



Pressure gauges
Part 1: Bourdon tube pressure gauges – Dimensions,
metrology, requirements and testing
English version of DIN EN 837-1

DIN
EN 837-1

ICS 17.100

Descriptors: Pressure gauges, Bourdon tubes, requirements, testing.

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

This standard supersedes
DIN 16006:1987-02, DIN 16063:1987-02,
DIN 16064:1987-02, DIN 16070:1987-02,
DIN 16102:1983-12, and, together with
DIN EN 837-3:1997-02,
supersedes DIN 16005:1987-02,
DIN 16007:1987-02, DIN 16099:1987-02,
DIN 16109:1987-02, DIN 16117:1987-02,
DIN 16123:1987-02, DIN 16128:1987-02,
DIN 16254:1983-02, DIN 16258:1987-02,
DIN 16288:1987-02, and, together with
DIN 16287:1995-10,
supersedes DIN 16259:1987-05.

European Standard EN 837-1:1996 has the status of a DIN Standard.*A comma is used as the decimal marker.***National foreword**

This standard has been prepared by GEN/TC 141.

The responsible German body involved in its preparation was the *Normenausschuß Technische Grundlagen* (Principles of Standards Work Standards Committee).

Although this standard only covers pressure gauges of circular form, it may also be applied by analogy to gauges of square or rectangular form. It should be noted that the pressure connections and tapped holes specified in this standard are also suitable for use with DIN 16086 gauges and transducers, as well as transducers common in process engineering.

Since this standard specifies only dimensions for sealing washers and lenses, but no materials and pressure/temperature ratings, information on these parameters, so far included in DIN 16258 and DIN 16259 (now withdrawn), is provided in the tables below.

Table 1: Washer materials

Material	Allowable working pressure, in bar	Allowable working temperature, in °C	Hardness of ready-to-use washer
Non-metallic (asbestos-free)	100	250	–
Al 99,5 F13 as in DIN 1745-1	250	100	≈ HB 40
SF-Cu F20 as in DIN 17670-1	400 (1600)	400	HB 40 to HB 60
X 6 CrNiMoTi 17 12 2 as in DIN 17440	400	550	HB 130 to HB 190
Ni 99,6 F37 (soft-annealed) as in DIN 17750	400	600	HB 110 maximum

The values given in brackets apply to flush mounting or similar types of mounting.

Continued overleaf.
EN comprises 38 pages.Bearbeitet: **Normung****18.9.01**

Table 2: Sealing lens material

Material	Allowable working temperature, in C°	Allowable working pressure, in bar
Stainless steel as in DIN 17440 ($R_{p0,2} \geq 190/\text{mm}^2$)	250	1600

Pressure gauges designated S3 with a baffle wall are of a design similar to those specified in DIN 16006 (now withdrawn). The DIN Standards corresponding to the European/International Standards referred to in clause 2 of the EN are as follows:

European/International Standard	DIN Standard
EN 22768-1	DIN ISO 2768-1
ISO 228-1	DIN ISO 228-1
ISO 1302	DIN ISO 1302
ISO 2859-1	DIN ISO 2859-1

Amendments

The specifications of the standards listed in the Superseding note have been combined to form the present standard (and DIN EN 837-3).

