BRITISH STANDARD

BS EN
837-1 : 1998

Pressure gauges

Part 1. Bourdon tube pressure gauges — Dimensions, metrology, requirements and testing

The European Standard EN 837-1 : 1996 has the status of a British Standard

ICS 17.100

National foreword

This British Standard is the English language version of EN 837-1 : 1996, and it includes the corrections to table A.2 issued on 1997-02-20. It supersedes BS 1780 : 1985 which is withdrawn.

The UK participation in its preparation was entrusted by Technical Committee GEL/65, Measurement and control, to Subcommittee GEL/65/2, Elements of systems, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this subcommittee can be obtained on request to its secretary.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the BSI Standards Catalogue under the section entitled 'International Standards Correspondence Index', or by using the 'Find' facility of the BSI Standards Electronic Catalogue.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 21 and a back cover.

This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on 15 March 1998

ISBN 0 580 28893 5

Amendments issued since publication

Amd. No.	Date	Text affected

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 837-1

December 1996

ICS 17.100

Descriptors: Metrology, measuring instruments, manometers, vacuum gauges, indicating instruments, designation, specifications, dimensions, fidelity, safety, metrology inspection, marking

English version

Pressure gauges — Part 1: Bourdon tube pressure gauges — Dimensions, metrology, requirements and testing

Manomètres — Partie 1: Manomètres à tubes de Bourdon — Dimensions, métrologie, prescriptions et essais

Druckmeßgeräte — Teil 1: Druckmeßgeräte mit Rohrfedern — Maße, Meßtechnik, Anforderungen und Prüfung

This European Standard was approved by CEN on 1996-10-30. CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Central Secretariat: rue de Stassart 36, B-1050 Brussels

Foreword

This European Standard has been prepared by Technical Committee CEN/TC 141, Pressure gauges — Thermometers — Means of measuring and/or recording temperature during the distribution of refrigerated frozen and quick-frozen products, the secretariat of which is held by AFNOR.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by June 1997, and conflicting national standards shall be withdrawn at the latest by June 1997.

This European Standard is a part of the series of the following standards:

– EN 837-1: *Pressure gauges — Part 1: Bourdon tube pressure gauges — Dimensions, metrology, requirements and testing*;

– EN 837-2: *Pressure gauges — Part 2: Selection and installation recommendations for pressure gauges*;

– EN 837-3: *Pressure gauges — Part 3: Diaphragm and capsule pressure gauges — Dimensions, metrology, requirements and testing.*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Contents

1 Scope

This European Standard specifies requirements for Bourdon tube (designated by 'B', see clause **12**) indicating pressure gauges, vacuum gauges and combined vacuum and pressure gauges (compound gauges), with circular, spiral or coiled forms, from 40 to 250 nominal size, and with ranges up to 1600 bar, for the measurement of gauge pressure.

A reading of zero bar is atmospheric pressure.
1 bar = 10^5 Pa.

Gauges specified have circular dials with concentric scales for industrial and test use.

The standard includes methods of test for performance to be applied at type approval and production piece tests.

The standard applies to gauges suitable for industrial use with common industrial fluids. It applies also to liquid-filled gauges, gauges for high pressure gases and gauges for use with oxygen or acetylene. It does not apply to pressure gauges with electrical contacts.

Pressure gauges for welding, cutting and associated processes are not included in this standard, but are specified in EN 562.

2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

ANSI/ASME B1.20.1	*Pipe threads, general purpose (inch)*
EN 472 : 1994	*Pressure gauges — Vocabulary*
EN 562 : 1994	*Gas welding equipment — Pressure gauges used for welding, cutting and allied processes*
EN 29539 : 1992	*Materials used for equipment used in gas welding, cutting and allied processes* (ISO 9539 : 1988)
EN 60529 : 1991	*Degrees of protection provided by enclosures*
EN 60068-2-6 : 1995	*Electrical engineering — Basic environmental testing procedures — Part 2: Tests — Test Fc and guidance: Vibration (sinusoidal)*
EN 60068-2-27 : 1993	*Electrical engineering — Basic environmental testing procedures — Part 2: Tests — Test Ea and guidance: Shock*
ISO 228-1 : 1994	*Pipe threads where pressure-tight joints are not made on the threads — Part 1: Designation, dimensions and tolerances*
ISO 1302 : 1992	*Technical drawings — Methods of indicating surface texture on drawings*
EN 22768-1 : 1993	*General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*
ISO 2859-1 : 1989	*Sampling procedures for inspection by attributes — Part 1: Sampling plans indexed by acceptable quality level (AQL) for lot-by-lot inspection*
ISO 7000 : 1989	*Motor vehicles — Graphic symbols — Principles, synopsis*
ISO 10102 : 1990	*Assembly tools for screws and nuts — Double-headed open-ended engineers' wrenches*

