

# Hydrogen applications with electronic pressure measurement

WIKA data sheet IN 00.40

## Description

Due to hydrogen diffusion into the sensor structures, signal drift can occur over time. The time until the occurrence of a relevant signal drift and the size of the signal drift depend mainly on the following factors:

- The temperature of the hydrogen
- The pressure of the hydrogen
- The hydrogen content in the medium

The user shall test the selected product version for suitability in the specific application environment.

### Sensor technologies for electronic pressure measurement:

| Thin-film measuring cell                                                                                               | Without oil filling |
|------------------------------------------------------------------------------------------------------------------------|---------------------|
| For pressure ranges $\geq 0 \dots 25$ bar [ $\geq 0 \dots 360$ psi] or $\geq 0 \dots 60$ bar [ $\geq 0 \dots 870$ psi] |                     |
| Piezo measuring cell                                                                                                   | With oil filling    |
| Pressure ranges from $0 \dots 0.4$ bar [ $0 \dots 5.8$ psi] to $0 \dots 25$ bar [ $0 \dots 360$ psi]                   |                     |

### Wetted parts

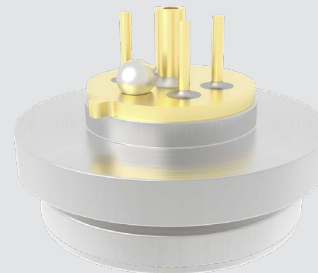
For wetted parts, only those materials are used which are suitable for permanent hydrogen pressure measurement.

### Leak test

The models listed here are subjected to a leak test with a leakage rate of max.  $1 \times 10^{-6}$  mbar·l/s during production.



Thin-film measuring cell



Piezo measuring cell

# Scope: thin-film measuring cell

Supplement to the following data sheets with the corresponding restrictions with respect to the measuring range:

| Data sheet | Model              | Material (wetted)        | Measuring ranges                                            |
|------------|--------------------|--------------------------|-------------------------------------------------------------|
| PE 81.61   | S-20 <sup>1)</sup> | Austenitic steel, 2.4711 | 0 ... 25 to 0 ... 1,000 bar [0 ... 400 to 0 ... 15,000 psi] |
| PE 86.05   | UPT-20             | Austenitic steel, 2.4711 | 0 ... 60 to 0 ... 1,000 bar [0 ... 700 to 0 ... 15,000 psi] |
| PE 86.06   | IPT-20             | Austenitic steel, 2.4711 |                                                             |

1) During configuration, select the suitability for hydrogen.

→ Other measuring ranges on request.

## Representation



## Long-term drift (per IEC 61298-2)

Deviating from the specifications in the respective data sheet, a higher long-term drift can occur.

Typical: ≤ 1 % of span/year

Maximum: ≤ 3 % of span/year

Valid at a temperature of up to 30 °C [86 °F].

For higher temperatures, the sensor must be tested by the user for suitability for the application.

# Scope: piezo measuring cell

Supplement to the following data sheet with the corresponding restrictions with respect to the measuring range:

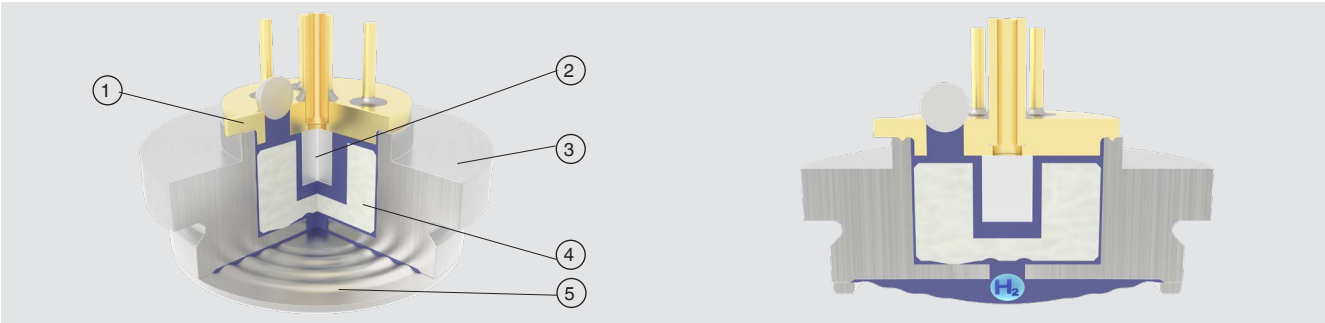
| Data sheet | Model | Material (wetted)    | Gauge pressure measuring ranges                      |
|------------|-------|----------------------|------------------------------------------------------|
| PE 81.61   | S-20  | Stainless steel 316L | 0 ... 0.4 to 0 ... 25 bar [0 ... 5 to 0 ... 400 psi] |

- During configuration, select the suitability for hydrogen.
- Other measuring ranges on request.



Absolute pressure measuring ranges do not fall within the scope of this document.

## Design



- ① Header
- ② MEMS chip with glass base
- ③ Case
- ④ Volume displacer
- ⑤ Diaphragm

The permeation (penetration) of hydrogen into the oil filling of the sensor can cause a gas bubble to form there. This bubble creates internal pressure in the measuring cell, leading to a signal offset (zero point offset).  
→ This theory has been checked in tests.

## Test

| Test conditions                                                                                                  |                      |
|------------------------------------------------------------------------------------------------------------------|----------------------|
| Medium                                                                                                           | Hydrogen 3.0         |
| Measuring range                                                                                                  | 1 bar gauge pressure |
| Duration                                                                                                         | 6,000 h and ongoing  |
| Temperature                                                                                                      | 125 °C [257°F]       |
| Material (wetted)                                                                                                | 316L                 |
| → After every 1,000 hours, a mechanical pulse was applied to release any gas that may have dissolved in the oil. |                      |

## Result

Even after 6,000 hours, the devices under test showed no hydrogen-induced signal drift.  
→ Taking into account the test conditions, a gauge pressure piezo measuring cell can also be used to measure hydrogen.

Pressure signals should be monitored regularly.

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# Notes on equipment protection per IEC/EN 60529 and NEMA For Bourdon tube or diaphragm pressure gauges

WIKA data sheet IN 00.18

## General information

This technical information describes the measures to prevent both the formation of condensation within a hermetically sealed case, and also the intrusion of water into cases vented to the atmosphere. These measures apply both to Bourdon tube pressure gauges and to diaphragm pressure gauges.

## 1. Introduction and explanation of physical conditions

The formation of condensation in the cases of hermetically sealed, unfilled instruments cannot generally be avoided. This is based on the physical fact that the humidity found in air, under particular conditions, settles on cold surfaces as condensation. The warmer the air, the more humidity it can hold. If the air cools (e.g. at the window of a measuring instru-

ment), then the air can only hold a small amount of humidity. The excess humidity settles as condensation on the window.

In addition, water in the form of splash, jet and rain water from outside can intrude into the case, so long as the instrument is vented to atmosphere.

## 2. Explanation of the degrees of protection per IEC/EN 60529

Degrees of protection against solid foreign bodies, defined by the first index number

| First index number | Degree of protection                                                  |                                                                                                                                                                    |
|--------------------|-----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                    | Code designation                                                      | Definition                                                                                                                                                         |
| 0                  | Not protected                                                         | –                                                                                                                                                                  |
| 1                  | Protected against solid foreign bodies of 50 mm diameter and larger   | The object probe, a round body of 50 mm diameter, must not fully intrude <sup>1)</sup>                                                                             |
| 2                  | Protected against solid foreign bodies of 12.5 mm diameter and larger | The object probe, a round body of 12.5 mm diameter, must not fully intrude <sup>1)</sup>                                                                           |
| 3                  | Protected against solid foreign bodies of 2.5 mm diameter and larger  | The object probe, 2.5 mm in diameter, must not intrude at all <sup>1)</sup>                                                                                        |
| 4                  | Protected against solid foreign bodies of 1.0 mm diameter and larger  | The object probe, 1.0 mm in diameter, must not intrude at all <sup>1)</sup>                                                                                        |
| 5                  | Dust protected                                                        | Ingress of dust is not completely prevented, but dust may not intrude in a such a quantity that the satisfactory operation of the instrument or safety is impaired |
| 6                  | Dust-proof                                                            | No ingress of dust                                                                                                                                                 |

<sup>1)</sup> The full diameter of the object probe must not pass through any opening in the case.

### Illustration 1

Source: IEC/EN 60529

## Degrees of protection against water, defined by the second index number

| Second index number | Degree of protection                                               |                                                                                                                                                                                                                                                                            |
|---------------------|--------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                     | Code designation                                                   | Definition                                                                                                                                                                                                                                                                 |
| 0                   | Not protected                                                      | –                                                                                                                                                                                                                                                                          |
| 1                   | Protected against dripping water                                   | Perpendicularly falling drops must have no damaging effects.                                                                                                                                                                                                               |
| 2                   | Protected against dripping water when the case is inclined to 15°. | Perpendicularly falling drops must have no damaging effects, when the case is inclined to an angle of up to 15°, either side of perpendicular.                                                                                                                             |
| 3                   | Protected against sprayed water                                    | Water that is sprayed at an angle of up to 60°, either side of perpendicular, must have no damaging effects.                                                                                                                                                               |
| 4                   | Protected against splash water                                     | Water that splashes against the case from any direction must have no damaging effects.                                                                                                                                                                                     |
| 5                   | Protected against water jets                                       | Water that splashes against the case, as a jet, from any direction, must have no damaging effects.                                                                                                                                                                         |
| 6                   | Protected against strong water jets                                | Water that splashes against the case, as a strong jet, from any direction, must have no damaging effects.                                                                                                                                                                  |
| 7                   | Protected against the effects of temporary immersion in water      | Water must not enter in any quantity which could cause damage, when the case, under standardised pressure and temperature conditions, is temporarily immersed in water.                                                                                                    |
| 8                   | Protected against the effects of permanent immersion in water      | Water must not enter in any quantity which could cause damage, when the case is permanently immersed in water, under conditions which must be agreed between the manufacturer and user. The conditions must, however, be more demanding than those for the index number 7. |

### Illustration 2

Source: IEC/EN 60529

#### Example: Ingress protection IP65

- First index number 6: Dust-proof, no ingress of dust
- Second index number 5: Protected against water jets: Water that splashes against the case as a jet from any direction must have no damaging effects.

## 3. Comparison of NEMA (National Electrical Manufacturers Association) and IEC/EN 60529

| NEMA ingress protection Model number | IEC/EN 60529 ingress protection Classification |
|--------------------------------------|------------------------------------------------|
| 1                                    | IP10                                           |
| 2                                    | IP11                                           |
| 3                                    | IP54                                           |
| 3 R                                  | IP14                                           |
| 3 S                                  | IP54                                           |
| 4 and 4 X                            | IP66                                           |
| 5                                    | IP52                                           |
| 6 and 6 P                            | IP67                                           |
| 12 and 12 K                          | IP52                                           |
| 13                                   | IP54                                           |

### Illustration 3

## 4. Measures against the formation of condensation

### Different fill fluids depending on the ambient temperature and the electrical conductivity

In order to avoid the formation of condensation in the case, WIKA recommends filling the instruments with glycerine. For contact gauges, the filling can be made with silicone oil, since silicone oil, unlike glycerine, is not hygroscopic and therefore prevents a short-circuit within the instrument.

If the ambient temperature drops below  $-20\text{ }^{\circ}\text{C}$ , then we recommend that the instrument absolutely must be filled with silicone oil. Even at temperatures down to  $-50\text{ }^{\circ}\text{C}$ , silicone oil can still be used due to its low viscosity.

For flammable and/or explosive media, e.g. oxygen, inert fill fluids must be used.

## 5. Hermetically sealed instruments and effects associated with them

In order to prevent the intrusion of water into the case, it is recommended that an ingress protection method is chosen that reliably inhibits this (see illustrations 1 and 2). The ingress protection demands that the instrument is hermetically sealed.

With vented instruments, the vent valve has to be closed in order to achieve the specified ingress protection. This, however, produces a temperature error, which can affect the measuring result (see illustrations 4, 5 and 6). Therefore the vent valve has to be opened for a short time before reading the measured value.

### 5.1 Temperature errors in unfilled and filled Bourdon tube pressure gauges

A standard 232.50/30 instrument with a pressure range greater than 25 bar can be made hermetically sealed without any problems, and manufactured with an ingress protection of IP66. The temperature error that occurs with these instruments is negligible, since it is so small in relation to the pressure range, that the instrument still will operate within its specified class accuracy.

Instruments with a scale range of less than 25 bar can likewise be made hermetically sealed, though a temperature error will then be present (see illustration 4). The temperature errors present are shown in the following graphs.