Previous editions

DIN 3701: 1925-07	DIN 16100: 1943-08, 1952-06
DIN 3702: 1925-07	DIN 16102: 1968-12, 1983-12
DIN 3705: 1925-07	DIN 16103: 1979-02, 1987-12
DIN 3708: 1925-07	DIN 16109: 1965-05, 1987-02
DIN 3730: 1928-10	DIN 16109-1: 1973-12
DIN 16005: 1968-11, 1987-02	DIN 16109-2: 1983-02
DIN 16005-1: 1981-07	DIN 16110: 1942-08, 1954-03, 1962-06
DIN 16005-2: 1981-07	DIN 16117: 1987-02
DIN 16006: 1987-02	DIN 16117-1: 1979-10
DIN 16006-1: 1976-10, 1979-07	DIN 16117-2: 1967-11, 1983-10
DIN 16006-2: 1979-02	DIN 16117-3: 1979-10
DIN 16006-3: 1983-01	DIN 16123: 1987-02
DIN 16007: 1987-02	DIN 16123-1: 1977-04
DIN 16040: 1942-06, 1953-05	DIN 16123-2: 1967-10, 1977-04
DIN 16041: 1942-06, 1953-03	DIN 16123-3: 1977-04
DIN 16043: 1942-06, 1953-05	DIN 16123-4: 1977-04
DIN 16044: 1942-06, 1953-05	DIN 16128: 1974-03, 1987-02
DIN 16048: 1943-05	DIN 16128-1: 1965-06
DIN 16049: 1965-08, 1979-02	DIN 16128-2: 1965-06
DIN 16050: 1976-01	DIN 16128-3: 1965-06
DIN 16063: 1965-05, 1965-07, 1976-01, 1987-02	DIN 16128-4: 1974-03
DIN 16064: 1965-05, 1976-01, 1987-02	DIN 16254: 1961-10
DIN 16070: 1969-08, 1979-02, 1987-02	DIN 16258: 1987-02
DIN 16099: 1965-05, 1965-11, 1983-12, 1987-02	DIN 16259: 1987-05
DIN 16099-1: 1974-02	DIN 16288: 1964-09, 1972-04, 1985-09, 1987-02

Standards referred to

(and not included in **Normative references**)

DIN 1745-1	Wrought aluminium and aluminium alloy plate, sheet and strip greater than 0,35 mm in thickness – Properties
DIN 16086	Electrical pressure measuring instruments – Pressure sensors, pressure transmitters, pressure measuring instruments – Concepts, specifications for data sheets
DIN 17440	Technical delivery conditions for stainless steel plate, hot rolled strip, and bars for pressure purposes, drawn wire and forgings
DIN 17670-1	Wrought copper and copper alloy plate, sheet and strip – Properties
DIN 17750	Wrought nickel and nickel alloy plate, sheet and strip – Properties

ICS 17.100

Descriptors: Pressure gauges, Bourdon tubes, requirements, testing.

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.

The European Standards exist 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.

CEN members are the national standards bodies of Austria, Belgium, the Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

CEN

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

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

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Foreword

This European Standard has been prepared by the 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.

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 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 anti-clockwise 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		

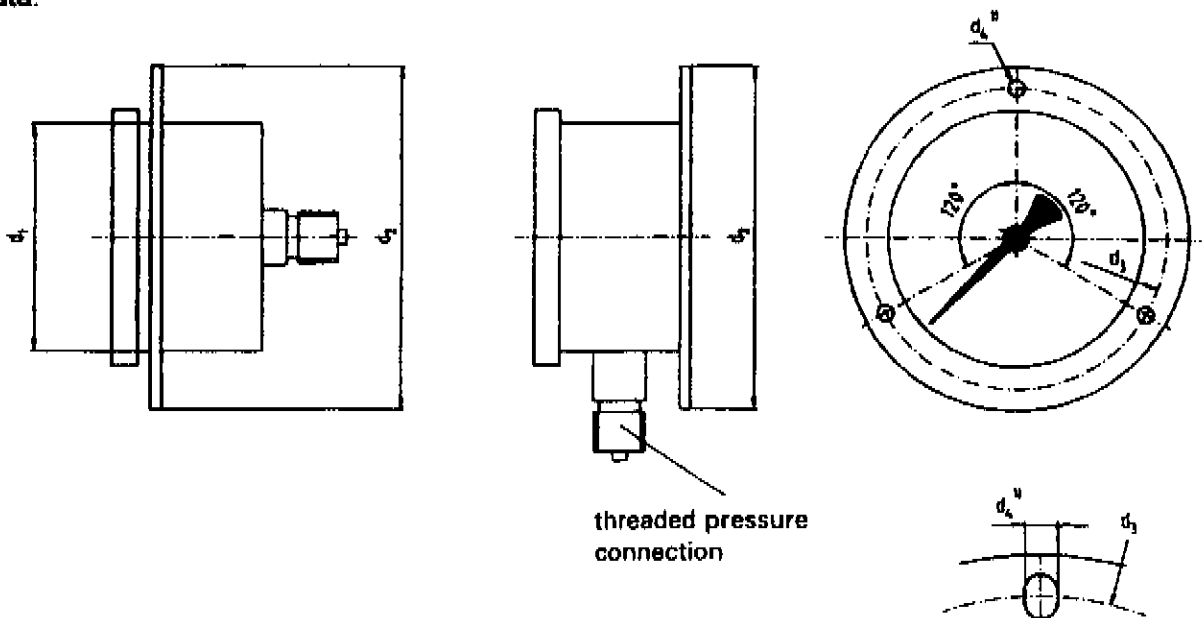
7 Dimensions

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.



