Operating instructions

Chemical seal CSS

for VEGADIF 85

Document ID: 54851

Contents

1 About this document ... 3
1.1 Function ... 3
1.2 Target group ... 3
1.3 Symbols used ... 3

2 For your safety ... 4
2.1 Authorised personnel ... 4
2.2 Appropriate use ... 4
2.3 Warning about incorrect use ... 4
2.4 General safety instructions ... 4
2.5 Installation and operation in the USA and Canada ... 4

3 Product description ... 5
3.1 Configuration ... 5
3.2 Principle of operation ... 5
3.3 Packaging, transport and storage ... 5

4 Planning instructions for isolating systems ... 7
4.1 Influence of the components ... 7
4.2 Influence of temperature changes ... 8
4.3 Calculation of the temperature error ... 8

5 Mounting ... 10
5.1 Application conditions ... 10
5.2 Oxygen applications ... 11
5.3 Instructions for handling ... 12
5.4 Mounting instructions ... 12

6 Maintenance and fault rectification ... 13
6.1 Maintenance ... 13

7 Supplement ... 14
7.1 Technical data ... 14
7.2 Chemical seal with vacuum applications ... 14
7.3 Dimensions ... 18
7.4 Industrial property rights ... 21
7.5 Trademark ... 21

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1 About this document

1.1 Function

This operating instructions provides all the information you need for mounting, connection and setup as well as important instructions for maintenance, fault rectification, the exchange of parts and the safety of the user. Please read this information before putting the instrument into operation and keep this manual accessible in the immediate vicinity of the device.

1.2 Target group

This operating instructions manual is directed to trained personnel. The contents of this manual must be made available to the qualified personnel and implemented.

1.3 Symbols used

Document ID
This symbol on the front page of this instruction refers to the Document ID. By entering the Document ID on www.vega.com you will reach the document download.

Information, tip, note
This symbol indicates helpful additional information.

Caution: If this warning is ignored, faults or malfunctions can result.

Warning: If this warning is ignored, injury to persons and/or serious damage to the instrument can result.

Danger: If this warning is ignored, serious injury to persons and/or destruction of the instrument can result.

Ex applications
This symbol indicates special instructions for Ex applications.

SIL applications
This symbol indicates instructions for functional safety which must be taken into account particularly for safety-relevant applications.

- **List**
  The dot set in front indicates a list with no implied sequence.

→ **Action**
This arrow indicates a single action.

1 **Sequence of actions**
Numbers set in front indicate successive steps in a procedure.

Disposal
This symbol indicates special instructions for disposal.

2 For your safety

2.1 Authorised personnel

All operations described in this documentation must be carried out only by trained, qualified personnel authorised by the plant operator.

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

2.2 Appropriate use

The chemical seal is a functional part of the differential pressure transmitter VEGADIF 85.

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.

2.3 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.

2.4 General safety instructions

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

2.5 Installation and operation in the USA and Canada

This information is only valid for USA and Canada. Hence the following text is only available in the English language.

Installations in the US shall comply with the relevant requirements of the National Electrical Code (ANSI/NFPA 70).

Installations in Canada shall comply with the relevant requirements of the Canadian Electrical Code.

54851-EN-220909

3 Product description

3.1 Configuration

Scope of delivery

The scope of delivery encompasses:

- VEGADIF 85 differential pressure transmitter
- Chemical seal CSS mounted on VEGADIF 85
- Documentation
  – This operating instructions manual

Constituent parts

The CSS chemical seal consists of the following components: separating diaphragm, process fitting as well as temperature decoupler. The components are welded with the associated differential pressure transmitter and represent a hermetically sealed system.