#### Temperature errors in hermetically sealed, unfilled Bourdon tube pressure gauges

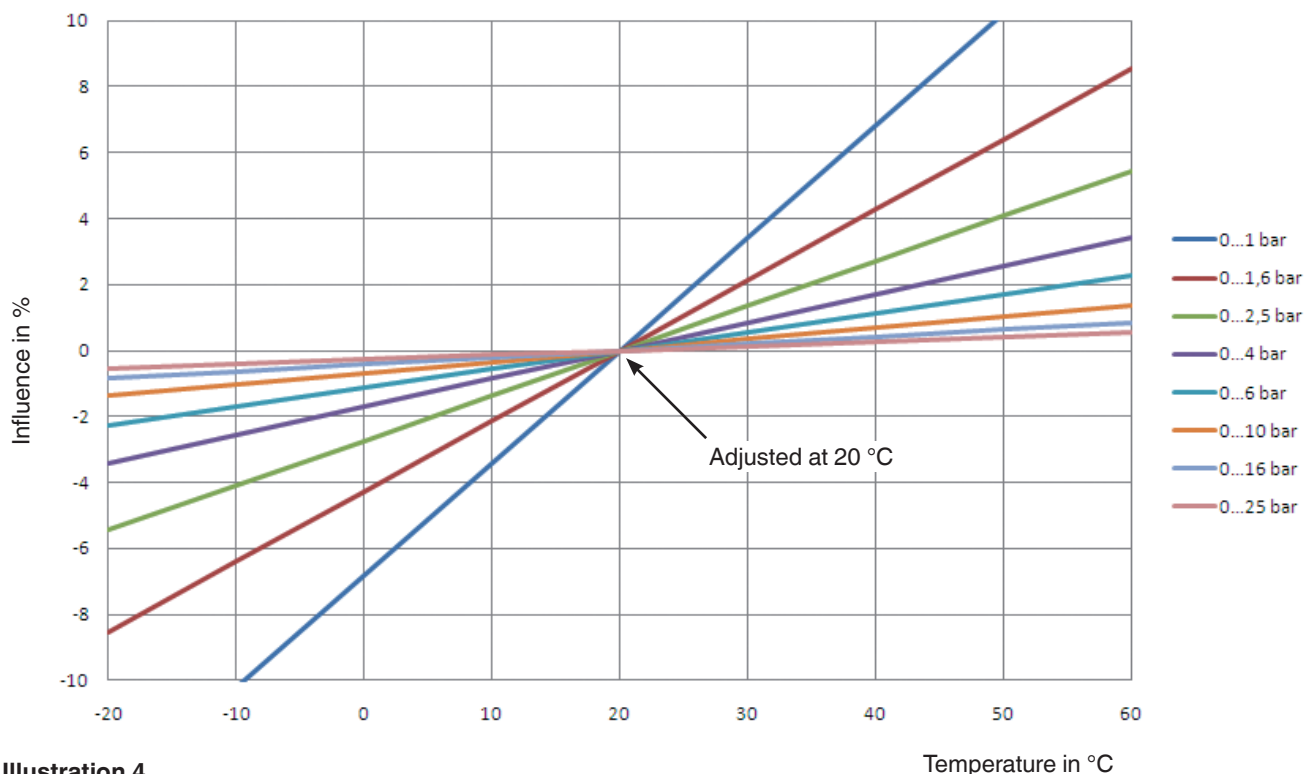


Illustration 4

## Temperature errors in hermetically sealed, filled Bourdon tube pressure gauges

Filled to 90 % with glycerine

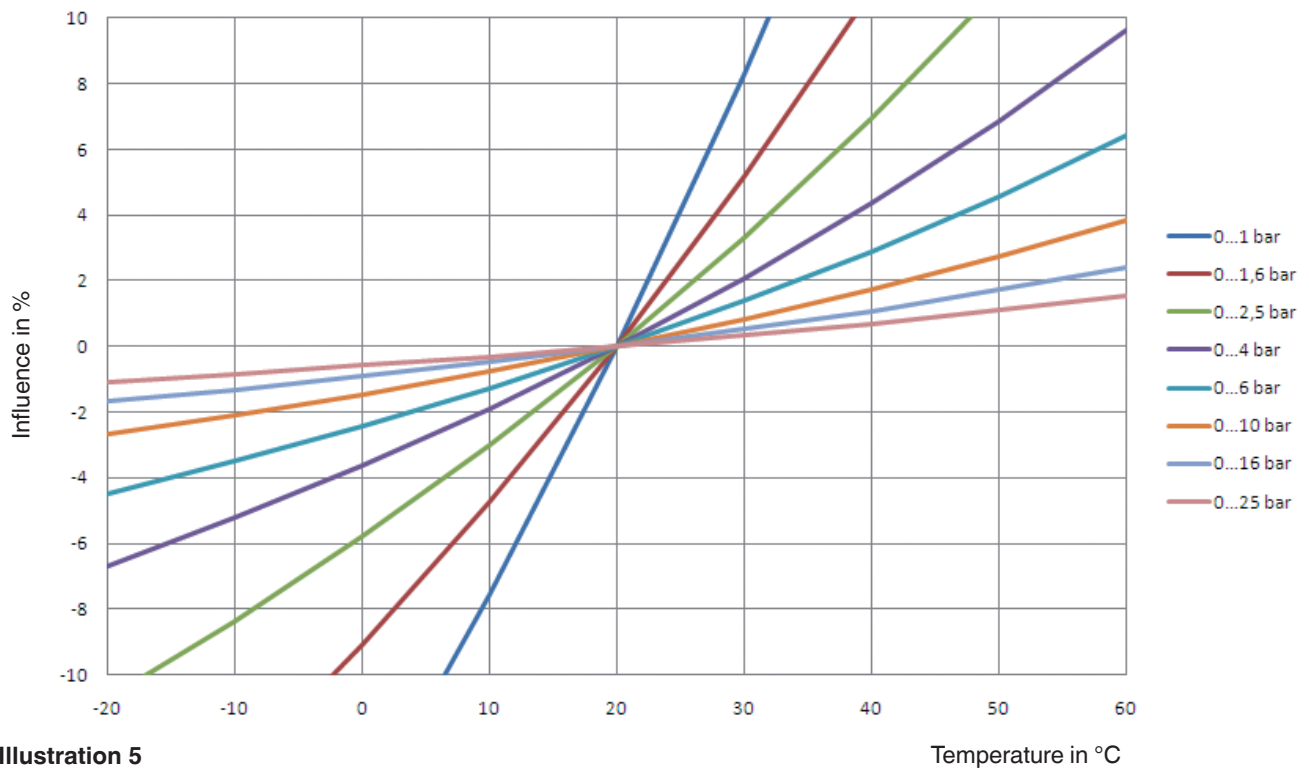


Illustration 5

Filled to 90 % with silicone oil

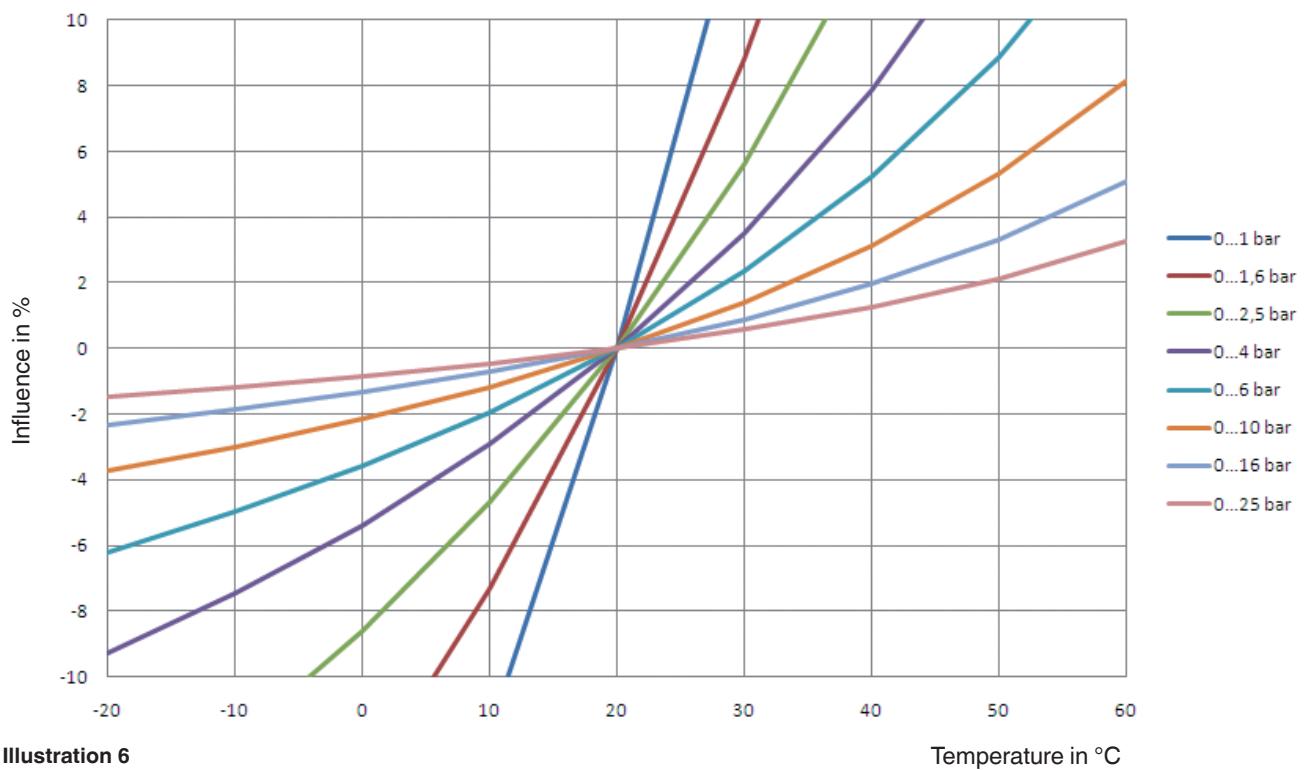


Illustration 6

## 5.1 Temperature errors in unfilled and filled diaphragm pressure gauges

With model 4, 5 and 7 hermetically sealed diaphragm pressure gauges, the temperature error for scale ranges  $\geq 100$  mbar is negligible. For scale ranges  $< 100$  mbar we recommend only using instruments with a pressure compensating diaphragm.

For instrument models 7xx.14, DPG40, DPGS40, DPGS40TA, DPGT40, DPS40, 700.01/02 and 7x2.15, due to their mechanical design, there are no additional temperature errors.

## 5.3 Model overview

Pressure gauges for which the formation of condensation and the ingress of water from the outside can be prevented:

| Influence                         | Bourdon tube pressure gauges |                                  |                      |                                       |                                                           | Diaphragm pressure gauges |                          |                      |                          |                                                              |                                                            |
|-----------------------------------|------------------------------|----------------------------------|----------------------|---------------------------------------|-----------------------------------------------------------|---------------------------|--------------------------|----------------------|--------------------------|--------------------------------------------------------------|------------------------------------------------------------|
|                                   | Model 2 unfilled             |                                  | Model 2 filled       |                                       | Model 233.30 filled, with pressure compensating diaphragm | Model 4 and 7 unfilled    |                          | Model 4 and 7 filled |                          | Model 4 and 7 unfilled, with pressure compensating diaphragm | Model 4 and 7 filled, with pressure compensating diaphragm |
|                                   | $\geq 25$ bar                | $< 25$ bar                       | $\geq 25$ bar        | $< 25$ bar                            | all pressure ranges                                       | $> 100$ mbar              | $< 100$ mbar             | $> 100$ mbar         | $< 100$ mbar             | all pressure ranges                                          | all pressure ranges                                        |
| Formation of condensation         | unavoidable                  |                                  | ✓                    | ✓                                     | ✓                                                         | unavoidable               |                          | ✓                    | ✓                        | unavoidable                                                  | ✓                                                          |
| Hermetically sealed <sup>1)</sup> | Influence negligible         | For influence see illustration 4 | Influence negligible | For influence see illustration 5 or 6 | ✓                                                         | Influence negligible      | Technically not solvable | Influence negligible | Technically not solvable | ✓                                                            | ✓                                                          |

1) Hermetically sealed = air-tight case

### Illustration 7

## 6. Pressure compensating diaphragm

As can be seen in illustration 7, formation of condensation in filled pressure gauges can be prevented by the use of pressure compensation diaphragms, without any temperature error. Pressure compensation diaphragms can be used for all safety pressure gauges per EN 837-1 S3.

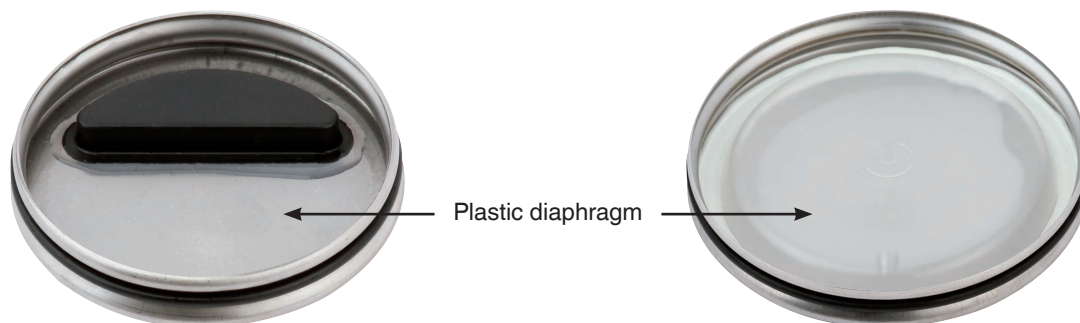
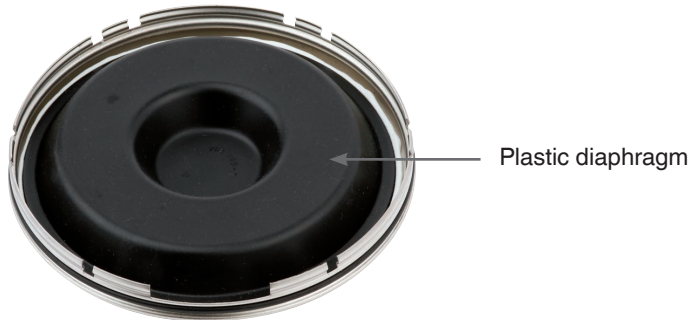
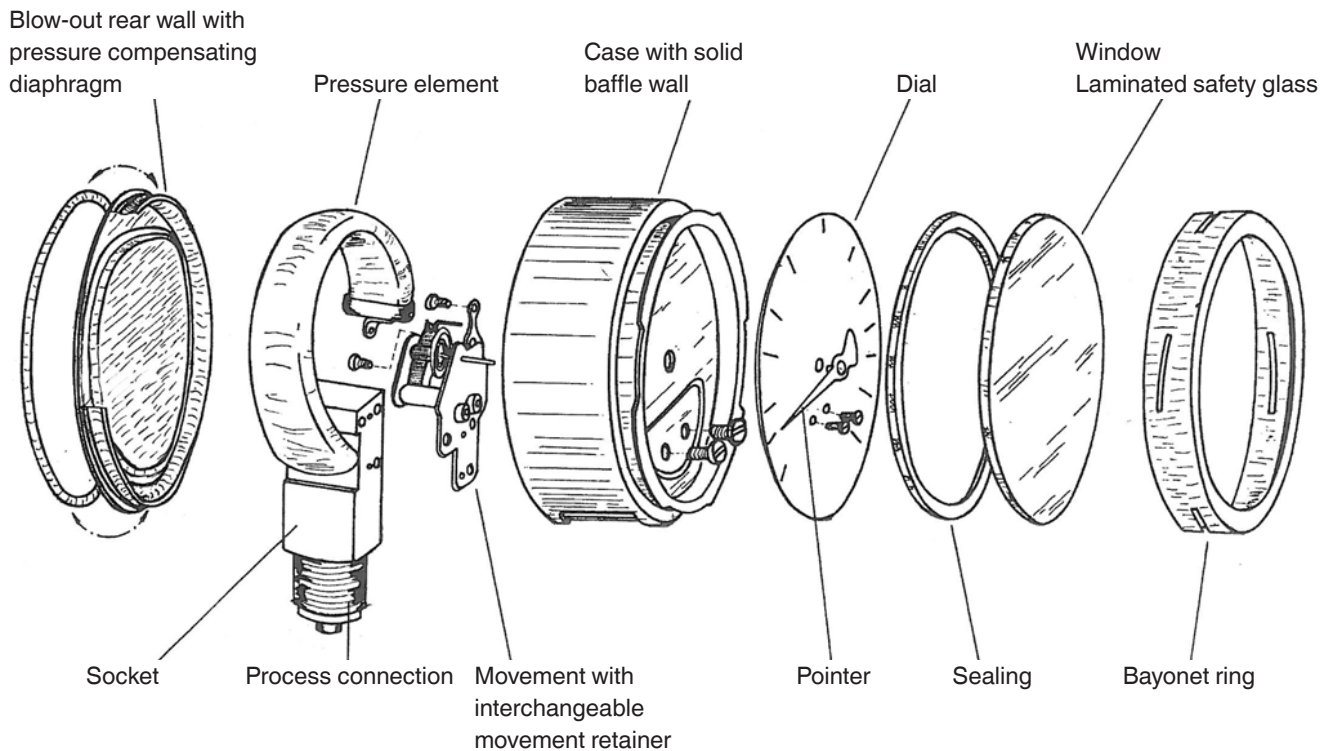


Illustration 8: Rear wall of case with pressure compensating diaphragm, nominal size 63

Illustration 9: Rear wall of case with pressure compensating diaphragm, nominal size 100



**Illustration 10: Rear wall of case with pressure compensating diaphragm for contact gauges, nominal size 160**



**Illustration 11: Exploded view drawing**

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# Diaphragm seal systems for vacuum processes

WIKA data sheet IN 00.25

## Vacuum

The word vacuum (from the Latin: vacuus - empty) means “(largely) empty or free space”.

Physics refers to a space that is completely free from molecules as a vacuum. In practice, this condition is never feasible.

## Diaphragm seals

Diaphragm seals are used for pressure measurements when the process medium should not come into contact with the pressurised parts of the measuring instrument.

A diaphragm seal has two primary tasks:

1. Separation of the measuring instrument from the process medium
2. Hydraulic transfer of the pressure to the measuring instrument

(see also Technical information IN 00.06 “Diaphragm seals - Diaphragm seal systems, application, operating principle, designs”)

## Absolute pressure

Absolute pressure refers to the perfect vacuum. In this absolutely molecule-free space the zero point of the absolute pressure is defined. An example of a common “absolute” indicated value is the air pressure.

For the required differentiation from other types of pressure, it is denoted with the index “abs.”, which is derived from the Latin “absolutus”, meaning detached or independent.

## Diaphragm seal systems in vacuum service

For application in vacuum, there are different diaphragm seal system fill fluids (KN 2, KN 17, KN 21, KN 32, KN 59 and KN 92) used. Each reacts differently in vacuum applications. In terms of physics, the boiling point temperature of a liquid decreases with falling pressure.



**Differential pressure transmitter connected to two flange-type diaphragm seals via a capillary**

In a liquid, at a temperature of greater than 0 K, the particles attempt to leave the liquid bond (transition from liquid to gaseous).

The vapour pressure increases with increasing temperature and is dependent on the substance or mixture present. Thus the operating limits for the individual measuring assemblies drop with a process pressure < 1 bar abs. WIKA has developed three manufacturing processes for this (Basic, Advanced and Premium), which are described below. This technical information should assist in assessing the limits of the measuring instruments.

## Vacuum in the process industry

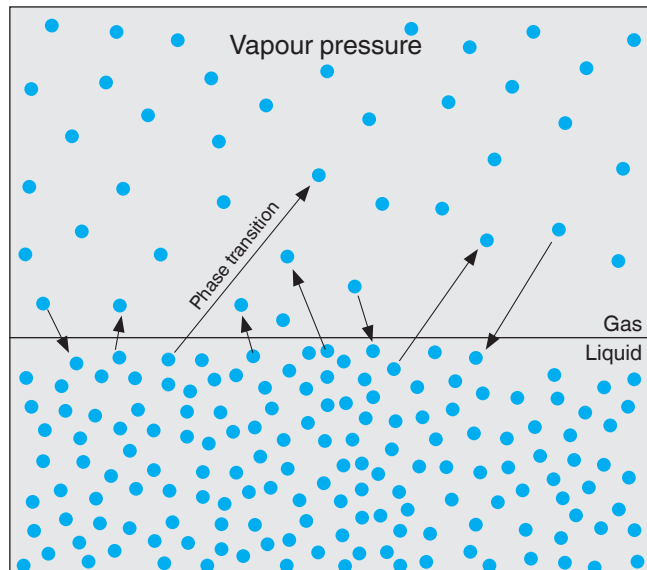
In the meantime, vacuum processes have established themselves in many industrial and biotechnology plants. Many processes are no longer conceivable without vacuum processes. An example for a vacuum process in an industrial operation is a distillation column or rectification column in crude oil production.

Crude oil is the base. It is introduced to the process, and the products are then distilled from it separately according to the individual boiling point ranges (also known as fractions). The products are then subjected to further processing.

This occurs in two steps:

Initially, the easily evaporated substances can be separated at "normal" pressure ( $\geq 1,013$  mbar abs.). In a second step, the hard-to-evaporate substances are distilled in a vacuum ( $< 1,013$  mbar abs.). In a vacuum, the boiling point of individual compounds can be lowered significantly without destroying them through too high temperatures.

The temperature increases during the course of the process, while the pressure decreases.



**Illustration of the vapour pressure of liquid particles at their transition to the gaseous phase**

## Diaphragm seal systems in vacuum service

The following basically applies: The higher the temperature and the smaller the corresponding process pressure, the more difficult it is to design a functioning measuring assembly.

In terms of physics, there are different types of vacuum. From low vacuum, fine vacuum, high vacuum through to ultra-high vacuum. The process pressure in industrial plant is generally  $\geq 5$  mbar abs. (low vacuum range).

Applicable core factors for the required design of a functioning measuring assembly are given in the following points:

### **Influence quantities for the application process:**

- Process temperature
- Process pressure

### **Influence quantities of the diaphragm seal system:**

- Production process of the diaphragm seal system
- Vapour pressure curve of the selected system fill fluid
- The selected process connection with the corresponding diaphragm diameter

Below, the vacuum processes available from WIKA are described in more detail. The processes basically depend on the minimum process pressure at maximum temperature and the individual system fill fluids. This technical information applies for electronic process and industrial transmitters.

## Section ① Basic service

Through ongoing and continuous advancements in WIKA's vacuum production processes, measuring ranges, for which specific conditioning of components is no longer necessary, are possible.

The basic service will be designated in the following illustration by section no. ① "Basic service".

## Section ② Advanced service

For the more-demanding measuring points, WIKA has established the advanced service. The majority of all measuring assemblies which are intended for use in vacuum can be covered by the advanced service.

The illustration of this service will be designated below in section no. ② with "Advanced service".

## Section ③ Premium service

For measuring points in lower vacuum ranges and/or with high process temperatures, the "Advanced service" is no longer sufficient.

For this, WIKA has developed the "Premium service" with specifically designed component conditioning and a refinement of the system fill fluid. The "Premium service" is designated in the illustration with the section no. ③.

## Section ④ Customer support

If the application finds itself in section no. ④ "Customer support", our technical clarification will work out a solution for your application.

For this, precise information on the application process is required. For this reason, simply fill out this questionnaire and send it to your contact person at WIKA.