- 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 2 : Dimensions

Dimensions in millimetres

Nominal size	d_1 min.	d_2 max.	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.

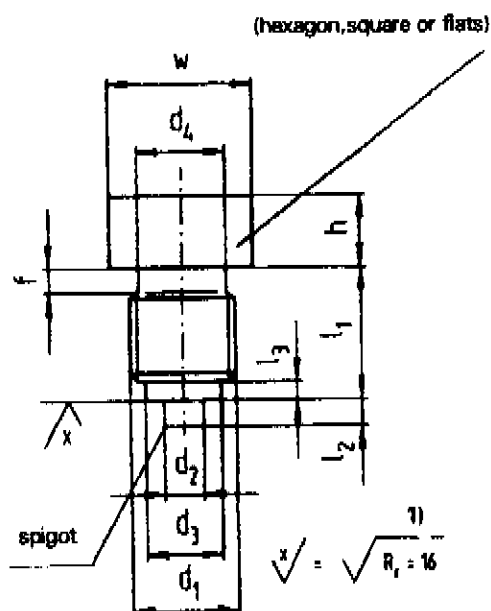
7.3.1 Screw threads

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

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

¹⁾ According to ISO 1302

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

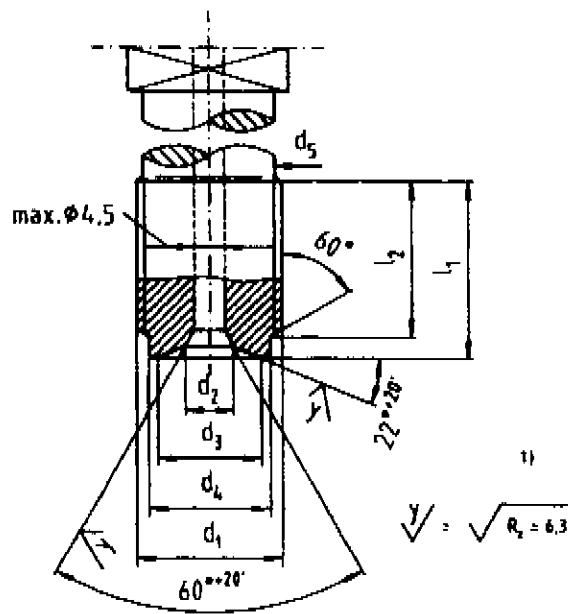


Figure 3

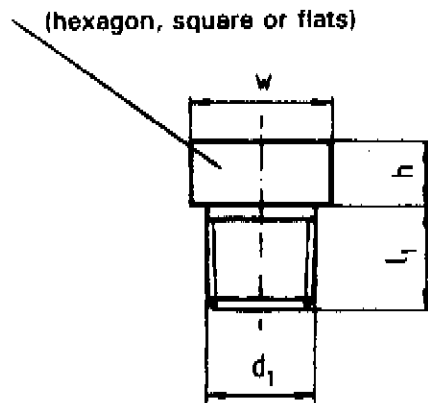
Table 5 : Dimensions for high pressure shank

Dimensions in millimetres

Thread size	d_2	d_3	d_4	d_5	l_1	l_2
d_1	$\pm 0,1$			0 -0,3	+0,3 0	+0,3 0
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



1)

Figure 4

Table 6 : Dimensions of taper threaded shanks

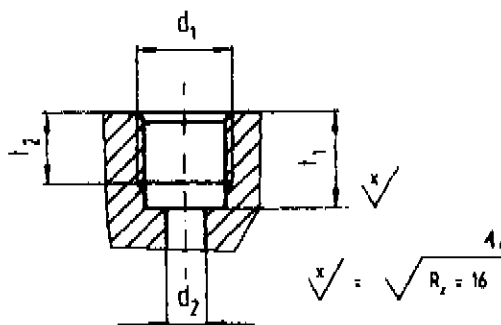
Dimensions in millimetres

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.

