Operating instructions

Chemical seal CSS

for VEGADIF 65

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Contents

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1 For your safety

1.1 Authorised personnel

All operations described in this operating instructions manual must be carried out only by trained specialist personnel authorised by the plant operator.

During work on and with the device the required personal protective equipment must always be worn.

1.2 Appropriate use

The chemical seal is a functional part of the differential pressure transmitter VEGADIF 65.

You can find detailed information about the area of application in chapter "*Product description*".

Operational reliability is ensured only if the instrument is properly used according to the specifications in the operating instructions manual as well as possible supplementary instructions.

1.3 Warning about incorrect use

Inappropriate or incorrect use of the instrument can give rise to application-specific hazards, e.g. vessel overfill or damage to system components through incorrect mounting or adjustment.

1.4 General safety instructions

The safety information in the operating instructions manual of the respective sensor must be noted.

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2 Product description

2.1 Configuration

Scope of delivery

The scope of delivery encompasses:

- VEGADIF 65
- Chemical seal CSS mounted on VEGADIF 65
- Documentation
  – This operating instructions manual

Constituent parts

The CSS chemical seal consists of the following components: separating diaphragm, process fitting as well as transmission line (capillaries). The components are fully welded together with each other and with the associated differential pressure transmitter and represent a hermetically sealed system.

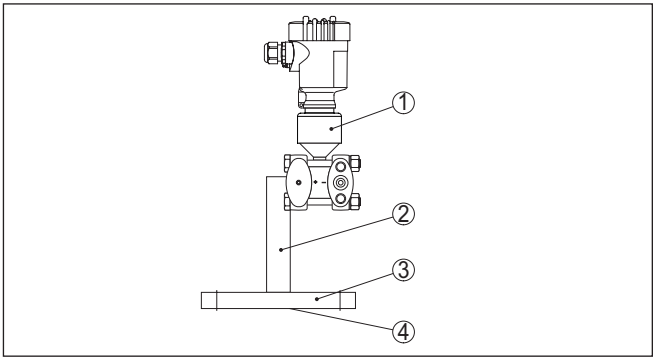

Fig. 1: VEGADIF 65 with chemical seal CSS

1 VEGADIF 65
2 Transmission line (capillaries)
3 Process fitting
4 Separating diaphragm

2.2 Principle of operation

Area of application

Chemical seals should be used if a separation between medium and pressure transmitter is necessary, particularly with:

- High product temperatures
- Corrosive products
- Strong vibration at the measuring point

Functional principle

The process pressure acts on the separating diaphragm. This diaphragm transmits the process pressure through the capillary line to the sensor element of the differential pressure transmitter.

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3 Planning instructions for isolating systems

3.1 Influence of the components

Separating diaphragm

The following properties of the separating diaphragm determine the application area of the chemical seal:

- Diameter
- Resilience
- Material

The bigger the diaphragm diameter, the higher the resilience and the smaller the temperature influence on the measuring result. Note: To keep this influence within reasonable limits, you should use a chemical seal with a nominal width ≥ DN 80.

The resilience also depends on the diaphragm thickness, the material as well as a possible coating.

Chemical seal filling oil

In the selection of filling oil, product and ambient temperature as well as process pressure are of utmost importance. Also take note of temperatures and pressures during setup and cleaning.

Another criterium is the compatibility of the filling oil with the requirements of the medium. In the food processing industry, for example, only filling oils that present no health risks are permitted, e.g. medicinal white oil. See overview of filling oils in the following chart.

The table also shows the permissible medium temperature depending on the isolating liquid and instrument version for p_{abs} > 1 bar/14.5 psi. For the medium temperature with instrument version for p_{abs} < 1 bar/14.5 psi, see chapter "*Chemical seal for vacuum applications*".