3 Definitions

For the purpose of this European Standard, the definitions given in EN 472 apply.

4 Nominal sizes

Nominal sizes of gauges are as follows: 40, 50, 63, 80, 100, 150, 160 and 250.

See table 2 for dimensions.

5 Pressure ranges

The bar is the preferred unit of pressure.

Pressure ranges in bar:

0 to 0,6	0 to 6	0 to 60	0 to 600
0 to 1	0 to 10	0 to 100	0 to 1000
0 to 1,6	0 to 16	0 to 160	0 to 1600
0 to 2,5	0 to 25	0 to 250	
0 to 4	0 to 40	0 to 400	

Vacuum ranges in bar:

Vacuum gauges have anticlockwise pointer travel with increasing vacuum.

−0,6 to 0 −1 to 0

Combined pressure and vacuum ranges in bar:

−1 to +0,6	−1 to +3	−1 to +9	−1 to +24
−1 to +1,5	−1 to +5	−1 to +15	

The SI units kilopascal (kPa) and megapascal (MPa) should follow the bar series from 0 to 60 kPa up to 1000 kPa, then change to 0 MPa to 1,6 MPa up to a maximum of 160 MPa.

6 Accuracy classes

The accuracy class stating the limits of permissible error is expressed as a percentage of the span.

The following accuracy classes are defined: 0,1; 0,25; 0,6; 1; 1,6; 2,5 and 4 (see table 1).

For gauges with a pointer stop, the accuracy class will cover 10 % to 100 % of the range. For gauges with a free zero, the accuracy class will cover 0 % to 100 % of the range and zero shall be used as an accuracy check point.

Table 1. Nominal size compared to the accuracy class

Nominal size	Accuracy class						
	0,1	0,25	0,6	1	1,6	2,5	4
40 and 50					X	X	X
63				X	X	X	X
80				X	X	X	X
100			X	X	X	X	
150 and 160		X	X	X	X		
250	X	X	X	X	X		

7 Dimensions

7.1 General tolerances

General tolerances: EN 22768-1.

7.2 Cases and flanges

The user will have to determine the dimensions for panel cut-out according to the manufacturer's data.

Table 2. Dimensions

Dimensions in millimetres

Nominal size	d_1	d_2	d_3	d_4
40	38	61	51	3,6
50	48	71	60	3,6
63	61	86	75	3,6
80	78	110	95	5
100	97	134	118	6
150	147	186	168	6
160	157	196	178	6
250	245	290	276	7

NOTE. d_4 elongated holes can be accepted to ensure interchangeability with previous standards.