¹⁾ According to ISO 1302

7.3.5 Parallel threaded tapped holes



1)

Figure 5

Table 7 : Dimensions of parallel threaded tapped holes

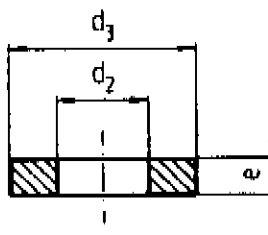
Dimensions in millimetres

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.



1)

Figure 6

1) According to ISO 1302.

Table 8 : Dimensions of sealing washers

Dimensions in millimetres

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

7.3.7 Sealing lens

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

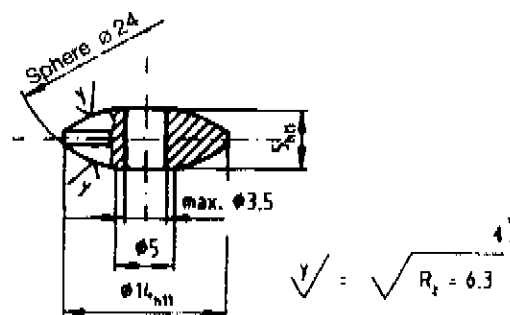





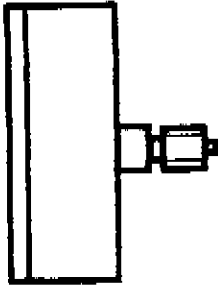
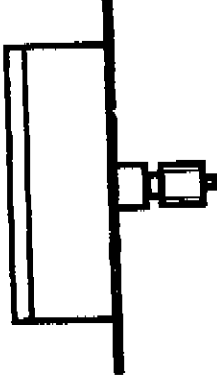
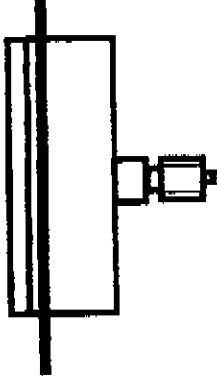
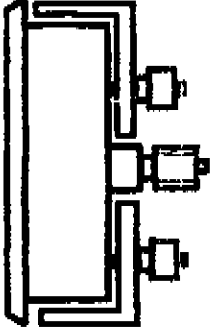
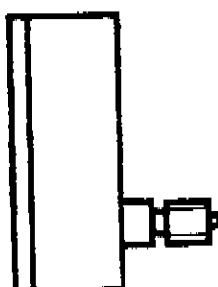
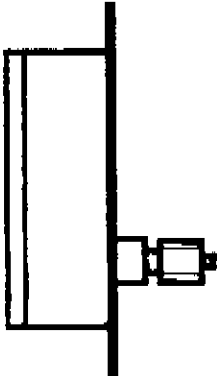
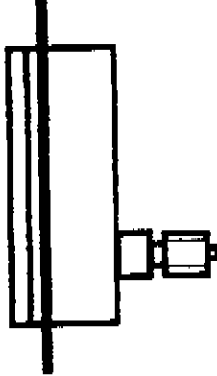
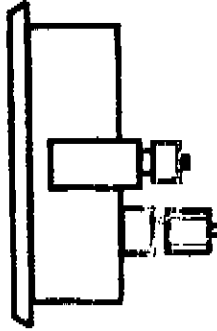
Figure 7

¹⁾ According 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	<p>10</p> 	<p>11</p> 	<p>12</p>  <p>Type not preferred</p>	
CENTRE BACK CONNECTION	<p>20</p> 	<p>21</p>  <p>Type not preferred</p>	<p>22</p> 	<p>23</p> 
OFFSET BACK CONNECTION	<p>30</p> 	<p>31</p>  <p>Type not preferred</p>	<p>32</p> 	<p>33</p> 
	DIRECT MOUNTING	SURFACE MOUNTING	FLUSH MOUNTING 3-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							(-)
G 1/2 B (For HP)					100 150 and 160 250		

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

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

 Material with $R_p 0,2 \geq 260$ 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 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 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 x maximum scale value
> 100 to ≤ 600	1,15 x maximum scale value
> 600 to $\leq 1\ 600$	1,10 x 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 $\leq 1\,600$	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. 15000 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 $5 \times 10^{-3} \text{ mbar.l/s}$.

