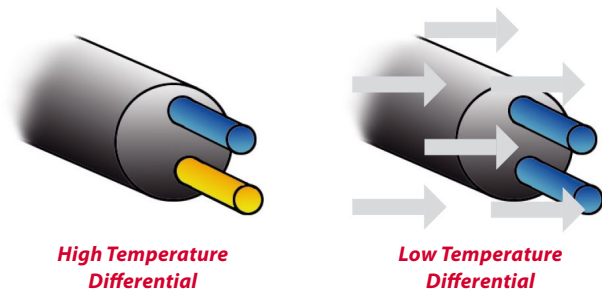


Advantages of Thermal Dispersion Switches for Pump Protection

Technology

Thermal dispersion switches use similar measurement principles to thermal mass flow meters. Fluid carries heat away from the probe tip reducing the temperature difference between a heated resistance temperature detector (RTD) and a reference RTD. As the temperature difference increases or decreases due to heat transfer, the set point is reached and the relay de-energizes. Manufacturers will refer to the switch being in “alarm” at set point. How the relay is wired (NC-CO or NO-CO) depends on the needs of the application.



High or low flows can both be detected by thermal dispersion switches. For the purpose of this paper, it will be liquid flows as opposed to gas, and low flow detection that we focus upon. Running pumps in a dry state can damage parts or cause cavitation in centrifugal pumps. Replacement parts can amount to thousands of pounds. These costs do not include for inefficiencies arising from poor pump operation or downtime.

Advantages

There are many technologies available for pump protection applications. Flow meters can be used, but a continuous flow measurement is not always required and flow meters typically cost more than switches.

Mechanical flow switches can be used to actuate a relay. Typically, a vane or paddle in the flow stream swings in the direction of the flow. When the vane moves a specific distance, a magnetic sleeve rises to draw the magnet in to trigger the switch. Moving parts can be subject to wear and increased maintenance over time. If it is a viscous liquid or build-up is present, this can decrease reliability of the switch. A mechanical flow switch may be desirable if there is limited on-site power. In terms of the installation, the pipeline must be horizontal.

Tuning forks and ultrasonic gap switches are two other technologies that are used for pump protection. It is inherent in the technologies that the fork or gap must be wet or dry for detection. Therefore, they cannot detect decreasing flow rates and the opening creates room for possible plugging. Common applications for these switches are sumps or wet wells. Dual ultrasonic gap switches have pump control modes where the unit performs auto-fill or auto-empty as needed.

With thermal dispersion, the user gets the most robust feature set and flexibility. This would include:

- No moving parts means less maintenance
- Many probe types for water or more viscous liquids
- Installation in horizontal or vertical lines and does not need to be installed top dead centre
- Optional remote mount electronics
- Hot tap options available
- Low flow detection as opposed to dry pipe
- Current output for trending and fault indication
- Temperature compensation to reduce set point drift under varying operating temperatures

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Probe Types

The standard probe design offered by thermal dispersion switch manufacturers is a twin tip construction to house the sensors.

The twin tip is essentially two tubes welded to the end of the probe that are in the process liquid.

A twin tip probe has a very high-pressure rating and is available in many different materials of construction. While this probe is suitable in liquid applications, it is typically recommended for gas.



Thermatel® Model TD1
with twin-tip probe



Thermatel® Model TD2
with spherical tip probe

A unique design that is preferred for liquid applications is the spherical tip probe. The lack of pins at the end of the probe eliminates plugging in viscous applications while the thin wall facilitates increased sensitivity. With pressure ratings up to 600 psig (41 barg) and standard 316 stainless steel material of construction, it is suitable for most pump applications.

Electronics

The electronics are offered as integral or remote to the probe and are enclosed in an explosion proof housing. Wiring is simplified with the terminals easily accessible without removal of the bezel or any circuit boards. Together with ease of installation, the microprocessor-based electronics provide many diagnostic features, one of which being the current output. It is not a linear 4-20 mA output

in keeping with a typical flow meter; the current will act as a live signal that varies with heat transfer. For example, in a low flow condition the current may be 8 mA and at normal flows 12 mA (output varies for each application). The current will be repeatable for a given low flow set point. If there is turbulence in the line, possibly caused by a closed valve with the pump still running, the sensor will see this turbulence as a higher flow rate than is actually occurring. Monitoring this live signal allows the user to observe what the sensor is seeing inside the pipe.

Along with the trending capabilities of the current output, this signal will also go low or high when a fault condition occurs, in accordance with NAMUR NE 43. For pump applications where a low flow alarm is desirable, the current will fall to less than or equal to 3.6 mA during the fault. The microprocessor-based electronics are essential for monitoring any open wires or out of range flow condition. Without a microprocessor, the flow switch could be subject to more noise, have drift issues and need more frequent recalibration to maintain the set point.

The user also has the option to select a window in the housing of the electronics. This window allows viewing of the LEDs to show normal operational status (relay energized), alarm/set point (relay de-energized) and fault conditions (relay de-energized). It is highly beneficial to be able to confirm switch and process operation at a glance by viewing the LEDs.



Thermatel® Model TD2 with Window

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Because the principal of operation of thermal dispersion switches is temperature dependent, manufacturers should provide temperature compensation in the circuitry. The THERMATEL Model TD2 with spherical tip probe was tested in water for a set point of 15 GPM in a 2" pipe and showed minimal set point drift over a 75-185°F (24-85°C) temperature swing.

Pump Installations

Both positive displacement and centrifugal pumps have performance curves to maximize efficiency. There is an ideal combination of differential head and flow rate that will provide the best results. If monitoring the differential head, a thermal switch can be set up to shut the pump down when it is operating below the ideal flow rates. Worst case scenario, the thermal switch is installed to verify there is liquid flow to prevent wear, eventual replacements and downtime.

Installing the thermal switch in the suction or discharge piping is acceptable. It is important to install in a location where the sensor tip will see liquid movement (in case of a partially filled pipe). When field calibrated, which is most often the case for thermal switches, it is not necessary to install at the centreline of the pipe. As long as the probe is far enough into the pipe to see liquid movement then it will provide repeatability at the given flow rate. A quarter to half-way into the pipe is common.

Installing a few diameters away from the pump will reduce excess turbulence. Turbulence may cause the switch to see a higher flow rate than is actual. Movement of liquid due to turbulence can theoretically create as much heat transfer as the liquid flow itself. The aforementioned current output is a helpful diagnostic feature in difficult installations such as these.

Summary

Thermal dispersion switches are used in pump protection applications ranging from standard water to high viscosity liquids. There are unique sensor designs for each individual application, including the popular spherical tip, low flow bodies and high temperature/pressure probes. The variety of probes in conjunction with the advanced electronics make thermal dispersion switches the most competitive technology on the market for pump protection.



Thermatel® Model TD2 with Low Flow Body

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