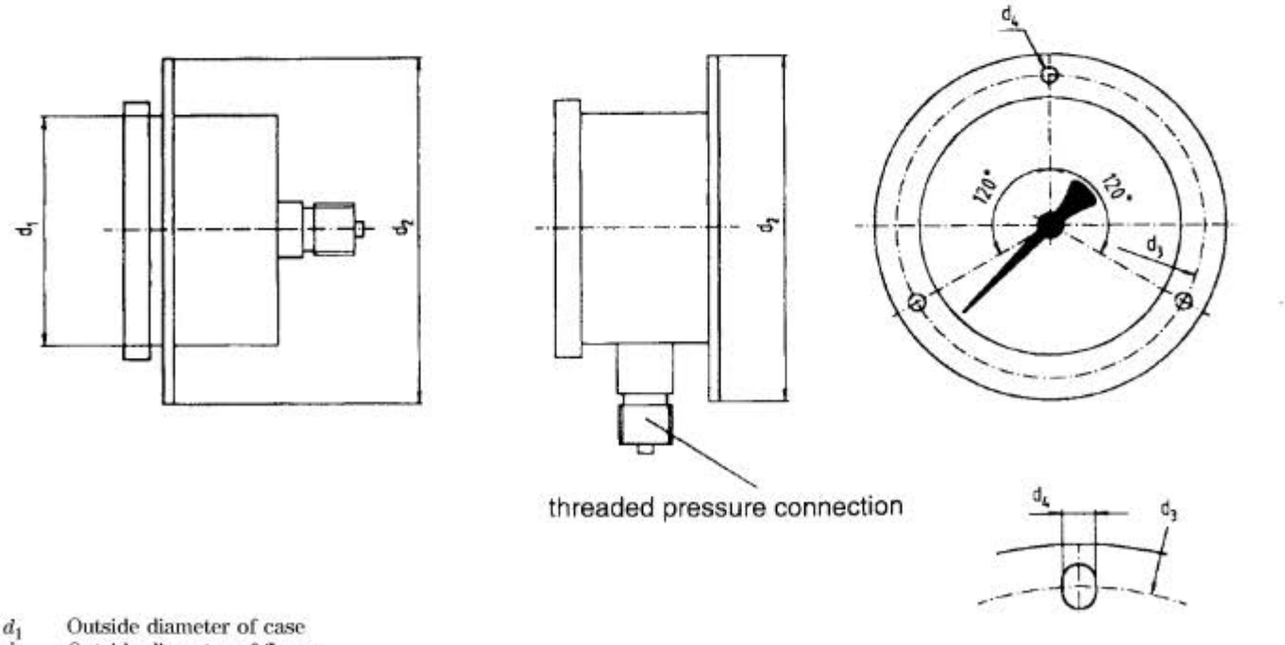
7.3 Pressure connection

The positions of the connections can be selected from table 9 (types of mounting and connection position). For thread forms and sizes, see table 3.

Table 3. Thread forms and sizes

Parallel pipe threads	Taper pipe threads
G 1/8 B	1/8-27 NPT-EXT
G 1/4 B	1/4-18 NPT-EXT
G 3/8 B	
G 1/2 B	1/2-14 NPT-EXT

NOTE. G 3/8 B is not preferred.



d_1 Outside diameter of case
d_2 Outside diameter of flange
d_3 Diameter of fixing hole circle
d_4 Diameter of fixing holes

Figure 1

Table 4. Dimensions of parallel threaded shanks

Dimensions in millimetres

Thread size d_1	d_2	d_3	d_4 min.	l_1 $^{+0,5}_{0}$	l_2	l_3 $^{+0,5}_{0}$	f	w min.
G 1/8 B	4	8	8	10	2	2	1,6	8
G 1/4 B	5	9,5	9,5	13	2	2	2	10
G 3/8 B	5,5	13	13	16	3	3	2	13
G 1/2 B	6	17,5	17,5	20	3	3	3	17

NOTE 1. For stainless steel screwed connection, f dimensions can be raised up to 50 %.

NOTE 2. G 1/8 B may be made without spigot.

NOTE 3. G 1/8 B may be made without groove f. In this case, the length of threading shall be equal to l_1.

NOTE 4. For inchangeability with previous standards, the spigot of G 1/4 B can be manufactured with diameter 4 mm.

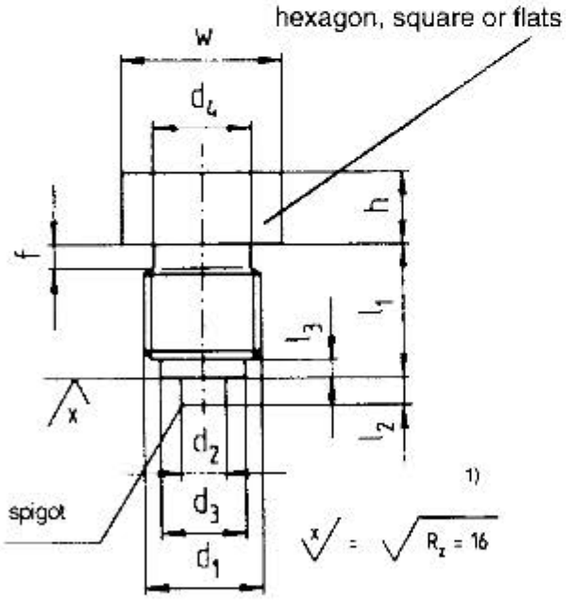
7.3.1 *Screw threads*

Parallel pipe threads (symbol G) according to ISO 228-1.