9.5.7 Mounting position

A variation of the nominal mounting position of $\pm 5^\circ$ 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.

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 250	-	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 250	-	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 250	-	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 250	-	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 250	-	120	120	60	60	-	-
	250	300	300	120	60	60	-	-

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.

9.6.3.2 The scale spacing shall not be smaller than 1 mm.

9.6.3.3 The scale spacing shall be as constant as possible. The difference between the longest and shortest spacing shall not exceed $1/5$ of the latter.

9.6.4 Scale numbering

Scale numbering will be at manufacturer's discretion.

Examples of scale numbering are shown in Annex A for accuracy classes from 0,6 to 4.

9.6.5 Pointer dimensions

The tip of the pointer that sweeps the scale mark shall be no wider than the minor scale mark.

The pointer shall cover between $1/10$ to $9/10$ of the length of the shortest lines of the minor scale marks.

The minimum lengths of pointer from axis to the tip are shown in table 15.

Table 15 : Minimum length of pointer

Gauge nominal size	Minimum length of pointer
40 mm	14 mm
50 mm	18 mm
63 mm	23 mm
80 mm	28 mm
100 mm	36 mm
150 mm	57 mm
160 mm	62 mm
250 mm	95 mm

9.6.6 Mirror scales

Pressure gauges of accuracy class 0,1 shall be equipped with a mirror scale.

Pressure gauges of accuracy classes 0,25 and 0,6 shall incorporate provisions to minimise parallax errors, such as a knife edge pointer. A mirror scale may be fitted in addition.

9.6.7 Information on dial

- a) unit of pressure shall be marked ;
- b) accuracy class shall be marked preferably at the end of the scale ;
- c) the symbol for the type of pressure element may be marked, see table 16 ;
- d) gauges suitable for maximum steady working pressure equal to the maximum scale value shall have an identifying mark at the maximum scale value (see figure 8) ;
- e) the symbol for the dial plane shall be marked when the manufacturer is required to calibrate the gauges other than in the vertical position (see figure 9) ;
- f) If the customer requires the gauge to be calibrated at other than reference temperature this shall be marked. This applies to 0,1, 0,25 and 0,6 class gauges ;
- g) If the gauge meets the accuracy requirements on only gas or liquid, then this shall be marked. This applies to 0,1, 0,25 and 0,6 accuracy class gauges ;
- h) EN-number of this standard may be marked ;
- i) Name or logo of the manufacturer and/or supplier shall be marked ;
- j) Serial numbers shall be marked for accuracy classes 0,1 and 0,25, and may be marked for accuracy classes from 0,6 to 4. Serial numbers shall also be marked on all gauges which are subject to state metrological control ;
- k) Where the gauge has wetted parts, different from brass, bronze, tin or hard solder, then the material of the wetted parts may be marked ;
- l) Safety pattern gauges shall be marked as specified in 9.7.2.5 ;
- m) Pressure gauges for use with oxygen or acetylene shall be marked as specified in 9.8.

