Diaphragm Seal Repair Service

Giving pressure instruments a second life

BADOTHERM

BADOTHERM: DIAPHRAGM SEAL SPECIALIST

Introduction

Diaphragm Seals are used to separate the pressure instrument from the process to protect the vulnerable measuring element. This protection enhances the lifetime of the measuring instrument significantly. However, it is possible that the diaphragm eventually breaks. One of the advantages of Diaphragm Seals is that they can be renewed, whilst re-using the pressure instrument. It will function just as a new instrument, but with the benefits of lower costs, and a much shorter lead time than buying a new instrument with seals. Badotherm has been supplying this service for over 25 years to the end users. All brands of transmitters with Diaphragm Seals can be sent back to Badotherm, because Badotherm operates independently of transmitter manufacturers. In addition to short lead times, we also offer rush repairs (within 48 hours) and when requested we analyze the defective instrument to learn what has happened and advice how to improve the reliability and lifetime of the instrument in the future.

Badotherm has over 30 years experience in mounting and filling Diaphragm Seals with pressure instruments, and specializes in mounting and filling with pressure transmitters. Badotherm is the preferred supplier of several leading pressure transmitter manufacturers, where most applications end in the demanding chemical and petrochemical industries. The mounting and filling is done professionally according to stringent procedures, which also applies for repairs. All communication tools for the various communication protocols are available (a.o. HART, FIELDBUS, D/E, BRAIN, Foxcom) as are the required machines and (calibration) test tools, with a 0,01% accuracy. Of course, Badotherm is ISO 9001 certified and is being audited annually.

When to use Diaphragm Seals?

A Diaphragm Seal can be mounted to almost all pressure instruments. They are mostly used in combination with pressure (differential) transmitters, but also in combination with pressure gauges and pressure switches. The use of Diaphragm Seals is recommended, when the process-medium:

- is aggressive, corrosive, toxic and/or highly viscous
- has a (extremely) high or low temperature
- has crystallization and/or polymerization

Diaphragm seals are also used for liquid level measurements in pressure retaining tanks instead of 'wet legs'. Also. when in the process medium there is a chance of presence of hydrogen ions (H+) that can permeate the diaphragm. In that case, a Diaphragm Seal with gold coating offers the required protection.

How does it work?

The pressure instrument is directly mounted or through a capillary line to the Diaphragm Seal. The complete volume of the Diaphragm Seal, the capillary and the measuring system, is filled under high vacuum with the appropriate filling fluid. The applied process pressure will be transferred through the diaphragm to the measuring system. The volume displacement has to be sufficient to steer the sensor of the transmitter or the bourdon tube of a pressure gauge. For an accurate measurement the relation between diaphragm diameter and volume displacement is important.
Making use of a self-developed, high accuracy filling equipment, allowing for an optimal degassing of the filling fluids, Badotherm's Diaphragm Seals only have an influence of 0.025% on top of the accuracy of the instrument.

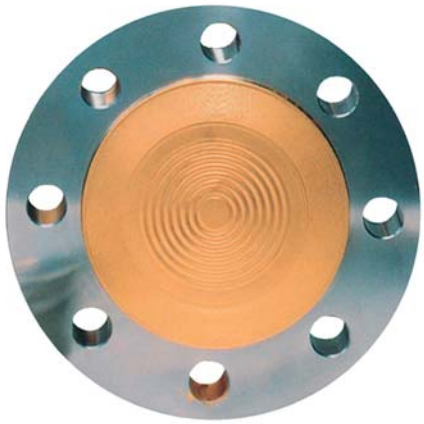
Selection of filling fluid

The selection of the filling fluid is dependent on factors such as temperature, pressure, displaced volume, response time and process safety. Most used filling fluids are silicone oil, glycerin, or vegetable oils. There are also special inert filling fluids, such as halocarbon for chloride and oxygen applications and other special filling fluids for high temperatures up to 410 °C.

Various types of Diaphragm Seals

There are various types of Diaphragm Seals, such as threaded and flanged executions, but also Diaphragm Seals with connections for sanitary requirements. Badotherm seals are conform to several different standards, such as the ASME B16.5 or the EN1092-1 (former DIN standard), and even JIS and API executions are possible. Normally, the Diaphragm Seals are made from stainless steel AISI 316(L), but often it is required that the Diaphragm Seal needs to be made of exotic material like Tantalum, Monel 400, Titanium Gr. 1, Duplex 2205, Super Duplex 2507, Hastelloy C-276, Nickel 201 or Inconel 600. This applies not only for the diaphragm material, but also for the complete wetted parts, being in contact with the process medium. Furthermore, it is possible to plate the diaphragm with a coating (PTFE, PFA or gold). Badotherm makes standard use of a diaphragm of 75 micron, allowing an increased flexibility and a higher accuracy.

THE INFLUENCE OF TEMPERATURE



A pressure instrument with Diaphragm Seals is filled under high vacuum at a temperature of +/- 20 °C. When the instrument with Diaphragm Seals is being used at an operating temperature different to this, a measurement error will occur.
When the process and/or ambient temperature increase, the filling fluid will expand resulting in a pressure build up, that will be measured by the pressure retainer on top of the actual process pressure. On request, Badotherm can determine the expected additional measurement error of an application, so it can be compensated in the system. It is also possible to get a reliable measurement, where the pressure instrument will be set at a given operating process temperature.

Usage of capillary lines

The Diaphragm Seals and the pressure instrument can be connected by means of a stainless steel capillary with a flexible stainless steel armor. Any reasonable length of capillary is possible.
For the best result, the length of capillary should be carefully selected. A too long capillary influences the accuracy of the measurement negatively.

