Technical cleanliness of pointer measuring instruments of special versions

Application area

This document describes manufacturing processes for special versions that require a very high technical cleanliness of the wetted parts.

This applies for mechanical and mechatronic pointer measuring instruments with stainless steel materials (e.g. 316L) and special materials (e.g. Monel, Hastelloy).

Instrument	Model
Bourdon tube pressure gauge	1, 2, 3
Diaphragm pressure gauge	4
Absolute pressure gauge	5
Capsule pressure gauge	6
Differential pressure gauge	7
Mechatronic pressure gauge	PGS, DPGS, PGT, DPGT, APGT
Bimetal thermometer	TG53, TG54, 55
Gas-actuated thermometer	73
Mechatronic thermometer	TGS55, TGS73, TGT73

Pointer measuring instruments with wetted parts from copper alloy (brass) and diaphragm seals are not considered in this technical information.

WIKA expertise

WIKA has decades of experience in the production of pressure gauges and thermometers guarantees a high level of cleanliness of the wetted parts. This is ensured, among other things, by the use of standardised processes and the support of the WIKA expert group for technical cleanliness.

For the pressure gauge version “Oil- and grease-free for oxygen”, WIKA confirms a hydrocarbon limit value of < 550 mg/m^2 for scale ranges ≤ 30 bar [≤ 400 psi] and < 220 mg/m^2 for scale ranges > 30 bar [> 400 psi], based on periodically recurring tests (in line with ISO 15001:2012 and ASTM G93 level D/E).

Additional fundamental sampling tests (burn-out test when exposed to oxygen pressure surges) at external test centres confirm the basic suitability of the “Oil and grease-free for oxygen” version of pressure gauges for this medium.

These special versions, and the additional cleaning-related manufacturing processes carried out for them, are described below.

Smart in sensing

Version: “Silicone-free”

Silicone-free or silicone oil-free means that all components in contact with the atmosphere must be largely free of silicone. This requirement is often made for paint finishing systems (e.g. in the automotive industry). The smallest silicone residues can lead to painting defects (so-called silicone craters) and ruin the painting result.
However, for process and production reasons, it is not possible to provide general confirmation of the absence of paint wetting impairment substances (freedom from PWIS) by selecting this version.

Cleaning steps in the production process

- If necessary, thorough hand cleaning before starting production, without the use of skin care products (hand cream)
- Regular cleanliness checks and, if necessary, cleaning of equipment (test and adjustment benches)
- Avoidance of assembly aids with silicone-containing, paint wetting impairment substances, where possible
- No storage of silicone or lubricating materials in the vicinity of the production process, where possible
- Selected models (e.g. diaphragm pressure gauges) receive separate cleaning and drying of selected parts and assemblies before assembly (also for internal surfaces)
- 100% cleaning of the surrounding parts of the instrument before packaging
- Individual packaging in silicone-free, sealable or heat-sealed plastic bag

Marking “Silicone-free”

Version: “Oil- and grease-free”

The requirement for internal parts to be free of oil and grease is often made in the food and pharmaceutical industries. This requirement also exists in other sectors such as industrial gases, water and wastewater, machine building and automation.

Cleaning steps in the production process

- Regular cleanliness checks and, if necessary, cleaning of equipment (test and adjustment benches)
- The instruments are primarily adjusted using oil- and grease-free, dry compressed air or nitrogen. For higher pressure ranges, adjustment is only possible with water, followed by drying of all wetted parts in a vacuum oven.
- Particularly thorough visual inspection of the surfaces before shipping

Marking “Oil- and grease-free”

Version: “Oil and grease-free for oxygen”

The use of oxygen is very versatile and widespread. The demands are extremely high due to the easy flammability and high explosion risk of oxygen. Oil and grease are particularly dangerous in the presence of oxygen, as they can easily be an ignition source and burn with explosive ferocity. This ignition source is not always obvious in piping systems. A fire can be caused by friction, high flow rates, heating due to turbulence or adiabatic compression. For example, gas with a high flow rate can suddenly hit an obstacle, e.g. a closed valve. If pipe connections are contaminated with mineral oils or greases, oxidation reactions with the carbon components can easily occur. The resulting high temperatures can then lead to spontaneous combustion and trigger a chain reaction.
For oxygen applications, WIKA recommends the use of a restrictor in the process connection to reduce the rate of pressure increase in the measuring system.

Applications of oxygen

- Breathing gas in medicine and aerospace
- Oxidising agents in combustion processes to achieve high temperatures
- Metallurgy, in pig iron and steel production and in copper refining
- Chemistry and biology
  - Olefin oxidation, partial oxidation of coal and heavy oil
  - Production of hydrogen and synthesis gas, sulphuric and nitric acid, acetylene
- Welding, cutting, separating, flame annealing
- Drinking water and wastewater treatment
- Semiconductor technology
- Fuel cells

Cleaning steps in the production process

- Regular cleanliness checks and, if necessary, cleaning of equipment (test and adjustment benches)
- The instruments are primarily adjusted using oil- and grease-free, dry compressed air or nitrogen. For higher pressure ranges, only adjustment with water is possible. In this case, the entire measuring system is then dried in a vacuum oven.
- Use of wetted materials, system fill fluids and casing fill fluids that are suitable or approved for use in conjunction with oxygen
- Before installation, the wetted parts are cleaned (e.g. in an ultrasonic bath) and then dried again. This also applies, in particular, to internal surfaces.
- After cleaning, internal transport is carried out in separately sealed and cleaned transport containers.
- The instruments are largely handled with gloves, so as not to contaminate internal parts
- Particularly thorough visual inspection of the surfaces
- The process connection is usually sealed with a protective cap for shipping
- Instruments are packed in sealed plastic bags (sometimes with desiccant)

Marking “Oil and grease-free for oxygen”

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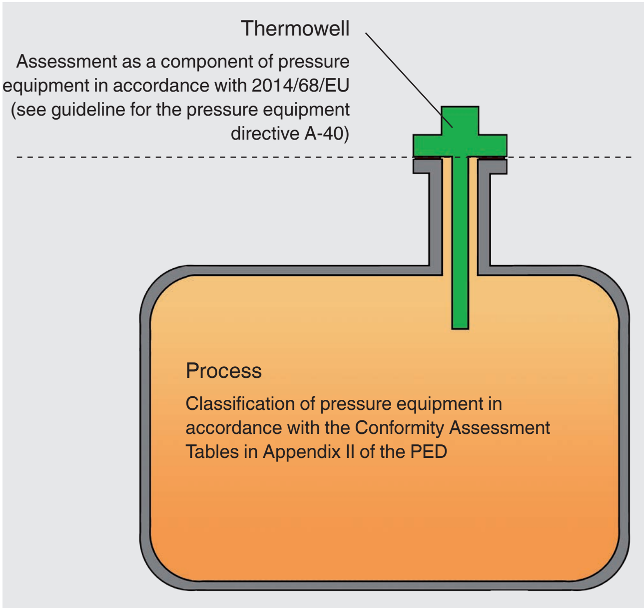
Pressure equipment directive 2014/68/EU (PED) in reference to thermowells

The following, among others, is defined in the 2014/68/EU Pressure equipment directive (PED) of the European Parliament and Council of 15 May 2014 on the harmonisation of the laws of the member states relating to the making available on the market of pressure equipment:
From 30th May 2002 onwards, all pressure measuring instruments placed onto the market in the EU with a maximum permissible pressure (PS) greater than 0.5 bar must comply with the PED. The applicability of the 2014/68/EU Pressure equipment directive in reference to thermowells is explained below.