Taper pipe threads (symbol NPT) according to ANSI/ASME B1.20.1.

Other threads specific to certain industries are acceptable.

7.3.2 *Shanks with parallel pipe threads*



NOTE. Minimum height h of flats shall be compatible with use of standard spanners according to ISO 10102.

Figure 2

7.3.3 *High pressure shank (HP) for connection with lens seal*

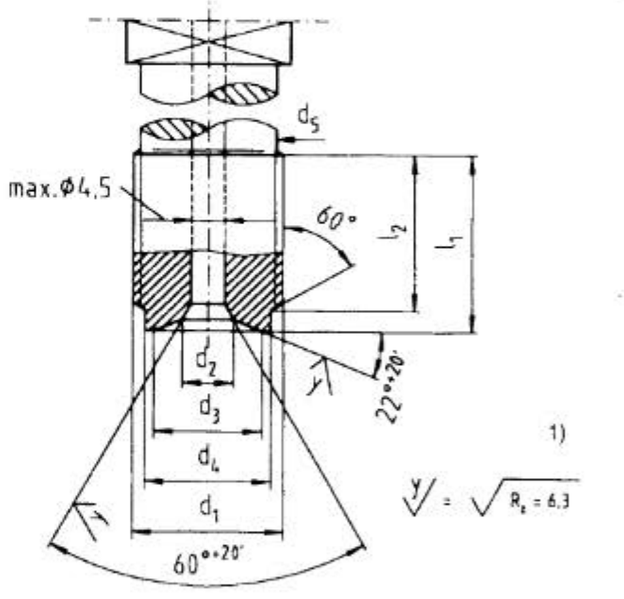


Figure 3

Table 5. Dimensions for high pressure shank

Dimensions in millimetres

Thread size d_1	d_2 $\pm 0,1$	d_3	d_4	d_5 $^{0}_{-0,3}$	l_1 $^{0}_{-0,3}$	l_2 $^{0}_{-0,3}$
G 1/2 B (for HP)	7,14	15	17,5	19	25	22

[1] According to ISO 1302.

7.3.4 *Shanks with taper pipe threads*

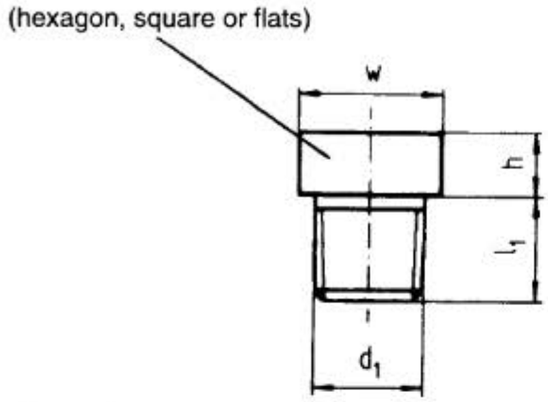


Figure 4

Table 6. Dimensions of taper threaded shanks

Dimensions in millimetres

Thread size d_1	l_1 min.	w min.
1/8-27 NPT-EXT	10	8
1/4-18 NPT-EXT	13	10
1/2-14 NPT-EXT	18	17

NOTE. Height of flats (h) shall be compatible with use of standard spanners according to ISO 10102.

7.3.5 *Parallel threaded tapped holes*

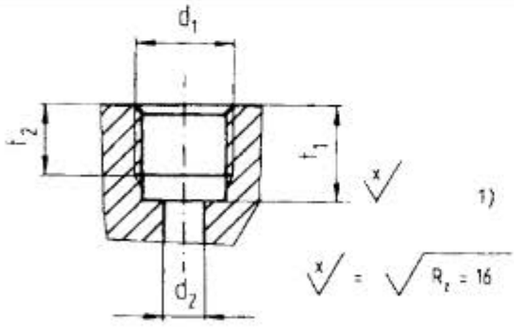


Figure 5

Table 7. Dimensions of parallel threaded tapped holes

Dimensions in millimetres

Thread size d_1	d_2	l_1 −0,5	l_2 min.
G 1/8	4,5	10	7,5
G 1/4	5,5	13	10
G 3/8	6,5	16	12
G 1/2	7	19	15

7.3.6 *Sealing washers*

For use with parallel screw threads only.

