Liquid Media-Compatible Pressure Sensors Improve Design, Cut Costs

AJ Smith

With the wide range of sensors on the market, selecting the best pressure measurement device for medical equipment in applications that require liquid sensing or condensing humidity can be a big challenge for medical OEMs. Designers need to choose sensors that offer the right balance of technical features, reliability, and cost for their specific applications.

Medical device designers dealing with applications that require liquid compatibility have historically had fewer sensing options. Before the introduction of liquid compatible board-mounted sensors, the only choice for designers was media-isolated pressure transducers. Pressure transducers remain the product of choice when dealing with higher pressures (e.g., over 150 psi); however, for lower pressures, they are larger and more expensive than their board-mounted alternatives.

But what’s the best choice when the application requires modest pressures and the sensor must interface with liquids or humid gases in category C applications?

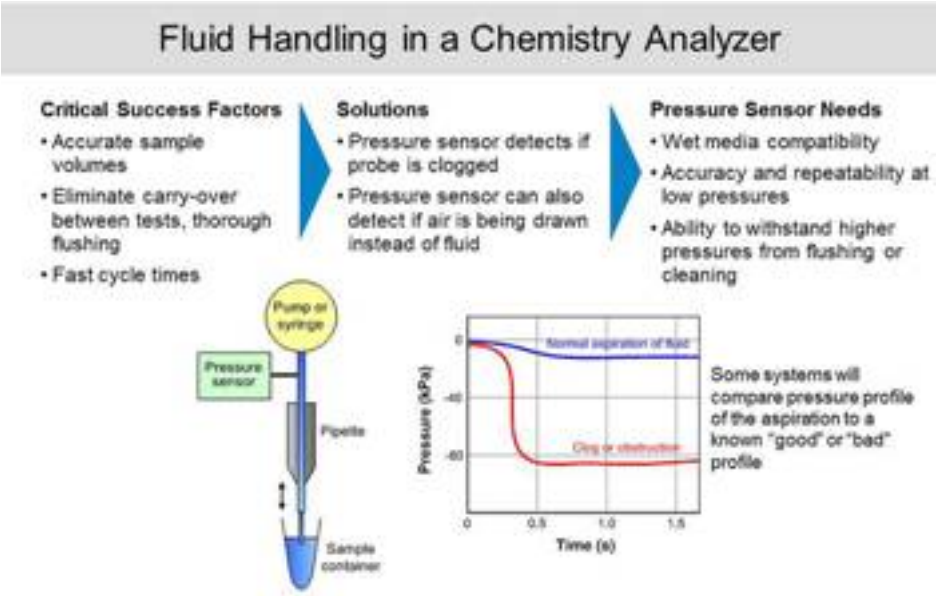
Category C applications include gas or liquid chromatography, chemistry analyzers, and blood diagnostic equipment where accurate pressure measurement of reagents, samples, and cleaning fluids is critical. Given the required pressure range—often less than 150 psi—and size constraints, a board-mounted pressure sensor is preferred.

Designers typically choose to position the sensor in close proximity to the media being measured in order to get the most accurate sensor reading. But, if the pressure sensor is not compatible with the fluid being measured, this poses a key challenge for medical device designers who need to add features to protect the sensor from the fluids. In many cases, these additional components add design time and costs to the medical device.

Even in the case of diagnostics applications where fluids typically don't reach the sensor, designers still need to plan for worst-case scenarios. For example, over pressurization could occur, causing the fluid to move up a tube further than expected, and potentially contact the pressure sensor.

What can designers do to ensure that the sensor is protected from the fluid? It could be related to how the tubing is run, so they may have to think about the positioning of components in the system to keep the fluids from contacting the sensor. Or a design may need to incorporate an additional component, such as a filter, to address humidity issues.

To make it easier for designers to select a pressure sensor for these types of medical devices, sensor manufacturers are developing solutions that not only protect against liquid media, but also help to simplify designs by eliminating the need to incorporate additional protection features or requiring engineers to modify a design so the fluids won't be in contact with the sensor.



[1]Chemistry analyzers provide a good application example of where to use board-mounted liquid media-compatible pressure sensors. In a chemistry analyzer, a pipette is used to pull sample fluid and deposit it into other locations for mixing or analysis. Pressure sensors are required to ensure that the proper amount of fluid is being handled by determining if there are obstructions in the pipette or if the pipette is not properly placed in the sample vial.

Chemistry analyzers depend on the precise measurement of a specific amount of fluid passing through the system repeatedly. Pressure sensors must provide high accuracy and repeatability. In addition, while they must perform at low pressure levels, they should also be able to withstand higher pressures that are generated when flushing or cleaning the fluid pathway.