In thermowells there is neither a fluid under pressure, nor is there any fluid transported within. Thermowells therefore are not “pressure-containing equipment” within the meaning of the Pressure equipment directive (see guideline for the pressure equipment directive A-40). The exception is for thermowells suitable for inline mounting in pipes, such as models TW61, TR25.

Thermowells are components within pressure equipment in accordance with the PED (guideline A-40). As such a component, it does not comply with the definition for pressure equipment in article 2 (1) of the PED and does not have to be marked with CE (see guideline A-22).



WIKA thermowells are designed and manufactured in compliance with “good engineering practice”.

This is achieved, for example, by:
- Basic layout of the thermowell design from standard thermowells in accordance with national or international standards, such as DIN 43772
- Approval to AD2000 HP0 und DIN EN ISO 3834-2
- TÜV approved welding procedure tests to AD2000 HP2/1 (EN 288-3 / ISO 15614/1) or ASME sec. IX
- Certified welders
- Mill certificates to EN 10204
- Hydrostatic pressure testing with 1.5 x PN or to customer specification.
- Non-destructive testing by authorised personnel, such as dye penetrant testing, ultrasonic testing of the bore concentricity or wall thickness, PMI (positive material identification), X-ray tests, helium leak testing
- Thermowell strength calculations in accordance with ASME PTC 19.3 TW-2016 or Dittrich/Klotter
- Development and manufacturing certified in accordance with ISO 9001 QM system

Some of the above tests/certifications are conducted optionally on customer request.

WIKA
Part of your business

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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 "**M**aterial **R**equirements".

- NACE [1] MR0175
  "Petroleum and natural gas industries. Material for use in H_2S-containing environments in oil and gas production."
- NACE [1] 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

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

Thermowells in various design

Description

Natural gas and crude oil, as raw materials, contain greater or lesser high levels of hydrogen sulphide (H_2S). If there is a minimum amount of H_2S 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_2S 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_2S is considered. This is aided at higher temperatures and is described by NACE MR0175. A typical application is the production of oil and gas.

1) The term **"NACE"** refers to an organisation (**N**ational **A**ssociation of **C**orrosion **E**ngineers), 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.

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).

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.

Material selection

In sour gas applications, the corrosion properties of metals depend on the environmental conditions (pH value, chloride content, H_2S 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.

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_2S 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
Mechanical pressure measuring instruments	max. 120 °C [1)]	no limit	n/a	n/a	n/a
Electronic pressure measuring instruments	n/a	n/a	n/a	n/a	no limit [3)]
Diaphragm seal	no limit [2)]	no limit	max. 232 °C	max. 132 °C	n/a
Thermowells	no limit [2)]	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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Technical information

Mounting arrangements
Instrument hook-ups for the process industry

WIKA data sheet IN 00.34

In many applications within the process industries, measuring instruments are exposed to critical operating conditions. In order to be able to withstand, for example, strong pressure surges or extreme temperatures, WIKA attaches valves, protective devices and mounting accessories to the pressure measuring instrument, depending on the application. This ensures a stable measurement and optimises maintenance and servicing activities.

Added value for mounting arrangements
The combination of pressure measuring instruments with matched components enables the protection and the extension of the function of the entire measuring unit. WIKA offers the qualified assembly of all elements with the pressure measuring instrument into a mounting arrangement, known as an "instrument hook-up".
The diverse portfolio of the attachable components results from the variation in the applications and customer requirements.

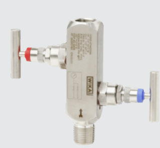
Example of a mounting arrangement

Valves

Models IV1, IV2 – Shut-off valve

Needle valve and multiport needle valve
Block-and-bleed valve

Data sheets AC 09.19 and AC 09.21



Model IVM – Monoflange

Compact block-and-bleed arrangement with flange connection

Data sheet AC 09.17

Models IV3, IV5 – Valve manifold

Shut-off, pressure equalising, purge and vent valves for differential pressure measuring instruments

Data sheet AC 09.23

Model 910.10 – Stopcock

Shut-off device for pressure measuring instruments

Data sheet AC 09.01

Model 910.11 – Shut-off valve

Shut-off and throttle valve

Data sheet AC 09.02

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Protective devices and adapters

Model 910.12 – Snubber

Protection from pressure surges and pulsations in the medium

Data sheet AC 09.03

Model 910.14 – Connection adapter

Adapter pieces for the mounting of valves and protective devices

Data sheet AC 09.05

Model 910.13 – Overpressure protector

Adjustable protection against overpressure

Data sheet AC 09.04

Model 910.15 – Syphon

Protection from pulsations and overheating through the medium

Data sheet AC 09.06

Model 910.22 – In-line filter

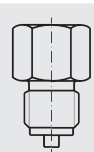
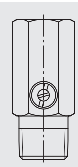
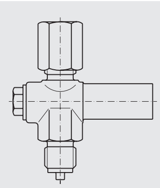
Filtration of solids from gaseous and liquid media

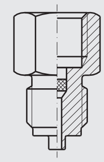
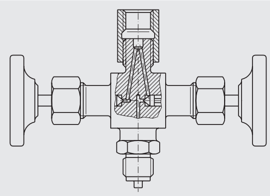
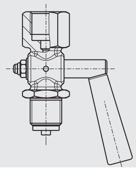
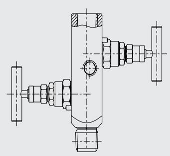
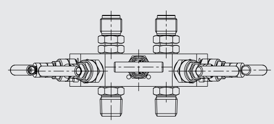
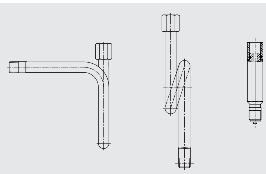
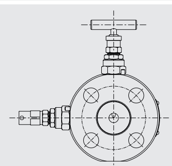
Data sheet AC 09.10

Mounting instructions

WIKA mounts the desired components to process industry pressure measuring instruments. For the mounting, WIKA standards with respect to sealing and leak testing apply. The flow direction on valves and valve manifolds is marked with an arrow. This marking is particularly important for the orientation of differential pressure instruments on valve manifolds.
If there are no alternative customer specifications, the instrument hook-up is assembled starting from the pressure measuring instrument in the following sequence.