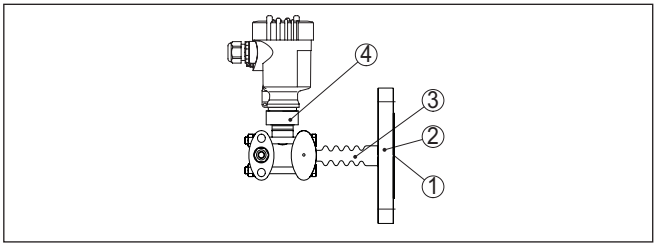

Fig. 1: VEGADIF 85 with chemical seal CSS

1 Separating diaphragm
2 Process fitting
3 Transmission line (capillaries)
4 VEGADIF 85

3.2 Principle of operation

Application area

Chemical seals are used if a separation of 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 with a pressure transmission liquids to the sensor element of the differential pressure transmitter.

3.3 Packaging, transport and storage

Packaging

Your instrument was protected by packaging during transport. Its capacity to handle normal loads during transport is assured by a test based on ISO 4180.

The packaging of standard instruments consists of environment-friendly, recyclable cardboard. For special versions, PE foam or PE

foil is also used. Dispose of the packaging material via specialised recycling companies.

Caution:
Instruments for oxygen applications are sealed in PE foil and provided with a label "Oxygen! Use no Oil". Remove this foil just before mounting the instrument! See instruction under " *Mounting*".

Transport

Transport must be carried out in due consideration of the notes on the transport packaging. Nonobservance of these instructions can cause damage to the device.

Transport inspection

The delivery must be checked for completeness and possible transit damage immediately at receipt. Ascertained transit damage or concealed defects must be appropriately dealt with.

Storage

Up to the time of installation, the packages must be left closed and stored according to the orientation and storage markings on the outside.

Unless otherwise indicated, the packages must be stored only under the following conditions:

- Not in the open
- Dry and dust free
- Not exposed to corrosive media
- Protected against solar radiation
- Avoiding mechanical shock and vibration

Storage and transport temperature

- Storage and transport temperature see chapter " *Supplement - Technical data - Ambient conditions*"
- Relative moisture 20 … 85 %

Lifting and carrying

With instrument weights of more than 18 kg (39.68 lbs) suitable and approved equipment must be used for lifting and carrying.

4 Planning instructions for isolating systems

4.1 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 product temperatures	Permissible medium temperature with p_{abs} < 1 bar/14.5 psi	Density in g/cm³ at 25 °C	Kinematic viscosity in cSt at 25 °C	Corrective factor for TK	Application area
Silicone oil VE 2.2, KN 2.2	-40 … +150 °C (-40 … +302 °F)		0.96	54.5	1	Standard
Silicone oil KN 17	-90 … +180 °C (-130 … +356 °F)	-90 … +80 °C (-130 … +176 °F)	0.92	4.4	-	Low temperatures
Silicone oil VE 2.2, KN 2.2 and cooling element	-40 … +200 °C (-40 … +392 °F)	-40 … +150 °C (-40 … +302 °F)	0.96	54.5	1	High temperatures
High temperature oil VE 32, KN 32	-10 … +300 °C (-14 … +572 °F)	-10 … +200 °C (-14 … +392 °F)	1.06	47.1	0.77	
High temperature oil VE 32, KN 32	-10 … +400 °C (+14 … +752 °F)					

Filling oil	Permissible product temperatures	Permissible medium temperature with p_{abs} < 1 bar/14.5 psi	Density in g/cm³ at 25 °C	Kinematic viscosity in cSt at 25 °C	Corrective factor for TK	Application area
Halocarbon oil KN 21	-40 … +150 °C (-40 … +302 °F)	-90 … +80 °C (-130 … +176 °F)	1.89	10.6	0.83	Chlorine applications
Halocarbon oil KN 21 (BAM tested) [1]	-40 … +60 °C (-40 … +140 °F)					Oxygen applications
Medical white oil KN 92, KN 92 (FDA approved)	-10 … +150 °C (+14 … +302 °F)		0.85	45.3	0.63	Food applications
Medical white oil KN 92, KN 92 (FDA approved) and cooling element	-10 … +250 °C (+14 … +482 °F)	-10 … +160 °C (+14 … +320 °F)				Food applications, high temperatures
Neobee M-20 KN 59 (FDA approved)	-10 … +150 °C (+14 … +302 °F)		0.92	10	-	Food applications

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. [2]

4.2 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*".