Filling oil	Permissible medium temperature with p_{abs} > 1 bar/14.5 psi	Density in g/cm³	Viscosity in m²/s•10⁻⁶	Expansion coefficient 1/K	Corrective factor for TK	Application area
Silicone oil KN17	-40 … +180 °C (-40 … +356 °F)	0.96 up to 25 °C	55 up to 25 °C	0.00104	1	Standard
silicone oil KN2.2	-40 … +200 °C (-40 … +392 °F)	0.96 up to 20 °C	55 up to 20 °C	0.00104	1	Standard
High temperature oil KN 3.1	-10 … +300 °C (-14 … +572 °F)	1.07 up to 20 °C	39 up to 20 °C	0.0008	0.77	High temperatures
High temperature oil KN 3.2	-10 … +400 °C (+14 … +752 °F)	1.07 up to 20 °C	39 up to 20 °C	0.0008	0.77	High temperatures
Halocarbon oil KN21 (BAM tested)	-40 … +150 °C (-40 … +302 °F)	1.968 up to 20 °C	14 up to 20 °C	0.00086	0.83	For oxygen and chlorine applications

Filling oil	Permissible medium temperature with p_{abs} > 1 bar/14.5 psi	Density in g/cm³	Viscosity in m²/s•10⁻⁶	Expansion coefficient 1/K	Corrective factor for TK	Application area
Med. white oil KN92 (FDA approved)	-10 … +250 °C (+14 … +482 °F)	0.85 up to 20 °C	5.6 up to 40 °C	0.00065	0.63	suitable for foodstuffs

The implemented filling oil also influences the $TK_{zero\ point}$, the permissible ambient temperature and the step response time of a chemical seal. See also chapter "*Influence of the temperature on the zero point*" and "*Step response time*".

Differential pressure transmitter

The differential pressure transmitter also influences the temperature application range, the $TK_{zero\ point}$ and the step response time of the isolating system through the volume of its lateral flanges and its control volume.[1)]

3.2 Influence of temperature changes

The filling oil expands as the temperature increases. The additional volume presses on the chemical seal. The more rigid the diaphragm, the more it counteracts a volume change. The additional volume also adds to the process pressure on the measuring cell and thus shifts the zero point. The respective temperature coefficient "$TK_{Process}$" is listed in chapter "*Dimensions and weights*".

3.3 Calculation of the temperature error

Actuating variables

With single-sided mounting of chemical seals, the total temperature influence is composed of the following:

- Influence of the process temperature on the chemical seal ($TK_{Process}$ [mbar/10K])
- Influence of the ambient temperature on the capillary ($TK_{Ambient}$ [mbar/10K])
- Corrective factor with special materials (with Tantalum, Alloy: 1.5; with PTFE: 1.8)
- Corrective factor for filling oil
- Influence of the ambient temperature on the pressure transmitter (thermal modification of zero signal and span)

The calibration temperature of the isolating system is 20 °C. For the calculation, the temperature must be deducted from the respective process or ambient temperature.

The $TK_{Process}$ chemical seal is listed in the tables in chapter "*Dimensions and weights*" of this operating instructions. The correction factor for the filling oil is listed in chapter "*Influence of the components*". The thermal change of zero signal and span is specified in chapter "*Technical data*" of the differential pressure transmitter.

Finally, the calculated temperature errors of pressure transmitter and chemical seal must be added up geometrically.

[1)] The control volume is the volume that must be shifted in order to utilise the entire measuring range.

Example for single chemical seal

- Process temperature: 100 °C
- Flange isolating diaphragm DN 80 PN 40 with extension 50 mm
- Capillary length: 4 m
- Diaphragm material.: Tantalum, correction factor 1.5
- Ambient temperature TU: 40 °C

$TK_{chemical\ seal}$ = 1.34 mbar/10K

ΔT Process temperature-Reference temperature chemical seal = 100 °C - 20 °C = 80 K

$TK_{Capillaries}$ = 0.3 mbar/(10K•1 m)

ΔT Ambient temperature-Reference temperature capillaries = 40 °C - 20 °C = 20 K

Error calculation

$\Delta p_{chemical\ seal}$ = (1.34 mbar/10K) • 80K = 10.72 mbar

Corrective factor diaphragm material = 10.72 mbar • 1.5 = 16.08 mbar

$\Delta p_{Capillaries}$ = (0.3 mbar/10K • 1 m) • 20K • 4 m = 2.4 mbar

Δp_{Total} = 16.08 mbar + 2.4 mbar = 18.48 mbar

With one-side chemical seals, the total temperature influence is 18.48 mbar

4 Mounting

4.1 Application conditions

Suitability for the process conditions

Before mounting, setup and operation, take note that the pressure transmitter as well as the chemical seal were selected according to measuring range, version and material suitable for the process conditions. The load limits must be maintained in order to guarantee the specified accuracy.