Attachment sequence

Attachment sequence starting from the pressure measuring instrument		Standard orientation and options
Model 910.14 **Connection adapter**		For adapting threads or to enable positioning of the pressure measuring instrument through a 360° range.
Model 910.12 **Snubber**		Adjustment screw will be aligned to the front, in the direction of the dial.
Model 910.13 **Overpressure protector**		Adjustment screw (longer side) will be aligned to the right, as shown in the drawing. The set value, as standard, depends on the pressure element: Bourdon tube: 1.1 x full scale value Diaphragm or capsule element: Between full scale value and max. permissible overpressure

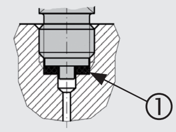
Attachment sequence starting from the pressure measuring instrument		Standard orientation and options
Model 910.22 **In-line filter**		To filter out solid substances from gaseous and liquid media.
Model 910.11 **Shut-off valve**		■ Shut-off valve without test connection per DIN 16270 (with vent screw) ■ Shut-off valve with test connection per DIN 16271 (with vent screw) ■ Shut-off valve with separate shut-off test connection per DIN 16272
Model 910.10 **Stopcock**		■ Shut-off device ■ Shut-off device with test connection
Models IV1, IV2 **Shut-off valve (square or flat version)**		Vent connections (if available) point to the rear. All T-handles, for safety reasons, will be supplied in fully closed position.
Models IV3, IV5 **Valve manifold (only for differential pressure measuring instruments)**		Orientation is determined by the threaded connections of both process connections on the differential pressure measuring instrument and the arrow marking on the valve manifold.
Model 910.15 **Syphon**		■ U-form: process connection points to the rear ■ Trumpet form: upper half of the pipe loop runs forward ■ Compact form: with fixed connection thread or LH-RH adjusting nut
Connecting flange or model IVM monoflange		Flanges (if available) are the first accessory component on the process side. A flange-mounting of the complete mounting arrangement to the application is thus enabled.

Mounting instructions

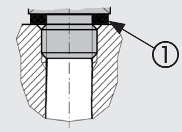
The assembly of all components is made in compliance with the specified torques and positions. Each mounting point is sealed expertly. Depending on the connection threads and the temperature and pressure ranges, PTFE tape, stainless steel sealings and other sealing rings are used (for details, see WIKA model 910.17).
The forces required for mounting and dismounting of instrument hook-ups should be applied as close to the process side as possible. For the mounting and dismounting only the designated spanner flats are to be used to prevent mounting forces from damaging the instrument or valve body.

Parallel connection threads

The sealing face ① is sealed with flat gasket, lens-type sealing ring or WIKA profile sealing, usually metallic. High-temperature resistant ceramic paste is normally used for thread lubrication. The sealing point is located before or after the thread.



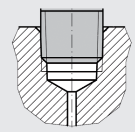
e.g. G ½ per EN 837



e.g. G ¼ per DIN 3852-E

Tapered connection threads

The thread is wrapped with sealing material (e.g. PTFE tape).
The sealing point is located in the thread.



e.g. ½ NPT

For instrument hook-ups of oxygen applications, only tested sealants and lubricants can be used. For hazardous areas, either conductive sealants and lubricants are used or the mounting arrangement offers additional possibilities for equipotential bonding (e.g. weld spots or fuse plates).

Leak test

In line with EN 12266-1:2003, each sealing point will be 100 % tested with leak detection spray under standard test pressure. At leaking points, after the application of the leak detection spray, bubbles become visible. The bubble detection method can detect leakage rates of approx. $1 \cdot 10^{-3}$ mbar l/s.
For critical applications, further tests are carried out, depending on the complexity of the instrument hook-up.
Besides the bubble detection method with leak detection spray, WIKA also uses the pressure drop method or determination of leakage rates with helium. In accordance with the EN 1779 (test gas method B4 and B6) leak testing standard, leakage rates of better than $1 \cdot 10^{-6}$ mbar · l/s can be detectable with helium.

Further information

For the selection, installation and operation of pressure gauges, see technical information IN 00.05.

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Instrument mounting
Mounting flanges, panel cutouts

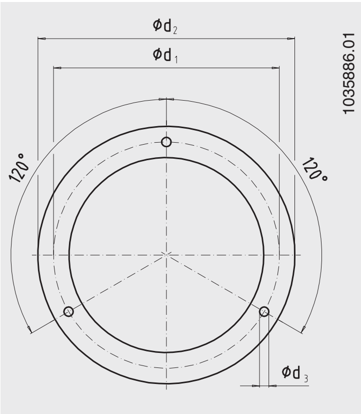
Mounting flanges

Circular housing, without electrical accessories

Front mounting flange for panel mounting

NS	Recommended panel cutout 1)
40	Ø 44 ±0.3 mm
50	Ø 54 ±0.3 mm
63	Ø 67 ±0.3 mm
80	Ø 84 ±0.3 mm
100	Ø 104 ±0.5 mm
160	Ø 164 ±0.5 mm
250	Ø 254 ±0.5 mm

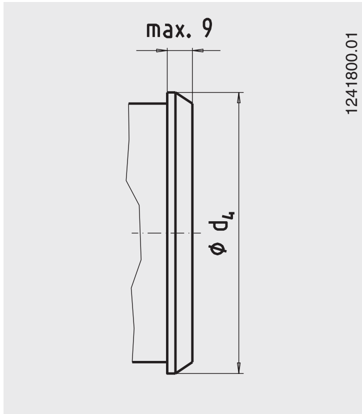
1) With back mount connection



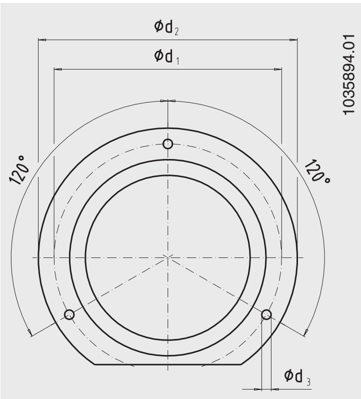
Triangular bezel for panel mounting

NS	Recommended panel cutout 1)
40	Ø 41.5 +0.5 mm
50	Ø 51 ±0.5 mm
63	Ø 64.5 +0.5 mm
80	Ø 82 ±1 mm
100	Ø 102 +1 mm
160	Ø 162.6 +1 mm

1) With back mount connection



Rear mounting flange for surface mounting 2)