4.3 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 ($TK_{Process}$)
- Influence of the ambient temperature on the capillary ($TK_{Ambient}$)

1) Cleaning procedure oil and grease-free for oxygen applications, max. oxygen pressure 50 bar (725.2 psi) acc. to BAM investigation (Federal Institute for Materials Research and Testing)
2) The control volume is the volume that must be shifted in order to utilise the entire measuring range.

- Corrective factor with special materials (with Tantalum, Alloy: 1.5; with PTFE: 1.8)
- Corrective factor for filling oil
- Influence of the ambient temperature $TK_{Amb.}$ 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.

Example for single chemical seal

- Process temperature: 100 °C
- Flange isolating diaphragm DN 80 PN 40 with extension 50 mm
- TK Process flange isolating diaphragm: 1.34 mbar/10K (see chapter " *Supplement*" of this manual)
- Capillary length: 4 m
- Filing oil silicone: correction factor 1
- Diaphragm material.: Tantalum, correction factor 1.5
- Ambient temperature TU: 40 °C

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

5 Mounting

5.1 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 85 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.

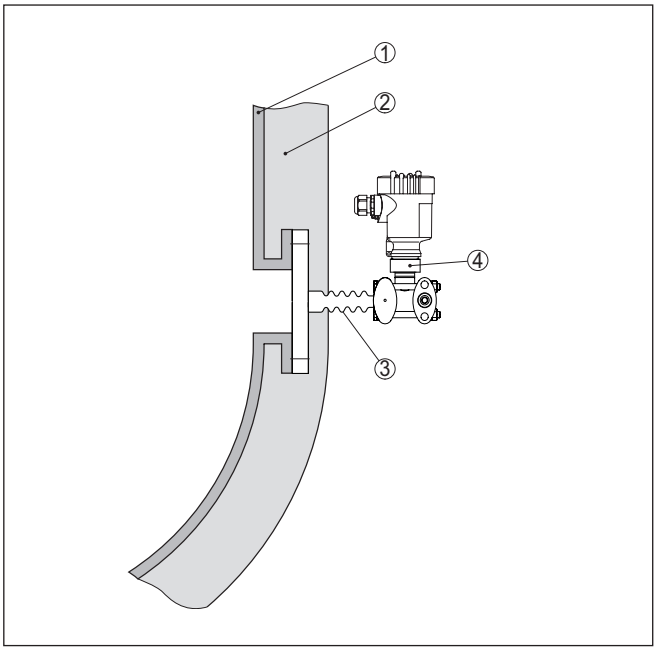

Fig. 2: Recommended vessel insulation with chemical seal without cooling area (length 100 mm)

1 Vessel wall
2 Vessel insulation
3 Temperature decoupler
4 VEGADIF 85

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

5.2 Oxygen applications

Oxygen applications

Oxygen and other gases can be explosive when brought into contact with oils, grease and plastics, so the following measures must also be taken:

- All components of the plant, such as e.g. measuring instruments must be cleaned oil and grease-free for oxygen applications according to the requirements of BAM (Federal Institute for Materials Research and Testing)
- Max. temperatures and pressures determined with oxygen applications must not be exceeded, see chapter " *Technical data*" and " *Chemical seals with vacuum applications*", also keep sealing material in mind

Danger:
Instruments for oxygen applications must be unpacked just before mounting. After removing the protective cover of the process fitting,

the label "O2" will be visible on the process fitting. Penetration of oil, grease and dirt should be avoided. Danger of explosion!