NOTE. The choice of the sealing washer material depends on the pressure and the fluid to be measured.

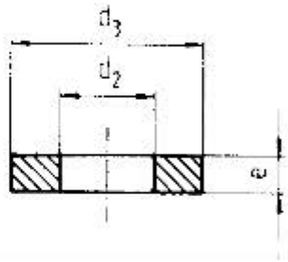


Figure 6

Table 8. Dimensions of sealing washers

Dimensions in millimetres

Thread size	d_2	d_3	$e \pm 0{,}2$
G 1/8 B	$4{,}2^{+0,2}_{0}$	$8^{0}_{-0,2}$	1,5
G 1/4 B	$5{,}2^{+0,2}_{0}$	$9{,}5^{0}_{-0,2}$	1,5
G 3/8 B	$5{,}7^{+0,3}_{0}$	$13^{0}_{-0,3}$	2
G 1/2 B	$6{,}2^{+0,4}_{0}$	$17{,}5^{0}_{-0,5}$	2

7.3.7 *Sealing lens*

For use with high pressure shank (HP) only, according to **7.3.3**.

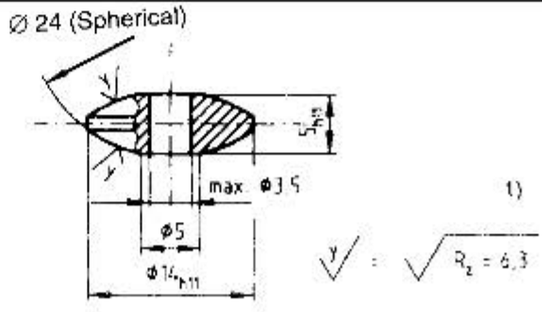


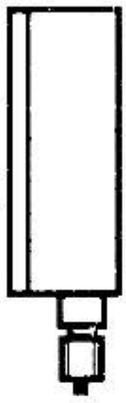
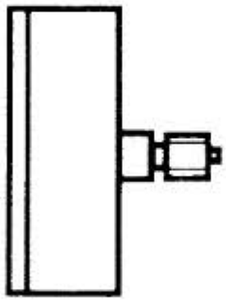
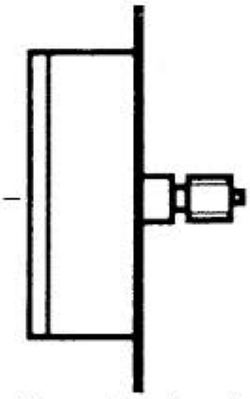
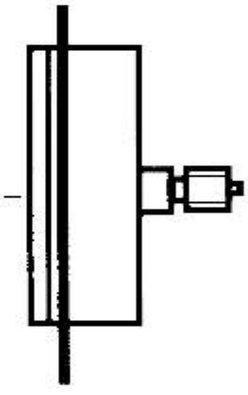
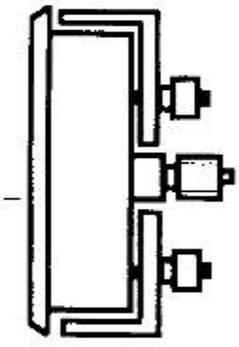
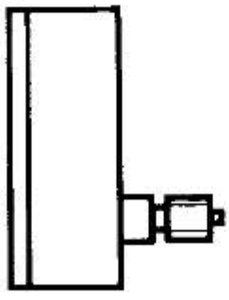
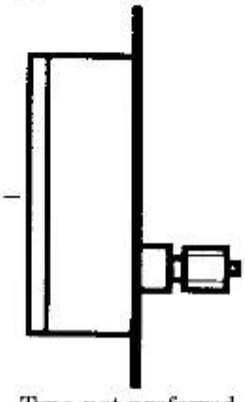
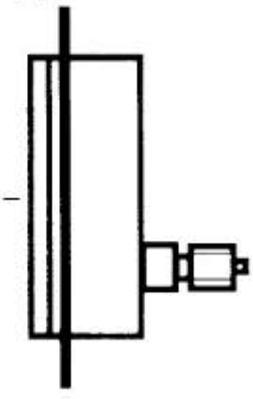
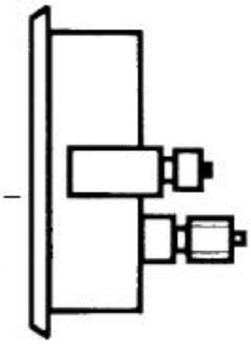
Figure 7

[1] According to ISO 1302.