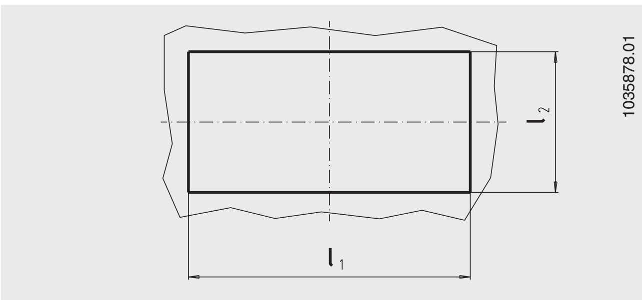


Nominal size	Dimensions in mm d_1	d_2	d_3	d_4 max.
40	51	61	3.6	44
50	60	71	3.6	55.5
63	75	85	3.6	69
80	95	110	4.8	88
100	117	132	4.8	108
160	178	196	5.8	168
250	270	285	5.8	-

2) For some models this is achieved through three mounting lugs

Panel cutout in accordance with DIN 43700

Square and rectangular housings



Nominal size	Dimensions in mm l_1	Permissible tolerance	l_2	Permissible tolerance
48 x 24	45	+0.6	22.2	+0.3
72 x 36	68	+0.7	33	+0.6
72 x 72	68	+0.7	68	+0.7
96 x 96	92	+0.8	92	+0.8
144 x 72	138	+1.0	68	+0.7
144 x 144	138	+1.0	138	+1.0

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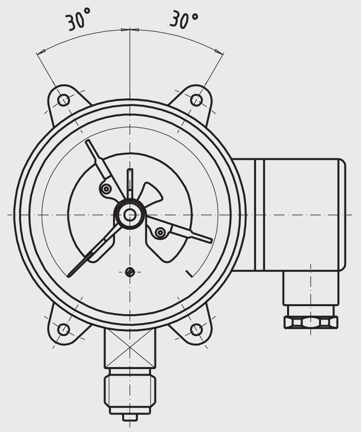
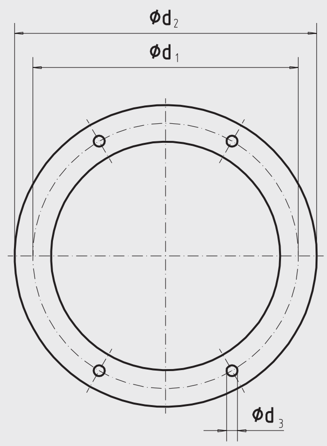
Panel mounting flange

Circular housing, with electrical accessories

Lugs on housing
(for securing in the panel)



Corresponding mounting ring
(to cover the panel cutout)



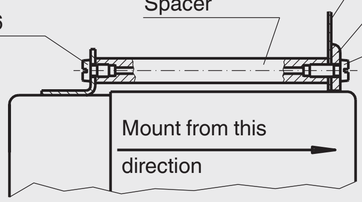
Nominal size	Dimensions in mm d_1	d_2	d_3	Panel cutout Ø
100	116	132	4.8	105
160	178	196	5.8 1)	165

1) Mounting lugs with M5 internal thread

Mounting principle with front mounting flange

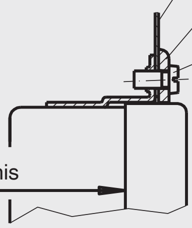
with electrical accessories

NS 100



Delivered package includes:
- Mounting ring
- 4 spacers
- 8 screws, M4 x 10

NS 160



Delivered package includes:
- Mounting ring

Additionally required
- 4 screws, M5 x 10

Note: In addition to this overview, model-specific mounting drawings are available on request.

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Process connection per EN 837

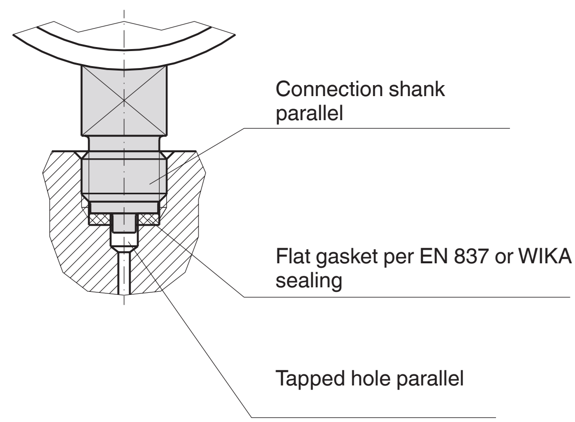
WIKA data sheet IN 00.03

Applications

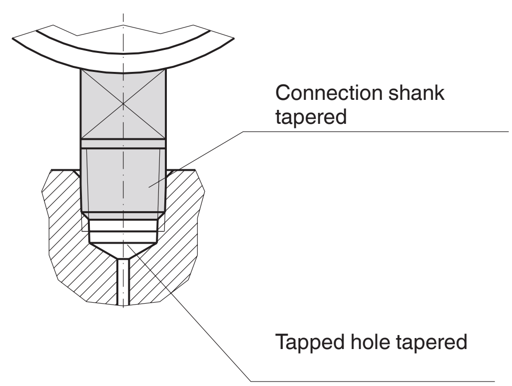
- For the definition of the process connections for WIKA pressure measuring instruments

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.

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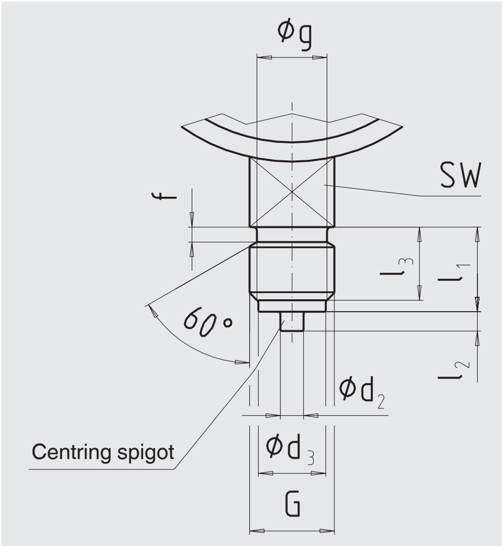
Connection shank with parallel male thread

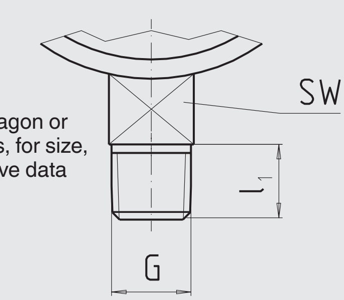


Parallel thread G	Dimensions in mm							
	d2	d3	f with Brass	Stain-less steel	g -0.2	l_1 +0.3	l_2 ±0.1	l_3 +0.3
G ⅛ 1)	2)	8	2)	2)	2)	10	2)	8
M10 x 1	2)	8	2)	2)	2)	10	2)	8
G ¼ 1)	5	9.5	2	3	11	13	2	11
M12 x 1.5	5	9.5	2	3	9.7	13	2	11
G ⅜	5.5	13	2	3	14.5	16	3	13
G ½ 1)	6	17.5	3	4	18	20	3	17
M20 x 1.5	6	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