Caution:
In dangerous substances such as e.g. oxygen, acetylene, combustible or toxic products as well as in refrigerating plants, compressors, etc., the pertinent instructions must be observed in addition to the general regulations.

Process and ambient temperature

Take note of the following issues in respect to the process and ambient temperature:

- Mount the differential pressure transmitter in such a way that the permissible process and ambient temperature limits are neither underrun nor exceeded.
- Take the influence of convection and heat radiation into account
- When selecting the chemical seals, make sure that the fittings and flanges are pressure and temperature resistant
- For this purpose select the suitable material and pressure stage
- Mount in such a way that plus and minus side have the same ambient temperatures to keep the temperature influences low

Caution:
With a surface temperature of the vessel >100 °C the electronices of VEGADIF 65 is heated up unnecessarily. This can cause damages or a failure of the electronics.

The vessel must be isolated in a suitable way so that this can be avoided.

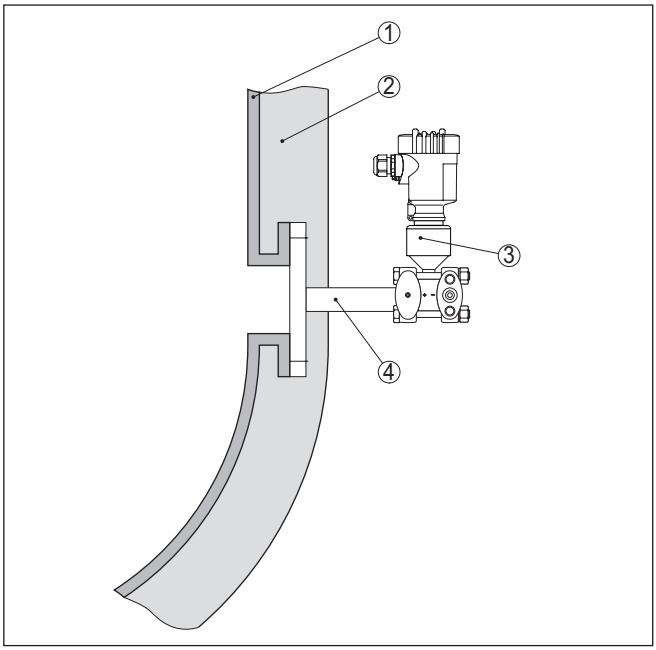

Fig. 2: Recommended vessel insulation with chemical seal without cooling area (length 100 mm)

1 Vessel wall
2 Vessel insulation
3 VEGADIF 65
4 Chemical seal

If a suitable insulation of the vessel is not possible, use a chemical seal with cooling area (length 150 mm).

4.2 Instructions for handling

- Instruments must be protected against soiling and strong fluctuations of the ambient temperature
- Leave the measuring system in the packaging until mounting to protect it against mechanical damages
- When removing the packaging and when mounting, take special care to avoid mechanical damage and deformation of the diaphragm
- Do not carry the pressure transmitter by holding the capillary line
- Do not bent the capillary lines. Kinks can cause leakage and lead to an increase in response time
- Never loosen sealed screws on the chemical seal or the pressure transmitter
- Do not damage the isolating diaphragm: scratches on the isolating diaphragm (e.g. from sharp subjects) are the main areas where corrosion can occur

4.3 Mounting instructions

Sealing

- Suitable seals must be selected for sealing
- For flange mounting, use a seal with a sufficiently large inner diameter and place the seal centrically; contact with the diaphragm will cause measurement deviations
- When using soft material or PTFE seals, take note of the regulations of the seal manuffacturer, particularly with respect to torque and settling cycles

Laying the capillaries

- Lay in vibration-free areas to avoid additional pressure fluctuations
- Do not lay close to heating or cooling lines
- Insulate in case of colder or warmer ambient temperatures
- Bending radius of the capillaries ≥ 150 mm

5 Maintenance and fault rectification

5.1 Maintenance

Maintenance

If the instrument is used properly, no special maintenance is required in normal operation.