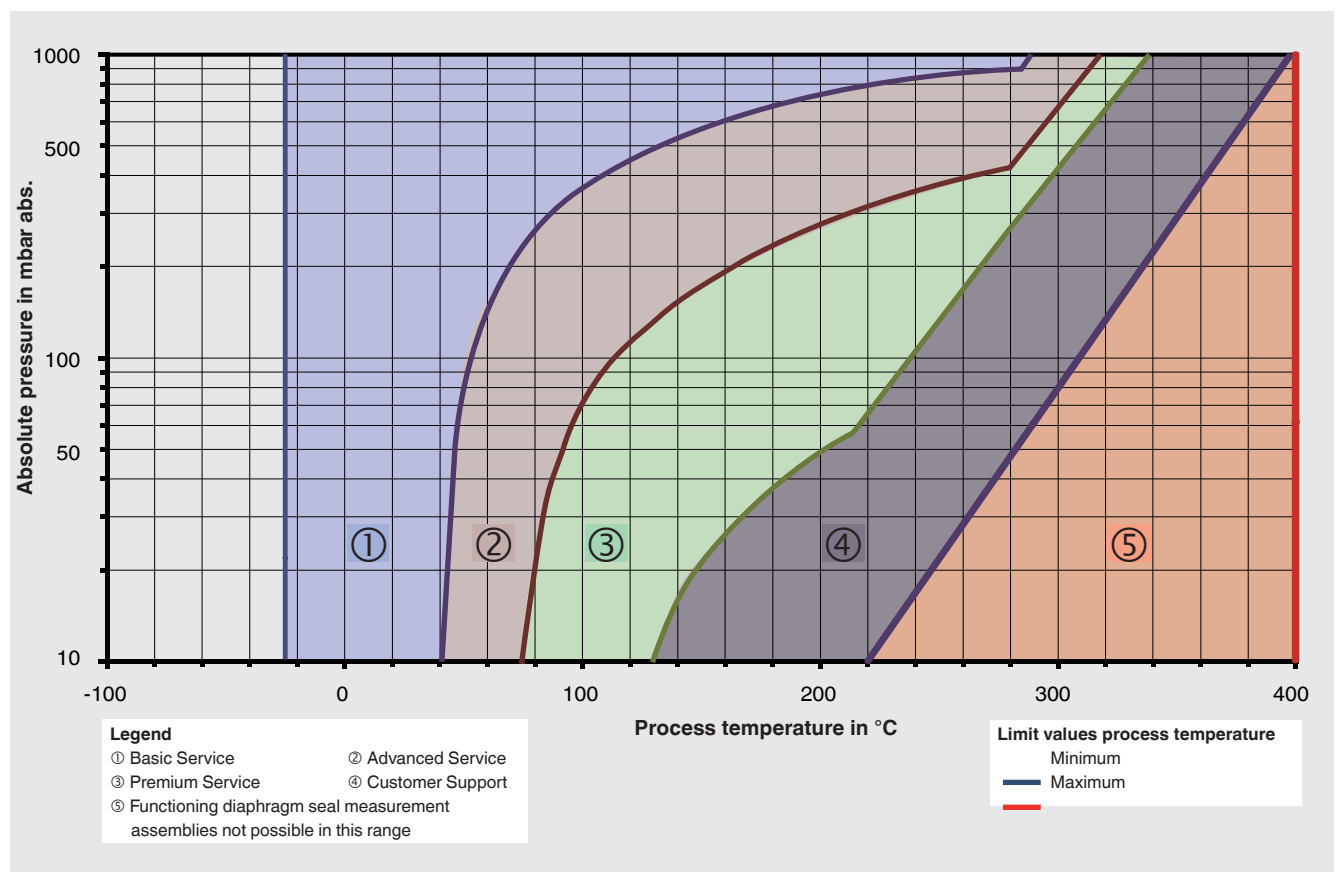
Questionnaire for diaphragm seals

[http://de-de.wika.de/upload/DS\\_QuestionnaireDS\\_GB\\_5796.pdf](http://de-de.wika.de/upload/DS_QuestionnaireDS_GB_5796.pdf)

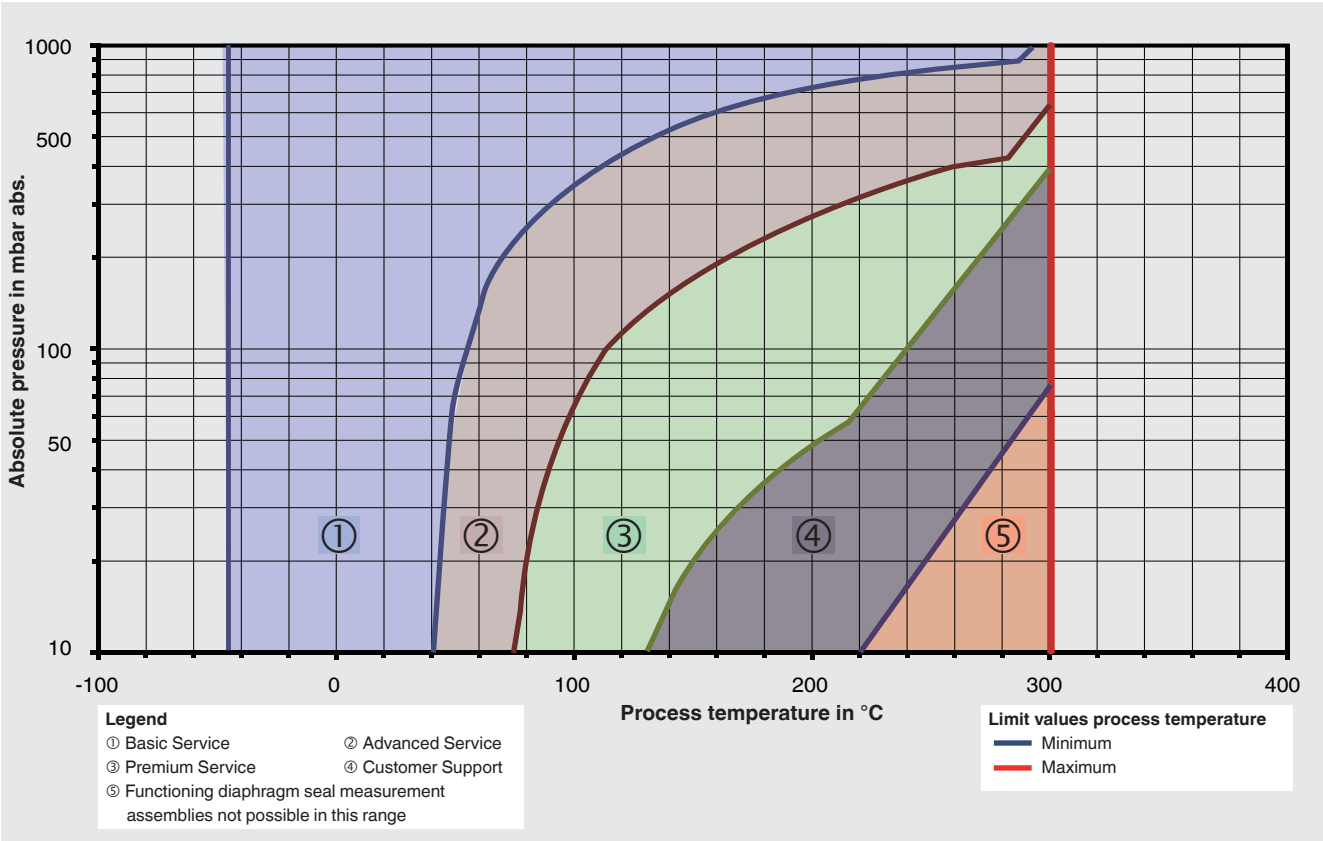
## Explanation of the vacuum processes

Our vacuum processes are clearly illustrated in the following diagrams.

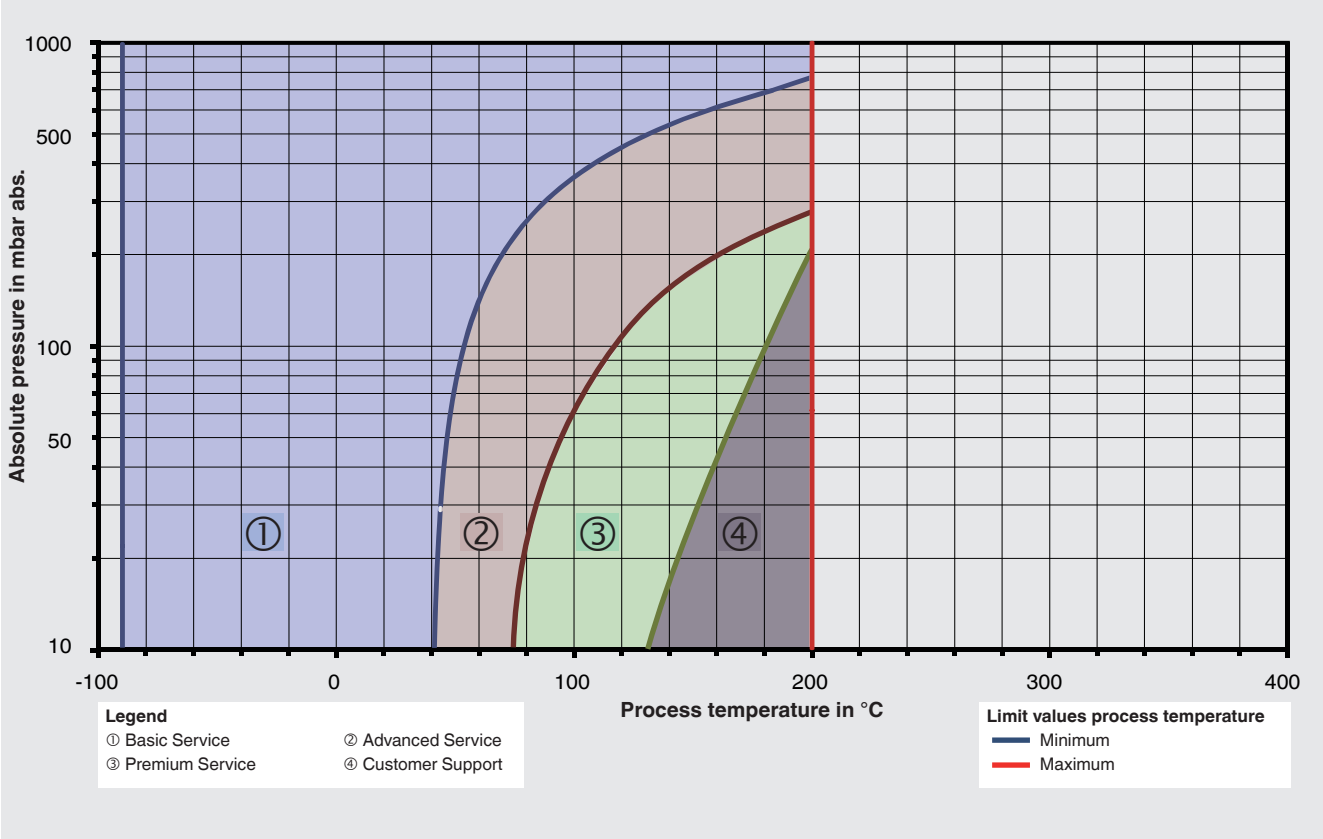
## Vacuum application with system fill fluid KN 32



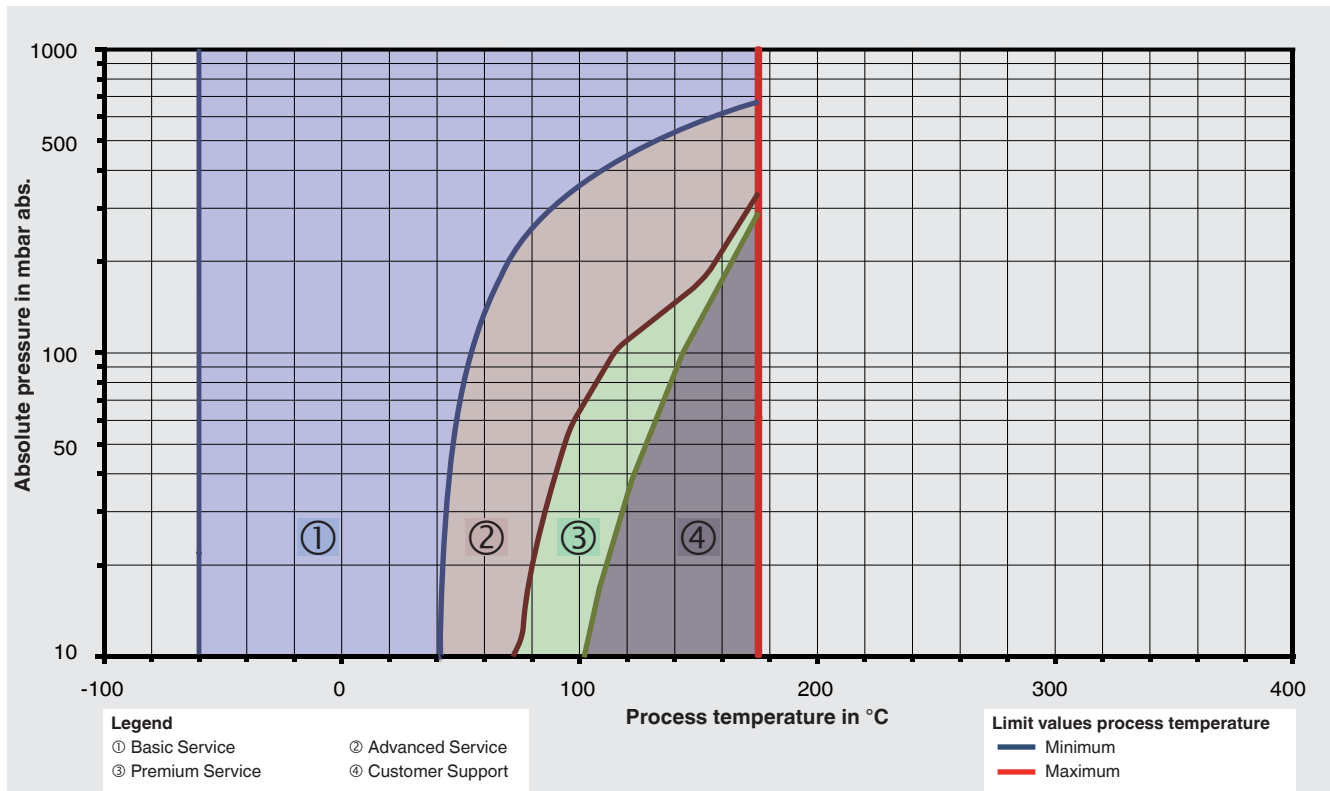
Vacuum application with system fill fluid KN 2



Vacuum application with system fill fluid KN 17



## Vacuum application with system fill fluid KN 21

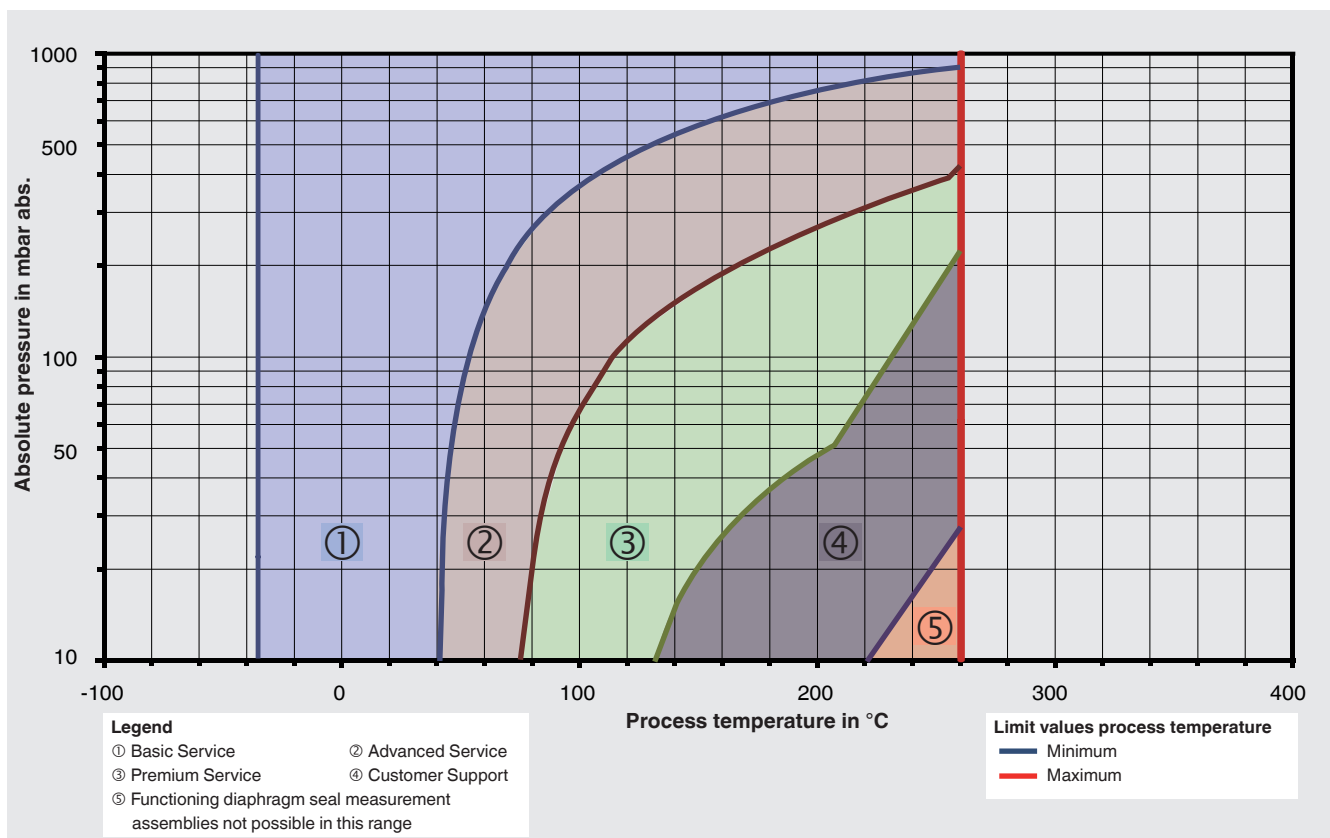


### Oxygen applications

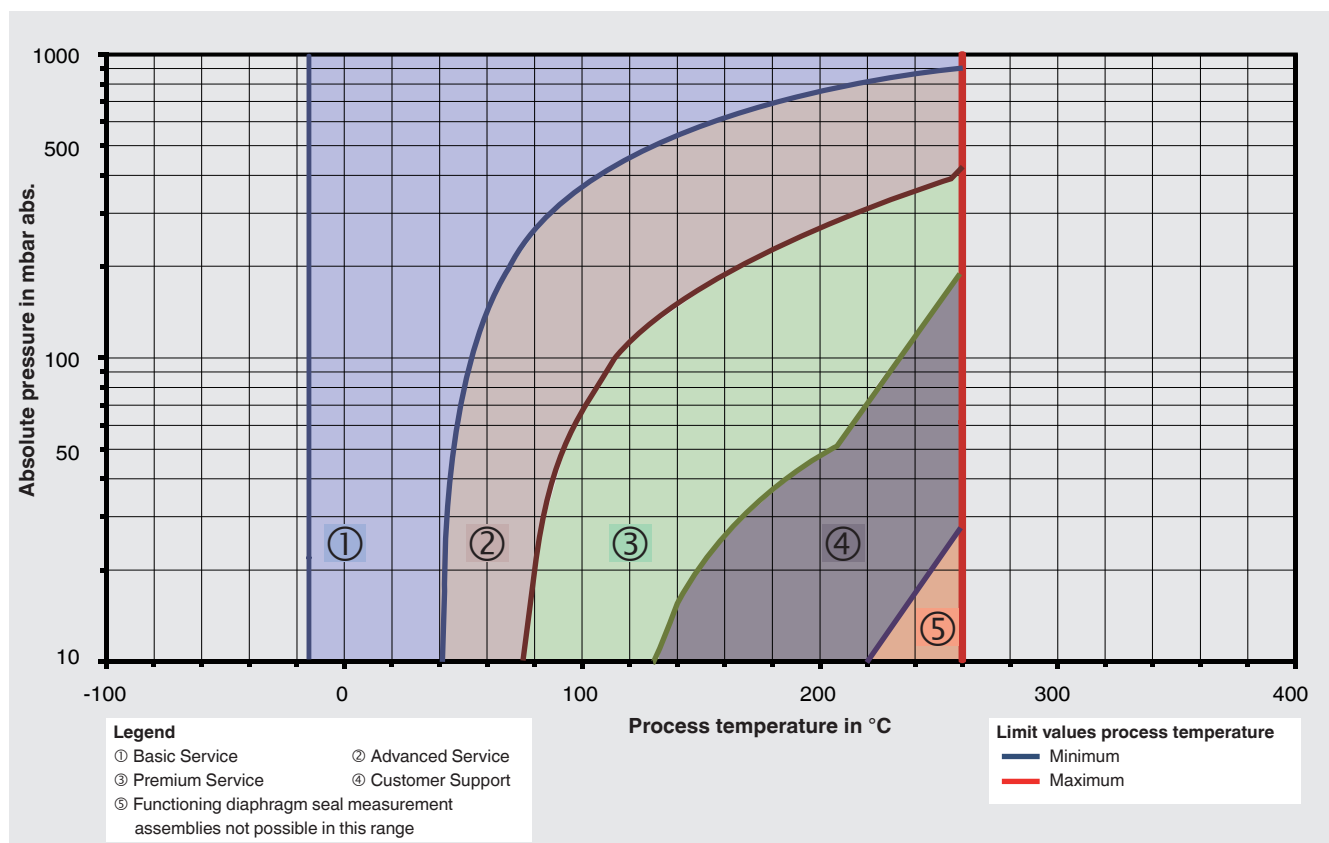
Per BAM test (Federal Institute for Materials Research and Testing) these table values apply.

| Maximum temperature | Maximum oxygen pressure |
|---------------------|-------------------------|
| to 60 °C            | 50 bar                  |
| > 60 °C to 100 °C   | 30 bar                  |
| > 100 °C to 175 °C  | 25 bar                  |

## Vacuum application with system fill fluid KN 59



## Vacuum application with system fill fluid KN 92



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# WIKAI standard documentation

WIKAI data sheet IN 00.24

## Requirements

Extensive processes require detailed documentation. For complex operations, data sheets and operating instructions are not sufficient anymore as documents accompanying the products.