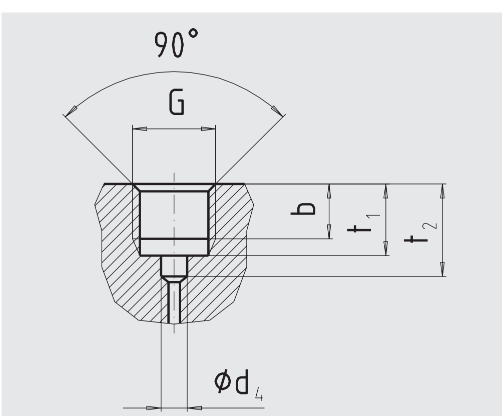
Connection shank with tapered thread

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



Tapered thread G	Dimensions in mm l_1 min.
⅛ NPT, R ⅛	10
¼ NPT, R ¼	13
⅜ NPT, R ⅜	15
½ NPT, R ½	19

Tapped hole with parallel female thread



Parallel female thread G	Dimensions in mm			
	b min.	d_4	t_1 -0.5	t_2 min.
G ⅛ 1)	7.5	4.4 3)	10	13
M10 x 1	7.5	4.5 3)	10	13
G ¼ 1)	10	5.5	13	16.5
M12 x 1.5	9.5	5.5	13	16.5
G ⅜	12	6.5	16	19.5
G ½ 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

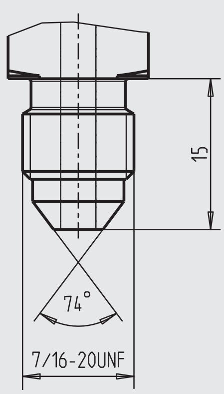
Maximum allowable pressure

Thread 1)	Maximum allowable pressure 2)					
	Cu alloy		Stainless steel		Monel®	
	bar	psi	bar	psi	bar	psi
G ⅛	400	6,000	400	6,000	400	6,000
G ¼	600	8,600	1,000	15,000	1,000	15,000
G ⅜	600	8,600	1,000	15,000	1,000	15,000
G ½	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
⅛ NPT, R ⅛	400	6,000	400	6,000	400	6,000
¼ NPT, R ¼	600	8,600	1,000	15,000	1,000	15,000
⅜ NPT, R ⅜	600	8,600	1,000	15,000	1,000	15,000
½ NPT, R ½	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

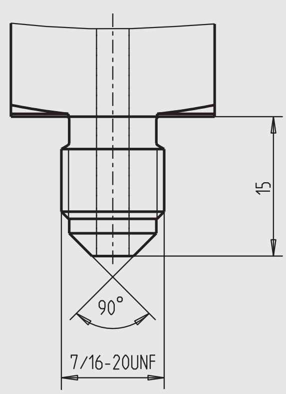
1) Valid for the thread standards for connection shanks and female threads mentioned on page 2.
2) The specified values for the maximum pressure are rounded values and are assigned to the nearest standard scale range.

Examples of industry-specific process connections

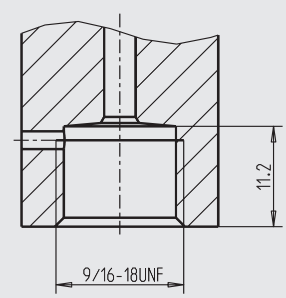
Hydraulic connection with 74° sealing cone SAE J 514



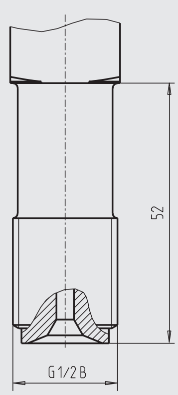
Refrigeration connection with 90° sealing cone SAE J 513



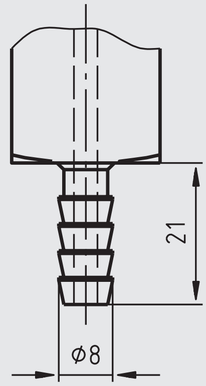
High-pressure process connection per Autoclave Engineering or Nova Swiss M16 x 1.5 female



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



Hose connection

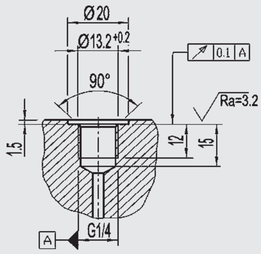


Other process connections on request

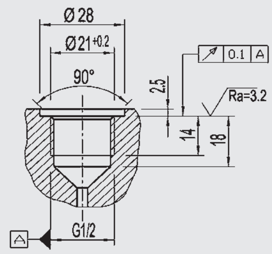
Examples of other tapped holes

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

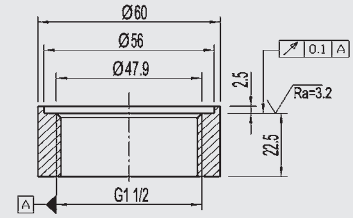
G ¼



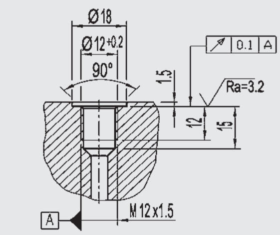
G ½



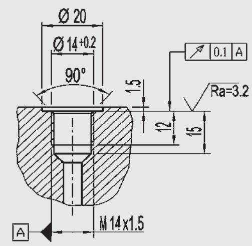
G 1 ½ 1)
Order number: 2158982



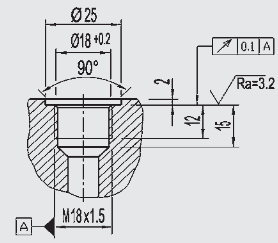
M12 x 1.5



M14 x 1.5

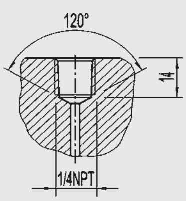


M18 x 1.5

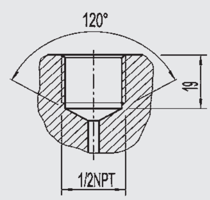


Version per ANSI / ASME B1.20.1

¼ NPT

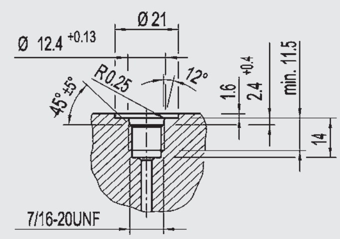


½ NPT



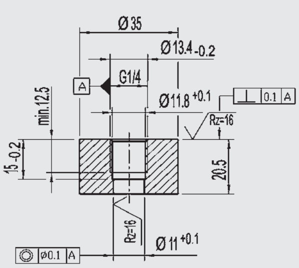
Version per SAE J 514

7/16-20 UNF

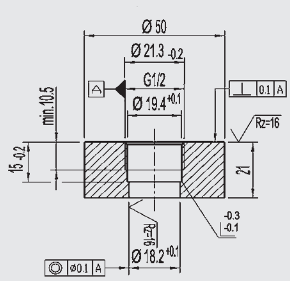


Flush WIKA version

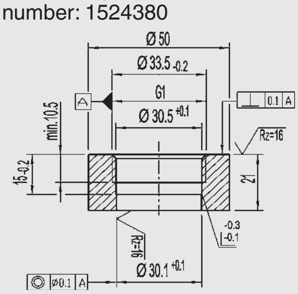
G ¼, with O-ring 2)



