U5200 - Media compatible pressure transmitters for hydraulic applications

For many years, stainless steel transmitters* for pressure sensing in hydraulic systems have proved effective where the measurement medium is separated from the silicon pressure sensing element by an oil seal. These sensors are suitable for the measurement of absolute and relative pressure in gases and liquids within a wide pressure range.

Figure 1: *construction vehicle with a hydraulic lifting system on the new Rhine bridge building site between Mainz and Wiesbaden.*

Figure 2: *pressure transmitter U5200 [1] for hydraulic applications*

**A transmitter is a sensor which is calibrated to fixed output values, linearized and temperature compensated and packaged ready to mount.*

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Pressure transmitter with an oil seal

Most modern pressure transmitters are based on a silicon sensing element *(Figure 2*) which is often mounted on a ceramic substrate.

For the purpose of substrate bonding the upper membrane surface of the silicon sensing element has several small metal surfaces (bonding pads) made of refined aluminum that are not corrosion resistant. After gold wires have been attached (wire bonding), the sensing element surface is covered with soft silicone gel for protection. There are gels that provide good protection against water, oils or alcohol, for example, but there is no gel that guarantees universal protection against all kinds of media under all temperature conditions. This causes uncertainty, especially with measurement media whose composition is not known.

Another disadvantage of gel material is its hygroscopic behavior. Through direct contact with liquids or through condensation moisture can be stored in the gel that in time diffuses to the silicon layer. When it does, this moisture can not only cause corrosion but also a high impedance between the wires connected at various potentials. This can distort the measurement values.

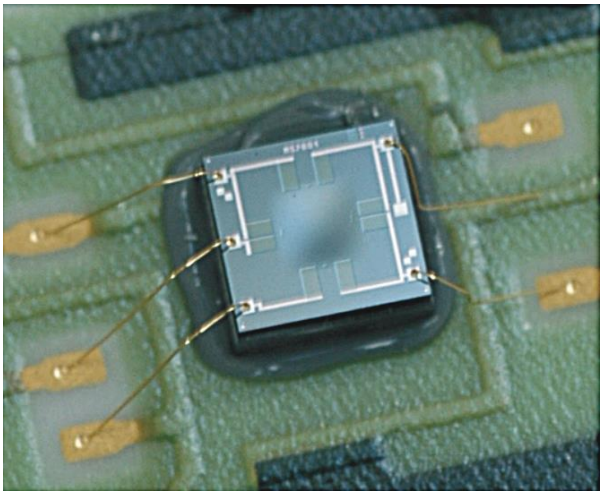

Figure 2: *silicon pressure sensing element on a ceramic substrate, connected with bonding wires (white squares = bonding pads)*

To sum up, for the mentioned reasons the standard sensing element design with a gel cover cannot be used to measure liquids or aggressive gases, or if it can, then only under very limited conditions.

This disadvantage of the silicon sensing element can be avoided to achieve the required media compatibility by mounting the sensing element in a pressure-sensitive chamber filled with oil (*Figures 3* and *4*).

The stainless steel chamber (e.g. 316L) is sealed pressure tight by a thin separating diaphragm, which is also made of stainless steel. This is deformed depending on the applied pressure. As the space between the sensing element and the separating diaphragm is filled with an inert oil as a pressure buffer, the induced pressure on the silicon sensing element is transferred and converted into an electrical signal.

As most media – from water, oils and solvents through alcohols, fuels and caustics to moderately aggressive liquids – do not damage the steel chamber with the separating diaphragm, sensors with oil seals can be used in all applications where media are to be measured which are compatible with stainless steel.