5.3 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

5.4 Mounting instructions

Sealing

- Suitable seals must be selected for sealing
- With the 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 Elastomer 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 ≥ 30 mm

6 Maintenance and fault rectification

6.1 Maintenance

Maintenance

If the device 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.

7 Supplement

7.1 Technical data

Materials	
Diaphragm	316L, 316L gold-coated, Alloy C276 (2.4819), Tantalum, PTFE foil on 316L, Inconell 600, Superduplex (1.4410)
Flanges	316L
Capillaries	316Ti
Protective hose for capillaries	316L
Seal low pressure side	PTFE

Process conditions	
Max. process pressure, max. process temperature	see operating instructions manual of the respective sensor

Process conditions with oxygen applications

Max. process temperature	Max. oxygen pressure
+60 °C	50 bar
>+60 °C up to 100 °C	30 bar
>+100 °C up to 175 °C	25 bar

Process conditions - mechanical

For the process conditions, please also note the specifications on the type label. The lowest value (amount) always applies.

Vibration resistance[3)]

Version	Housing	Vibration resistance
Pressure transmitter vertically or horizontally	Plastic housing	4M5 (1 g)
	Aluminium housing	
	Stainless steel housing	4M3 (0.5 g)

Schock resistance[4)]

Version	Housing	Shock resistance
Pressure transmitter vertically or horizontally	Plastic housing	6M4 (10 g/11 ms, 30 g/6 ms, 50 g/2.3 ms)
	Aluminium housing	
	Stainless steel housing	

7.2 Chemical seal with vacuum applications

A chemical seal is closed to the medium with a metallic diaphragm. The inner space between the diaphragm and the sensor element is completely filled with a pressure transmission fluid.

3) Test sequence acc. to IEC 60068-2-6 (5 … 200 Hz), classification acc. to IEC 60721-3-4
4) Tested acc. to IEC 60068-2-27, classification acc. to IEC 60721-3-6

As the pressure decreases, the boiling temperature of the pressure transmission liquid drops. Thus, at pressure values < 1 bar_{abs}, depending on the temperature, gas particles can be released which are dissolved in the pressure transmission fluid. This makes it compressible, which leads to faulty measured values.

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 typical areas of application for different pressure transmission liquids. The characteristic curves are exemplary and can also deviate depending on the process fitting and diaphragm material.