Additional documents such as certificates, analyses or quality management procedures provide exact proof that the instruments are ideally suited for the particular application. In this way a detailed documentation conforming to the law contributes to plant safety.

## WIKAI standard documentation

The WIKAI standard documentation complies with the legal conditions of acceptance (in paper format and/or as a navigable CD-ROM).

Our individual documents are constantly updated. They are subject to the "product lifecycle" (further development of the existing product). A unique attribution of the documents to the production order at the time of manufacture is ensured. WIKAI provides these documents in many languages and in the desired quantity.

### Customer-specific designs

Of course we can also provide the documentation according to your requirements:

- Customer logo
- Cover sheet layout
- Ring binders
- Sequence
- Further documents



WIKAI standard documentation

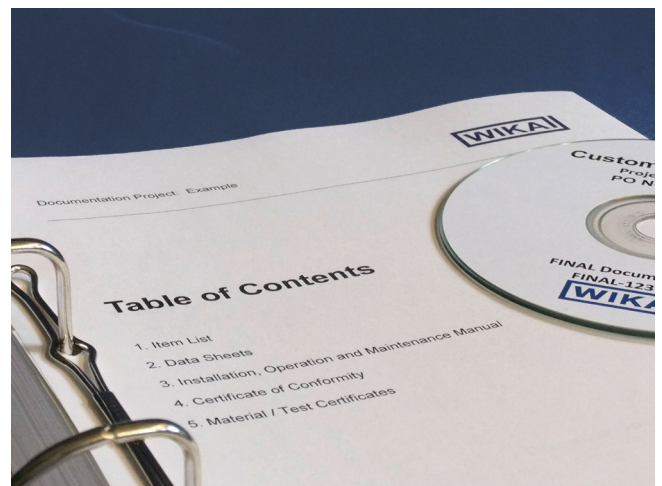


Table of Contents

## WIKA standard documentation

This contains following documents:

| Abbreviation | Description                                                      |
|--------------|------------------------------------------------------------------|
| TAG          | Item list (Tag no. list)                                         |
| CATL         | Data sheets (catalogues)                                         |
| IOM          | Operating instructions (installation, operation and maintenance) |
| DOC          | Declaration of conformity (EC, ATEX, EMC, PED)                   |
| ZGN          | Certificates/Test reports                                        |
| WFC          | Wake frequency calculation (optional)                            |
| FLC          | Flow calculation (optional)                                      |

These documents can be provided additionally:

| Abbreviation | Description                                                  |
|--------------|--------------------------------------------------------------|
| DRWG         | Drawings                                                     |
| QM           | Quality management procedures                                |
| QT           | Quality test procedures                                      |
| CSP          | Commissioning spare parts list                               |
| 2SP          | 2 years spare parts list                                     |
| NDE          | Non-destructive examinations                                 |
| SIP/RPP      | Transport, packaging and storage instructions                |
| MCOC         | Manufacturer's certificates of compliance                    |
| PASS         | Passport (import permit for instruments destined for Russia) |

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# General information about NACE standards For sour gas applications with WIKA products

WIKA data sheet IN 00.21

## General information

This technical information refers to two publications in the area of material requirements. Here MR stands for "Material Requirements".

- NACE <sup>1)</sup> MR0175  
"Petroleum and natural gas industries. Material for use in H<sub>2</sub>S-containing environments in oil and gas production."
- NACE <sup>1)</sup> MR0103  
"Materials resistant to sulphide stress cracking in corrosive petroleum refining environments."
- Only for pressure gauges, pressure transmitters, diaphragm seals and thermowells



**Fig. left: Bourdon tube pressure gauge model 232.30**  
**Fig. right: Diaphragm seal, flange connection model 990.27**

## Description

Natural gas and crude oil, as raw materials, contain greater or lesser high levels of hydrogen sulphide (H<sub>2</sub>S). If there is a minimum amount of H<sub>2</sub>S and a minimum total pressure, such a mixture is recognised as "sour gas" or "sour oil".

Both standards describe the corrosion properties of metals in the presence of H<sub>2</sub>S under different corrosion mechanisms. Firstly, hydrogen-induced stress cracking corrosion is considered. This is greatest at room temperature and is the focus of MR0103. A typical application for this standard is downstream processing in a refinery. Secondly, chlorine-induced stress cracking corrosion under the influence of H<sub>2</sub>S is considered. This is aided at higher temperatures and is described by NACE MR0175. A typical application is the production of oil and gas.

<sup>1)</sup> The term "NACE" refers to an organisation (National Association of Corrosion Engineers), which primarily deals with any form of corrosion. The results of their work are published in many publications as NACE standards and updated regularly. The headquarters of this organisation is in Houston, Texas/USA.



**Application example:**  
**Pressure transmitter models E-10 and E-11**



**Thermowells in various design**

The NACE MR0175 standard is represented in the ISO 15156 standard (part 1 - 3) internationally valid. This deals with technical issues regarding corrosion of materials during the extraction and processing of natural gas and crude oil. The ISO 15156 standard, Part 3, describes the use of corrosion-resistant metals and complies with to NACE MR0175.

### NACE MR0175

NACE MR0175 (ISO 15156-3) describes, according to the application, for the various material groups, the relevant requirements for each individual material and the maximum permissible temperature limits (see table).

## Material selection

In sour gas applications, the corrosion properties of metals depend on the environmental conditions (pH value, chloride content, H<sub>2</sub>S concentration and temperature limits) and the maximum strength of the materials. For different materials there are different strength requirements.

In accordance with the standard, ISO 15156-1/section 5 "General principles", it is the responsibility of the user to specify which material is suitable for the application.

With knowledge of the above-mentioned environmental conditions, WIKA can make recommendations on the selection of materials.

If the details of the environmental conditions are not adequately known, WIKA specifies the operating conditions for ISO 15156-3 under the assumption of critical environmental conditions.

On this basis, therefore, only the lowest maximum process temperature can be confirmed.

### NACE MR0103

This standard is similarly constructed and can also be implemented for WIKA products if a customer wishes. It defines the material requirements and temperature limits for applications in refineries.

### Example:

For nickel-based alloys such as HC276, in a work-hardened condition, without knowledge of the environment conditions, a maximum temperature of 132 °C will apply, whereby, at a given partial pressure of H<sub>2</sub>S of less than 200 kPa, a maximum temperature of 232 °C would be possible.

Generally, with its products, WIKA fulfills the strength requirements (maximum hardness) of materials. Exceptions are the elements of mechanical pressure gauges. Here, due to their elastic properties, higher strength is required. WIKA has demonstrated in detail the suitability of its Bourdon tube measuring system in accordance with ISO 15156-3 through independent laboratory testing up to 120 °C.

The following table gives an example-based overview of the lowest maximum operating temperatures by material and product group per "Any equipment and component" in accordance with ISO 15156-3/NACE MR0175.

| Product group                                    | Stainless steel 316L      | Monel 400 | Duplex 1.4462 | Alloy C276  | Elgiloy 2.4711         |
|--------------------------------------------------|---------------------------|-----------|---------------|-------------|------------------------|
| <b>Mechanical pressure measuring instruments</b> | max. 120 °C <sup>1)</sup> | no limit  | n/a           | n/a         | n/a                    |
| <b>Electronic pressure measuring instruments</b> | n/a                       | n/a       | n/a           | n/a         | no limit <sup>3)</sup> |
| <b>Diaphragm seal</b>                            | no limit <sup>2)</sup>    | no limit  | max. 232 °C   | max. 132 °C | n/a                    |
| <b>Thermowells</b>                               | no limit <sup>2)</sup>    | no limit  | max. 232 °C   | max. 132 °C | n/a                    |

1) Measured using laboratory testing

2) Classified using "Instrumentation and control device": as of 2009

3) Classified using "Diaphragms, pressure diaphragms, pressure measuring devices and pressure seals"

Even if the NACE standard has no temperature limit, the product-specific details, which can limit the maximum operating temperature, should be considered.

## General information

### **Welding**

The welding processes (WPS/PQR) are qualified in accordance with the appropriate standards (AD 2000 or ASME). One element of the welding procedure tests is hardness testing of the weld seam. A retrospective verification of the hardness on the welded product is not prescribed by the NACE standards for cracking-resistant alloys.

### **Heat treatment following welding**

Heat treatment (PWHT) is not mandatory. For certain materials (e.g. carbon steel) heat treatment can be required due to technical considerations of the welding.

### **Hardness values on semifinished product**

A proof of the hardness values of the semi-finished products is made via the supplier's 3.1 acceptance test certificate (except for stainless steel Bourdon tubes and NiCrCo alloy 2.4668 (Inconel 718) diaphragm elements).

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The specifications given in this document represent the state of engineering at the time of publishing.  
We reserve the right to make modifications to the specifications and materials.



# Process connection per EN 837

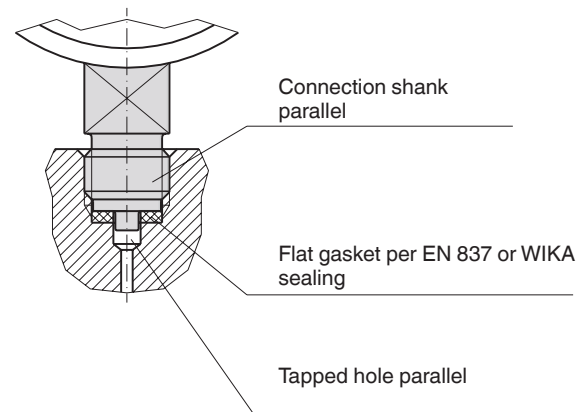
WIKA data sheet IN 00.03

## Applications

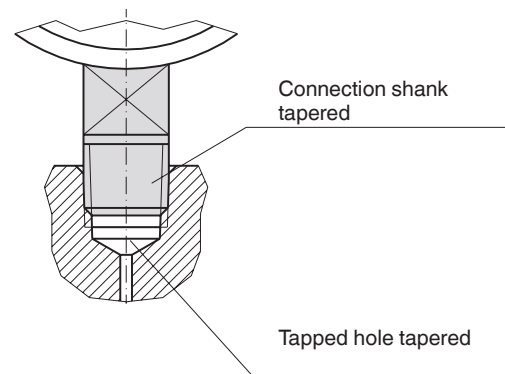
- For the definition of the process connections for WIKA pressure measuring instruments

## Variants

- Process connections with parallel thread
- Process connections with tapered thread
- Industry-specific special connections



### Installation example with parallel thread



### Installation example with tapered thread

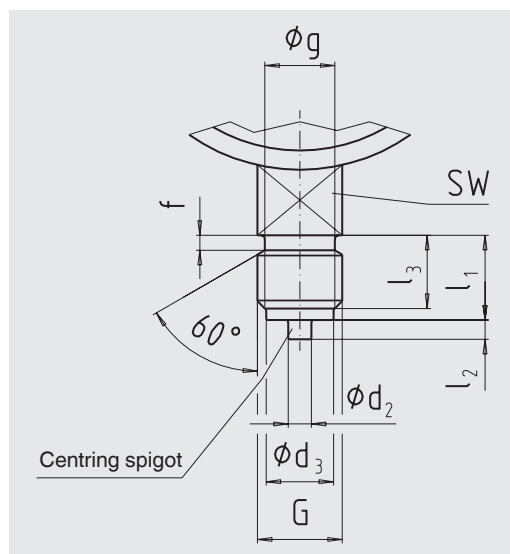
## Description

WIKA offers pressure measuring instruments with a variety of process connections in order to meet diverse customer-specific application requirements.

For pressure measuring instruments with parallel or tapered thread, process connections with a range of dimensions are specified.

The permissible maximum pressure of a process connection is a result of the combination of thread size and material. The correlation is illustrated for a selection of representative process connections in a table on page 3.

## Connection shank with parallel male thread

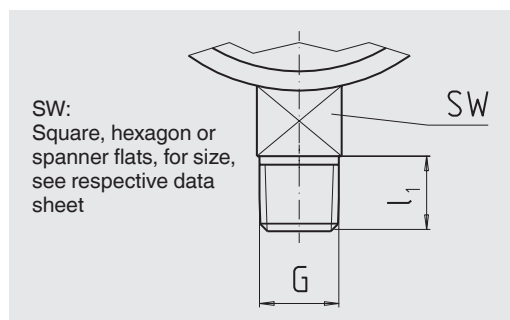


| Parallel thread<br>G | Dimensions in mm |      |              |                 |        |            |               |            |
|----------------------|------------------|------|--------------|-----------------|--------|------------|---------------|------------|
|                      | d2               | d3   | f with Brass | Stainless steel | g -0.2 | $l_1 +0.3$ | $l_2 \pm 0.1$ | $l_3 +0.3$ |
| G 1/8 1)             | 2)               | 8    | 2)           | 2)              | 2)     | 10         | 2)            | 8          |
| M10 x 1              | 2)               | 8    | 2)           | 2)              | 2)     | 10         | 2)            | 8          |
| G 1/4 1)             | 5                | 9.5  | 2            | 3               | 11     | 13         | 2             | 11         |
| M12 x 1.5            | 5                | 9.5  | 2            | 3               | 9.7    | 13         | 2             | 11         |
| G 3/8                | 5.5              | 13   | 2            | 3               | 14.5   | 16         | 3             | 13         |
| G 1/2 1)             | 6                | 17.5 | 3            | 4               | 18     | 20         | 3             | 17         |
| M20 x 1.5            | 6                | 17.5 | 3            | 4               | 17.7   | 20         | 3             | 17         |

1) Preferably with WIKA standard versions

2) With WIKA, without centring spigot; thread run-out instead of thread undercut

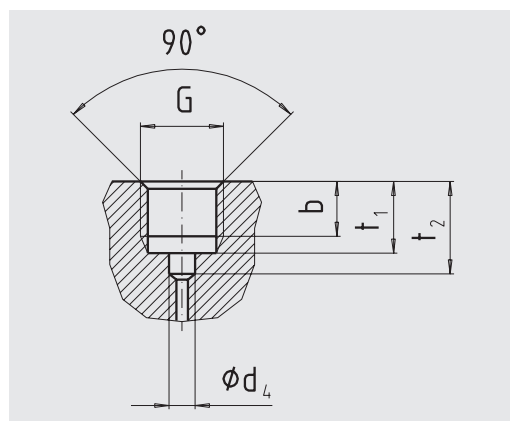
## Connection shank with tapered thread



SW:  
Square, hexagon or  
spanner flats, for size,  
see respective data  
sheet

| Tapered thread<br>G | Dimensions in mm<br>$l_1$ min. |
|---------------------|--------------------------------|
| 1/8 NPT, R 1/8      | 10                             |
| 1/4 NPT, R 1/4      | 13                             |
| 3/8 NPT, R 3/8      | 15                             |
| 1/2 NPT, R 1/2      | 19                             |

## Tapped hole with parallel female thread



| Parallel female thread<br>G | Dimensions in mm |        |            |            |
|-----------------------------|------------------|--------|------------|------------|
|                             | b min.           | $d_4$  | $t_1 -0.5$ | $t_2$ min. |
| G 1/8 1)                    | 7.5              | 4.4 3) | 10         | 13         |
| M10 x 1                     | 7.5              | 4.5 3) | 10         | 13         |
| G 1/4 1)                    | 10               | 5.5    | 13         | 16.5       |
| M12 x 1.5                   | 9.5              | 5.5    | 13         | 16.5       |
| G 3/8                       | 12               | 6.5    | 16         | 19.5       |
| G 1/2 1)                    | 15               | 7      | 19         | 24.5       |
| M20 x 1.5                   | 15.5             | 7      | 19         | 24.5       |

1) Preferably with WIKA standard versions

3) Can be omitted with WIKA instruments since without centring spigot

## Standards for threads

Parallel threads: Pipe threads, code G, per ISO 228-1  
Metric ISO threads, code M, per DIN 13

Tapered threads: Pipe threads, code NPT, per ANSI / ASME B1.20.1  
Pipe threads, code R, per ISO 7

## Maximum allowable pressure

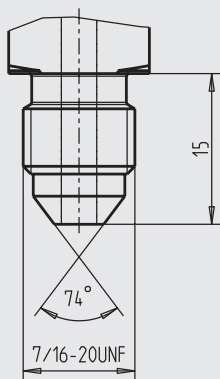
| Thread <sup>1)</sup> | Maximum allowable pressure <sup>2)</sup> |        |                 |        |        |        |
|----------------------|------------------------------------------|--------|-----------------|--------|--------|--------|
|                      | Cu alloy                                 |        | Stainless steel |        | Monel® |        |
|                      | bar                                      | psi    | bar             | psi    | bar    | psi    |
| G 1/8                | 400                                      | 6,000  | 400             | 6,000  | 400    | 6,000  |
| G 1/4                | 600                                      | 8,600  | 1,000           | 15,000 | 1,000  | 15,000 |
| G 3/8                | 600                                      | 8,600  | 1,000           | 15,000 | 1,000  | 15,000 |
| G 1/2                | 1,000                                    | 15,000 | 2,500           | 36,000 | 2,500  | 36,000 |
| M10 x 1              | 400                                      | 6,000  | 400             | 6,000  | 400    | 6,000  |
| M12 x 1.5            | 400                                      | 6,000  | 400             | 6,000  | 400    | 6,000  |
| M20 x 1.5            | 1,000                                    | 15,000 | 2,500           | 36,000 | 2,500  | 36,000 |
| 1/8 NPT, R 1/8       | 400                                      | 6,000  | 400             | 6,000  | 400    | 6,000  |
| 1/4 NPT, R 1/4       | 600                                      | 8,600  | 1,000           | 15,000 | 1,000  | 15,000 |
| 3/8 NPT, R 3/8       | 600                                      | 8,600  | 1,000           | 15,000 | 1,000  | 15,000 |
| 1/2 NPT, R 1/2       | 1,000                                    | 15,000 | 1,600           | 23,000 | 1,600  | 23,000 |
| 7/16-20 UNF          | 400                                      | 6,000  | 800             | 12,000 | 800    | 12,000 |

1) Valid for the thread standards for connection shanks and female threads mentioned on page 2.

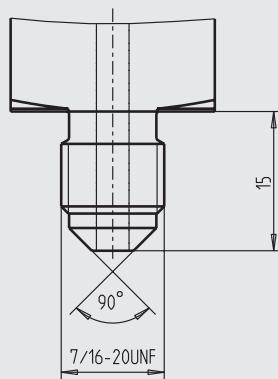
2) The specified values for the maximum pressure are rounded values and are assigned to the nearest standard scale range.