In some applications, product buildup on the separating diaphragm can influence the measuring result. Depending on the application, take precautions to ensure that heavy buildup, and especially a hardening thereof, is avoided.

Caution:
Never clean the separating diaphragm mechanically, for example with tools! This can damage the diaphragm and lead to oil leakage.

Cleaning

If necessary, clean the separating diaphragm with a soft brush and suitable cleaning detergent. Make sure that the materials are resistant to the cleaning process. The wide variety of applications of chemical seals makes special cleaning instructions necessary for each application. Please ask the agency serving you.

6 Supplement

6.1 Technical data

Materials	
Diaphragm	316L, Alloy C276 (2.4819), Tantalum, Alloy 600 (2.4816)
Flanges	316L
Capillaries	316Ti
Protective hose for capillaries	304

Process conditions	
Vessel pressure max.	see operating instructions manual of the respective sensor
Process temperature max.	see operating instructions manual of the respective sensor

6.2 Chemical seal with vacuum applications

Introduction

A chemical seal has two tasks:

- Separation of the sensor element from the medium
- Transmission of the process pressure hydraulically to the sensor element

The chemical seal is closed off from the medium with a metallic diaphragm. The interior space between this diaphragm and the sensor element is completely filled with a pressure transmission liquid. The chemical seal thus forms a closed system.

Vacuum

With decreasing pressure, the boiling temperature of the pressure transmission liquid decreases. With pressure values < 1 bar_{abs}, gas molecules dissolved in the isolating liquid may be released depending on the temperature. This causes measurement deviations.

For that reason, chemical seal systems can only be used to a limited extent in a vacuum, depending on the pressure transmission liquid, process temperature and pressure. To extend the area of application, we offer a so-called vacuum service as an option. The following graphics show the areas of application for the different pressure transmission liquids.