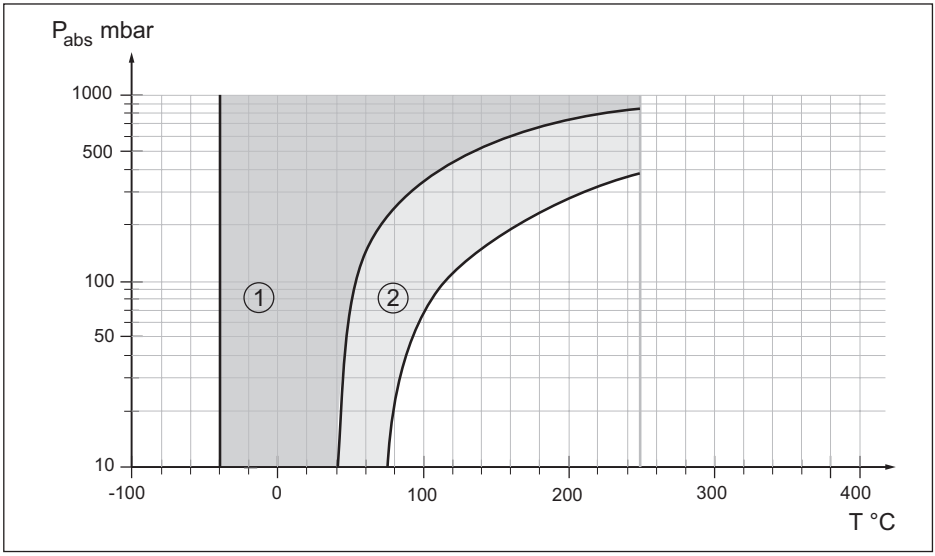

Fig. 3: Area of application for silicone oil VE 2.2, KN 2.2

1 Standard chemical seal
2 Chemical seal with vacuum service

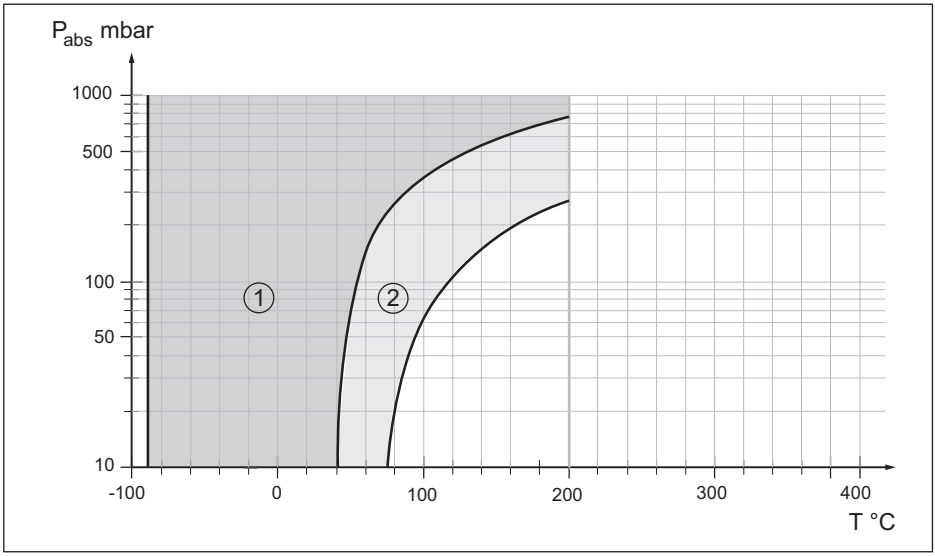

Fig. 4: Area of application for silicone oil KN 17

1 Standard chemical seal