## Examples of industry-specific process connections

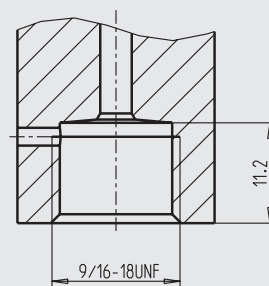
**Hydraulic connection  
with 74° sealing cone SAE J 514**



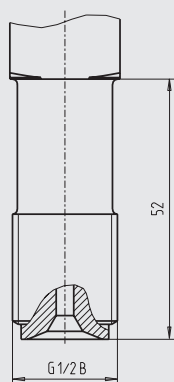
**Refrigeration connection  
with 90° sealing cone SAE J 513**



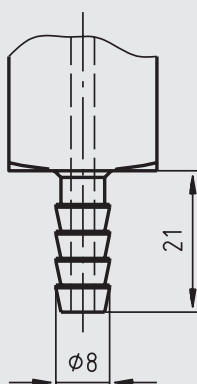
**High-pressure process connection  
per Autoclave Engineering or Nova  
Swiss M16 x 1.5 female**



**High-pressure process connection  
(HP) for connection with lens-type  
sealing ring, per EN 837**



**Hose connection**

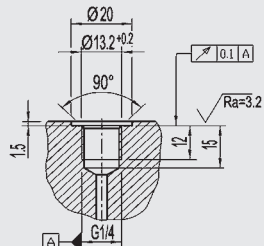


Other process connections on request

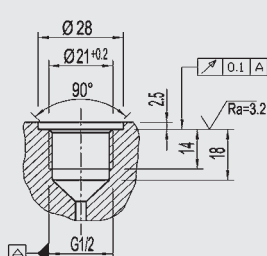
## Examples of other tapped holes

### Version per DIN EN ISO 1179-2 (sealing with profile sealing)

**G ¼**

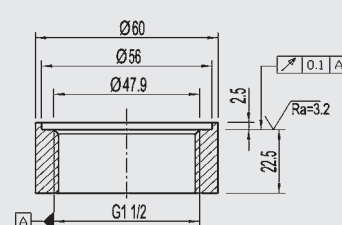


**G ½**

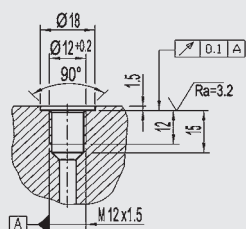


**G 1 ½ 1)**

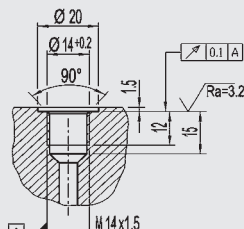
Order number: 2158982



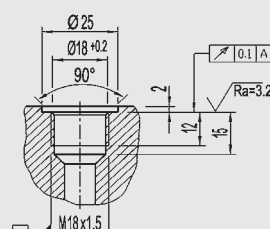
**M12 x 1.5**



**M14 x 1.5**

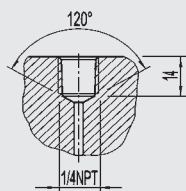


**M18 x 1.5**

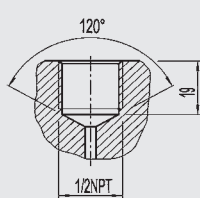


### Version per ANSI / ASME B1.20.1

**¼ NPT**

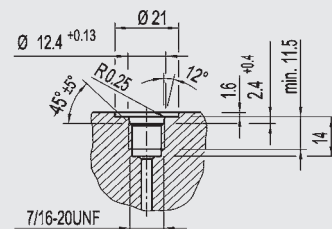


**½ NPT**



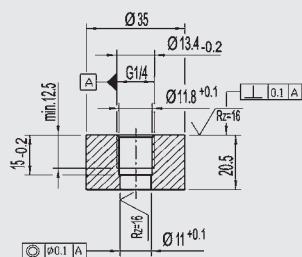
### Version per SAE J 514

**7/16-20 UNF**

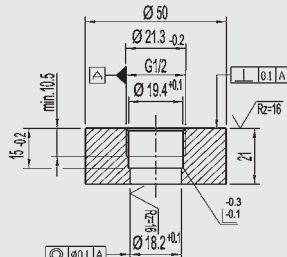


### Flush WIKA version

**G ¼, with O-ring 2)**



**G ½, with O-ring 1) 2)**

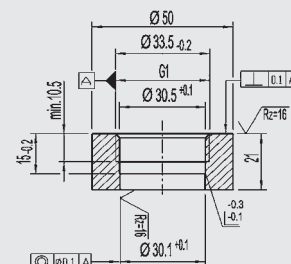


**G 1, with O-ring 1) 2)**

Order number: 1192264

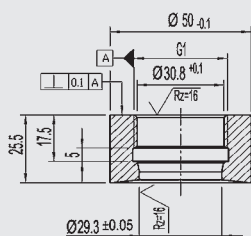
**G 1, with sealing cone**

Order number: 1524380



**G 1, EHEDG 1) 2) 3)**

Order number: 2166011



1) Also available as welding socket from WIKA.

2) The screw-in holes made by the customer must be drilled out after thread cutting.

3) European Hygienic Engineering & Design Group

WIKA makes every effort to ensure that the screw-in holes shown are kept up-to-date. The corresponding current regulations are applicable for the production of the screw-in hole.

We reserve the right to make technical changes to the WIKA versions for screw-in holes and welding sockets.

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The specifications given in this document represent the state of engineering at the time of publishing.  
We reserve the right to make modifications to the specifications and materials.



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www.wika.de

# Information on process connections

WIKA data sheet IN 00.14

## Applications

- For the definition of the process connections for WIKA pressure measuring instruments

## Scope

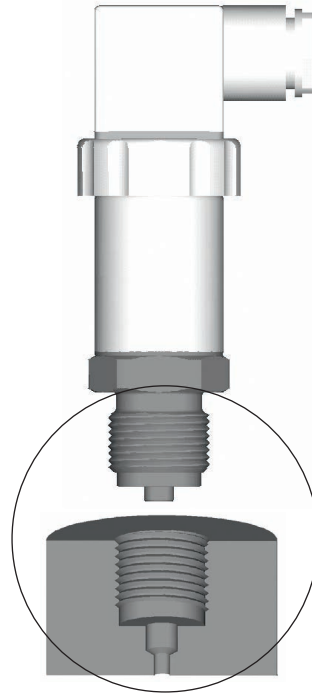
- Pressure sensors
- Electronic pressure switches
- UHP transducer

## Contents

- Mounting at the process connection
- Dimensions of the process connections
- Max. measuring ranges and overpressure limits depending on the process connections

## Description

WIKA offers pressure measuring instruments with a variety of process connections in order to meet diverse customer-specific application requirements.



## Mounting

The following notes relate to process connections with specified geometric and functional features in accordance with technical regulations.

### Requirements for the mounting point

The mounting point must meet the following conditions:

- Keep the sealing faces at the pressure sensor and the measuring location clean and free from scratches.
- Remove the protective cap and/or the Mylar or protective foil not until shortly before installation.
- Observe the permissible ambient temperatures. Do not exceed the performance limits of the measuring instrument specified by the manufacturer. Consider possible restrictions on the ambient temperature range due to the mating connectors used.

### Mechanical mounting

Carry out the mounting in accordance with the following steps:

1. Prior to commissioning, subject the instrument to a visual inspection.  
→ Leaking liquid is indicative of damage.
2. Depressurise the container, pipeline or system.
3. Ensure that the sealing faces are clean and do not show any mechanical damage.
4. Seal the sealing face, see [„Sealing variants“](#).
5. At the mounting point, screw the instrument in hand-tight.  
→ Make sure not to cross the threads.
6. For force transmission, use only the defined spanner flats, see [„Spanner flats“](#).  
→ The case must not be subjected to mechanical load. Never use the case as a working surface.
7. Tighten the instrument with a torque wrench using the spanner flats.



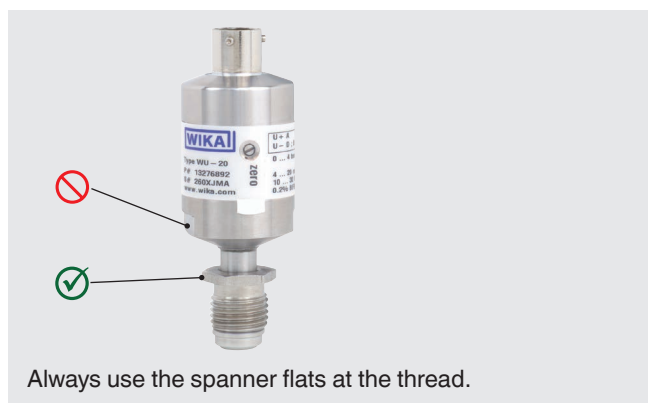
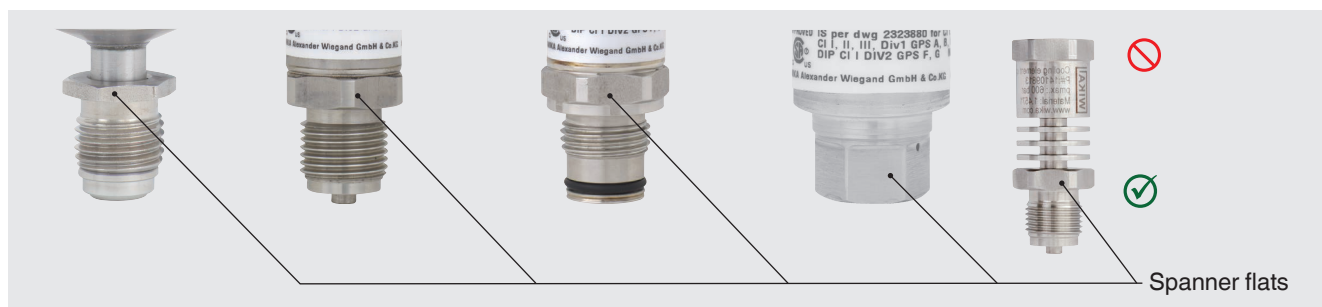
The correct torque depends on the mounting point (e.g. material and shape).

Only use the instrument if it is in perfect condition with respect to safety.

Only use original accessories. For accessories, see data sheet for the respective pressure sensor or pressure switch.

### Spanner flats

To avoid damage to the instrument, always use the correct spanner flats.

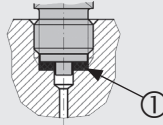


## Sealing variants

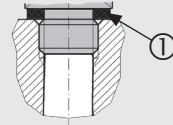
To meet the diverse requirements and operating conditions in different applications, seal the process connections as follows:

### Parallel threads

For sealing, use flat gaskets, lens-type sealing rings or WIKA profile sealings at the sealing face ①.



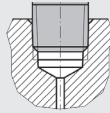
per EN 837



per DIN EN ISO 1179-2  
(formerly DIN 3852-E)

### Tapered threads

For sealing, the thread is wound with additional sealing material, e.g. PTFE tape.



NPT, R and PT

→ For notes on seals, see WIKA data sheet AC 09.08 at [www.wika.com](http://www.wika.com).

## Additional notes for special process connections

In certain applications, process connections with special geometric or functional properties are used. This section describes the relevant deviations, technical requirements and notes on the safe and compliant use of such connections.

### Cooling element

Cooling elements must not be insulated.

The cooling elements are crucial for regulating the temperature of the pressure measuring instrument. Insulation would impede heat dissipation and could cause the instrument to overheat. This impairs the measurement accuracy and shortens the service life of the pressure measuring instrument.

### Flush process connections

Diaphragms must be undamaged.

The diaphragm is the direct interface between the medium and the measuring instrument and is crucial for the following aspects:

- Measurement accuracy: An intact diaphragm ensures correct pressure transmission without errors.
- Prevention of blockages: Especially with viscous, crystalline or abrasive media, an undamaged diaphragm prevents blockages and damage to the pressure port.
- Protection of the measuring instrument: The diaphragm protects the measuring instrument from aggressive or adhesive media.
- Hygiene and cleaning: An undamaged diaphragm makes cleaning easier and prevents contamination, which is particularly important in hygienic applications.

### Hygienic process connections

The following notes must be observed when using hygienic process connections:

- Never loosen sealed filling screws on the measuring instrument. Loosening of the filling screws can lead to leakage and contamination.
- For mounting, use the appropriate fastenings. In accordance with the fittings and flange standards, suitable screws, nuts or clamps must be used to ensure a secure and leak-tight connection.
- Only use seals with a sufficiently large inner diameter. The seal must be inserted centrally to prevent contact with the diaphragm, which could lead to measuring deviations.
- Position the welding socket correctly. Position the welding socket so that the bore for leakage detection points downwards. The nozzle must be welded flush with the inner wall of the vessel and ground smooth. The surface roughness of the ground surfaces must be  $Ra \leq 0.8 \mu m$ .
- Observe the seal manufacturer's instructions. When using soft or PTFE seals, observe the instructions of the seal manufacturer, particularly with regard to tightening torque and load cycles.

## UHP process connections

The following notes must be observed when using UHP process connections:

- Complete the weld seam. The weld seam must be fully welded to ensure a secure and leak-tight connection.
- Observe the minimum current and heat input. To avoid damage, ensure that the current and heat input during the welding process are as low as possible.
- Cool the argon flow during the welding process. To improve the quality of the weld seam, cool the flow of argon during welding.
- Perform test welds in advance. Test welds help to prevent welding errors and improve the quality of the weld.
- Clean the connection components. Clean the connection components (such as cable glands, seals and connectors) with pure/filtered gas.



Observe the specifications and notes. Observe the specifications and notes of all components and manufacturers.

### Note on VCR®-compatible connections

For VCR®-compatible connections, the union nut/male nut or fitting must be tightened beyond the hand-tight position (depending on the seals used) using a 1/8 or 1/4 turn. Excessive tightening can damage the sealing lips and lead to possible leakage. Do not scratch the sealing lips.

VCR® is a registered trademark of Swagelok

### Notes on rework

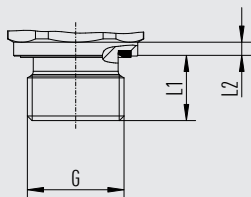
The following rework steps are required for UHP products:

- Set the zero point. A zero point is required; see the operating instructions for the respective instrument.
- Check for leak tightness. Check the UHP connections (threaded connections, welds) for leak tightness using a suitable test (e.g. helium leak test).
- Check the gas flow. Switch the gas flow on and off at least 10 times to remove any particles that may have entered during installation. The flow rate of the gas should correspond to the subsequent process flow.

## Dimensions in mm [in]

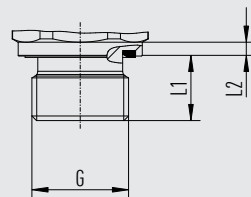
### Threaded connections

DIN EN ISO 1179-2



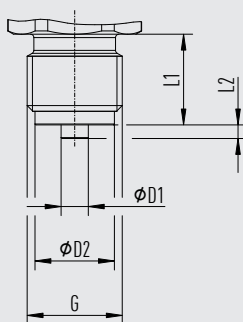
| G     | L1        | L2          |
|-------|-----------|-------------|
| G ⅜ A | 8 [0.31]  | 1.5 [0.059] |
| G ¼ A | 12 [0.47] | 2 [0.08]    |
| G ½ A | 14 [0.55] | 3 [0.12]    |

DIN EN ISO 9974-2



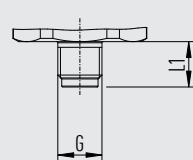
| G         | L1        | L2          |
|-----------|-----------|-------------|
| M10 x 1.0 | 8 [0.31]  | 1.5 [0.059] |
| M14 x 1.5 | 12 [0.47] | 2 [0.08]    |

EN 837



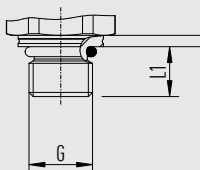
| G     | L1        | L2       | D1         | D2           |
|-------|-----------|----------|------------|--------------|
| G ¼ B | 13 [0.51] | 2 [0.08] | 5 [0.19]   | 9.5 [0.374]  |
| G ⅝ B | 16 [0.63] | 3 [0.12] | 5.5 [0.22] | 13 [0.512]   |
| G ½ B | 20 [0.79] | 3 [0.12] | 6 [0.24]   | 17.5 [0.689] |

EN 837



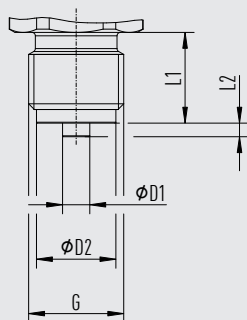
| G   | L1        |
|-----|-----------|
| G ⅝ | 10 [0.39] |

ISO 6149-2



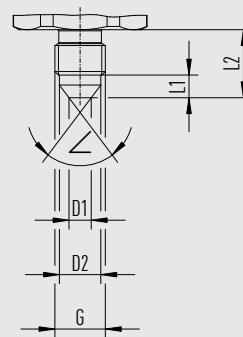
| G         | L1        |
|-----------|-----------|
| M14 x 1.5 | 11 [0.43] |

# DIN 16288



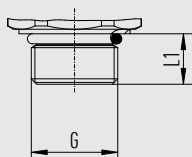
| G         | L1        | L2       | D1       | D2           |
|-----------|-----------|----------|----------|--------------|
| M12 x 1.5 | 13 [0.51] | 2 [0.08] | 5 [0.19] | 9.5 [0.374]  |
| M20 x 1.5 | 20 [0.79] | 3 [0.12] | 6 [0.24] | 17.5 [0.689] |

# SAE J514, sealing cone



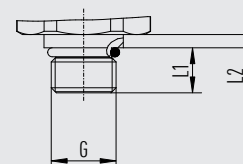
| G              | L1      | L2        | D1          | D2           | ∠   |
|----------------|---------|-----------|-------------|--------------|-----|
| 7/16-20 UNF-2A | 5 [0.2] | 15 [0.59] | 4.9 [0.193] | 9.12 [0.359] | 74° |

# SAE J514, O-ring BOSS



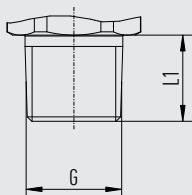
| G                          | L1             |
|----------------------------|----------------|
| 3/4-16 UNF-2A, O-ring BOSS | 11.13 [0.4382] |

# SAE J514, O-ring BOSS



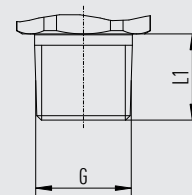
| G                           | L1            | L2            |
|-----------------------------|---------------|---------------|
| 7/16-20 UNF-2A, O-ring BOSS | 9.14 [0.3598] | 2.92 [0.1149] |
| 9/16-18 UNF-2A, O-ring BOSS | 9.93 [0.3909] | 2.92 [0.1149] |

# ANSI/ASME B1.20.1



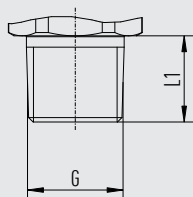
| G       | L1        |
|---------|-----------|
| 1/8 NPT | 10 [0.39] |
| 1/4 NPT | 13 [0.51] |
| 1/2 NPT | 19 [0.75] |

# KS B 0222



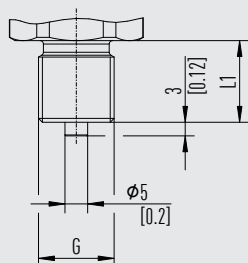
| G      | L1        |
|--------|-----------|
| PT 1/4 | 13 [0.51] |
| PT 3/8 | 15 [0.59] |
| PT 1/2 | 19 [0.75] |

## ISO 7



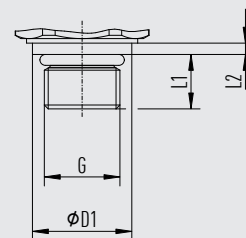
| G   | L1        |
|-----|-----------|
| R ¼ | 13 [0.51] |
| R ⅜ | 15 [0.59] |
| R ½ | 19 [0.75] |