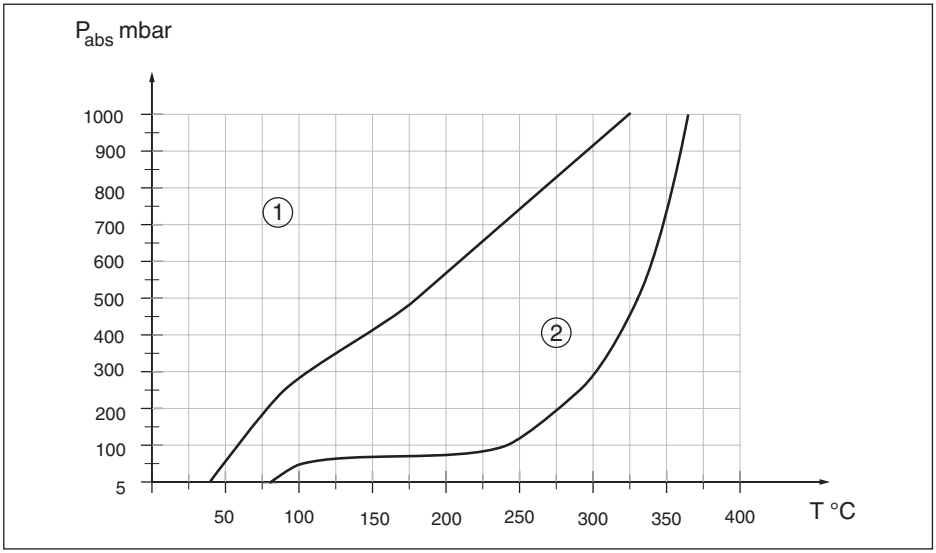

Fig. 3: Area of application for high temperature oil KN 32

1 Standard chemical seal
2 Chemical seal with vacuum service

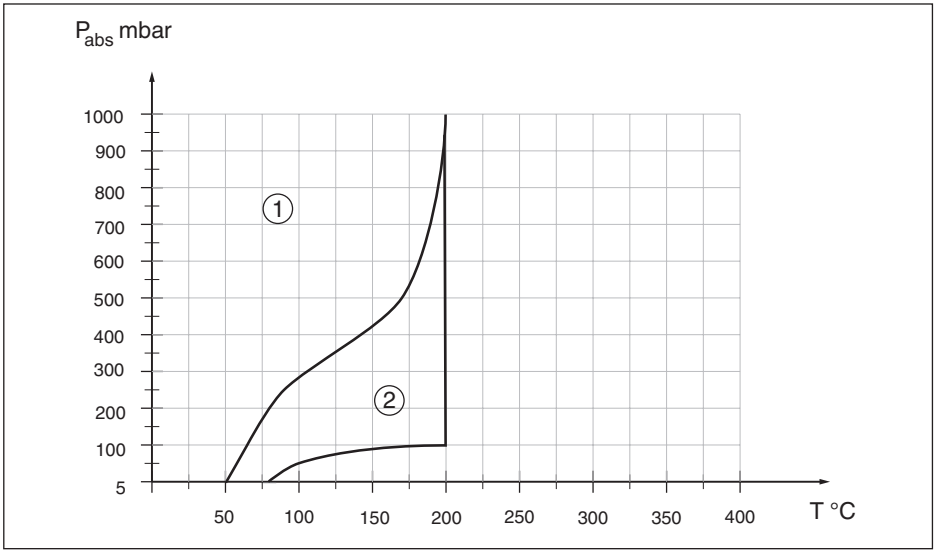

Fig. 4: Area of application for silicone oil KN 2.2

1 Standard chemical seal
2 Chemical seal with vacuum service

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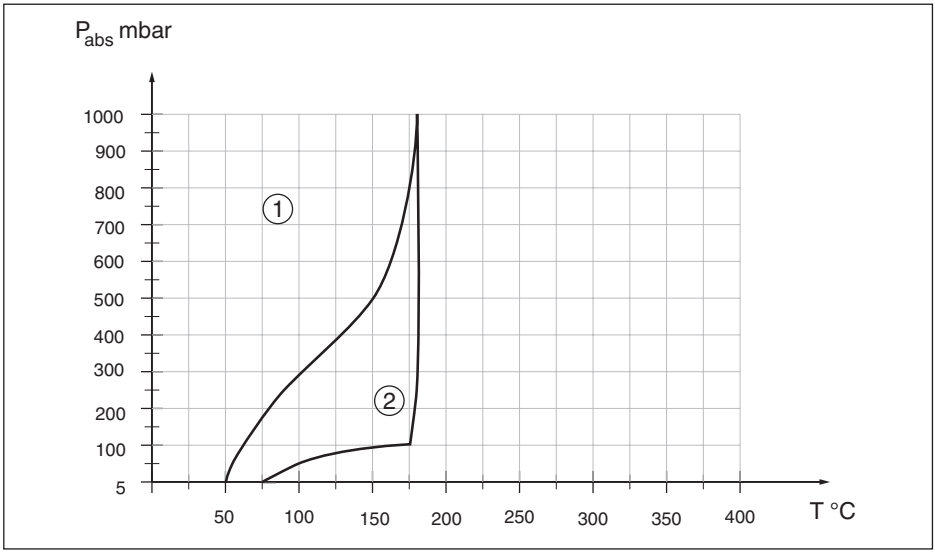