2 Chemical seal with vacuum service

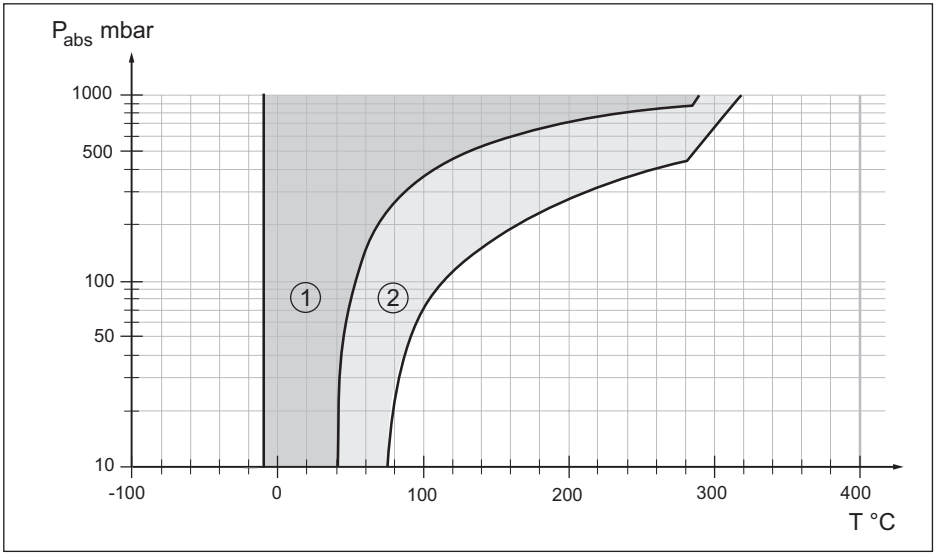

Fig. 5: Area of application for high temperature oil VE 32, KN 32

1 Standard chemical seal
2 Chemical seal with vacuum service

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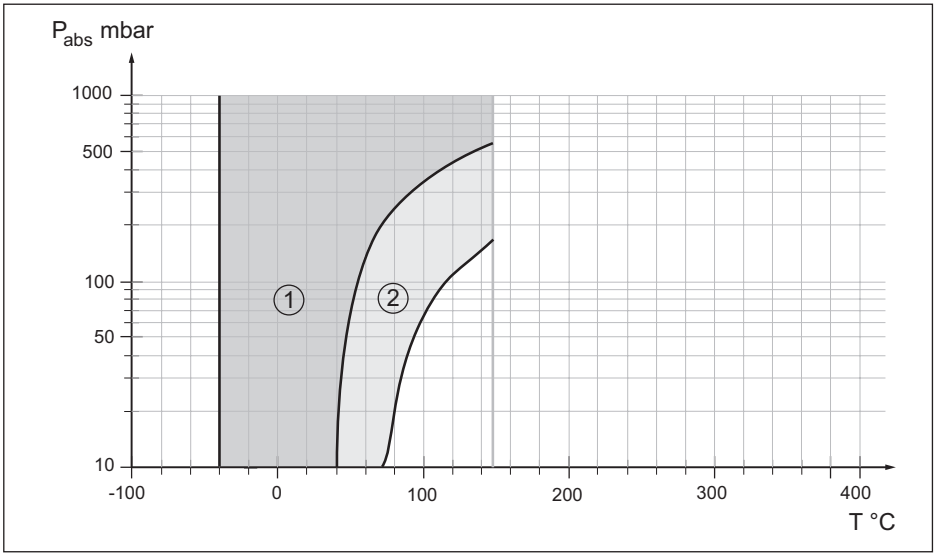