## JIS B 7505-76



| G     | L         |
|-------|-----------|
| G ¼ B | 16 [0.63] |

## JIS B 2351-1

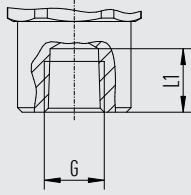


| G                      | D1                         | L1                      | L2          |
|------------------------|----------------------------|-------------------------|-------------|
| G ¼ FORM O with collar | 19 [0.75]                  | 10 [0.39] <sup>1)</sup> | 2 [0.08]    |
| G ⅜ FORM O with collar | 21.9 [0.962] <sup>1)</sup> | 12 [0.47]               | 2.5 [0.098] |

1) Not in accordance with standard

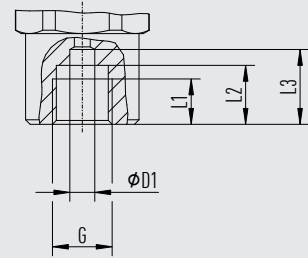
## Connections with female thread

ANSI/ASME B1.20.1



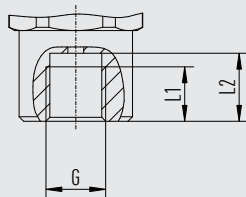
| G       | L1        |
|---------|-----------|
| 1/4 NPT | 14 [0.55] |

EN 837



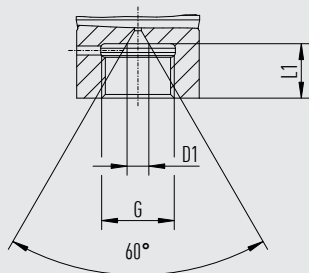
| G     | L1        | L2        | L3          | D1          |
|-------|-----------|-----------|-------------|-------------|
| G 1/4 | 10 [0.39] | 13 [0.51] | 16.5 [0.65] | 5.5 [0.217] |

ISO 8434-1



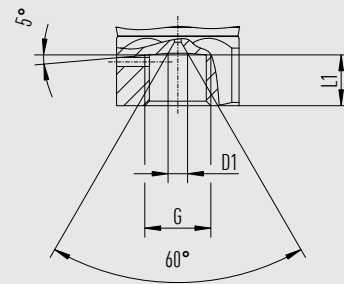
| G                                          | L1        | L2        |
|--------------------------------------------|-----------|-----------|
| G 1/4 (compatible with bite-type fittings) | 12 [0.47] | 15 [0.59] |

Metric threads



| G                            | L1        | D1          |
|------------------------------|-----------|-------------|
| M16 x 1.5, with sealing cone | 12 [0.47] | 4.8 [0.189] |
| M20 x 1.5, with sealing cone | 15 [0.59] | 4.8 [0.189] |

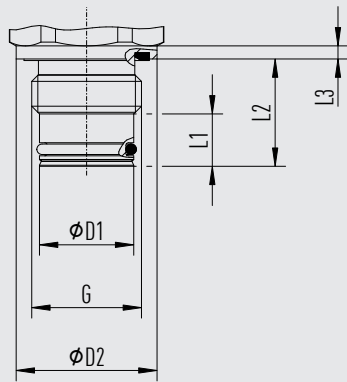
UNF thread



| G                       | L1           | D1          |
|-------------------------|--------------|-------------|
| 9/16-18 UNF-2B (F250-C) | 11.2 [0.441] | 4.3 [0.169] |

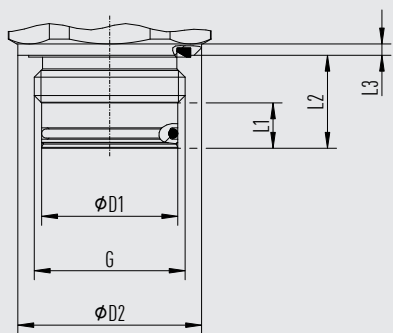
Flush threaded connections

G ½ B flush



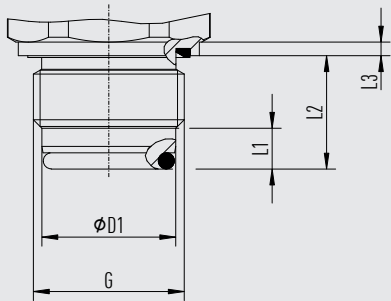
| G     | L1        | L2           | L3       | D1        | D2           |
|-------|-----------|--------------|----------|-----------|--------------|
| G ½ B | 10 [0.39] | 20.5 [0.807] | 3 [0.12] | 18 [0.71] | 26.9 [1.059] |

G 1 B flush



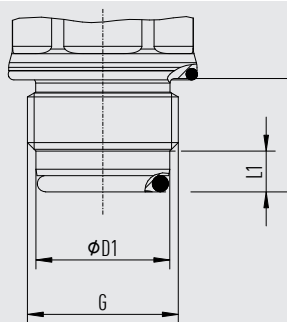
| G     | L1        | L2           | L3          | D1        | D2           |
|-------|-----------|--------------|-------------|-----------|--------------|
| G 1 B | 10 [0.39] | 20.5 [0.807] | 2.5 [0.098] | 30 [1.18] | 40.5 [1.595] |

G 1 B hygienic



| G     | L1       | L2        | L3       | D1           |
|-------|----------|-----------|----------|--------------|
| G 1 B | 9 [0.35] | 25 [0.98] | 3 [0.12] | 29.5 [1.161] |

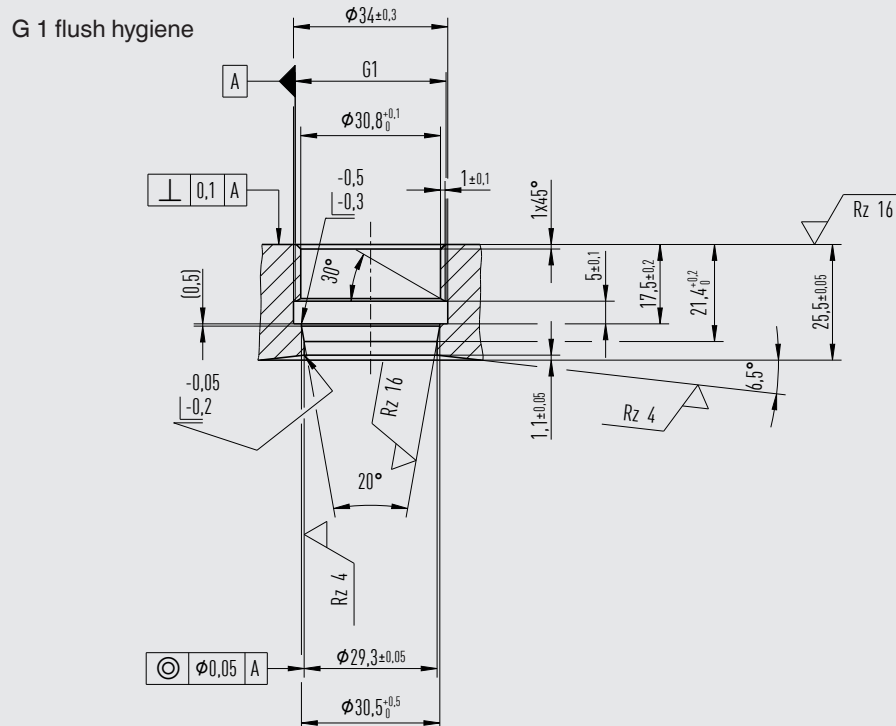
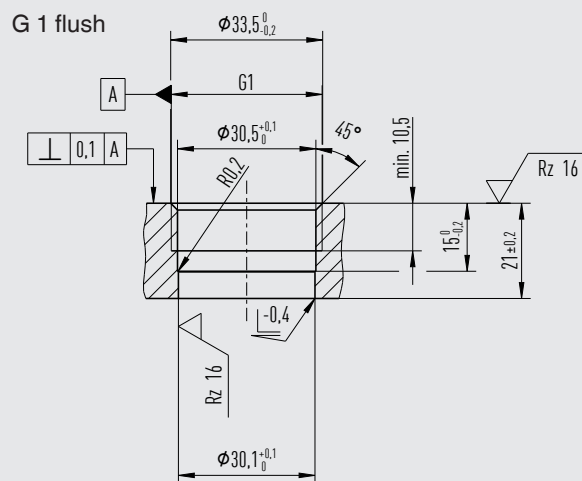
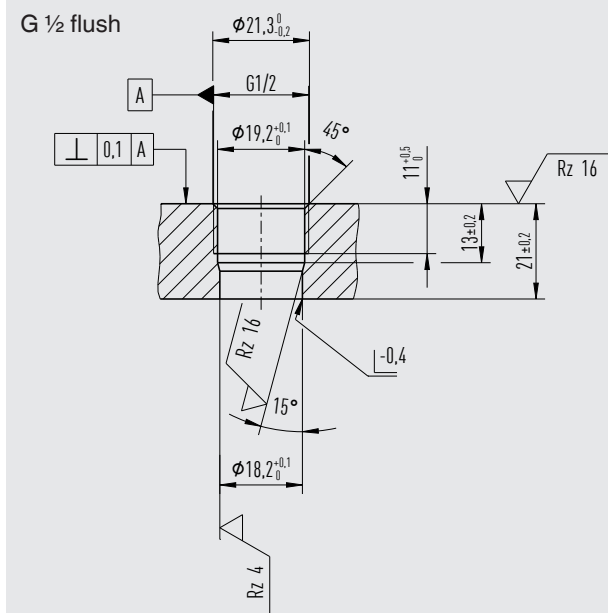
G 1 B hygienic 3A



| G     | L1       | D1           |
|-------|----------|--------------|
| G 1 B | 9 [0.35] | 29.5 [1.161] |

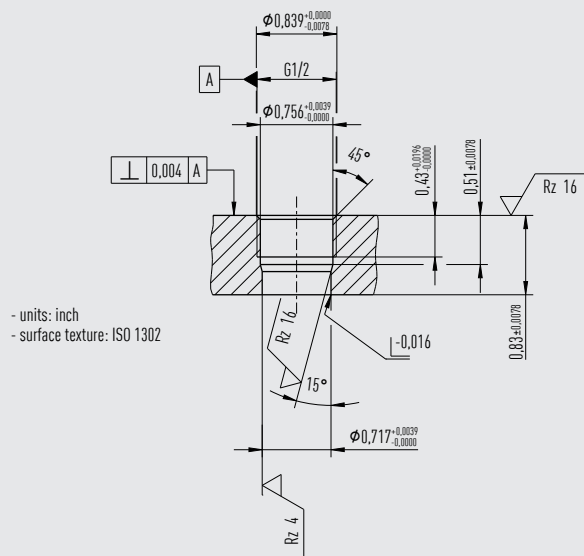
### Tapped holes in mm

Tapped holes are only shown for WIKA-specific threads. For all other tapped holes, observe the applicable standards.

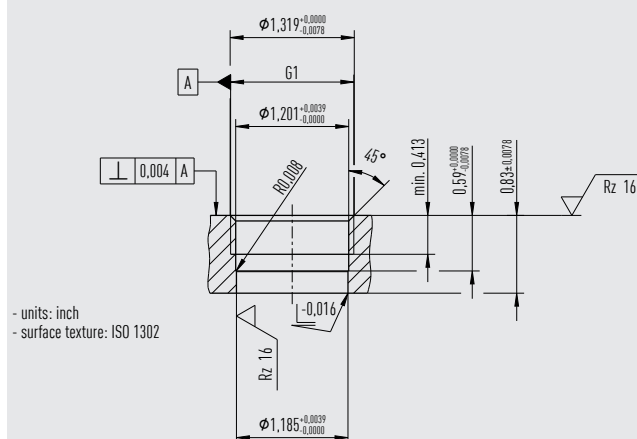


## Tapped holes in inch

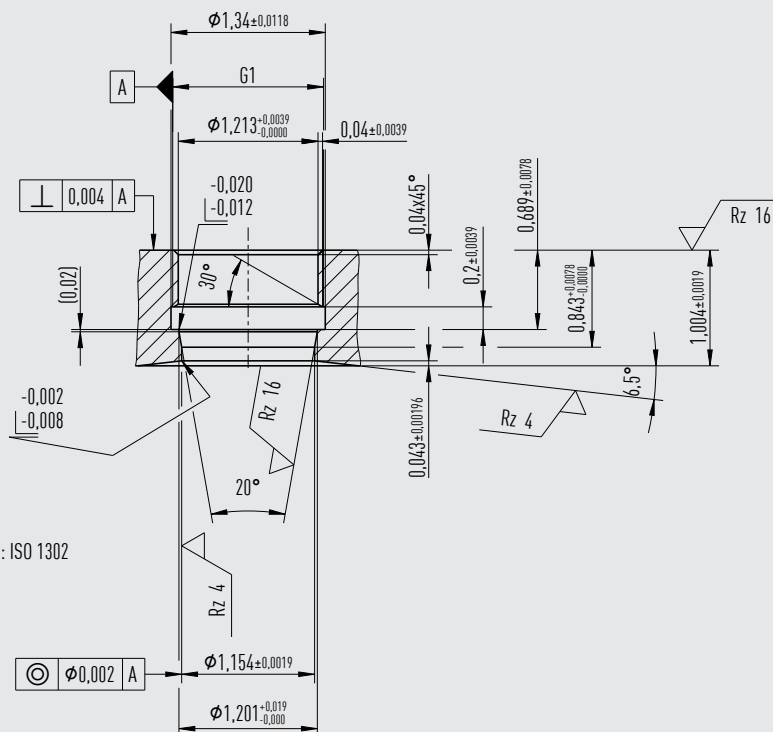
G 1/2 flash



G 1 flash



G 1 flush hygiene



## Max. measuring ranges and overpressure limits depending on the process connections

| Thread size                                       | Seal                                      | Max. measuring range in bar [psi] | Overpressure limit in bar [psi] |
|---------------------------------------------------|-------------------------------------------|-----------------------------------|---------------------------------|
| <b>EN 837</b>                                     |                                           |                                   |                                 |
| G 3/8 B, male                                     | WIKA seal <sup>1)</sup>                   | 1,035 [15,000]                    | 1,480 [21,500]                  |
| G 1/8 B, male                                     | WIKA seal <sup>1)</sup>                   | 400 [5,800]                       | 572 [8,200]                     |
| G 1/4 B, male                                     | WIKA seal <sup>1)</sup>                   | 1,035 [15,000]                    | 1,480 [21,500]                  |
| G 1/4, female                                     | WIKA seal <sup>1)</sup>                   | 1,035 [15,000]                    | 1,480 [21,500]                  |
| G 1/2 B, male                                     | WIKA seal <sup>1)</sup>                   | 1,035 [15,000]                    | 1,480 [21,500]                  |
| G 1/2 B, male <sup>3)</sup>                       | Without (from ≥ 1,000 bar <sup>4)</sup> ) | 1,600 [23,200]                    | 2,288 [33,185]                  |
| <b>DIN EN ISO 1179-2</b>                          |                                           |                                   |                                 |
| G 1/8 A, male                                     | Elastomer seal <sup>2)</sup>              | 250 [3,600]                       | 358 [3,700]                     |
| G 1/4 A, male                                     | Elastomer seal <sup>2)</sup>              | 600 [8,700]                       | 858 [12,400]                    |
| G 1/4 A, male                                     | Elastomer seal (item no. 14045531)        | 1,035 [15,000]                    | 1,480 [21,500]                  |
| G 1/2 A, male                                     | Elastomer seal <sup>2)</sup>              | 600 [8,700]                       | 858 [12,400]                    |
| <b>DIN EN ISO 9974-2</b>                          |                                           |                                   |                                 |
| M10 x 1.0, male                                   | Elastomer seal <sup>2)</sup>              | 250 [3,600]                       | 358 [3,700]                     |
| M14 x 1.5, male                                   | Elastomer seal <sup>2)</sup>              | 600 [8,700]                       | 858 [12,400]                    |
| <b>ANSI/ASME B1.20.1</b>                          |                                           |                                   |                                 |
| 1/8 NPT, male                                     | Self-sealing                              | 400 [5,800]                       | 572 [8,300]                     |
| 1/4 NPT, male                                     | Self-sealing                              | 1,035 [15,000]                    | 1,480 [21,500]                  |
| 1/4 NPT, female                                   | Self-sealing                              | 1,035 [15,000]                    | 1,480 [21,500]                  |
| 1/2 NPT, male                                     | Self-sealing                              | 1,035 [15,000]                    | 1,480 [21,500]                  |
| 1/2 NPT, male <sup>3)</sup>                       | Self-sealing                              | 1,600 [23,200]                    | 2,288 [33,185]                  |
| <b>ISO 7</b>                                      |                                           |                                   |                                 |
| R 3/8, male                                       | WIKA seal <sup>1)</sup>                   | 1,035 [15,000]                    | 1,480 [21,500]                  |
| R 1/4, male                                       | WIKA seal <sup>1)</sup>                   | 1,035 [15,000]                    | 1,480 [21,500]                  |
| R 1/2, male                                       | WIKA seal <sup>1)</sup>                   | 1,035 [15,000]                    | 1,480 [21,500]                  |
| <b>SAE J514</b>                                   |                                           |                                   |                                 |
| 3/4-16 UNF-2A SAE J514 O-ring BOSS                | Elastomer seal <sup>2)</sup>              | 600 [8,700]                       | 858 [12,400]                    |
| 7/16-20 UNF-2A SAE J514 O-ring BOSS               | Elastomer seal <sup>2)</sup>              | 600 [8,700]                       | 858 [12,400]                    |
| 7/16-20 UNF-2A SAE J514 74°                       | Self-sealing                              | 800 [11,600]                      | 1,144 [16,600]                  |
| 9/16-18 UNF-2A SAE J514 O-ring BOSS               | Elastomer seal <sup>2)</sup>              | 600 [8,700]                       | 858 [12,400]                    |
| <b>JIS B2351-1</b>                                |                                           |                                   |                                 |
| G 3/8, male, form O with collar                   | Elastomer seal <sup>2)</sup>              | 600 [8,700]                       | 858 [12,400]                    |
| G 1/4 x 10, male, form O with collar              | Elastomer seal <sup>2)</sup>              | 600 [8,700]                       | 858 [12,400]                    |
| <b>DIN 16288</b>                                  |                                           |                                   |                                 |
| M20 x 1.5, male                                   | WIKA seal <sup>1)</sup>                   | 1,035 [15,000]                    | 1,480 [21,500]                  |
| M20 x 1.5, male <sup>3)</sup>                     | Without (from ≥ 1000 bar <sup>4)</sup> )  | 1,600 [23,200]                    | 2,288 [33,185]                  |
| <b>DIN 16288 (similar to EN 837)</b>              |                                           |                                   |                                 |
| M12 x 1.5, male (similar to EN 837)               | WIKA seal <sup>1)</sup>                   | 1,035 [15,000]                    | 1,480 [21,500]                  |
| M12 x 1.5, male (similar to EN 837) <sup>3)</sup> | Without (from ≥ 1000 bar <sup>4)</sup> )  | 1,600 [23,200]                    | 2,288 [33,185]                  |
| <b>JIS B7505-76</b>                               |                                           |                                   |                                 |
| G 1/4 B, male                                     | WIKA seal <sup>1)</sup>                   | 1,035 [15,000]                    | 1,480 [21,500]                  |
| <b>ISO 6149-2</b>                                 |                                           |                                   |                                 |

| Thread size                                        | Seal                         | Max. measuring range in bar [psi] | Overpressure limit in bar [psi] |
|----------------------------------------------------|------------------------------|-----------------------------------|---------------------------------|
| M14 x 1.5                                          | Elastomer seal <sup>2)</sup> | 600 [8,700]                       | 858 [12,400]                    |
| <b>ISO 8434-1</b>                                  |                              |                                   |                                 |
| G 1/4, female (compatible with bite-type fittings) | Without <sup>4)</sup>        | 1,035 [15,000]                    | 1,480 [21,500]                  |
| <b>KS B 0222</b>                                   |                              |                                   |                                 |
| PT 3/8, male                                       | self-sealing                 | 1,035 [15,000]                    | 1,480 [21,500]                  |
| PT 1/4, male                                       | self-sealing                 | 1,035 [15,000]                    | 1,480 [21,500]                  |
| PT 1/2, male                                       | self-sealing                 | 1,035 [15,000]                    | 1,480 [21,500]                  |
| <b>Without</b>                                     |                              |                                   |                                 |
| G 1/2, flush                                       | NBR, up to 120 °C            | 600 [8,700]                       | 1,200 [17,400]                  |
| G 1/2, flush                                       | FKM, up to 100 °C            | 420 [6,100]                       | 600 [8,700]                     |
| G 1/2, flush                                       | EPDM, up to 150 °C           | 280 [4,100]                       | 400 [5,800]                     |
| G 1/2, flush                                       | FFKM, up to 150 °C           | 600 [8,700]                       | 1,200 [17,400]                  |
| M16 x 1.5 female with sealing cone                 | Without <sup>4)</sup>        | 7,000 [101,500]                   | 8,000 [116,000]                 |
| M20 x 1.5 female with sealing cone                 | Without <sup>4)</sup>        | 15,000 [217,600]                  | 16,000 [232,100]                |
| 9/16-18 UNF, female F250-C                         | Without <sup>4)</sup>        | 7,000 [101,500]                   | 8,000 [116,000]                 |
| G 1 B hygienic 3A                                  | Elastomer seal <sup>2)</sup> | Not required <sup>5)</sup>        | Not required <sup>5)</sup>      |
| G 1 B hygienic                                     | Elastomer seal <sup>2)</sup> | Not required <sup>5)</sup>        | Not required <sup>5)</sup>      |
| G 1 B, flush                                       | Elastomer seal <sup>2)</sup> | Not required <sup>5)</sup>        | Not required <sup>5)</sup>      |

1) Per DS AC 09.08 (materials only Cu and 1.4571)

2) Per section "Spare parts" of the respective DS

3) Process connection from CrNiMo steel 1.4542

4) The information on the maximum measuring range and overpressure limit refers to the process connection.