7.4 Type of mounting and connection position

The different mounting types of gauges shall be as given in table 9. When mounting, ensure that there is enough free space for the blow-out device, if any.

Table 9. Type of mounting and connection position

~~Radial connection~~	~~10~~	~~11~~	~~12~~	
				
			~~Type not preferred~~	
Centre back connection	20	21	22	23
				
		~~Type not preferred~~		
~~Offset back connection~~	~~30~~	~~31~~	~~32~~	~~33~~
				
		~~Type not preferred~~		
	~~Direct mounting~~	~~Surface mounting~~	Flush mounting Three-hole fixing	Clamp fixing

8 Pressure element assembly

Table 10. Table of combination: pressure, threads, nominal size, materials

Pressure / Threads	$p \leq 250$ bar	$p > 250$ bar $p \leq 400$ bar	$p > 400$ bar $p \leq 600$ bar	$p > 600$ bar $p \leq 1000$ bar	$p > 1000$ bar $p \leq 1600$ bar	Nominal size preferred
G 1/8 B 1/8-27 NPT EXT			(-)	(-)	(-)	40 50
G 1/4 B 1/4-18 NPT EXT					(-)	40 50 63 80
G 3/8 B					(-)	80 100 150 and 160
G 1/2 B						80 100 150 and 160 250
1/2-14 NPT EXT					(-)	80 100 150 and 160 250
G 1/2 B (For HP)						100 150 and 160 250

Material with R_p 0,2 ≥ 150 N/mm² (e.g. brass)

Material with R_p 0,2 ≥ 190 N/mm² (e.g. stainless steel - monel)

Material with R_p 0,2 ≥ 260 N/mm² (e.g. stainless steel)

NOTE. Combinations marked (-) shall not be used.

9 Requirements

The test methods for these requirements are given in clause **10**.

9.1 Accuracy

The total errors of indication at reference temperature 20 °C of the gauge shall not exceed the values given in table 11.

Installation of the pressure gauges shall not cause any change of readings.

Table 11 shows the limits of permissible error as a percentage of span at reference temperature 20 °C corresponding to accuracy classes.

Table 11. Maximum permissible errors

Accuracy classes	Limits of permissible error (percentage of span)
~~0,1~~	~~± 0,1 %~~
~~0,25~~	~~± 0,25 %~~
~~0,6~~	~~± 0,6 %~~
~~1~~	~~± 1 %~~
~~1,6~~	~~± 1,6 %~~
~~2,5~~	~~± 2,5 %~~
~~4~~	~~± 4 %~~

9.2 Hysteresis

Hysteresis error in pressure gauges shall not exceed the absolute value of the limits of permissible error at reference temperature 20 °C.

EXAMPLE

Pressure gauge with a maximum scale value of 10 bar, accuracy class 1. The maximum permissible hysteresis error is 1 %. The difference between the readings taken at decreasing and increasing pressure shall not exceed 0,1 bar (= 1 % of 10 bar).

9.3 Temperature effect

The variation of indication caused by effects of temperature shall not exceed the percentage values given by the formula:

$$\pm 0{,}04 \times (t_2 - t_1)\ \%\ \text{of the span}$$

where:

t_1 is the reference temperature in degrees Celsius;

t_2 is the ambient temperature in degrees Celsius.

9.4 Endurance

Gauges shall withstand the steady pressure, over-pressures and cyclic pressures as described below without exceeding the specified change of accuracy (see **10.4.3**). For gauges with combined pressure and vacuum ranges the endurance test required may be met with gauges of positive range only with the same span.

EXAMPLE

A gauge with a range of −1 to + 5 bar may be substituted by a gauge with a range of 0 to 6 bar.

