INTERNATIONAL STANDARD

ISO 5171

Fourth edition
2019-05

Gas welding equipment — Pressure gauges used in welding, cutting and allied processes

Matériels de soudage au gaz — Manomètres utilisés pour le soudage, le coupage et les techniques connexes

Reference number
ISO 5171:2019(E)

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Published in Switzerland

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 8, *Equipment for gas welding, cutting and allied processes*.

This fourth edition cancels and replaces the third edition (ISO 5171:2009) which has been technically revised.

The main changes compared to the previous edition are as follows:

— Clause 7 has been revised;

— Clause 8 has been clarified regarding the amount of test samples to be used;

— editorial changes have been made;

— test B has been added in 5.2.1.2.3 for supplementary leakage rate under the testing conditions of 8.7.2.

Any feedback, question or request for official interpretation related to any aspect of this document should be directed to the Secretariat of ISO/TC 44/SC 8 via your national standards body. A complete listing of these bodies can be found at www.iso.org/members.html. Official interpretations, where they exist, are available from this page: https://committee.iso.org/sites/tc44/home/interpretation.html.

Gas welding equipment — Pressure gauges used in welding, cutting and allied processes

1 Scope

This document specifies requirements for Bourdon-tube pressure gauges normally used with compressed gas systems at pressures up to 30 MPa (300 bar) in welding, cutting and allied processes. It also covers use for dissolved acetylene and for liquefied gases under pressure.

It does not cover gauges for acetylene in acetylene-manufacturing plants.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 7-1, *Pipe threads where pressure-tight joints are made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 228-1, *Pipe threads where pressure-tight joints are not made on the threads — Part 1: Dimensions, tolerances and designation*

ISO 497, *Guide to the choice of series of preferred numbers and of series containing more rounded values of preferred numbers*

ISO 4589-2:2017, *Plastics — Determination of burning behaviour by oxygen index — Part 2: Ambient-temperature test*

ISO 9539, *Gas welding equipment — Materials for equipment used in gas welding, cutting and allied processes*

ISO 10102, *Assembly tools for screws and nuts — Double-headed open-ended engineers' wrenches — Outside dimensions*

ISO 14114, *Gas welding equipment — Acetylene manifold systems for welding, cutting and allied processes — General requirements*

ISO 15296, *Gas welding equipment — Vocabulary*

ANSI/ASME B1.20.1[1)], *Pipe threads, general purpose (inch)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 15296 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

1) Published by and available from the American National Standards Institute (ANSI), 11 West 42nd Street, New York, NY 10036.

3.1
Bourdon tube pressure gauge
device incorporating elastic tube with direct indication by *pointer* (3.5) and graduated *scale* (3.7) of the pressure being measured

3.2
case
outer housing that contains the Bourdon tube and the movement (if existing)

3.3
dial
plate or area on which the *scale* (3.7) is marked

3.4
flange
circular extension of the *case* (3.2) used for mounting

3.5
pointer
indicator whose position in relation to the *scale* (3.7) indicates the value of the measured pressure

3.6
pointer stop
projection that stops the travel of the *pointer* (3.5)

3.7
scale
array of marks, together with any associated figuring, in relation to which the position of the *pointer* (3.5) is observed

3.8
vent
blowout safety device or venting area incorporated in the gauge to permit the rapid safe dissipation of internal pressure in the event of a leakage or burst in the Bourdon tube

3.9
window
transparent front through which the *dial* (3.3) is observed

4 Pressure

4.1 Unit of pressure

All pressures given are gauge (effective) pressures in megapascals (MPa) (and bar).

4.2 Maximum scale reading

Where practical, the maximum scale reading for a particular gas and pressure level shall be selected from the values given in Table 1. Where not practical, the maximum scale reading shall be selected from the R10 series of preferred numbers or the more rounded values given in ISO 497.

4.3 Maximum pressure mark

The maximum operating pressure shall be indicated on the dial by a symbol or coloured mark and shall not exceed 3/4 of the maximum scale reading.

NOTE For pressure gauges used with regulators conforming to ISO 2503, the maximum pressure mark is normally p_2 for low-pressure gauges and p_1 for high-pressure gauges, as defined in ISO 2503.

