



Badotherm: Diaphragm Seal Solutions



LGP – Extreme Low Pressure Measurement with Diaphragm Seals

In today's process industry there are many processes that operate with very low pressures (< 100 mbar). Badotherm developed a Diaphragm Seal for low pressure gauge pressure applications. This solution is referred to as LGP (Low Gauge Pressure) Diaphragm Seal and can be used in combination with several types. With this solution it is possible to measure up to 5 mbar with minimal temperature effects.

LGP – Extreme Low Pressure Measurement with Diaphragm Seals

Introduction to LGP

Low pressures can be difficult to measure, however also low pressures required monitoring. With standard Diaphragm Seals the limitation is around 100 mbar, but several processes required accurate pressure measurements up to 5 mbar, and at the same time also do require Diaphragm Seals for protection of the pressure instrument.

Case study: Nitrogen blanketing

A process, where very low pressure need to be measured, is nitrogen blanketing, a commonly used technique to prevent process gases entering the atmosphere. To prevent this, a small nitrogen overpressure of approximately 10 mbar is applied to a vessel containing these gases. Accurate measurement of this small overpressure is necessary to minimize or even avoid interference with the process in the vessel. Additionally, a significant cost reduction is achieved by limiting the consumption of nitrogen to an absolute minimum.

Difficulties arise when this technique is applied in a corrosive environment. In these circumstances it is essential that the pressure measurement devices used are equipped with Diaphragm Seals. However, the use of a standard Diaphragm Seal in combination with the very low overpressure ranges implies relatively high temperature effects when exposed to process and ambient conditions. These high temperature effects, and especially ambient temperature effects, result in unstable, unreliable and inaccurate pressure measurements, subsequently resulting in poor control of the process.

Solution Developed

After thorough analysis of the process data and requirements, Badotherm developed a solution for this challenge, which can be generally used for low for low pressure Gauge Pressure applications. This solution is referred to as LGP and can be used in combination with several seal types. Test results obtained by measuring low gauge pressures showed that the minimum GP range reduces from 80 mbar with a standard Diaphragm Seal to only 5 mbar with the LGP Diaphragm Seal. Similarly the ambient temperature effect reduces from 0.4 mbar per 10°C to 0.03 mbar per 10°C, while the process temperature effect reduces from 0.39 mbar to 0.09 mbar.

In addition to accurately measuring low pressure and limiting the consumption of nitrogen, there are 2 additional benefits:

- The way of mounting the transmitter to the vessels has no effect on the zero and span adjustments of the transmitter, hence there is no zero adjustment required.
- There is no effect on the performance by a change in the density of the fill fluid caused by ambient temperature fluctuations, hence there is no mounting effect.



Typical BF type Diaphragm Seal in LGP construction.

Technical Specifications

The LGP Diaphragm Seal can be manufactured in combination with several seal types, standard materials are AISI 316(L). It can also be supplied with a range of exotic materials for the wetted parts. The LGP solution needs to be mounted on a DP transmitter.

	Standard 3" diaphragm	LGP 3" diaphragm
Min. GP range	80 mbar	5 mbar
Min. Capillary length	direct	0,5 mbar
Ambient temp. effect $\Delta 10^{\circ}\text{C}$		
Capillary	0.4 mbar	0.03 mbar
Transmitter	0.19 mbar	0.02 mbar
Process temp. effect		
Diaphragm Seal	0.39 mbar	0.09 mbar

Values based on AISI 316(L) diaphragm, BSO-22 filling fluid and BF-LGP seal type.

Calculation Example

Below is a calculation example demonstrating the specifications that are mentioned on the previous page.

	BF 3"	BF-LGP 3"
Process Pressure	80 mbar	80 mbar
Capillary length	5 mtr	5 mtr
Fill Fluid	BSO-22	BSO-22
Temp. at calibration	20°C	20°C
Ambient temp.	40°C	40°C
Process temp.	140°C	140°C
Temp. effect		
Diaphragm Seal	4.68 mbar	1.08 mbar
Capillary	4 mbar	0.3 mbar
Transmitter	0.38 mbar	0.04 mbar
Total temp. effect	9.06 mbar	1.42 mbar
Total Probable Error (TPE)	11.3%	1.8%