9.4.1 *Gauge suitable for maximum steady working pressure 75 % of the maximum scale value*

9.4.1.1 *Steady pressure*

The gauge shall withstand a steady pressure equal to the maximum scale value for an extended period.

9.4.1.2 *Over-pressure*

The gauge shall withstand the over-pressure shown in table 12 for a short period.

Table 12. Over-pressure

Maximum scale value of pressure gauge bar	Over-pressure to be applied
≤ 100	1,25 × maximum scale value
> 100 to ≤ 600	1,15 × maximum scale value
> 600 to ≤ 1 600	1,10 × maximum scale value

9.4.1.3 *Cyclic pressure*

The gauge shall withstand a pressure fluctuating from 30 % to 60 % of the maximum scale value for the number of pressure cycles shown in table 13.

Table 13. Cyclic pressure

Maximum scale value of pressure gauge bar	Number of pressure cycles
≤ 25	100 000
> 25 to ≤ 600	50 000
> 600 to ≤ 1 600	15 000

9.4.2 *Gauges suitable for maximum steady working pressure equal to the maximum scale value*

9.4.2.1 *Steady pressure and over-pressure*

The gauge shall withstand a steady pressure of 1,3 times the maximum scale value for an extended period.

9.4.2.2 *Cyclic pressure*

The gauge shall withstand a pressure fluctuating between 30 % and 95 % of the maximum scale value for 200 000 cycles. 15 000 cycles are sufficient for gauges of classes 0,1; 0,25 and 0,6.

9.5 Operating conditions

9.5.1 *Rated temperatures in service*

Ambient temperature and temperature of the fluid under pressure: −20 °C to + 60 °C

Minimum and maximum temperature in service for liquid-filled gauges shall be in accordance with the liquid properties.

9.5.2 *Rated storage temperature*

Storage temperature: −40 °C to +70 °C.

The gauge shall not change its appearance. The dial and pointer shall not crack, blister or change colour.

9.5.3 *Protection against ingress of water and foreign particles (degree of protection)*

Recommended minimum protection ratings in accordance with EN 60529:

– for indoor use: IP 31;

– for outdoor use: IP 44.

9.5.4 *Effect of mechanical shock*

After the application of shock loads of 150 m/s^2, the gauge shall remain within its accuracy class.

The shock test is required for gauges with accuracy classes 1 to 4 only.

9.5.5 *Effect of mechanical vibration*

The gauge shall be subjected to vibrations on three orthogonal axes of the following conditions:

– acceleration 5 m/s^2;

– range of frequency from 10 Hz to 150 Hz;

– scan rate 1 octave per minute for the period of 2 h per axis.

The change of indication after the vibration test shall not exceed 0,5 times class.

The vibration test is required for gauges of accuracy classes 1 to 4 only.

9.5.6 *Leak rate*

The leak rate shall not exceed 5×10^{-3} mbar · l/s.

9.5.7 *Mounting position*

A variation of the nominal mounting position of $\pm 5°$ shall not give a change of indication of more than 0,5 times class.

9.6 Dials and pointers

9.6.1 *Scale angle*

The scale normally covers 270° of arc, but may be longer for accuracy classes 0,1, 0,25 and 0,6.

9.6.2 *Scale interval*

The scale interval shall be a value that represents 1×10^n, 2×10^n or 5×10^n of the pressure unit, where n is the whole number which can be positive, negative or zero.

The minimum number of minor scale divisions for each class of accuracy and size of gauge are as shown in table 14. For illustrative examples see annex A.

9.6.3 *Scale marks*

9.6.3.1 The thickness of the scale marks shall not exceed 1/5 of the scale spacing. Examples are shown in annex A.

Table 14. Minimum number of minor scale divisions

Scale	Nominal size	Minimum number of minor scale divisions						
		Accuracy classes						
		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	—	—
	150 and 160	—	200	100	50	50	—	—
	250	500	200	100	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	—	—
	150 and 160	—	160	80	32	32	—	—
	250	320	320	80	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	—	—
	150 and 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	—	—
	150 and 160	—	200	80	40	40	—	—
	250	400	200	80	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	—	—
	150 and 160	—	120	120	60	60	—	—
	250	300	300	120	60	60	—	—