Fig. 5: Area of application for silicone oil KN 17

1 Standard chemical seal
2 Chemical seal with vacuum service

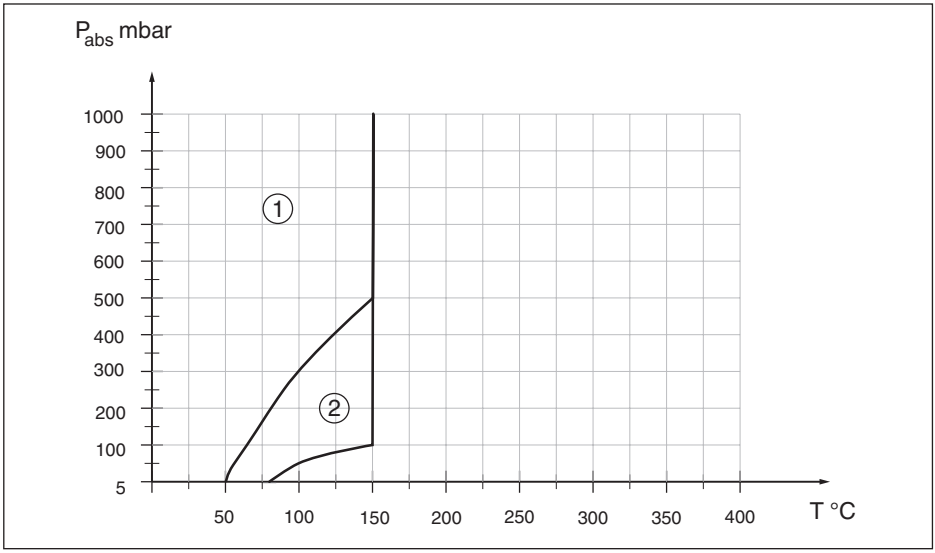

Fig. 6: Area of application for Halocarbon oil KN 21

1 Standard chemical seal
2 Chemical seal with vacuum service

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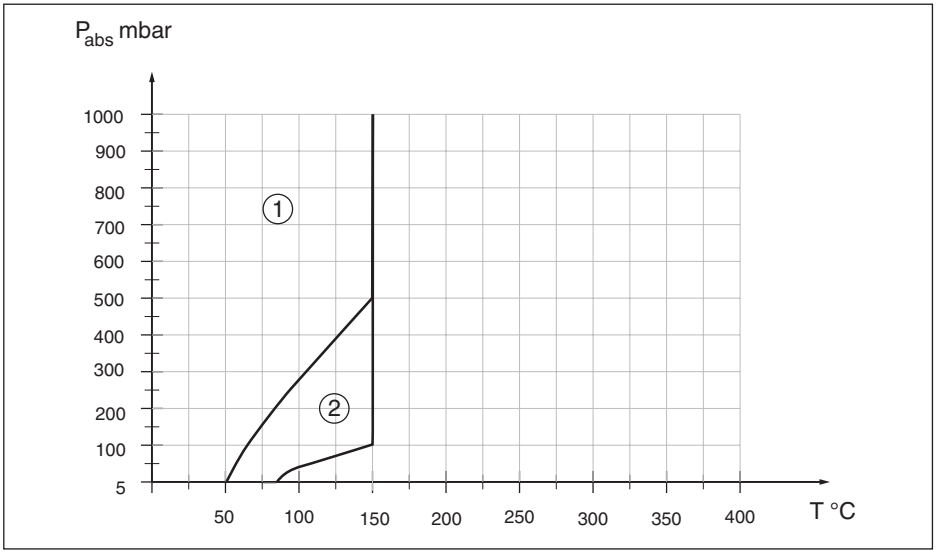