Depending on the selected process connection and the seal, restrictions in overpressure limit can result.

5) It is not necessary to specify the maximum measuring range and overpressure limit, as the thread is only used for significantly lower measuring ranges.

Details must be tested separately in the respective application. The specified values for the overpressure limit serve only as a rough orientation. The values depend on the temperature, the seal used, the selected torque, the type and the material of the mating thread and the prevailing operating conditions.

→ Other customised process connections on request

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We reserve the right to make modifications to the specifications and materials.



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# Conversion Table of commonly used pressure units

WIKA Data Sheet IN 00.08

## SI Units - Engineering units (based on the metre)

|                   |          | SI units          |                   |                   |                  |                   |                   | Engineering units |                   |                   |                   |                   |                    |  |
|-------------------|----------|-------------------|-------------------|-------------------|------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|--------------------|--|
| to<br>from        |          | bar               | mbar              | μbar              | Pa               | kPa               | MPa               | mmHg              | mmWS              | mWS               | kp/mm²            | kp/cm²            | atm                |  |
| SI units          | 1 bar    | 1                 | 10³               | 10⁶               | 10⁵              | 100               | 0.1               | 750.064           | 10.1972<br>• 10³  | 10.1972           | 10.1972<br>• 10⁻³ | 1.01972           | 0.986923           |  |
|                   | 1 mbar   | 10⁻³              | 1                 | 10³               | 100              | 0.1               | 0.1<br>• 10⁻³     | 750.064<br>• 10⁻³ | 10.1972           | 10.1972<br>• 10⁻³ | 10.1972<br>• 10⁻⁶ | 1.01972<br>• 10⁻³ | 0.986923<br>• 10⁻³ |  |
|                   | 1 μbar   | 10⁻⁶              | 10⁻³              | 1                 | 0.1              | 0.1<br>• 10⁻³     | 0.1<br>• 10⁻⁶     | 750.064<br>• 10⁻⁶ | 10.1972<br>• 10⁻³ | 10.1972<br>• 10⁻⁶ | 10.1972<br>• 10⁻⁹ | 1.01972<br>• 10⁻⁶ | 0.986923<br>• 10⁻⁶ |  |
|                   | 1 Pa     | 10⁻⁵              | 0.01              | 10                | 1                | 10⁻³              | 10⁻⁶              | 7.50064<br>• 10⁻³ | 101.972<br>• 10⁻³ | 101.972<br>• 10⁻⁶ | 101.972<br>• 10⁻⁹ | 10.1972<br>• 10⁻⁶ | 9.86923<br>• 10⁻⁶  |  |
|                   | 1 kPa    | 0.01              | 10                | 10<br>• 10³       | 10³              | 1                 | 10⁻³              | 7.50064           | 101.972           | 101.972<br>• 10⁻³ | 101.972<br>• 10⁻⁶ | 10.1972<br>• 10⁻³ | 0.986923<br>• 10⁻³ |  |
|                   | 1 MPa    | 10                | 10<br>• 10³       | 10<br>• 10⁶       | 10⁶              | 10³               | 1                 | 7.50064<br>• 10³  | 101.972<br>• 10³  | 101.972           | 101.972<br>• 10⁻³ | 10.1972           | 9.86923            |  |
| Engineering units | 1 mmHg   | 1.33322<br>• 10⁻³ | 1.33322           | 1.33322<br>• 10³  | 133.322          | 133.322<br>• 10⁻³ | 133.322<br>• 10⁻⁶ | 1                 | 13.5951           | 13.5951<br>• 10⁻³ | 13.5951<br>• 10⁻⁶ | 1.35951<br>• 10⁻³ | 1.31579<br>• 10⁻³  |  |
|                   | 1 mmWS   | 98.0665<br>• 10⁻⁶ | 98.0665<br>• 10⁻³ | 98.0665           | 9.80665          | 9.80665<br>• 10⁻³ | 9.80665<br>• 10⁻⁶ | 73.5561<br>• 10⁻³ | 1                 | 10⁻³              | 10⁻⁶              | 0.1<br>• 10⁻³     | 96.7841<br>• 10⁻⁶  |  |
|                   | 1 mWS    | 98.0665<br>• 10⁻³ | 98.0665           | 98.0665<br>• 10³  | 9.80665<br>• 10³ | 9.80665           | 9.80665<br>• 10⁻³ | 73.5561           | 10³               | 1                 | 10⁻³              | 0.1               | 96.7841<br>• 10⁻³  |  |
|                   | 1 kp/mm² | 98.0665           | 98.0665<br>• 10³  | 98.0665<br>• 10⁶  | 9.80665<br>• 10⁶ | 9.80665<br>• 10³  | 9.80665           | 73.5561<br>• 10³  | 10⁶               | 10³               | 1                 | 100               | 96.7841            |  |
|                   | 1 kp/cm² | 0.980665          | 0.980665<br>• 10³ | 0.980665<br>• 10⁶ | 98.0665<br>• 10³ | 98.0665           | 98.0665<br>• 10⁻³ | 735.561           | 10<br>• 10³       | 10                | 0,01              | 1                 | 0.967841           |  |
|                   | 1 atm    | 1.01325           | 1.01325<br>• 10³  | 1.01325<br>• 10⁶  | 101.325<br>• 10³ | 101.325           | 101.325<br>• 10⁻³ | 760               | 10.3323<br>• 10³  | 10.3323           | 10.3323<br>• 10⁻³ | 1.03323           | 1                  |  |

Corresponding pressure units:

- 1 Pa = 1 N/m<sup>2</sup>
- 1 hPa = 1 mbar
- 1 mmHg = 1 Torr
- 1 kp/cm<sup>2</sup> = 1 at (atü)

### Notes

The table refers to DIN 1301 Part 1 (2002) and Part 3 (1979).  
In accordance with the Execution Ordinance to the law on units in metrology (Federal German Units Ordinance) from 13th December 1985 only the following units are admissible for pressures:

- pascal (Pa)
- bar (bar)
- millimetre of mercury (mmHg), but only for blood pressure and the pressure of other physical liquids in medicine

Valid for these units in accordance with Federal German Unit Ordinance are the definitions and conversion factors per DIN 1301.

Listed in Part 1 of this standard

- pascal as derived SI unit with special name and with special unit symbol
- bar as generally applicable unit outside the SI
- millimetre of mercury as unit outside the SI with limited area of application

Part 3 of this standard defines amongst other things conversion factors for the following units

- conventional millimetre of mercury (mmHg)
- conventional metre of water (mWS)
- torr (Torr)
- technical atmosphere (at)
- standard atmosphere (atm)

## SI units - Engineering units (based on the foot)

|                   |                        | SI units                       |                         |                               |                               |                           |                                | Engineering units               |                                |                               |                                 |
|-------------------|------------------------|--------------------------------|-------------------------|-------------------------------|-------------------------------|---------------------------|--------------------------------|---------------------------------|--------------------------------|-------------------------------|---------------------------------|
|                   | from \ to              | bar                            | mbar                    | μbar                          | Pa                            | kPa                       | MPa                            | psi                             | ft H <sub>2</sub> O            | in. H <sub>2</sub> O          | in. Hg                          |
|                   |                        |                                |                         |                               |                               |                           |                                |                                 |                                |                               |                                 |
| SI units          | 1 bar                  | 1                              | 10 <sup>3</sup>         | 10 <sup>6</sup>               | 10 <sup>5</sup>               | 100                       | 0.1                            | 14.50377                        | 33.4553                        | 401.463                       | 29.52998                        |
|                   | 1 mbar                 | 10 <sup>-3</sup>               | 1                       | 10 <sup>3</sup>               | 100                           | 0.1                       | 0.1<br>• 10 <sup>-3</sup>      | 14.50377<br>• 10 <sup>-3</sup>  | 33.4553<br>• 10 <sup>-3</sup>  | 401.463<br>• 10 <sup>-3</sup> | 29.52998<br>• 10 <sup>-3</sup>  |
|                   | 1 μbar                 | 10 <sup>-6</sup>               | 10 <sup>-3</sup>        | 1                             | 0.1                           | 0.1<br>• 10 <sup>-3</sup> | 0.1<br>• 10 <sup>-6</sup>      | 14.50377<br>• 10 <sup>-6</sup>  | 33.4553<br>• 10 <sup>-6</sup>  | 401.463<br>• 10 <sup>-6</sup> | 29.52998<br>• 10 <sup>-6</sup>  |
|                   | 1 Pa                   | 10 <sup>-5</sup>               | 0.01                    | 10                            | 1                             | 10 <sup>-3</sup>          | 10 <sup>-6</sup>               | 0.1450377<br>• 10 <sup>-3</sup> | 0.334553<br>• 10 <sup>-3</sup> | 4.01463<br>• 10 <sup>-3</sup> | 0.2952998<br>• 10 <sup>-3</sup> |
|                   | 1 kPa                  | 0.01                           | 10                      | 10<br>• 10 <sup>3</sup>       | 10 <sup>3</sup>               | 1                         | 10 <sup>-3</sup>               | 0.1450377                       | 0.334553                       | 4.01463                       | 0.2952998                       |
|                   | 1 MPa                  | 10                             | 10<br>• 10 <sup>3</sup> | 10<br>• 10 <sup>6</sup>       | 10 <sup>6</sup>               | 10 <sup>3</sup>           | 1                              | 0.1450377<br>• 10 <sup>3</sup>  | 0.334553<br>• 10 <sup>3</sup>  | 4.01463<br>• 10 <sup>3</sup>  | 0.2952998<br>• 10 <sup>3</sup>  |
| Engineering units | 1 psi                  | 68.94757<br>• 10 <sup>-3</sup> | 68.94757                | 68.94757<br>• 10 <sup>3</sup> | 6.894757<br>• 10 <sup>3</sup> | 6.894757                  | 6.894757<br>• 10 <sup>-3</sup> | 1                               | 2.30666                        | 27.6799                       | 2.036020                        |
|                   | 1 ft H <sub>2</sub> O  | 29.8907<br>• 10 <sup>-3</sup>  | 29.8907                 | 29.8907<br>• 10 <sup>3</sup>  | 2.98907<br>• 10 <sup>3</sup>  | 2.98907                   | 2.98907<br>• 10 <sup>-3</sup>  | 433.5275<br>• 10 <sup>-3</sup>  | 1                              | 12                            | 0.8826709                       |
|                   | 1 in. H <sub>2</sub> O | 2.49089<br>• 10 <sup>-3</sup>  | 2.49089                 | 2.49089<br>• 10 <sup>3</sup>  | 0.249089<br>• 10 <sup>3</sup> | 0.249089                  | 0.249089<br>• 10 <sup>-3</sup> | 36.12729<br>• 10 <sup>-3</sup>  | 83.3333<br>• 10 <sup>-3</sup>  | 1                             | 73.55591<br>• 10 <sup>-3</sup>  |
|                   | 1 in. Hg               | 33.86389<br>• 10 <sup>-3</sup> | 33.86389                | 33.86389<br>• 10 <sup>3</sup> | 3.386389<br>• 10 <sup>3</sup> | 3.386389                  | 3.386389<br>• 10 <sup>-3</sup> | 0.4911542                       | 1.132925                       | 13.59510                      | 1                               |

Corresponding pressure units:

- 1 Pa = 1 N/m<sup>2</sup>
- 1 psi = 1 lbf/in.<sup>2</sup>
- 1 mmHg = 1 Torr
- 1 kgf/cm<sup>2</sup> = 1 at

### Notes

The table refers to ISO 31-1:1992 and ISO 31-3:1992

For lengths ISO 31-1 defines conversion factors for units no longer to be used:

- inch (in)
- foot (ft)

For pressures ISO 31-3 defines conversion factors for units no longer to be used:

- pound-force per square inch (lbf/in.<sup>2</sup>)
- conventional millimetre of water (mmH<sub>2</sub>O)
- conventional millimetre of mercury (mmHg)
- Torr (Torr)
- technical atmosphere (at)
- standard atmosphere (atm)



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# Diaphragm seals and diaphragm seal systems

## Application - Functionality - Design

WIKA data sheet IN 00.06

### Definition

Diaphragm seals are used for pressure measurements when the process medium should not come into contact with the pressurised parts of the measuring instrument.

A diaphragm seal has two primary tasks:

1. Separation of the measuring instrument from the process medium
2. Transfer of the pressure to the measuring instrument

### Functionality of a diaphragm seal

The functionality of a diaphragm seal is illustrated in the figure on the right.

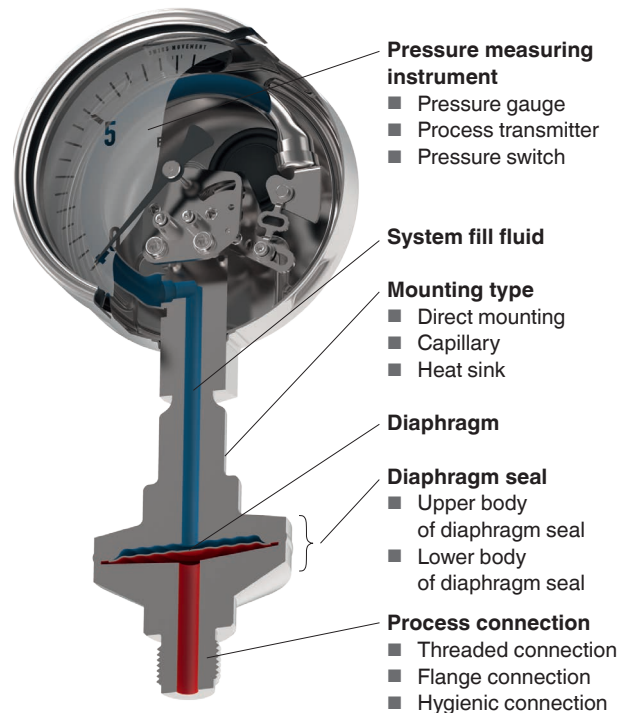
#### Principle

The process side of the seal is isolated by a flexible diaphragm. The internal space between this diaphragm and the pressure measuring instrument is completely filled with a system fill fluid. The process pressure is transmitted by the elastic diaphragm into the fluid and from there to the measuring element of the pressure measuring instrument.

In many cases, between the diaphragm seal and pressure measuring instrument, a capillary is connected in order (for example) to eliminate or to minimise temperature effects from the hot fluid to the measuring instrument. The capillary affects the response time of the overall system.

Diaphragm seal, capillary and measuring instrument form a closed system. The sealed filling screws on the diaphragm seal and the measuring instrument must therefore never be opened, since the function of the system is affected following any escape of fill fluid!

The diaphragm and the process connection are the elements of the system which come into contact with the medium. Therefore, the material from which they are made must meet the relevant requirements in terms of temperature and corrosion resistance.



### Installation example of a diaphragm seal system

If the diaphragm is leaking, the system fill fluid can enter the medium. For applications in the food industry, it must be approved for contact with food. In selecting the fill fluid, the factors of compatibility, temperature and pressure conditions in the medium are of crucial importance. Customer-specific solutions can be realised for the different operating conditions of the applications.

Diaphragm seal systems are capable of withstanding extreme temperatures of  $-130 \dots +450 \text{ }^{\circ}\text{C}$  [ $-202 \dots +842 \text{ }^{\circ}\text{F}$ ] and pressures of 35 mbar ... 3,600 bar [0.5 ... 52,200 psi].

## Fields of application

The use of diaphragm seals enables the user to employ a large number of pressure measuring instruments for the most difficult process conditions.

### Examples

- The medium is corrosive and the pressure measuring instrument itself (e.g. the interior of a Bourdon tube) cannot be sufficiently protected against it.
- The medium is highly viscous and fibrous, thus causing measuring problems due to dead spaces and constrictions in the bores of the pressure measuring instrument (pressure ports, Bourdon tubes).
- The medium has a tendency towards crystallisation or polymerisation.
- The medium has a very high temperature. As a result, the pressure measuring instrument is strongly heated. This heating leads to a large temperature error in the measurement on the pressure measuring instrument. The increased temperature can also lead to the upper limits for the thermal loading of the measuring instrument components being exceeded.
- The measuring location is not favourably located. For reasons of space, the pressure measuring instrument can either not be mounted or cannot be read or can only be read with difficulty. By installing a diaphragm seal and using a longer capillary, the pressure measuring instrument can be installed in a location where it can be easily viewed.

- In the manufacture of the product, and in the production plant, hygienic requirements must be followed. For this reason, dead spaces and undercuts in the wetted parts must be avoided.
- The medium is toxic or harmful to the environment. It cannot be allowed to escape into the atmosphere or environment through leakage. On the grounds of safety and environmental protection, the appropriate protective measures must therefore be taken.

Thanks to its many years of experience, WIKA is able to turn challenging tasks into solutions with a technological edge.