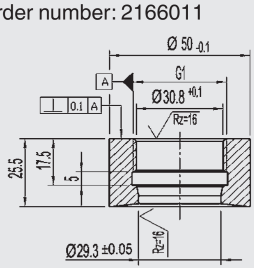
G ½, with O-ring 1) 2)



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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Scale ranges of pressure gauges
Scale mark spacing and numbering of the scale per EN 837

WIKA data sheet IN 00.02

General information

Scale range, nominal size (NS, case diameter) and accuracy class of a pressure gauge determine the design of the scale. In the European EN 837-1 and EN 837-3 standards, the specifications about the layout of dials with concentric scales are contained.
In addition to the scales in accordance with EN 837, all internationally common scale ranges, double and multiple scales, coloured scales etc. are, of course, also available.

Scale ranges of EN 837

The preferred pressure unit is the bar.

Scale ranges for pressure in bar				
0 ... 0.6	0 ... 1	0 ... 1.6	0 ... 2.5	0 ... 4
0 ... 6	0 ... 10	0 ... 16	0 ... 25	0 ... 40
0 ... 60	0 ... 100	0 ... 160	0 ... 250	0 ... 400
0 ... 600	0 ... 1,000	0 ... 1,600		

Scale ranges for pressure in mbar			
0 ... 1	0 ... 6	0 ... 40	0 ... 250
0 ... 1.6	0 ... 10	0 ... 60	0 ... 400
0 ... 2.5	0 ... 16	0 ... 100	0 ... 600
0 ... 4	0 ... 25	0 ... 160	

For pressure gauges, the pointer turns anticlockwise with increasing vacuum.

Scale ranges for vacuum in bar			
-0.6 ... 0	-1 ... 0		

Scale ranges for vacuum in mbar			
-1 ... 0	-6 ... 0	-40 ... 0	-100 ... 0
-1.6 ... 0	-10 ... 0	-60 ... 0	-160 ... 0
-2.5 ... 0	-16 ... 0	-100 ... 0	-600 ... 0
-4 ... 0	-25 ... 0	-160 ... 0	

Scale ranges for pressure and vacuum in bar				
-1 ... +0.6	-1 ... +1.5	-1 ... +3	-1 ... +5	-1 ... +9
-1 ... +15	-1 ... +24			

Nominal sizes

For pressure measuring instruments, the following nominal sizes (NS) are defined:
NS 40, 50, 63, 80, 100, 160 and 250

Accuracy classes

The following table specifies the error limits at the reference temperature of 20° C.

Accuracy class	Error limits (percent of scale range)
0.1	± 0.1 %
0.25	± 0.25 %
0.6	± 0.6 %
1	± 1 %
1.6	± 1.6 %
2.5	± 2.5 %
4	± 4 %

For pressure gauges with a pointer stop, the accuracy class applies from 10 to 100 % of the scale range. For pressure gauges with a free zero point, the accuracy class applies from 0 to 100 % of the scale range.

Assignment of nominal size and accuracy class

NS	Accuracy class						
	0.1	0.25	0.6	1.0	1.6	2.5	4
40, 50					x	x	x
63				x	x	x	x
80				x	x	x	x
100				x	x	x	
160		x	x	x	x		
250	x	x	x	x	x		

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Scale interval

The minimum number of scale divisions for each accuracy class and nominal size is given in the following table.

Scale (scale range)	Nominal size (NS)	Minimum number of scale divisions						
		Accuracy class						
		0.1	0.25	0.6	1	1.6	2.5	4
0 to 100	40					20	20	20
	50					20	20	20
	63				20	20	20	20
	80				50	50	50	50
	100			100	50	50		
	160		200	100 [1)]	50	50		
	250	500	200	100 [1)]	50	50		
0 to 160	40					32	32	32
	50					32	32	32
	63				32	32	32	32
	80				32	32	32	32
	100			80	32	32		
	160		160	80 [2)]	32	32		
	250	320	320	80 [2)]	32	32		
0 to 250	40					25	25	25
	50					25	25	25
	63				25	25	25	25
	80				50	50	50	50
	100			125	50	50		
	160		125	125	50	50		
	250	500	250	125	50	50		
0 to 400	40					20	20	20
	50					20	20	20
	63				20	20	20	20
	80				40	40	40	40
	100			80	40	40		
	160		200	200	40	40		
	250	400	200	200	40	40		
0 to 600	40					30	30	30
	50					30	30	30
	63				30	30	30	30
	80				60	60	60	60
	100			120	60	60		
	160		120	120	60	60		
	250	300	300	120	60	60		

1) Unless there is additional ordering information, WIKA manufactures these scales with 200 scale divisions
2) Unless there is additional ordering information, WIKA manufactures these scales with 160 scale divisions

See page 3 for pictorial examples of scale interval, various designs of the scale marks and the numbering of the scales at WIKA.

Additional information on this topic is given in the EN 837-1 and EN 837-3 standards.

The scale mark spacing is ≥ 1 mm.
The width of the scale marks is ≤ 1/5 of the scale mark spacing.

Examples for scale mark spacing and numbering of scales

Examples for accuracy class 1 to 4

Nominal size (NS)	Scale (scale range)	Scale mark spacing and numbering of the scale	Scale interval	Number of scale divisions
40 50 63	0 ... 1	0 0.2 0.4 0.6 0.8 1	0.05	20
	0 ... 10	0 2 4 6 8 10	0.5	
	0 ... 100	0 20 40 60 80 100	5	
	0 ... 1000	0 200 400 600 800 1000	50	
	-1 ... 0	-1 - 0.8 -0.6 -0.4 -0.2 0	0.05	
	-1 ... 0 ... +9	-1 0 1 2 3 4 5 6 7 8 9	0.5	
80 100 160 250	0 ... 2.5	0 0.5 1 1.5 2 2.5	0.05	50
	0 ... 25	0 5 10 15 20 25	0.5	
	0 ... 250	0 50 100 150 200 250	5	
	0 ... 2500	0 500 1000 1500 2000 2500	50	
	-1 ... 0 ... +1.5	-1 -0.5 0 0.5 1 1.5	0.05	
	-1 ... 0 ... +24	-1 0 5 10 15 20 24	0.5	
80 100 160 250	0 ... 0.6	0 0.1 0.2 0.3 0.4 0.5 0.6	0.01	60
	0 ... 6	0 1 2 3 4 5 6	0.1	
	0 ... 60	0 10 20 30 40 50 60	1	
	0 ... 600	0 100 200 300 400 500 600	10	
	-0.6 ... 0	-0.6 -0.5 -0.4 -0.3 -0.2 -0.1 0	0.01	
	-1 ... 0 ... +5	-1 0 1 2 3 4 5	0.1	