Fig. 7: Area of application for Neobee KN 59

1 Standard chemical seal
2 Chemical seal with vacuum service

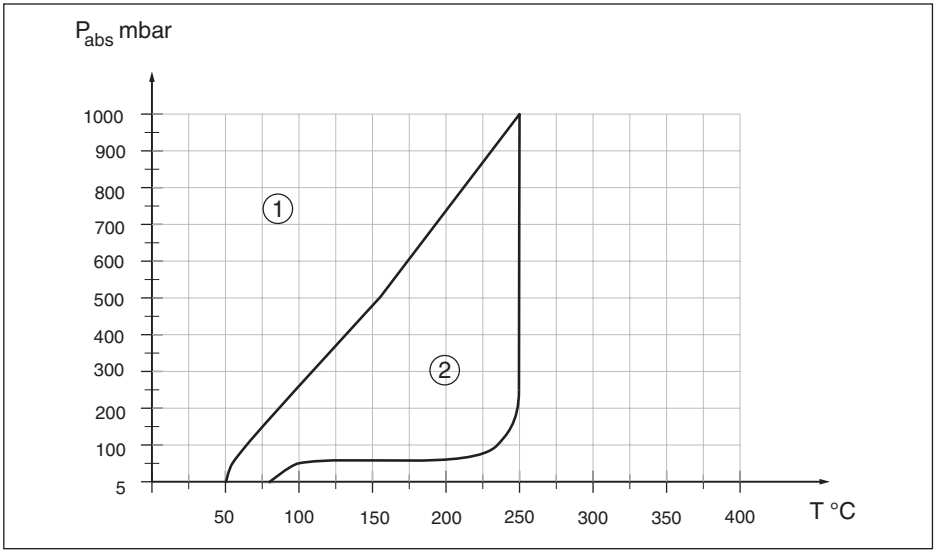

Fig. 8: Area of application for med. white oil KN 92

1 Standard chemical seal
2 Chemical seal with vacuum service

6.3 Dimensions

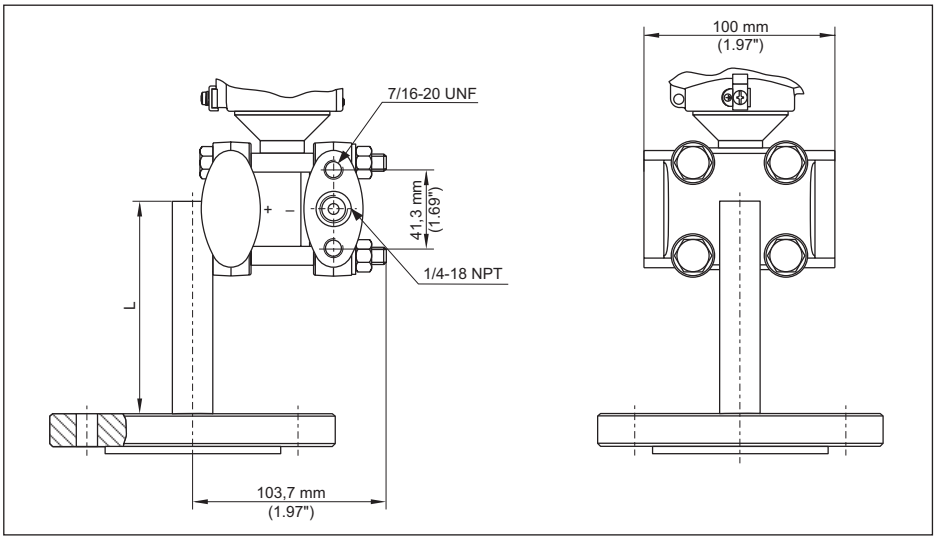

Fig. 9: Process fitting with chemical seal one-sided. Dimension L je dependent on the version 100 mm or 150 mm. Connection of the minus side via ¼-18 NPT, mounting via 7/16-20 UNF, connection of the plus side see following tables.

In the following charts, the typical values for the temperature coefficient "TK Process" are listed apart from the dimensions. The values apply for silicone oil and the diaphragm material 316L. For other filling oils, these must be multiplied by the TK corrective factor of the respective filling oil.

The stated nominal pressure applies to the chemical seal. The max. pressure for the complete measuring system depends on the weakest element (with regard to pressure) of the selected components.

The weights of the chemical seals are listed in the charts. For the weight of the transmitter see also "*Dimensions and weights*" in operating instructions VEGADIF 65.

The following drawings are unifilar diagrams. The actual dimensions of the chemical seal can deviate from these dimensions.

EN/DIN flanges, dimensions according to EN 1092-1/DIN 2501

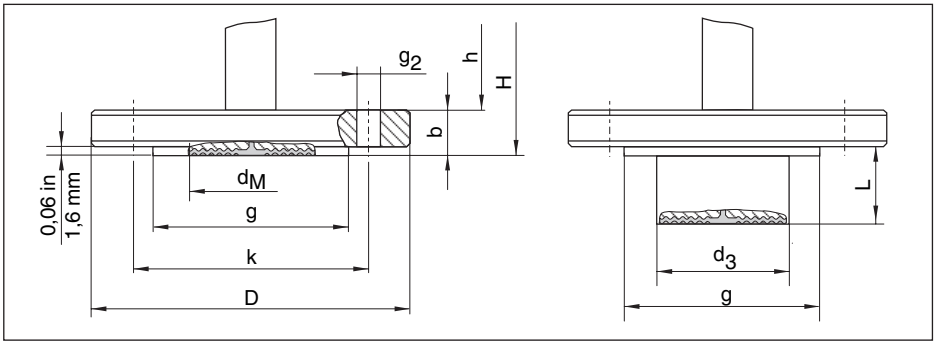

Fig. 10: Process fitting VEGADIF 65 with single-sided chemical seal, plus side EN/DIN flange with and without extension, 316L