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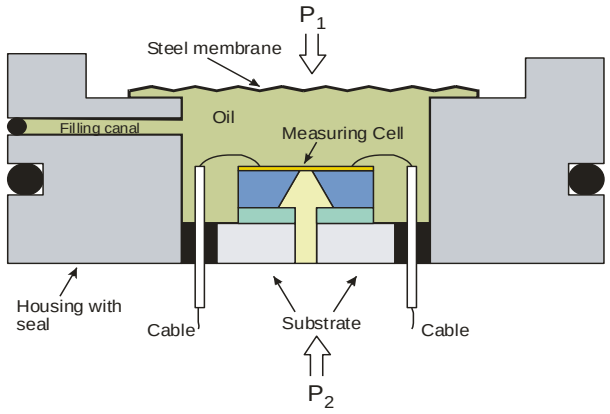

Figure 3: *pressure sensor with an oil seal for the measurement of relative pressure*

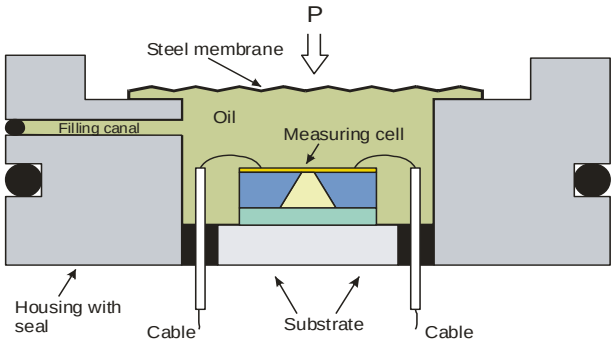

Figure 4: *pressure sensor with an oil seal for the measurement of absolute pressure*

Figure 5: *view of an absolute pressure sensor with an oil seal (reverse)*

Relative sensors

Most media-compatible pressure transmitters for relative measurement, for instance, are designed as shown in *Figure 3*:

(Measurement pressure = P_1, ambient pressure = P_2.)

The topside of the sensing element is protected against the media to be measured by the oil seal whereas the underside of the sensing element is not. As the materials on the underside are not sensitive to humidity, sensors like these can be used to measure relative pressure also in relation to saturated ambient air, for example.

The sensing element design and downstream electronics stipulate that:

$P_1 \geq P_2$.

Absolute sensors

Measurement of absolute pressure (see *Figures 4 and 5*) is not at all critical for sensors filled with oil as the reverse of the sensing element is sealed in a vacuum and not exposed to any medium. Absolute pressure sensors always measured in relation to a vacuum.

For customers who require the pressure sensors for their own package without a plug or thread, the pressure sensors with an oil seal shown here (*Figure 5*) are available in many different variations.

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Description of U5200

U5200 [1] is distinguished by its modular design which permits a large number of variations. It is protected against 10 V/m EMI and has negative pressure protection at the input and short-circuit protection at the output. Its compact design, weatherproofing and a temperature range of -40 to +125°C also make it suitable for mobile work machines.

The calibrated sensors in the U5200 series surpass the CE directives for heavy industry and are certified accordingly (IEC 61000). They are sold as absolute pressure, sealed and relative pressure transmitters in a number of variants for pressure ranges between 0–2 PSI and 0–10k PSI. They are also available in bar (0–140 mbar to 0–700 bar). The transmitters have a total error band of ±0.75% FS in the average pressure range.

The U5200 comes with a number of different pressure connections and various connectors and is supplied with various analog industrial outputs (amplified and unamplified: 0.5–4.5 V (ratiometric), 0–5 V, 1–5 V, 1–6 V, 0–10 V and 4–20 mA (for two-wire operation)).

These robust pressure transmitters can withstand shocks of up to 50 g (MIL-STD 202G) and vibrations of up to ±20 g (MIL-STD-810C).

Summary

The devices in the U5200 series are pressure transmitters with a compact design which are media compatible and can be used for critical pressure measurements. Possible applications range from filter monitoring through flowmetering to level sensing in liquid and critical gaseous media.

Further information

[1] Product information U5200: https://www.amsys-sensor.com/products/pressure-sensor/u5200-mediaresistent-pressure-transmitter-up-to-689-bar

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