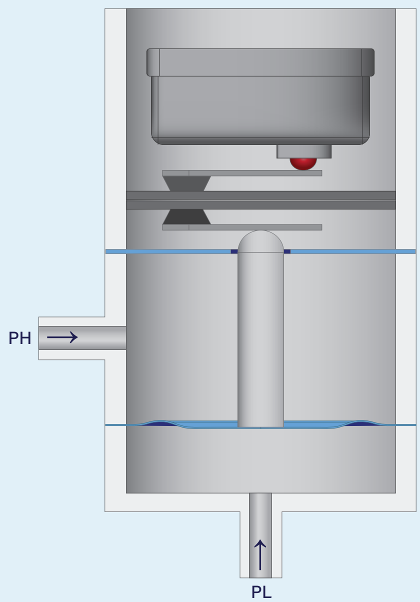
PH = High Pressure Port | **PL** = Low Pressure Port | **Tt** = Threshold Temperature



SYSTEM START-UP:

Fluid Temperature < Tt
PH>PL

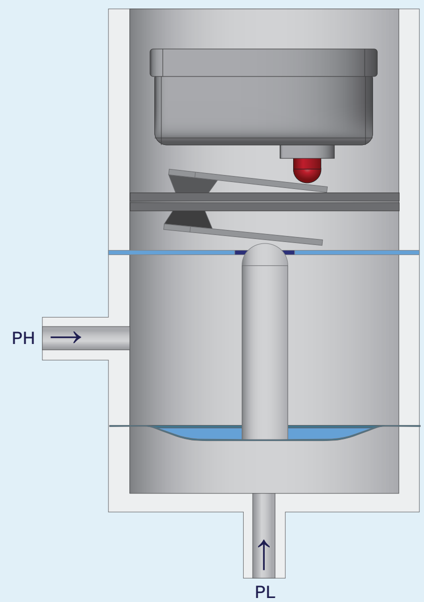
The fluid is cold and viscous and the differential pressure across the diaphragm is high. The diaphragm reacts by moving the actuator away from the electrical switch. To prevent a false high pressure signal, the thermal lockout disc snaps into a convex shape and contacts the motion transfer mechanism, disabling it from swiveling and triggering the electrical switch.



NORMAL OPERATION:

Fluid Temperature ≥ Tt
PH=PL

The fluid is at or above the lockout's threshold temperature, and the pressure differential is negligible across the diaphragm. In this condition both the diaphragm and bimetallic disc remain flat. The disc no longer contacts the motion transfer mechanism, enabling it to swivel freely.



ABNORMAL OPERATION:

Fluid Temperature ≥ Tt
PH>PL

The system is experiencing a high differential pressure condition across the diaphragm, forcing the diaphragm into a concave shape while the bimetallic disc remains flat. In this condition, the actuator and motion transfer mechanism follow the actuator away from the electrical switch. The switch then signals an undesirable pressure condition.