Table 1 — Maximum scale reading

Pressure level	Acetylene MPa (bar)	Oxygen and other gases MPa (bar)
Low-pressure (LP)[a]	0,1 (1) 0,16 (1,6) 0,25 (2,5)[b]	0,25 (2,5) 0,4 (4) 0,6 (6) 1,0 (10) 1,6 (16) 2,5 (25) 4,0 (40)
High-pressure (HP)[c,d,e,f]	4 (40)	25 (250) 31,5 (315) 40 (400)

[a] For acetylene, the low-pressure level shall be ≤0,15 MPa (1,5 bar) according to ISO 14114.

[b] 0,25 MPa (2,5 bar) only apply for acetylene systems up to maximum working pressure up to 1,5 bar.

[c] 25 MPa (250 bar) pressure gauge for use with CO_2 and compressed gas cylinders filled to a maximum settled filling pressure of 18,5 MPa (185 bar) at 15 °C.

[d] 31,5 MPa (315 bar) pressure gauge for use with compressed gas cylinders filled to a maximum settled filling pressure of 23 MPa (230 bar) at 15 °C.

[e] 40 MPa (400 bar) pressure gauge for use with compressed gas cylinders filled to a maximum settled filling pressure of 30 MPa (300 bar) at 15 °C.

[f] For acetylene, the high-pressure level shall be >0,15 MPa (1,5 bar) up to 2,5 MPa (25 bar) according to ISO 14114.

5 Manufacturing requirements

5.1 Materials

5.1.1 General

The materials of the pressure gauge components in contact with the gas shall have adequate resistance to the chemical action of the gas under operating conditions.

Bourdon tubes and other parts in contact with acetylene gas shall conform to ISO 9539.

5.1.2 Oxygen pressure gauges

Bourdon tubes and other parts in contact with the gas shall be resistant to the action of the oxygen and shall not be flammable under operating conditions (e.g. working pressures and temperatures).

Thread sealants or sealing rings shall also be resistant to the action of the oxygen and shall not be flammable under operating conditions (e.g. working pressures and temperatures).

Components in contact with oxygen gas shall conform to ISO 9539.

Only lubricants suitable for use in oxygen at the service pressure and temperature shall be used.

5.2 Design and dimensions

5.2.1 Operational equipment

5.2.1.1 Accuracy

The pressure gauge accuracy shall be at least that of class 2,5, i.e. with a maximum deviation within the tolerance, ±2,5 % (of full-scale reading), over the entire scale.

5.2.1.2 Overpressure and leakage test requirements

5.2.1.2.1 General

Test A of 5.2.1.2.2 and Test B of 5.2.1.2.3 apply to all gauges except for acetylene gauges located in the high-pressure part of manifold systems or high-pressure pipe systems, which shall fulfil the requirements defined in ISO 14114.

5.2.1.2.2 Test A

Those parts of the pressure gauge that are in contact with the gas shall not burst or leak when tested under the conditions given in 8.6.1 for a period of not less than 24 h at 60 °C. The leakage rate shall not exceed 0,306 mbar l/min (18 cm^3/h).

5.2.1.2.3 Test B

When tested in accordance with 8.6.2, the leakage rate shall not exceed 0,0612 mbar l/min (3,6 cm^3/h).

5.2.1.3 Torsion

After application of the torque of 10 Nm according to 8.3.1 for a period of not less than 30 s, the pressure gauge shall satisfy the conditions of accuracy specified in 5.2.1.1.

After application of the torque of 25 Nm according to 8.3.2 for a period of not less than 30 s, the pressure gauge shall be leak-tight at a pressure corresponding to the maximum scale reading.

The tests above apply to gauges with connecting threads of a nominal size of 1/4. Connecting threads of nominal size 1/8 shall only be used when equivalent safety can be demonstrated.

5.2.1.4 Bending

After application of the load of 1 kN according to 8.4, the pressure gauge shall be leak-tight to atmosphere at a pressure corresponding to the maximum scale reading.