Fig. 6: Area of application for Halocarbon oil KN 21

1 Standard chemical seal
2 Chemical seal with vacuum service

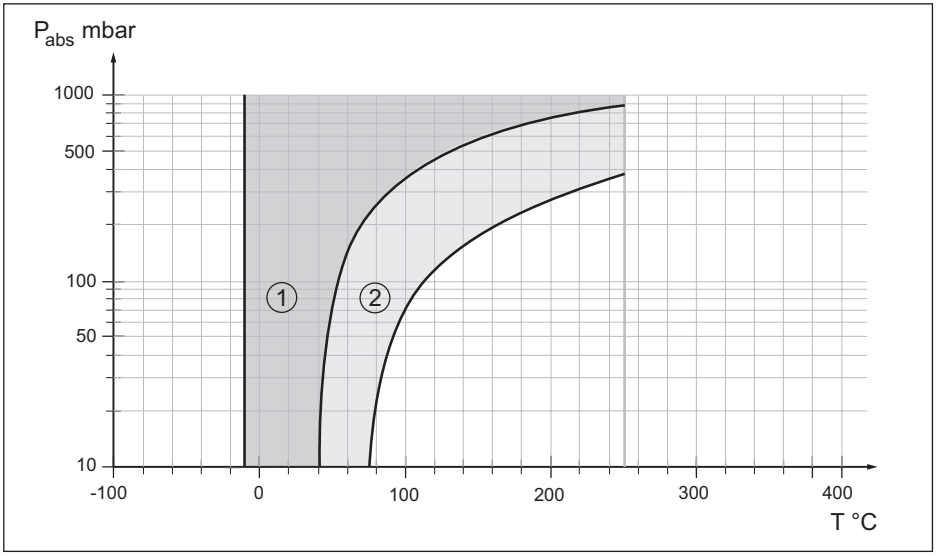

Fig. 7: Application area for medical white oil KN 92

1 Standard chemical seal
2 Chemical seal with vacuum service

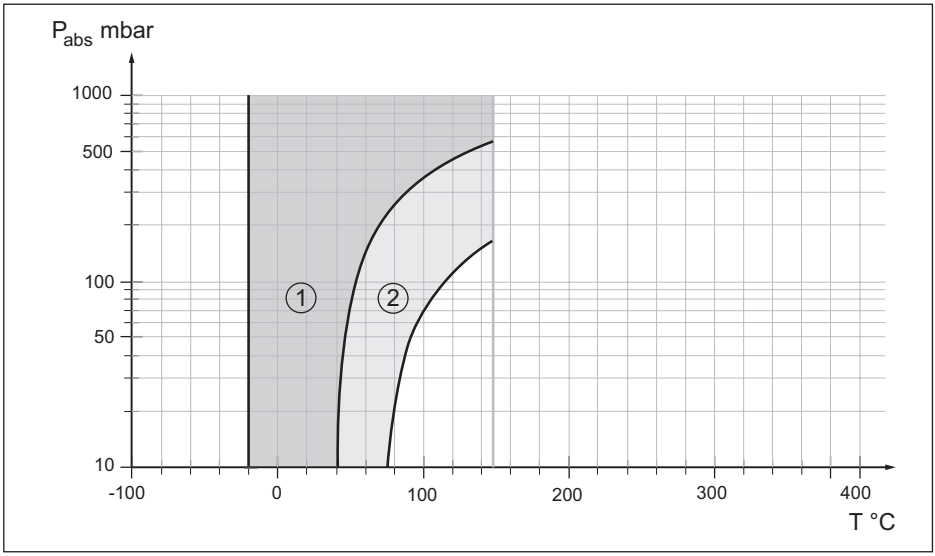

Fig. 8: Area of application for Neobee M-20 KN 59

1 Standard chemical seal
2 Chemical seal with vacuum service

7.3 Dimensions

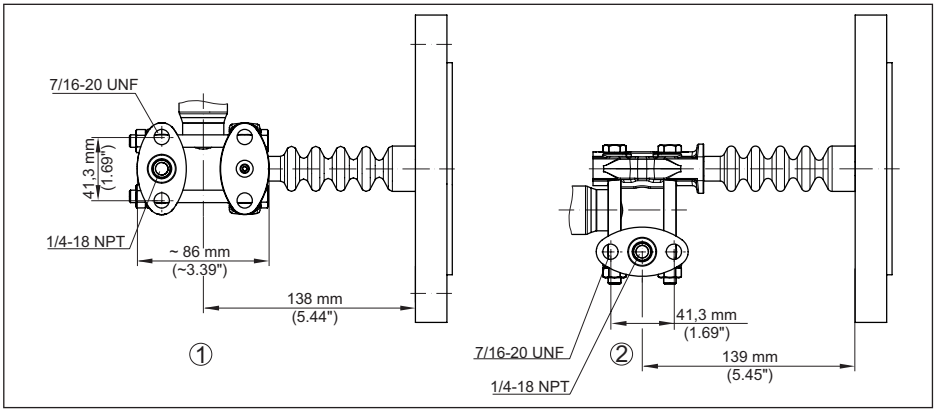

Fig. 9: Process fitting with chemical seal one-sided. Dimension L je dependent on the version 100 mm or 150 mm. Connection of the minus side via ¼-18 NPT, mounting via 7/16-20 UNF, connection of the plus side see following tables.

1 Pressure transmitter vertically (100 mm)
2 Pressure transmitter horizontally (100 mm)

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 85.