Version	Nominal diameter	Nominal pressure	Form	Diameter d[mm]	Thickness b [mm]	Seal ledge g [mm]	Extension length L [mm]	Extension diameter d3 [mm]
FC	DN 50	PN 40	D	165	20	102	-	-
FD	DN 50	PN 40	D	165	20	102	50	48.5
FH	DN 80	PN 40	D	200	24	138	-	-
FJ	DN 80	PN 40	D	200	24	138	50	76
DF	DN 100	PN 40	D	220	24	162	50	94

Version	Number of screw holes	Diame-ter, screw holes g2 [mm]	Hole cir-cle, screw holes k [mm]	Max. dia-phragm diameter dM [mm]	TK ambient [mbar/10K]	TK process [mbar/10K]	Weight flange [kg]
FC	4	18	125	59	+1.70	+1.20	3.3
FD	4	18	125	47	-	-	4.3
FH	8	18	160	89	+0.21	+0.25	5.8
FJ	8	18	160	72	+1.06	+1.34	6.8
DF	8	22	190	89	-	-	9.1

ASME flanges, dimensions according to B16.5, seal ledge RF

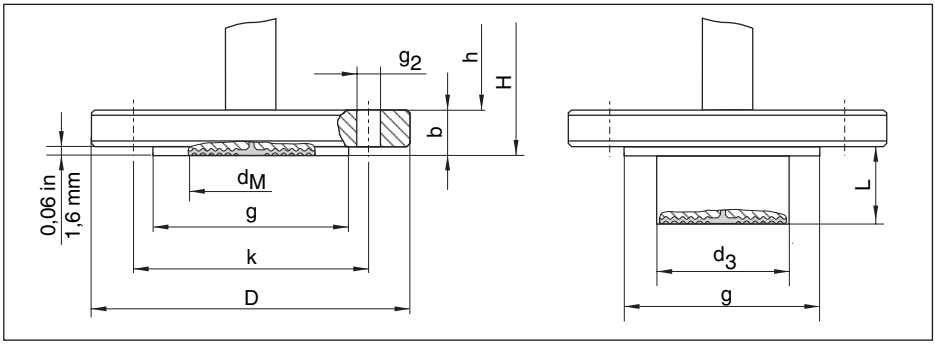

Fig. 11: Process fitting VEGADIF 65 with single-sided chemical seal, plus side ASME flange with and without extension, 316/316L

Version	Nominal diameter ["]	Class [lb] [sq.in]	Diameter d [in][mm]	Thickness b [in][mm]	Seal ledge g [in][mm]	Extension length L [in][mm]	Extension diameter d3 [in][mm]
F5	2	150	6 (150)	0.75 (20)	3.62 (92)	-	-
F7	2	150	6 (150)	0.75 (20)	3.62 (92)	2 (50)	1.9
FS	3	150	7.5 (190)	0.94 (24)	5 (127)	-	-
EW	3	150	7.5 (190)	0.94 (24)	5 (127)	2 (50)	2.9
FQ	3	150	7.5 (190)	0.94 (24)	5 (127)	6 (150)	2.9

Version	Number of screw holes	Diameter, screw holes g2 [in][mm]	Hole circle, screw holes k [in] [mm]	Max. diaphragm diameter dM [in] [mm]	TK ambient [mbar/10K]	TK process [mbar/10K]	Weight [kg]
F5	4	0.75 (20)	4.75 (120.5)	2.32 (59)	+1.70	+1.20	2.7
F7	4	0.75 (20)	4.75 (120.5)	1.85 (47)	-	-	3.7
FS	8	0.75 (20)	6 (152.5)	3.50 (89)	+0.21	0.25	5.3
EW	8	0.75 (20)	6 (152.5)	2.83 (72)	+1.06	+1.34	6.3
FQ	8	0.75 (20)	6 (152.5)	2.83 (72)	-	-	6.3

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6.4 Industrial property rights

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