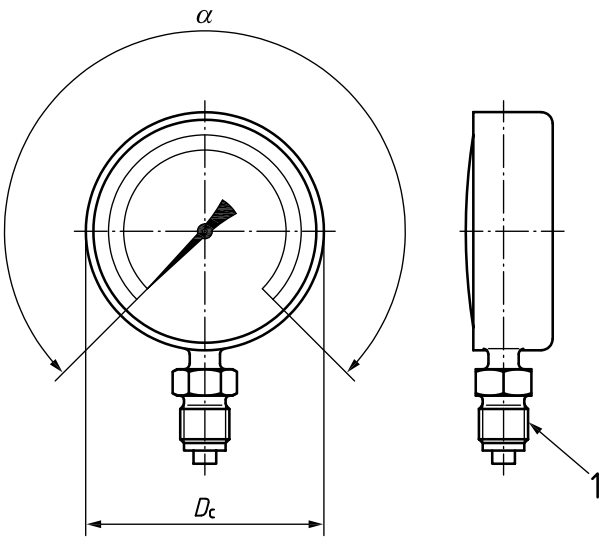
5.2.1.5 Case vent test

In case of rupture of the Bourdon tube, e.g. due to overpressure or fatigue, the vent on the pressure gauge shall allow the escape of gas safely and in any case not in the direction perpendicular to the front of the pressure gauge (see 8.5). Furthermore, the face of the gauge shall not burst, and no parts shall be thrown from the gauge in any direction.

5.2.2 Dimensions

The nominal size is based on the diameter of the casing (dimension *A* in Figures 1 and 2). The values 40, 50 and 63 are standardized.

The dimensions shall be in accordance with Figure 1 and Table 2, or Figure 2 and Table 3, as appropriate. The connecting dimensions are shown in Figure 3 and Table 4.



Key

1 thread

α scale angle

D_c diameter of the casing

Figure 1 — Pressure gauge with bottom entry

Table 2 — Dimensions of pressure gauge with bottom radial entry

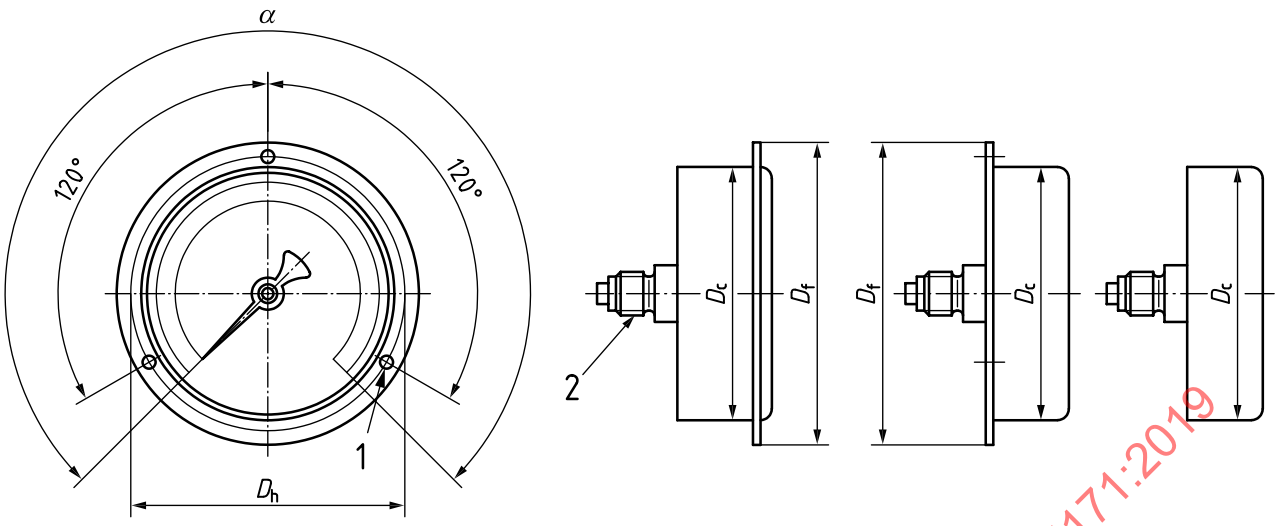
Normal size	α degrees	D_c mm	Thread	
			Parallel thread	Tapered thread
40	270	40^{+5}_{-2}	G1/8 *B* or G1/4 *B*	R1/8 or 1/8-27 NPT EXT or R1/4 or 1/4-18 NPT EXT
50	270	50^{+7}_{-2}	G1/8 *B* or G1/4 *B*	R1/8 or 1/8-27 NPT EXT or R1/4 or 1/4-18 NPT EXT
63	270	63^{+7}_{-2}	G1/4 *B*	R1/4 or 1/4-18 NPT EXT

The thread connection (see Figure 3), according to the type, shall conform to the following standards:

— for parallel thread, ISO 228-1;

— for tapered thread (Symbol R), ISO 7-1;

— for tapered thread (Symbol NPT), ANSI/ASME B1.20.1.