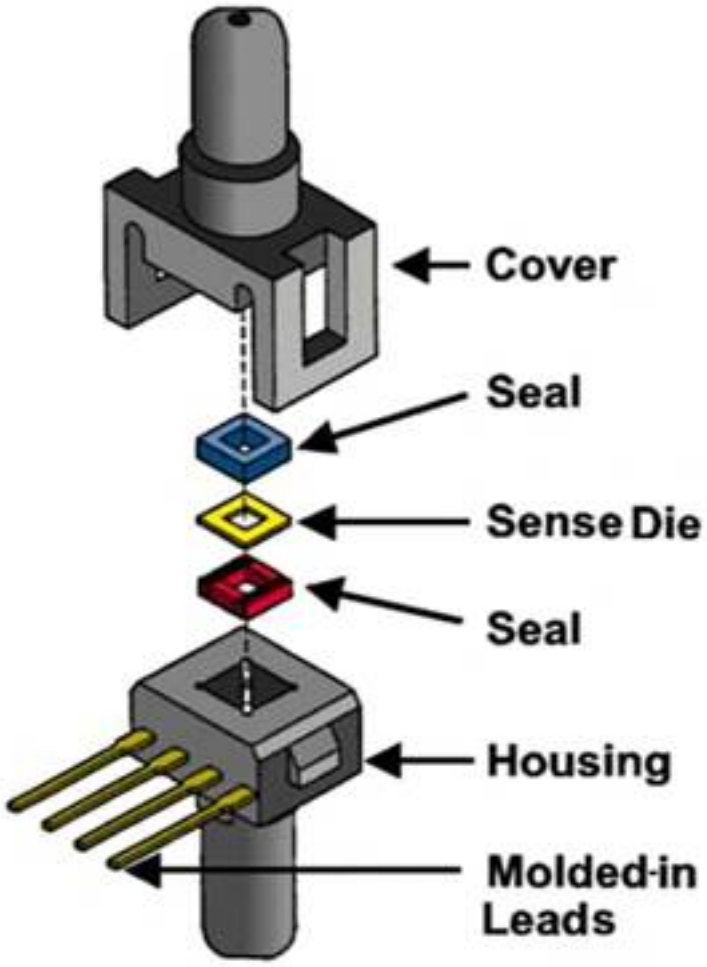
As an example, the high resolution and high repeatability of Honeywell Sensing & Control's 24PC/26PC board-mounted pressure sensors allow them to detect small changes in pressure from one reading to the next, and to provide precise measurement of a specific amount of fluid passing through the system in a repeatable manner, at the same volume and velocity, which are of key importance in analytical equipment.

In addition, the Honeywell 24PC/26PC sensors are unique solutions for applications requiring liquid contact on both pressure ports of a differential sensor.

In a ventilator application where the pressure sensor is used to measure the airflow to and from the patient, the sensing device needs to provide high stability and accuracy to measure air and oxygen pressure so it does not exceed the set level. Here, the Honeywell HSC/SSC TruStability sensors may be used due to their extremely tight accuracy that allows them to detect pressure at ranges down to 250 Pa (in an inch of water). Additionally, they may be directly interfaced to microprocessors and microcontrollers through either I2C or SPI digital outputs, which eases design and improves performance.

The TruStability HSC/SSC series pressure sensors have a liquid media option that can be implemented to make the sensor resilient to direct liquid media contact or condensing humidity. This option can be important when trying to locate the sensors close to the patient—especially within the expiratory portion of the ventilator application where the sensor has to withstand the patient coughing and breathing out high humidity air.

The 24PC/26PC and TruStability HSC/SSC pressure sensors allow the designer of a chemical analyzer, ventilator, blood analysis machine, or other similar type medical devices to place the pressure sensor in the media path to get the best pressure reading. They provide a wide range of flexibility through a number of options for characteristics such as pressure range, package styles, and digital/analog outputs. All of these devices can withstand a wide range of non-corrosive, non-ionic liquids or gases.



Mechanical Assembly

Selecting the Pressure Sensor

In medical device applications, it's critical for designers to understand what types of fluids will be in contact with the pressure sensor in order to select the right sensing solution that is compatible with those particular fluids. They also need to have a good understanding of other critical design criteria such as pressure type and range, accuracy, supply voltage, package requirements, and output types.

For easy implementation, designers should consider pressure sensors with liquid media compatibility that are fully compensated, amplified, and calibrated, which provide an amplified signal that can eliminate components from the printed-circuit board related to signal conditioning. The benefits include space savings, higher reliability, lower costs, and faster design time.

But, again, the best selection depends on the application. In applications such as alarm circuits, a designer may prefer a low-cost unamplified, uncompensated pressure sensor that is liquid media compatible.

Also, look for pressure sensors that are easy to integrate into a design. This means the devices should offer multiple options for port styles, packaging, and output types (analog and digital). Pre-validation of the sensor is also an advantage in terms of speeding up both development and manufacturing cycles.

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