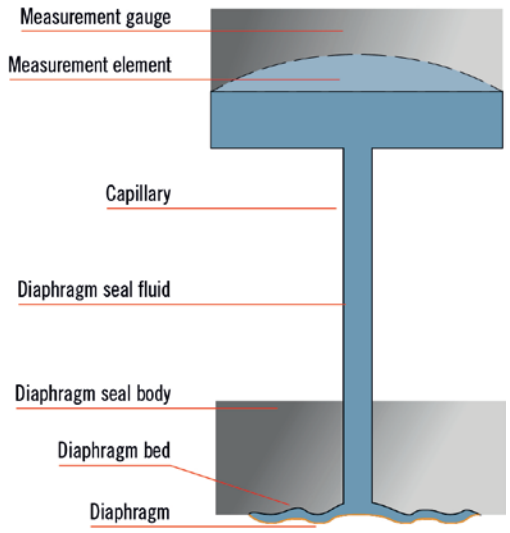
Labom

Diaphragm seal for difficult media

Due to the increasing level of automation in the process industry, new and more specialised measurement tasks are constantly being developed. With patented diaphragm types and customer-specific designs for diaphragm seals, Labom makes its contribution to exact results and a high level of operational reliability. This approach is particularly advantageous for measuring difficult media, for instance viscous paints and coatings.

Diaphragm seals are partitions in pressure measuring instruments which prevent the measured medium from entering the measuring system. This allows them to protect the gauges from aggressive, highly viscous or solidifying measurement media as well as from high media temperatures, vapours, measurement pressure fluctuations and pressure spikes as well as increasing the overload capacity. They also provide relief in case of an unfavourable location of the pressure measurement and enable the use of pressure gauges in potentially explosive areas as well as a measurement arrangement free of dead space.



Three basic components

The design of the diaphragm seals can vary greatly depending on the measurement task. Nonetheless, the basic components can be identified on any diaphragm seal. Particularly important for the protective function of the device is the diaphragm, a thin film that shields the gauge from pressure in the process vessel or pipe. The diaphragm is held in place in the diaphragm seal body, which is called the diaphragm body. It must have a suitable process connection so that it can be integrated into the system to be measured. To transfer the process pressure „caught“ by the diaphragm to the measurement element, a pressure transmission fluid is used. It is in the entire pressure measurement system and is used to transmit the pressure from the diaphragm seal via the fill head (which forms the connecting piece between diaphragm seal and measurement device) to the measurement device.

Diaphragm shapes and materials

Depending on the shape and material of the diaphragm, each diaphragm seal has a special characteristic, which must be taken into account during the selection of the right device for the corresponding application. A very common diaphragm shape is sinusoidal. It can be produced easily, but only up to a certain thickness. For applications that require greater diaphragm thicknesses or specific special materials, such as nickel or Monel, sinusoidal diaphragms can be pushed to their limits. While sinusoidal diaphragms made of stainless steel have a low temperature error, the use of special materials will cause this error to become larger.

For applications in which sinusoidal diaphragms are not the optimal solution, Labom has developed two patented alternatives. One of them is the compensation diaphragm made of Hastelloy or tantalum. With a material thickness of 0.1 millimetres, it is suitable for low-pressure applications. The temperature-dependent volume expansion of the transmission fluid, which would also affect the pressure recorded by the measurement element, is compensated by the compensation diaphragm automatically. This is possible due to the diaphragm contour and the different materials of the body and the diaphragm that are used here. The volumes under the individual circular rings of the diaphragm and the expansion behaviour of the diaphragm seal materials caused by the temperature ensure that the increasing volumes of the transmission volume are compensated for.

The LTC (Low Temperature Coefficient) diaphragm, also developed by Labom, compensates the temperature-dependent volume expansion of the pressure transmission fluid with a stainless-steel diaphragm. The mechanically robust stainless-steel diaphragm with a thickness of at least 0.1 millimetres is spanned radially to the centre using a special manufacturing process. Thus, it has at least two zero positions that it wants to assume. Using a special manufacturing process, the diaphragm is put into a position between the two zero positions and operates in this range with almost no deflection. This allows the diaphragm to absorb volume changes to the fluid due to the influence of temperature so that these fluctuations have practically no effect. Compared to conventional sinusoidal diaphragms, an LTC diaphragm can deliver up to 70 per cent greater measurement accuracy.

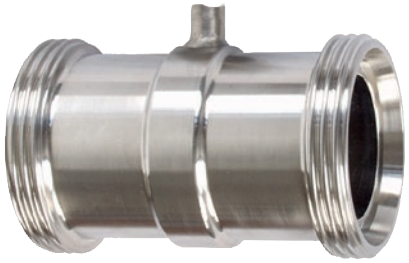
Diaphragm seal shapes

Depending on the shape of the separating diaphragm, a differentiation is made between flat diaphragm seals and inline diaphragm seals. For flat diaphragm seals, the diaphragm lies in a plane and is usually circular. This makes possible good spring properties of the diaphragm and thus low sensitivity of the diaphragm seal to temperature fluctuations. In addition, production is relatively simple. Flat diaphragm seals, which include flange, cell-type, screw-in and tubus diaphragm seals, are available with a wide range of connection types.

For inline diaphragm seals, a cylinder-shaped diaphragm is welded into a piece of piping. This avoids any turbulence, flow restrictions and dead spaces in piping. The temperature error is, however, typically larger than for flat diaphragm seals. Inline diaphragm seals are offered with all standard threaded, clamp and flange pipe connections.

The quality of a measurement system of pressure gauge and diaphragm seal is influenced by the interaction of various parameters. In addition to the shape and material of the diaphragms and the shape of the diaphragm seal, the work and control volume and the temperature range are also of importance. With calculation software for determining the temperature area, Labom supports its customers in the selection of the proper configuration from its modular system. The company also realises new developments for the requirements of specific customer applications on a daily basis.

Example of a diaphragm seal from Labom: The HYGIENIC Tubus Ø 101 mm with clamp connection.



Example of an inline diaphragm seal from Labom.

Practical example: paint system

For the painting systems Labom designed an inline diaphragm seal whose special shape ensured self-draning. The diaphragm seal is also piggable. These cleaning options are important for quality assurance, as they prevent undesired mixing of different paint colours. They are also important for economic operation, as even minor residue of the pasty paint in the process pipes can lead to considerable loss of material in the long run.

Painting systems used the inline diaphragm seals together with pressure gauges and pressure transducers from the North German measurement technology provider for the colour supply of the painting systems. Here the paint containers are pumped, together with solvents, into the circulation and distributed through the pipes to the application. The measurement equipment monitors the process pressure of approx. 12 to 16 bar and regulates the circulation process using this variable. The paint is processed at a temperature of 22 °C. For the transmission fluid, Labom developed for painting systems a diaphragm seal system filling that is absolutely free of silicone and prevents paint wetting.

The fill fluid can easily withstand temperatures from -20 °C to +120 °C. The aseptic screw fitting ensures a dead-space free measurement in which the paint is not compromised in any way. The device combination is in an intrinsically safe ATEX design in painting systems for automotive manufacturers around the world.

Combinable device from Labom consisting of pressure transducer with inline diaphragm seal and mechanical, on-site indicator.

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