Key

1 fixing holes, F
2 thread
α scale angle
D_c diameter of the casing
D_f flange diameter
D_h diameter of the fixing hole circle

Figure 2 — Pressure gauge with rear entry

Table 3 — Dimensions of pressure gauge with rear entry

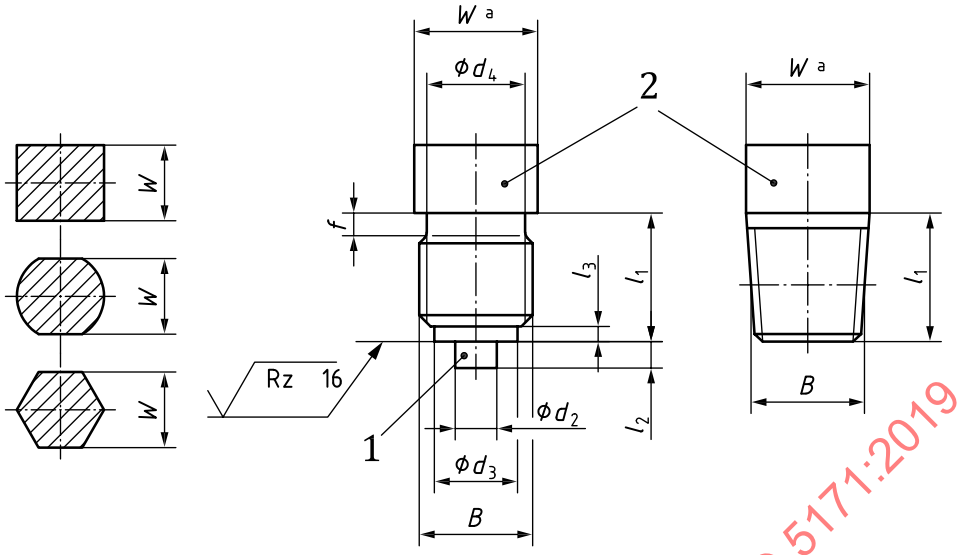
Normal size	α	$D_{c,\,max}$	Thread		$D_{f,\,max}$	D_h	F_{min}
	degrees	mm	Parallel thread	Tapered thread	mm	mm	mm
40	270	42	G1/8 *B* or G1/4 *B*	R1/8 or 1/8-27 NPT EXT or R1/4 or 1/4-18 NPT EXT	61	51	3,6
50	270	52	G1/8 *B* or G1/4 *B*	R1/8 or 1/8-27 NPT EXT or R1/4 or 1/4-18 NPT EXT	68	60	3,6
63	270	67	G1/4 *B*	R1/4 or 1/4-18 NPT EXT	81	75	3,6

The thread connection (see Figure 3), according to the type, shall conform to the following standards:

— for parallel thread, ISO 228-1;

— for tapered thread (symbol R), ISO 7-1;

— for tapered thread (Symbol NPT), ANSI/ASME B1.20.1.



Key

1 spigot
2 wrench flats (square, hexagon or other form)
W width of wrench flats
a The minimum height of flats shall be compatible with the use of standard spanners according to ISO 10102.

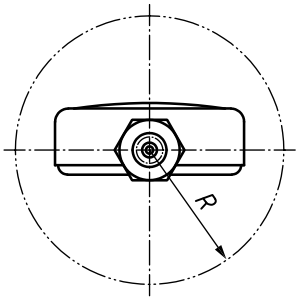
Figure 3 — Thread connection

Table 4 — Dimensions of threads

Dimensions in millimetres

Thread size	⌀ d_2	⌀ d_3	⌀ d_{4min}	l_1	l_2	l_3	f	W_{min}
G1/8 *B*	4	8	8	$10^{+0,5}_{0}$	2	$2^{+0,5}_{0}$	1,6	8[a]
G1/4 *B*	5	9,5	9,5	$13^{+0,5}_{0}$	2	$2^{+0,5}_{0}$	2	10[a]
R1/8	—	—	—	min. 10	—	—	—	8[a]
R1/4	—	—	—	min. 13	—	—	—	10[a]
1/8-27 NPT EXT	—	—	—	min. 10	—	—	—	8[a]
1/4-18 NPT EXT	—	—	—	min. 13	—	—	—	10[a]
G1/8 *B* may be made without spigot. G1/8 *B* may be made without groove *f*. In that case, the length of threading shall be equal to l_1.								
a Preferably 14 mm.								