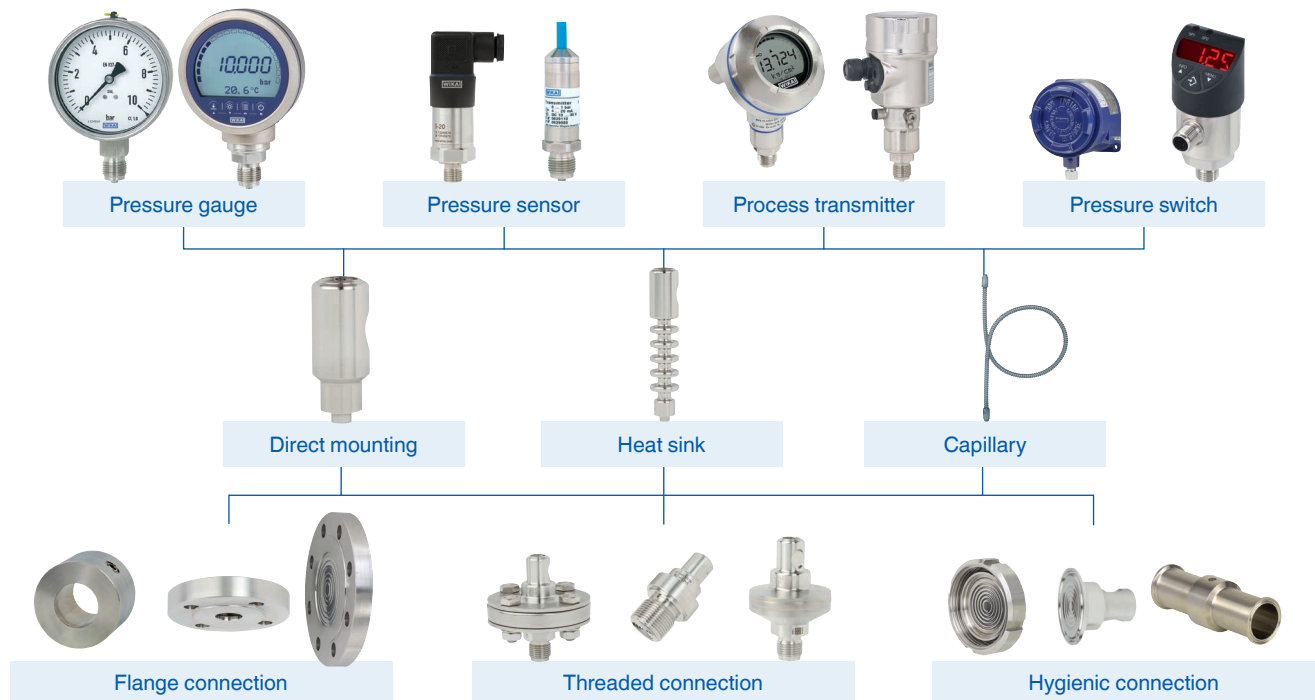
### Advantages from using diaphragm seals

- Long service life of the measuring assembly
- Reduced installation effort
- Elimination of maintenance

## Combinations for diaphragm seal systems

A diaphragm seal system is defined with the pressure measuring instrument, the mounting type and the diaphragm seal with process connection.

The optimal diaphragm seal designs, materials, system fill fluids and accessories are available for each application.



## Mounting types

The required mounting type for pressure measuring instruments with diaphragm seals depends, among other things, on the operating conditions of the diaphragm seal system. The choice is between direct mounting, flexible capillary or heat sink. This makes the diaphragm seal system adaptable to customer-specific conditions. When selecting the mounting type, influences on the measuring capability of the diaphragm seal system must be taken into account. Mounting via a capillary or a heat sink results in a longer response time than direct mounting, for example.

### Direct mounting

Direct mounting is achieved by welding the measuring instrument directly to the diaphragm seal via a connection adapter.

#### Direct mounting via axial connection adapter



### Capillary

The capillary is a flexible connecting piece between the measuring instrument and the diaphragm seal, which typically consists of a tube, a capillary protection hose and, optionally, a further jacket. Capillaries are used where the process media are at high temperatures, as these are cooled down through the connecting line. Furthermore, this mounting type is suitable for decoupling strong vibrations, or if the measuring instrument cannot be mounted at the measuring location or is easier to read at another location.

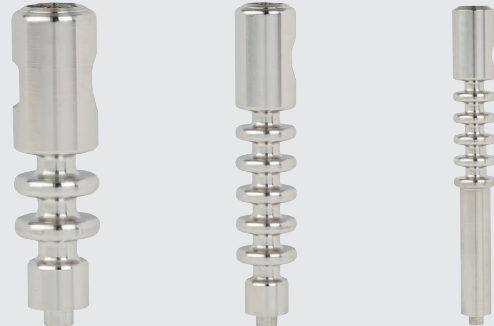
#### Capillary (example)



### Heat sink

With hot media, the heat sink ensures that the system fill fluid cools down sufficiently to guarantee precise measurement.

#### Heat sink (examples)



## Process connection and design

Diaphragm seal systems are used in demanding applications in a wide range of industries. The optimal process connections and designs are available for each application.

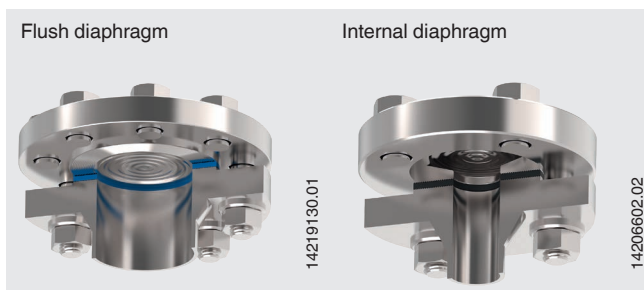
The decision for the right diaphragm seal depends on both the specifications as well as the installation options and requirements of each specific measuring task.

### Classification of the process connections

- Flange connection
- Threaded connection
- Hygienic connection

### Flange connection

Diaphragm seals with flange connection can be used for processes with aggressive, adhesive, corrosive, highly viscous, environmentally hazardous or toxic media. Diaphragm seals with flange connections are available with dimensions for all common standard flanges. The sealing face is flush and the diaphragm is designed to be either flush or internal.



### Cell-type

The cell-type is a specific variant of diaphragm seal with flange connection. It consists of a cylindrical plate, whose diameter is matched to the sealing face area of corresponding standard flanges. The diaphragm is flush and matched to the nominal width.

A blind flange is used to mount the cell-type, available for all common flange standards.



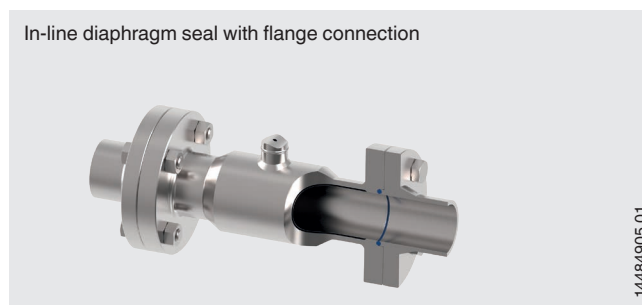
### Extended-diaphragm version

Diaphragm seals with extended diaphragm are used, among other things, on thick-walled and/or insulated product lines, vessel walls, etc. The version with extended diaphragm is available for flange- and cell-type designs.



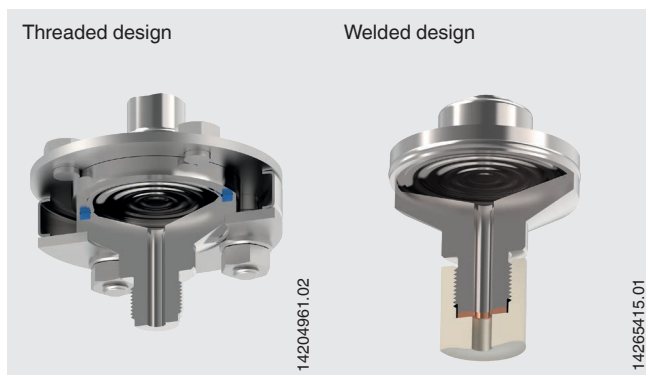
### In-line diaphragm seal with flange connection

These diaphragm seals are exceptionally suitable for the measurement of flowing media. The in-line diaphragm seal is clamped directly into the pipeline using flanges at both ends. This integration into the process line prevents disturbing turbulences, as this design has no corners, dead spaces or other obstructions in the flow direction. Different nominal widths allow the in-line diaphragm seals to be adapted to any pipeline cross-section. The in-line diaphragm seals are also available in a cell-type design.



## Threaded connection

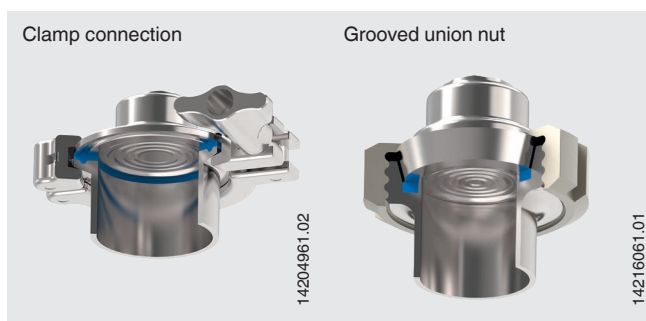
Diaphragm seals with threaded connection can be used for processes with aggressive, adhesive, corrosive, highly viscous, environmentally hazardous or toxic media. The connection of the upper and lower bodies of the diaphragm seal is available in either a threaded or a welded design. These diaphragm seals are available with female or male thread in their basic design. The wide variety of available process connections enables many different adaptations without any problems. The material of the upper body of the diaphragm seal and the lower body of the diaphragm seal can be the same or be different.



## Hygienic connection

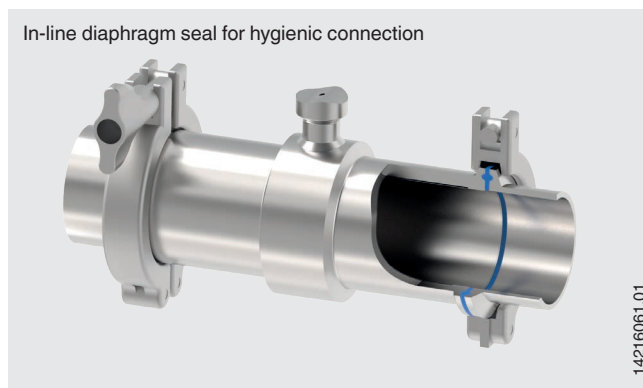
Diaphragm seals in hygienic design can be used for processes with gases, compressed air or vapour and also with liquid, pasty, powdery and crystallising media. The diaphragm seals resist the temperatures that occur and meet the requirements for sterile connections. The flush diaphragm can be integrated hygienically into all applications thanks to the various process connections.

SIP and CIP criteria, which are an essential requirement for sanitary applications, are met by using WIKA diaphragm seals.



### In-line diaphragm seal for hygienic connection

The in-line diaphragm seal is perfectly suited for use with flowing media. With the seal being completely integrated into the process line, measurements do not cause any disturbing turbulences, corners, dead spaces or other obstructions in the flow direction. The in-line diaphragm seal is clamped directly into the pipeline. With in-line diaphragm seals, the medium flows through unhindered and effects the self-cleaning of the measuring chamber. Different nominal widths allow the in-line diaphragm seals to be adapted to any pipeline cross-section.



## Materials and coatings

The predominant material for diaphragm seals is stainless steel 316L. For the wetted parts, a wide range of special materials and coatings are available for specific areas of application. WIKA offers this variety of different materials in order to be able to find the best possible solution for the demands of the measuring location.

The material selection for diaphragm seals is strongly dependent upon the operating conditions. In addition to the pressure load, the requirements for the temperature and also the resistance against the medium must be known. Then the material selection for the diaphragm seal can be made. The selection can be designed with different materials for the base body, the sealing face and the diaphragm, as these are not equally wetted in every design.

### Material combinations and coatings

Especially when using special materials, high costs and long delivery times can occur.

Such circumstance can be resolved by intelligent selection of material combinations or coatings. A cost-effective base material is used for the load-bearing parts, for example, and only the wetted parts are made of a special material or have a coating. The joining and connection technology play an important role here, as different materials cannot always be welded. Regardless of the type of connection technology, these diaphragm seals can withstand extreme operating conditions.

| Material                                | Unified numbering system (UNS) |
|-----------------------------------------|--------------------------------|
| Stainless steel 316L (1.4404 or 1.4435) | S31603                         |
| Stainless steel 904L (1.4539)           | N08904                         |
| Stainless steel 321 (1.4541)            | S32100                         |
| Stainless steel 316Ti (1.4571)          | S31635                         |
| Stainless steel 1.4466 (urea grade)     | S31050                         |
| Duplex 2205 (1.4462)                    | S31803                         |
| Superduplex 1.4410                      | S32750                         |
| Tantalum (also lining)                  | R05200                         |
| Hastelloy C276 (2.4819)                 | N01276                         |
| Hastelloy C22 (2.4602)                  | N06022                         |
| Inconel 600 (2.4816)                    | N06600                         |
| Incoloy 825 (2.4858)                    | N08825                         |
| Inconel 625 (2.485)                     | N06625                         |
| Monel 400 (2.4360)                      | N04400                         |
| Nickel 200 (2.4066)                     | N02200                         |
| Nickel 201 (2.4068)                     | N02201                         |
| Titanium 3.7035 (class 2)               | R50400                         |
| Titanium 3.7235 (class 7)               | R52400                         |
| Zirconium GR702                         | R60702                         |

The maximum permissible process temperature is limited by the joining method and the system fill fluid. The maximum process temperature can be found in the data sheet for the diaphragm seal.

### Coatings

|                                                                      |
|----------------------------------------------------------------------|
| Stainless steel with ECTFE coating                                   |
| Stainless steel with PFA (FDA; 21 CFR 177.1550 and 21 CFR 177.2440)  |
| Stainless steel with PFA, anti-static (suitable for Ex applications) |
| Stainless steel with gold plating                                    |
| Stainless steel with gold-rhodium                                    |
| Stainless steel with Wikaramic®                                      |

## System fill fluids

When selecting the system fill fluid for diaphragm seals, factors such as medium compatibility as well as temperature and pressure conditions at the measuring location are of critical importance in order to avoid endangering the process. Depending on the system fill fluid, the appropriate minimum and maximum operating temperature range must be observed. In addition, the change in volume of the system fill fluid at extreme application temperatures must be taken into account.

Highly flammable applications, such as oxygen and chlorine applications, and the high demands within both sanitary applications and the semiconductor industry are also crucial in choosing the right fluid.

The properties of the system fill fluids affect the permissible operating temperature of the diaphragm seal system. Since the parameters of the individual system fill fluids vary, WIKA offers a wide range to cover different applications.

### FDA approval

The FDA ("Food and Drug Administration") is a US authority under the Department of Health. It is responsible for the monitoring of foodstuffs and pharmaceuticals and serves to protect public health in the United States.

Liquids that could find their way into the end product in the event of a failure must be FDA-compliant.

| Designation                   | Identi-<br>fication<br>number | Solidi-<br>fication<br>point | Boiling/<br>degradation<br>point | Density at<br>25 °C | Kin. Viscosity at<br>25 °C | Remark                                              |
|-------------------------------|-------------------------------|------------------------------|----------------------------------|---------------------|----------------------------|-----------------------------------------------------|
|                               | KN                            | °C                           | °C                               | g/cm <sup>3</sup>   | cSt                        |                                                     |
| Silicone oil                  | 2                             | -45                          | +300                             | 0.96                | 54.5                       | Universal application                               |
| Glycerine                     | 7                             | -35                          | +240                             | 1.26                | 759.6                      | FDA 21 CFR 182.1320                                 |
| Silicone oil                  | 17                            | -90                          | +200                             | 0.92                | 4.4                        | Low temperatures                                    |
| Halocarbon                    | 21                            | -60                          | +175                             | 1.89                | 10.6                       | Oxygen <sup>1)</sup> and chlorine                   |
| Methylcyclopentane            | 30                            | -130                         | +60                              | 0.74                | 0.7                        | For very low temperatures                           |
| High-temperature silicone oil | 32                            | -25                          | +400                             | 1.06                | 47.1                       | For high temperatures                               |
| Neobee® M-20                  | 59                            | -35                          | +260                             | 0.92                | 10.0                       | FDA 21 CFR 172.856, 21 CFR 174.5                    |
| DI water                      | 64                            | +4                           | +85                              | 1.00                | 0.9                        | For ultrapure media                                 |
| Silicone oil                  | 68                            | -75                          | +250                             | 0.93                | 10.3                       |                                                     |
| DI water/propanol mixture     | 75                            | -30                          | +60                              | 0.92                | 3.6                        | For ultrapure media                                 |
| Medicinal white mineral oil   | 92                            | -15                          | +260                             | 0.85                | 45.3                       | FDA 21 CFR 172.878, 21 CFR 178.3620(a); USP, EP, SP |

Other system fill fluids on request

#### Note:

- The stated lower temperature limit is a purely physical characteristic of the system fill fluid. The resulting response time has to be calculated and evaluated separately.
- The upper temperature limit for a diaphragm seal system is further restricted by the operating pressure and the diaphragm. To determine the upper temperature limit for the individual diaphragm seal system, a calculation is required.

1) For oxygen applications the following values per BAM test (Federal Institute for Materials Research and Testing) apply:

| Maximum temperature | Maximum oxygen pressure |
|---------------------|-------------------------|
| to 60 °C            | 50 bar                  |
| > 60 °C to 100 °C   | 30 bar                  |
| > 100 °C to 175 °C  | 25 bar                  |

## Influencing factors on the measurement

### Response time

A combination of the individual components generally causes a delay in the output of the measured value. This delay is referred to as the response time and varies depending on the assembly.

Factors such as the control volume of the measuring instrument as well as the capillary length and its associated cross-section are included in the calculation. It can therefore be concluded that the response time increases with a large control volume or a long capillary. This effect can be counteracted by selecting a measuring instrument with a smaller control volume, a shorter capillary or a capillary with a larger cross-section.

In addition to the geometric variables of the diaphragm seal system, the viscosity of the fill fluid, among other things, must also be taken into account. The higher the viscosity value, the more viscous the medium. An optimisation of the response time can thus be realised through the selection of a fill fluid with a lower viscosity.

Furthermore, the temperatures applied influence the physical properties of the system fill fluid. If the temperature increases, then the medium becomes less viscous and the response time shortens. Conversely, the response time of the measuring instrument increases as the temperature drops due to the increasing viscosity.

### Temperature effect

Diaphragm seal systems are generally filled at room temperature. If there are now temperature changes in the environment or in the process, these have a negative effect on the output values of the measuring instrument. The reason is due to the change in the physical properties of the system fill fluid. If the measuring system experiences an increase in temperature, there is an increase in volume which leads to a deflection of the diaphragm in the direction of the process. The restoring force of the diaphragm simultaneously ensures a positive zero point offset on the measuring instrument.

To counteract this error, large diaphragm diameters should be chosen due to their low rigidity. Other factors that counteract the zero point offset are a lower dead volume of the entire system and a lower thermal expansion coefficient of the fill fluid.

The opposite effect is seen when the temperature drops. The decrease in volume now causes the diaphragm to deflect in the direction of the diaphragm bed. The temperature reduction causes a negative zero point offset due to the restoring force of the diaphragm.

### Height difference

Any height difference between the pressure measuring instrument and the diaphragm seal (this applies especially when using capillaries) affects the measurement. This is due to the hydrostatic pressure of the liquid column in the capillary. The display is reduced when the pressure measuring instrument is positioned higher than the diaphragm seal. It is increased when the pressure measuring instrument is positioned lower. This height difference must be known when designing the entire system at the factory so that it can be taken into account accordingly.

Note: After mounting, a zero point test and, if necessary, a zero point correction is recommended.