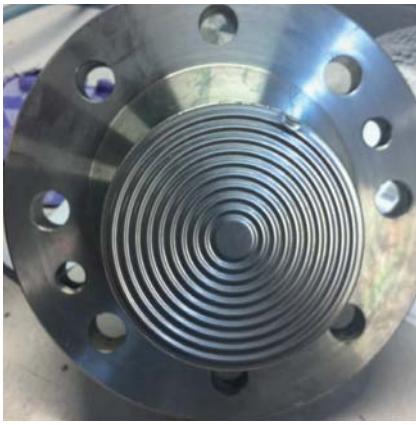
EXAMPLES OF DAMAGED DIAPHRAGM SEALS

Diaphragm is bulged

It happens frequently that the diaphragm is bulged. A possible cause could be that the process temperature has been too high and the filling fluid has cooked, resulting in a bulged diaphragm. Check the temperature specifications on the datasheet with the process. Another possible cause is the presence of hydrogen diffusion. This means that very small hydrogen ions (H+) have permeated the diaphragm and joined together again behind the diaphragm, resulting in a bulged diaphragm. Of course, the measurement is no longer correct. The solution preventing hydrogen permeation is a gold plated diaphragm. Badotherm offers a unique 40 µm layer, ensuring a longer lifetime.

Diaphragm is “blown up”

Sometimes a diaphragm is “blown up”. This can be caused by a high pressure water jet stream directed at the diaphragm, but it can also be a sign that the application has leaked and/or is on a vacuum. Extra care should be taken into account for installation, mounting and/or maintenance to prevent this problem from recurring.



Damaged (dents) diaphragms

The diaphragm has a thickness of only 75 micron and thus transmits the pressure accurately. However, it is also very sensitive and vulnerable and needs to be handled with care. In case the diaphragm is dented, it no longer gives a correct reading. A renewal of the Diaphragm Seal is the solution.
In the example of an extended type the diaphragm can be removed, the flange cleaned and machined, and a new diaphragm is welded to it, then, the complete application is mounted and filled and tested. The instrument is as good as new.

Diaphragm is corroded

Some processes are so aggressive that they corrode the diaphragm material. A correct selection of diaphragm material ensures a longer lifetime. Badotherm can assist and advise in making the selection. Several types of diaphragm materials are available from Badotherm (a.o.Tantalum, Monel 400, Titanium Gr. 1, Duplex 2205, Hastelloy C-276, Nickel 201 or Inconel 600). Also, exotic flange materials are readily available.

Process medium gets behind the diaphragm

When the diaphragm is damaged and the process medium gets behind the diaphragm a hazardous situation can exist. Because the complete system stays more or less liquid filled and continues to transmit a (process) pressure. This could give the (wrong) impression that the application is still functioning correctly. In the meantime, the process medium could corrode the flange material, which could lead to a dangerous situation. A periodic check to see if the diaphragm is still in perfect condition is recommenced, especially with corrosive processes.

Development of customer specific requirements

For specific applications, Badotherm develops together with the customer a joint solution for a “measurement challenge”. Recently a customer asked Badotherm for a specific construction due to the limited space in the plant. Here, the transmitter was placed in the radius of the Diaphragm Seal flange instead of the standard construction where the instrument is placed axial to the flange.

BENEFITS OF RENEWAL OF DIAPHRAGM SEALS

- All brands of pressure transmitters are accepted and new Diaphragm Seals can be mounted to them. Consequently, there is only one-central contact for Diaphragm Seals (repairs).
- As standard, any repair is executed within 3 weeks of receipt of the instrument, but a 48 hours service is also possible. Ideal in case of sudden plant-stops or other unplanned and urgent situations when the only alternative is a new instrument on a long delivery and with extra costs.
- Significantly more economic than ordering a complete new instrument again, because the pressure instrument is being reused.
- A clear and written quotation, so a clear insight in the costs and actions beforehand.
- Before executing the order, the transmitter is tested for proper functioning, so there are never unnecessary costs for a repair executed in vain.
- Badotherm offers advice with measurement challenges for Diaphragm Seals. A repair/renewal of Diaphragm Seals often provides valuable information regarding to the process and offers the opportunity of a better solution for increased lifetime and/or higher accuracy.

7 steps to an instrument as good as new

1. After receipt of the repair, a quotation will be sent to you within 48 hours.
2. Only after approval of the quotation, the order will be executed.
3. The Diaphragm Seal is carefully dismantled and the pressure instrument will be tested for correct (electronic) functioning. Hereby, a repair is never started in vain.
4. In most situations all parts are being renewed. However, in some occasions, for instance exotic flange materials, together with the customer it can be decided to reuse these parts.
5. The parts are always cleaned and when required machined. The gaskets are always checked and/or replaced. Surface facings are always cleaned and revised.
6. The application will be rebuilt, filled and tested on static pressure and measuring range (documented in a test report which is always included). The complete instrument is again working perfectly and conform to the original specifications. Material certificates according to EN10204 will be supplied when requested on the order.
7. The instrument can be shipped to any location, to be used again on its new life-cycle.

How do I contact Badotherm?

Please contact your nearest Badotherm office. See the back of this folder or check our website. The website also shows a short and informative movie on our Diaphragm Seal repair service.
You can send the instrument to be repaired to the nearest Badotherm service center with the instrument datasheet and with your contact details. We will contact you shortly.

About Badotherm

We are a European manufacturer of mechanical process instruments with a worldwide distribution network. We have regional Diaphragm Seal assembly facilities in Europe, the Middle East, India, the Far East and the Americas. We design, engineer and manufacture Diaphragm Seals, Pressure Gauges, Temperature Gauges and Thermowells, Instrument Valves and Manifolds. Next to our product offering, we develop tailor-made solutions for challenging conditions in the field of Diaphragm Seal measurements. Headquartered in the Netherlands, we employ over 225 people in seven different countries.

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