The maximum values for the turning radius, *R*, shall be as given in Figure 4 and Table 5.



Key

R turning radius

Figure 4 — Turning radius

Table 5 — Maximum values of turning radius, R_{max}

Pressure gauge size mm	R_{max} mm
40	30
50	37
63	45

5.2.3 Dial and pointer

The graduations and markings shall be clear and legible, and it shall be possible to read the indicated pressure easily.

The scale shall be numbered on at least every tenth mark but with a minimum of four numbered marks over the scale range.

The tip of the pointer shall be as near as practical to the dial, but the distance shall in no case exceed 2 mm.

6 Safety

All pressure gauges shall be degreased and free of flammable contaminations. The requirements for oxygen use according to ISO 9539 shall be fulfilled.

Substances that could react violently with oxygen, e.g. hydrocarbon-based solvents and oils, in general shall not be used for pressure gauges, regardless of which gas the gauge is intended for. The requirements for oxygen use according to ISO 9539 shall be fulfilled.

The inlet orifice of the Bourdon tube pressure gauge shall be limited to a maximum 0,1 mm^2.

All non-metallic external materials shall be self-extinguishing (see 8.7).

Under normal operating conditions, the vent shall be closed with a membrane, disk or similar closure which shall withstand normal handling.

7 Marking

The dial shall be marked at least with the following:

— a reference to this document, i.e ISO 5171;

— the symbol for the unit of pressure;

— the registered trade name or registered trade mark of the manufacturer and/or supplier;

— for an acetylene pressure gauge, the word “acetylene”[2] or the letter “A”;

— for an oxygen pressure gauge, the word “oxygen”[3] or the letter “O” and the symbol 0248 according to ISO 7000:2014, but crossed out, as shown in Figure 5.

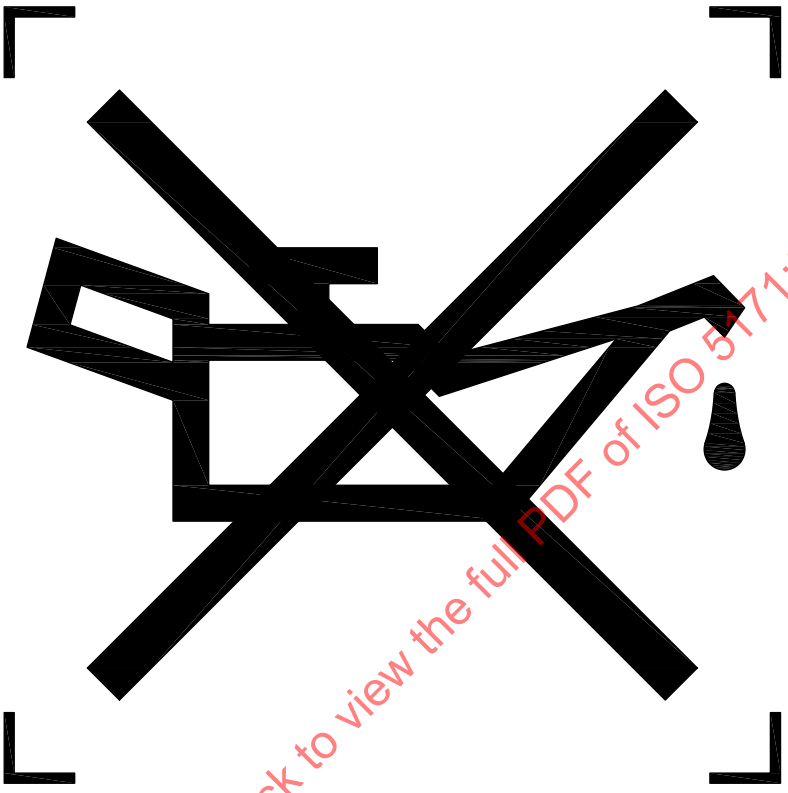


Figure 5 — Engine oil (crossed out)

An additional marking of the batch number shall be on the pressure gauge

8 Tests

8.1 General

The following tests are not intended as a production inspection procedure, but are to be applied to the sample gauges submitted to check compliance with this document.