Examples for accuracy class 0.6

Nominal size (NS)	Scale (scale range)	Scale mark spacing and numbering of the scale	Scale interval	Number of scale divisions
160 250	0 ... 4	0 0.5 1 3 3.5 4	0.02	200
	0 ... 40	0 5 10 30 35 40	0.2	
	0 ... 400	0 50 100 300 350 400	2	
	0 ... 4000	0 500 1000 3000 3500 4000	20	
	-1 ... 0 ... +3	-1 -0.5 0 2 2.5 3	0.02	

Examples for accuracy class 0.25

Nominal size (NS)	Scale (scale range)	Scale mark spacing and numbering of the scale	Scale interval	Number of scale divisions
250	0 ... 1.6	0 0.1 0.2 1.3 1.4 1.5 1.6	0.005	320
	0 ... 16	0 1 2 13 14 15 16	0.05	
	0 ...160	0 10 20 130 140 150 160	0.5	
	0 ... 1600	0 100 200 1300 1400 1500 1600	5	
	-1 ... 0 ... +0.6	-1 -0.9 -0.8 0.3 0.4 0.5 0.6	0.005	
	-1 ... 0 ... +15	-1 0 1 12 13 14 15	0.05	

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Elastic element pressure gauges

WIKA data sheet IN 00.01

Description

Indicating pressure gauges with elastic measuring elements are used extensively to measure pressure in technical applications due to their robustness and ease-of-use. They incorporate measuring elements which deform elastically under the influence of pressure. Mechanical pressure gauges are produced with bourdon tube, diaphragm, capsule and spring elements and are differentiated as a result of these.
The measuring elements are made of copper alloys, alloyed steels or, for specific measuring applications, produced in special materials. Pressures are only measurable in combination with a reference pressure. Atmospheric pressure usually serves as the reference pressure, and the pressure gauge therefore shows how much the measured pressure is higher or lower in relation to the given atmospheric pressure (i.e. an overpressure measuring instrument).
The pressure is indicated in standard measuring ranges over a 270 degree sweep on the dial. Liquid-filled pressure gauges, due to their damping effect, offer optimal protection against damage from high dynamic pressure loads or vibrations. By combination with limit signal indicators, switching can be carried out, while in combination with transmitters, electrical output signals (e.g. 4 ... 20 mA) can be used for industrial process automation.

Pressure gauges with bourdon tube

Bourdon tubes are circular-shaped tubes with an oval cross-section. The pressure of the media acts on the inside of this tube which results in the oval cross section becoming almost circular. Through the curvature of the tube, hoop stresses occur which bend the bourdon tube. The end of the tube, which is not fixed, moves, and this indicates the measurement for the pressure.

Through the pointer movement this motion is indicated on the display. The circular-shaped tubes, formed through an angle of approx. 250°, are used for pressures up to about 60 bar.

For higher pressures, bourdon tubes are used with either a number of superimposed coils of the same diameter (i.e. helical coils), or a spiral-shaped coil (i.e. spiral springs) in a single plane.

Bourdon tubes can only be protected against overload to a limited extent. In order to fulfil particularly harsh measuring tasks, the pressure gauge can be fitted with a chemical seal upstream as a separation or protection system.

The pressure ranges can be between 0 ... 0.6 and 0 ... 7000 bar with a reading accuracy (or class) from 0.1 to 4.0 %.

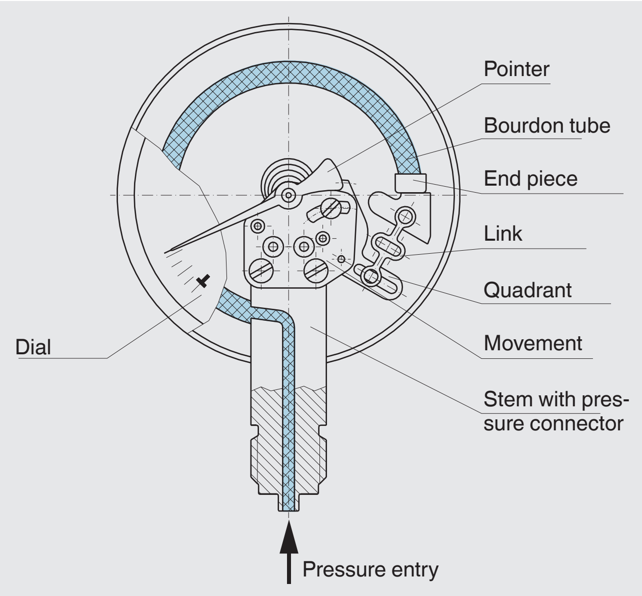

Fig. Pressure gauges with bourdon tube

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Pressure gauges with diaphragm elements

Diaphragm elements are circular-shaped, corrugated membranes. They are either clamped around their rim between two flanges or welded and are subjected to the pressure of the media acting on one side. The deflection caused by this is used as a measurement for the pressure and is indicated by a pointer.

In comparison with bourdon tubes, these diaphragm elements have a relatively high actuating force and, as a result of the annular clamping of the element, they are insensitive to vibration.

The diaphragm element can be subject to higher overload through the load take-up (diaphragm element resting against the upper flange), and by coating it with special material or covering it with foil, the gauge can be protected against extremely corrosive media.

For measurements with highly viscous, impure or crystallizing media, wide connection ports, open connection flanges and purging capabilities can be integrated.

Pressure ranges can be between 0 ... 16 mbar and 0 ... 40 bar with accuracy classes from 0.6 to 2.5.

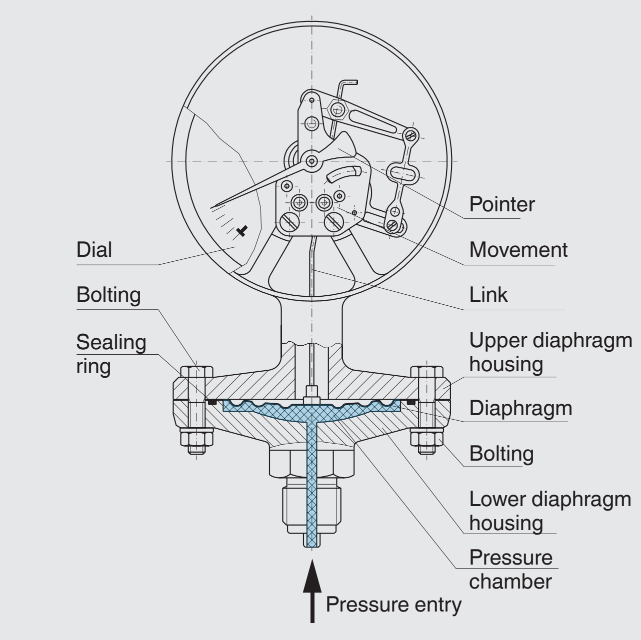

Fig. Pressure gauges with diaphragm elements

Pressure gauges with capsule elements

The capsule element comprises two circular-shaped, corrugated membranes fully-sealed around their circumference. The pressure acts on the inside of this capsule and the stroke movement generated is indicated by a pointer as the measurement of pressure.

