Liquid Level Sensors for Harsh Environments

Co-authored by Janice Despotakis and Robert Wawrzeniak, April, 2019.

Liquid level sensors have to operate in extreme conditions. Picture a holding tank on a drilling rig in the North Sea with temperatures dropping well below zero. Or, imagine the bilge tank in a shipping freighter, which contains the remnants of the industrial fluids and debris as it rolls through heavy seas. How about hot reactor fluids in a nuclear power plant? Those emergency fuel tanks? They could be cooking in the heat of an Arizona afternoon.

In commercial and industrial applications with harsh environments, it is vital to know the level of critical fluids or to know when to respond to or change mechanical functions based on changes in fluid level. Many times, the dependability and life of a sensor is critical to equipment operation and public safety.

Reed switch-based float level switches and sensors have been available for more than 60 years, and still provide the most cost-effective sensing solutions for commercial applications. They are easy to install, flexible in both materials and operation, provide accurate, dependable information, and are durable enough to survive extremes in temperature, pressure, and fluids.

Point level float switch

Point level float switches detect single distinct points as the float or sensor encounters fluids within the tank or enclosure.

Once inserted into a tank or positioned to contact the fluid, a float with an internal magnet is moved up/down on a sealed stem as the fluid level moves to change an internal reed switch.

Single point float switches switch between an open/closed state at a single point. They are accurate to within 1/8- in. of an inch of liquid level, as the float passes through the middle of its float travel.

Common harsh environmental commercial applications for sensors include offshore oil rigs and fracking, hydraulic systems for industrial power systems and steam co-generation plants *(shown left)*

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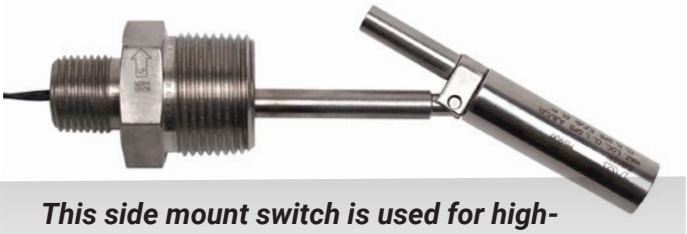
Float switches can be constructed of different materials to withstand chemicals, high temperatures, high pressures, and even acidic environments. They are suitable for fluids that remain liquid well below freezing, and for high-temperature applications like hot oils to 482F/250C.

Most single point float switches can be switched from Normally Opened to Normally Closed by flipping the float for vertically mounted float switches, or by changing the mounting orientation for side mounted float switches.

Multi-point float switch

When mounted in a tank or positioned to contact the fluid, a custom multi-point float switch may have from 1 to 6 single point float switches set on a single stem. The multi-point float switch can indicate multiple points within a tank from a single tank intrusion.

Like the single point float switches, multi-point float switches come in many different materials and features and can be sized up to 10-ft in length for specific application conditions.



This side mount switch is used for high-temperature, medical and petrochemical applications as well as plating processes.

Continuous level float sensors

Continuous level float sensors provide an accurate continuous liquid level value as a sealed float with a magnet moves up and down the stem.

These sensors typically provide an increasing or decreasing output value over a range of 6 to 96 inches, dependent upon the application. The sensor output can be 4-20mA, resistive, or proportional voltage. The output value can appear as inches, gallons or other values when displayed through a panel meter.

The internal element contains closely positioned switches that accurately indicate the position of the float corresponding to that fluid level. The accuracy is determined by the distance between the internal switches placed within the stem. Standard continuous float level sensors today can provide ¼-in. or better-stepped resolution (accuracy) over the full sensing length and can be customized for OEM applications.

What is considered harsh?

Like any other mechanical device, a sensor, and the fluid it senses, can be affected by extremes, including temperature and pressure. Other conditions can include corrosive environments, corrosive fluids, shock and vibration, (both mechanical and thermal), fluids containing dirt and debris, and even humidity. If the right technology, design, and materials are not carefully selected, performance and premature failure of the sensor can result.