Each test shall be conducted with 4 samples of the same model and version of the pressure gauge. The samples shall meet the requirements of Clauses 5 and 6.

The pressure gauges shall be checked for compliance with the manufacturing drawings and with this document.

Pressure gauges to be used with helium and/or hydrogen shall be tested with helium.

Pressure gauges to be used with other gases shall be tested with dry oil free air or nitrogen.

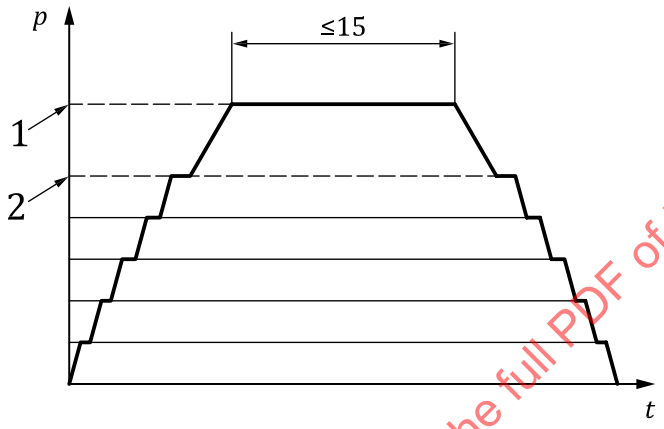
2) The word “acetylene” is not to be translated into any other language.

3) The word “oxygen” is not to be translated into any other language.

8.2 Accuracy

The test shall be carried out using a test pressure gauge of at least class 0,6 and at a temperature of (23 ± 2) °C (STP conditions). Each sample gauge shall be tested over its entire scale, the pressure being increased in at least five steps equally spread over the measurement range to the maximum operating pressure (see Figure 6). The pressure shall then be increased to the maximum scale reading after which it shall be decreased in at least five steps equally spread over the measurement range. The accuracy shall be compared only over the operation pressure range (see 5.2.1.1). The pressure gauge may be lightly tapped during this test.

If a pointer stop is incorporated, the accuracy shall meet the conditions of class 2,5 at the bottom of the scale.



Key

1 maximum scale reading
2 maximum operating pressure
p pressure
t time, s

Figure 6 — Accuracy test

8.3 Torsion test

8.3.1 With the gauge mounted by its thread, a torque of 10 N m shall be applied in the tightening direction to the gauge casing for a period of not less than 30 s, using a device that does not support the

casing (see Figures 7 and 8). Immediately after this loading, check the pressure gauge for accuracy in accordance with 5.2.1.1.

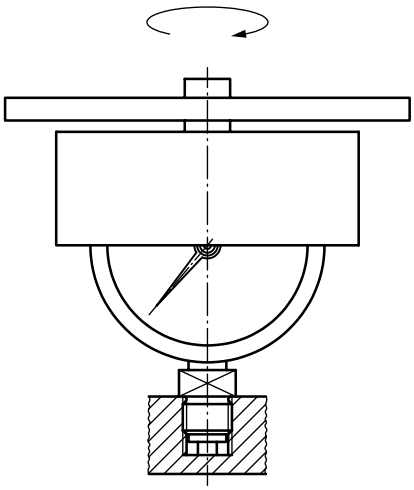


Figure 7 — Torsion test — Pressure gauge with bottom entry

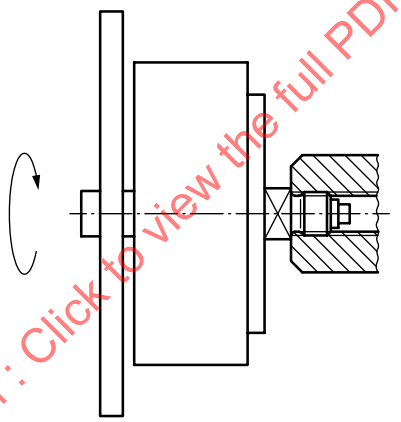
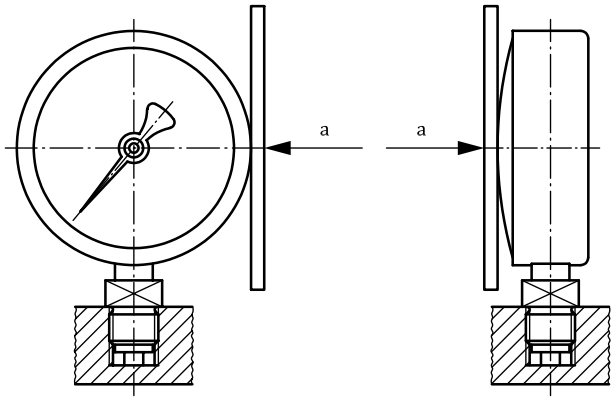