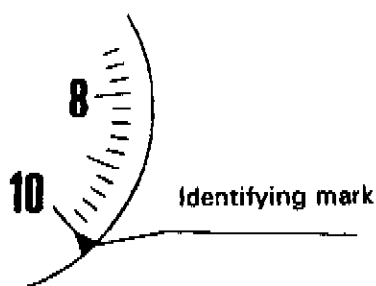


Figure 8

Table 16 : Symbols for types of pressure elements

Type of Bourdon tube	Symbol
Circular	
Spiral	
Coiled	

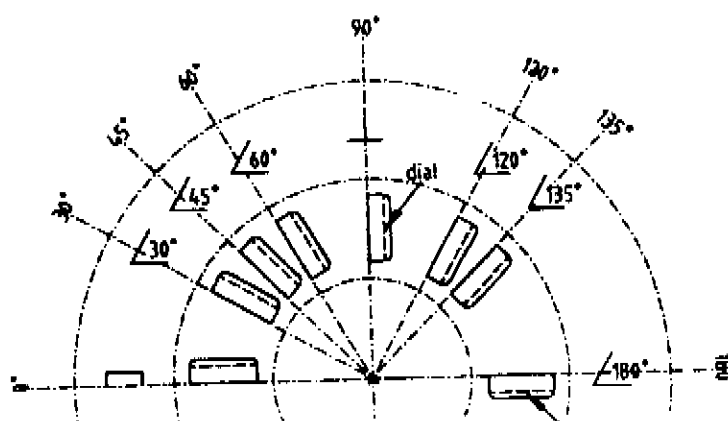


Figure 9

9.6.8 Pointer stop

Gauges with maximum steady working pressure equal to the maximum scale value shall have a free zero. Gauges with maximum steady working pressure 75 % of the maximum scale value may have a free zero.

9.7 Safety

Safety gauges shall protect an operator from failure of the pressure-responsive element and the release of high pressure gases into the case by deflecting the blast and debris away from the front of the gauge.

9.7.1 Blow-out device gauges

When a blow-out device is fitted to a pressure gauge (designated by S1, see clause 12) it shall be resistant to blocking by debris and dirt and shall operate at a pressure of not more than half of the window-burst pressure. Where the gauge is sealed for the purpose of liquid-filling a blow-out device shall be fitted.

These gauges shall have no special marking.

9.7.2 Safety pattern gauges

This standard defines two types of safety pattern gauges :

- a) 40 to 80 size safety pattern gauges without a baffle wall (designated by S2, see clause 12) ;
- b) 40 to 250 size safety pattern gauges with a baffle wall (designated by S3, see clause 12).

All types of safety pattern gauges shall meet the requirements defined in 9.7.2.1, 9.7.2.2, 9.7.2.3 and 9.7.2.5. Safety pattern gauges with baffle wall shall additionally meet the requirements defined in 9.7.2.4.

9.7.2.1 Energy release test

Pressure gauges shall pass the energy release test defined in 10.12.2.2 which simulates the failure of a pressure-responsive element and the release of high energy gas into the case.

9.7.2.2 Window

The window shall be of non splintering material, such as laminated glass or non splintering plastic.

9.7.2.3 Blow-out back

A blow-out back shall be fitted. The blow-out back shall be resistant to blocking by debris and dirt and shall operate at a pressure of not more than half of window burst pressure and not more than 1,5 bar.

Test as given in 10.12.1.2

The area of blow-out back shall be as large as is practicable.

NOTE : For safety pattern gauges without a baffle wall, blow-out device according to 9.7.1 is sufficient.

9.7.2.4 Baffle wall

The baffle wall shall form a permanently fixed structural part of the case interposed between the bourdon tube and the dial. The number and size of holes in the baffle wall shall be kept to a minimum consistent with fixing screws, pointer shaft and dial pillars and shall not exceed 5 % of the area of the baffle wall.

9.7.2.5 Marking

40 to 80 size safety pattern gauges without baffle wall (designated by S2) shall have dial marked S and the EN-number of this standard.

40 to 250 size safety pattern gauges with baffle wall (designated by S3) shall have dial marked S and the EN-number of this standard.

9.8 Gauges for use with oxygen or acetylene

The gauges shall be of safety pattern type.

All materials liable to come into contact with oxygen or acetylene shall comply with EN 29539.

9.8.1 Gauges for use with oxygen

Bourdon tubes and other parts in contact with the gas shall be free of oil and grease. Only lubricants suitable for use in oxygen at maximum working pressure shall be used. The dial shall be marked with the word "oxygen" written in English and the international symbol for "no lubrication" as shown below (ISO 7000 symbol 0248 with prohibition sign).



9.8.2 Gauges for use with acetylene

The dial shall be marked with the word "acetylene" written in English.

9.9 Liquid-filled gauges

Liquid-filled gauges shall have an appropriate device in order to assure atmospheric compensation.

9.10 Additional constructional requirements for gauges subject to Legal Metrology Control

For applications in Legal Metrology the appropriate OIML recommendations and the national legislation as well as the requirements below are to be observed.