Common harsh environmental commercial applications for sensors include; offshore oil rigs and fracking, hydraulic systems for industrial power systems and pumps (including those on military nuclear submarines), or remote fuel tanks. More examples include fire protection systems, hydraulic systems in heavy transport vehicles such as rail cars, semis, and construction, steam co-generation plants, and anywhere that combustible, flammable gases, vapors, and fumes exist as part of the industrial process.

Materials

For harsh environments with pressures to 500psi or more, stainless steel is generally the material of choice. Stainless steel float

level sensors are constructed with dry contact hermetically sealed sensor elements set inside of a stainlesssteel sealed stem.

Brass is highly resistant to petroleumbased liquids and a good choice for generators, transmissions and hydraulic systems. Other uses include lubricating equipment, waste oil recovery, refining and fuel processing equipment.

Kynar (PVDF) is a high purity engineered plastic that offers resistance to harsh thermal, chemical and ultraviolet environments, and is often used in chemical and semiconductor processing at a fraction of the cost of Teflon.

Polypropylene holds up well in acidic or alkaline liquids and is FDA approved for food contact.

Sensors designed for hazardous areas include sealed conduit connections to seal out the hazardous environment, weather, and other conditions. In many cases, sensors must be tested and approved by a third-party certifying agency for use in hazardous locations.

Hazardous Locations

Hazardous areas are defined by class and by division or zone (NFPA 70, National Electric Code):

Hazardous Area Classes

Class I – a location or area made hazardous by the presence of flammable gases or vapors that may be present in the air in quantities sufficient to produce an explosive or ignitable mixture.
Class II – a location or area made hazardous by the presence of combustible or electrically conductive dust.
Class III – a location or area made hazardous by the presence of easily ignitable fibers or flyings in the air, but not likely to be in suspension in quantities sufficient to produce ignitable mixtures.

Hazardous Area Divisions

Division 1 – A location or area where a classified hazard exists or is likely to exist under normal conditions.
Division 2 – A location or area where a classified hazard does not normally exist but is possible to appear under abnormal conditions.

Hazardous Area Zones

Zone 0 – An area in which an explosive gas atmosphere is continuously present for a long period of time
Zone 1 – An area in which an explosive atmosphere is likely to occur in normal operation
Zone 2 – An area in which an explosive gas atmosphere does not normally exist

What is essential when selecting a liquid level sensor for harsh environments? If you understand what your system is going to do but don't have working knowledge of liquid level sensors and how they can perform, look to the manufacturer for advice. It's important to remember that all sensors are not the same. Those manufactured overseas at lower prices may be lacking in quality, third-party certification, and application knowledge. Also, it's important to give the manufacturer as much information as possible about the application, including:

- Equipment in which the sensor will be used
- Expected sensor function
- What the signal will control/go to (PLC, relay, etc.)
- Environmental conditions
- Type of fluid
- Required approvals
- What could go wrong within the operation

Gathering the appropriate information to create the proper sensor design up front will reduce total overhead costs saving time and money during system installation and operation.

Around us, every day, smart devices and systems are making it more important to know the status of fluids or automate processes for better customer satisfaction under any environmental condition. Float level sensors and float switches are a critical part of these systems. The right liquid level sensor will contribute to the longevity, safety and high quality of service if chosen correctly.

The MSB5600 stainless steel float switch, bracket mount, 60-watt, slosh shield detects high-low levels in a container. It is frequntly used in food processing applications and other high-temperture environments where corrosion resistance is required.

Can Madison Help You?

Sophisticated sensing technologies for liquid level control can be part of an overall solution designed to save customers money and time. Madison Company is a trusted provider of liquid level sensing solutions for many applications.

Madison partners with every customer to provide either a stock or custom-engineered product for even the most demanding applications.

Madison Company has been providing sensing technologies for liquid level control in the U.S.A. since 1959.

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