Figure 8 — Torsion test — Pressure gauge with rear entry

8.3.2 A torque of 25 Nm shall be applied in the same manner as specified in 8.3.1. Immediately after this loading, check the pressure gauge for gas tightness at a pressure corresponding to its maximum scale reading.

8.4 Bend test

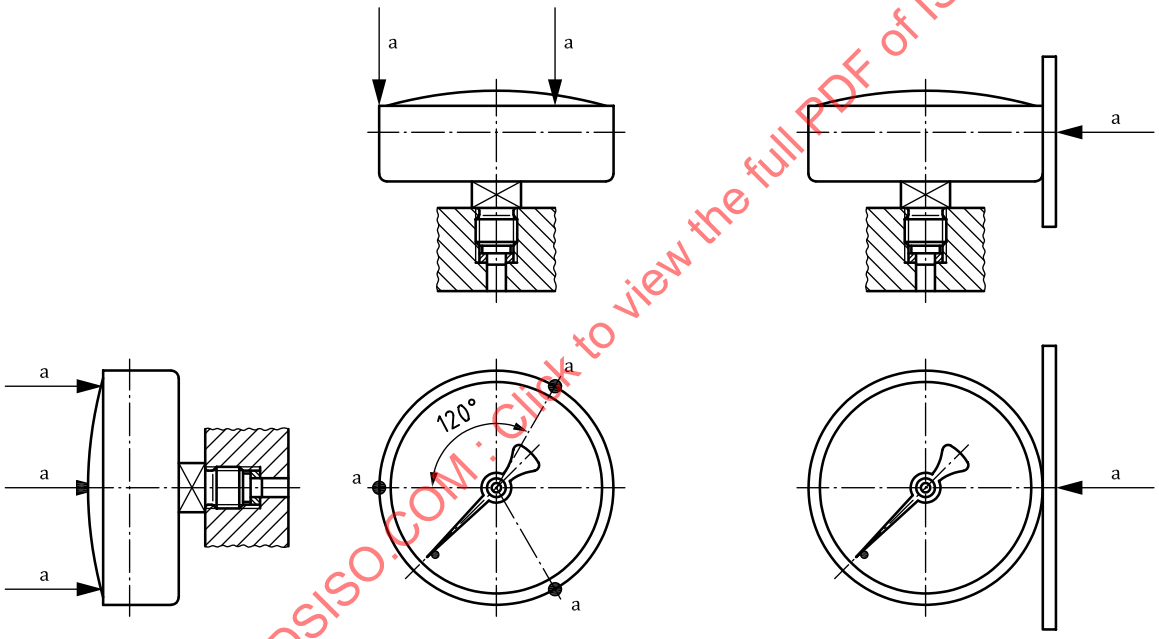
With the gauge mounted by its thread, a force of 1 kN shall be applied in an appropriate device to the face, back and one side of the case successively (see Figures 9 and 10). Immediately after this loading, check the pressure gauge for gas tightness at a pressure corresponding to its maximum scale reading. The failure of the gauge window is permitted.



Key

a Test force of 1 kN.

Figure 9 — Bend test — Pressure gauge with bottom entry



Key

a Test force of 1 kN.

Figure 10 — Bend test — Pressure gauge with rear entry

8.5 Case vent test

8.5.1 The requirements for this test are given in Clause 5. The complete pressure gauge shall be connected to a gas source of a pressure equal to its maximum scale reading or 30 MPa (300 bar), whichever is the greater. Pressurize the pressure gauge steeply through the inlet. The inlet pressure (measured in front of the test sample) shall be achieved to more than 95 % of the maximum scale reading pressure or 28,5 MPa (285 bar), whichever is the greater, within 20 ms.

If gas is vented during this test, note if the gas is vented safely or not and whether any parts are thrown from the gauge. If the requirements from 5.2.1.5 are not fulfilled, stop the test. If the requirements from Clause 5 are fulfilled, the test is passed.