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

EN flanges, dimensions according to EN 1092-1

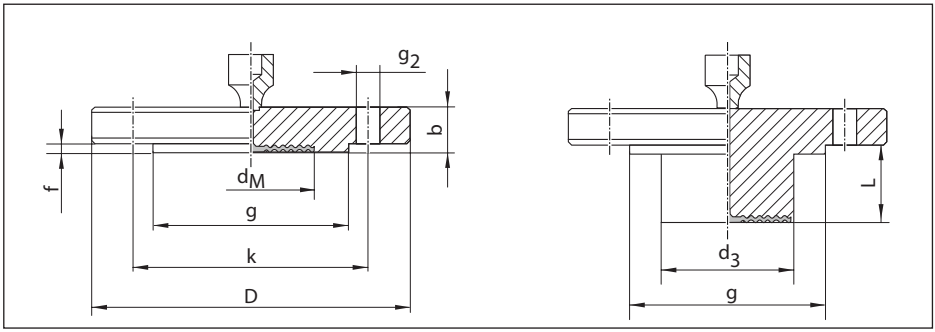

Fig. 10: Process fitting VEGADIF 85 with single-sided chemical seal, plus side EN flange with and without extension, 316L

Version	Nominal diameter	Nominal pressure	Form	Diameter D [mm]	Thickness b [mm]	Seal ledge g [mm]	Extension length L [mm]	Extension diameter d3 [mm]
EJ	DN 50	PN 40	B1	165	20	102	-	-
FD	DN 50	PN 40	B1	165	20	102	50	48.5
BW	DN 80	PN 40	B1	200	24	138	-	-
FJ	DN 80	PN 40	B1	200	24	138	50	76

Version	Number of screw holes	Diameter, screw holes g2 [mm]	Hole circle, screw holes k [mm]	Max. diaphragm diameter dM [mm]	TK ambient [mbar/10K]	TK process [mbar/10K]	Weight flange [kg (lb)]
EJ	4	18	125	58	+1.70	+1.20	3.0 (6.62)
FD	4	18	125	47	-	-	4.3 (9.48)
BW	8	18	160	89	+0.21	+0.25	5.2 (11.47)
FJ	8	18	160	72	+1.06	+1.34	6.2 (13.67)

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

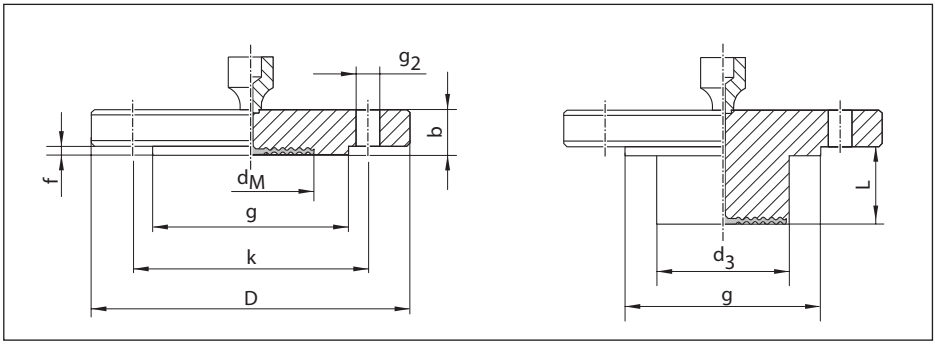

Fig. 11: Process fitting VEGADIF 85 with single-sided chemical seal, plus side ASME flange with and without extension, 316/316L

Version	Nominal diameter ["]	Class [lb]/ [sq.in]	Diameter D [in]	Thickness b [in]	Seal ledge g [in]	Extension length L [in]	Extension diameter d3 [in]
F5	2	150	6	0.75	3.62	-	-
FS	3	150	7.5	0.94	5	-	-
EW	3	150	7.5	0.94	5	2	2.99

Version	Number of screw holes	Diameter, screw holes g2 [in]	Hole circle, screw holes k [in]	Max. diaphragm diameter dM [in]	TK ambient [mbar/10K]	TK process [mbar/10K]	Weight [kg (lb)]
F5	4	0.75	4.75 (120.5)	2.05	+1.70	+1.20	2.6 (5.73)
FS	4	0.75	6 (152.5)	3.15	+0.21	0.25	5.1 (11.25)
EW	4	0.75	6 (152.5)	2.83	+1.06	+1.34	6 (13.23)

7.4 Industrial property rights

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