Pressure gauges with capsule elements are particularly suited to gaseous media and relatively low pressures. Overload protection is possible within certain limits. The actuating force is increased if a number of capsule elements are connected mechanically in series (a capsule element "package").

Pressure ranges can be between 0 ... 2.5 mbar and 0 ... 0.6 bar with accuracy classes of 0.1 to 2.5.

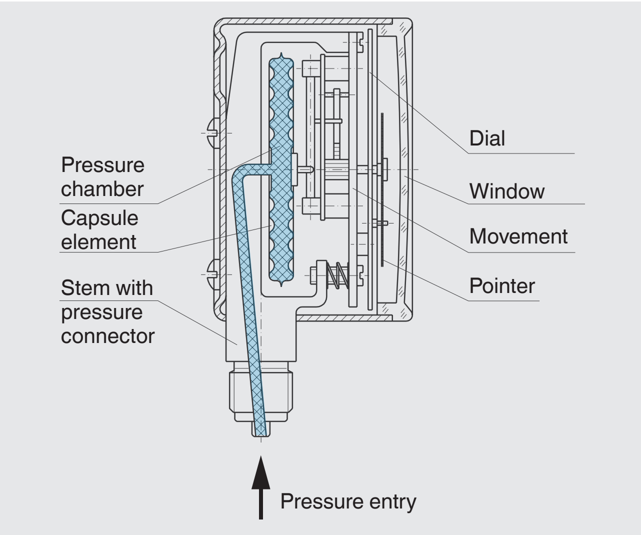

Fig. Pressure gauges with capsule elements

Absolute pressure gauges

These instruments are used where pressures are to be measured independently of the natural fluctuations in atmospheric pressure. As a general rule, all the previously shown overpressure gauge elements and measuring principles can be applied.

The pressure of the media to be measured is compared against a reference pressure which is equal to absolute zero. On the side of the measuring element that is not subjected to the pressure media, an absolute vacuum exists as the reference pressure. This function is achieved by sealing off the appropriate measuring chamber or surrounding housing.

Measuring element movement transmission and pressure indication are achieved in the same way as with the previously described overpressure gauges.

Pressure ranges can be between 0 ... 25 mbar and 0 ... 25 bar with accuracy classes of 0.6 to 2.5.

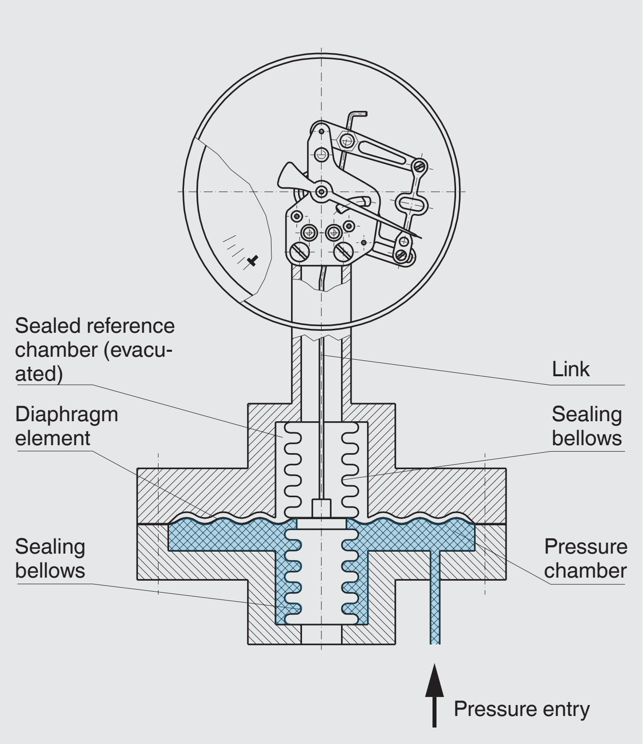

Fig. Absolute pressure gauges

Differential pressure gauges

With differential pressure gauges, the difference between two pressures is determined directly and shown on the display. Here again, all the previously shown overpressure gauge measuring elements and measuring principles can be applied.

Two sealed pressure media chambers are separated by the measuring element/s. If both operating pressures are the same, no movement of the measuring element occurs and no pressure will be indicated. A differential pressure reading is only given when one of the pressures is either higher or lower than the other.

Even with high static pressures, low differential pressures can be measured directly. With diaphragm elements, a very high overload capability is achieved.

The permissible static pressure and the overload capability on the ⊕ and ⊖ side must be observed.

In the majority of cases, measuring element movement transmission and pressure indication are achieved in the same way as with the previously described overpressure gauges.

Pressure ranges can be between 0 ... 16 mbar and 0 ... 40 bar with accuracy classes of 0.6 to 2.5.

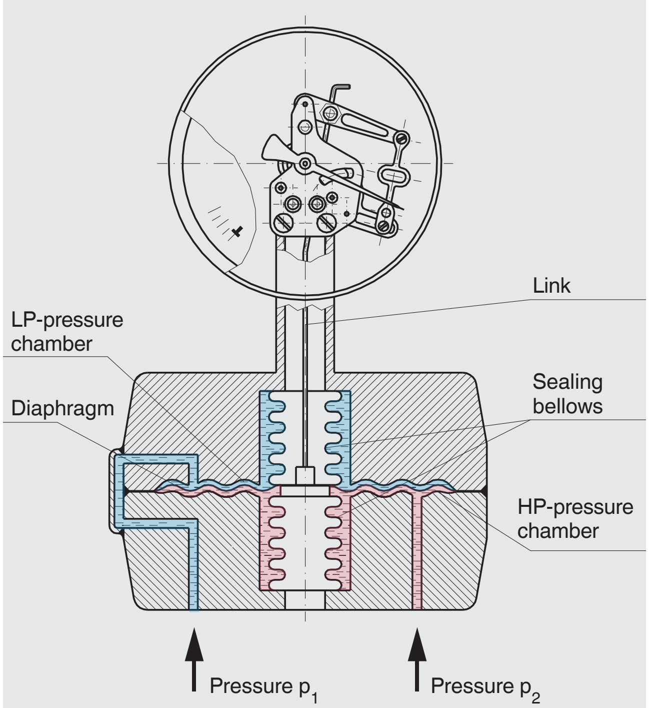

Fig. Differential pressure gauges

Applications

- Filter technology (monitoring filter state)
- Level measurement (in closed vessels)
- Flow measurement (pressure drop)

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