9.10.1 The pressure-responsive element, the movement, the pointer, and the dial shall be installed inside an enclosing case, which can be sealed by a securing seal in order to prevent access to the parts mentioned without destruction of surrounding components.

9.10.2 The motion of the pressure-responsive element and pointer shall not be obstructed on either side of the zero mark, e.g. by means of a pointer stop, within a range corresponding to twice the permissible error in 9.1.

9.10.3 The error caused by friction of movement components shall not exceed one half of the permissible error in 9.1.

9.10.4 The scale numbering shall directly reflect the value of the pressure to be measured. The use of a factor is not permitted.

9.10.5 A place to accommodate the control mark shall be provided on the window, on a sealing lead or on the case of the gauge.

10 Testing

Reference temperature : 20 °C.

For all type tests on all accuracy classes and for production piece testing of accuracy classes 0,1, 0,25 and 0,6 the reference temperature shall be maintained within ± 2 °C. For production piece testing of all other accuracy classes the reference temperature shall be maintained within ± 5 °C. The dial shall be in the nominal position $\pm 3^\circ$.

When calibrating pressure gauges of accuracy classes 0,1, 0,25 and 0,6 the reference temperature shall be maintained within the maximum variation permitted if temperature variation can affect indication of the gauge.

10.1 Type approval and production piece tests

As far as the ranges are concerned, it is not necessary to carry out the type approval tests for all ranges. The samples to be tested, stated in table 17 shall be selected according to table 18.

Table 17 : Type approval/production piece tests

Test	Type approval test						Production piece test	
	Testing see paragraph	Requirement see paragraph	Number of samples to be tested				Testing see paragraph	Requirement see paragraph
			Group A	Group B	Group C	Group D		
Visual inspection	-	-	4				-	-
Compliance with drawing dimensions	-	-					-	-
Leak test	10.10	9.5.6					10.10	9.5.6
Accuracy and hysteresis	10.2	9.1, 9.2					10.2	9.1, 9.2
Influence of mounting position	10.11	9.5.7	2					
Temperature effects	10.3	9.3						
Temperature in service	10.5	9.5.1						
Storage temperature	10.6	9.5.2						
Degree of protection	10.7	9.5.3						
Endurance steady pressure	10.4	9.4.1						
Endurance cyclic pressure	10.4	9.4.2						
Effects of mechanical vibration	10.9	9.5.5						
Effects of mechanical shock	10.8	9.5.4						
Safety : Blow-out test	10.12.1.2	9.7.1						
Energy release test	10.12.2.2	9.7.2.1	For these tests at least five samples are required. A test of particular case-design is considered sufficient when carried out with test energy of the pressure element that represents the highest energy source intended for this case-construction.					

NOTE 1: The selection of the samples out of each group, as well as the sequence of the testings, are at manufacturer's discretion.

NOTE 2: Production piece tests shall be carried out on each gauge accuracy classes 0,1 to 0,6. All other gauges be tested at an AQL-Level 1,5 according to ISO 2859-1 except for the leak test where each gauge shall be tested.

NOTE 3: For production piece test hysteresis test for gauges classes 0,1, 0,25 and 0,6 only.

Table 18 : Selection of gauges for type approval test

Group of pressure range	Pressure range in bar					Minimum number of sample (same range)
A	- 0,6 to 0 0 to 0,6	- 1 to 0 0 to 1	- 1 to 0,6 0 to 1,6	- 1 to 1,5 0 to 2,5	- 1 to 3 0 to 4	4
B	- 1 to 5 0 to 6	- 1 to 9 0 to 10	- 1 to 15 0 to 16	- 1 to 24 0 to 25	0 to 40	4
C	0 to 60	0 to 100	0 to 160	0 to 250	0 to 400	4
D	0 to 600	0 to 1 000	0 to 1 600			4

NOTE : The selected gauges of same range shall be for :

Group A : the lowest range manufactured ;
Group B and C : at manufacturer's discretion ;
Group D : the highest range manufactured.

10.2 Accuracy and hysteresis

Test for accuracy and hysteresis shall be made using a test instrument with an accuracy of at least four times better than the accuracy of the gauge to be tested (i.e. with limits of permissible error at least four times smaller than the limits of permissible error of the gauge tested). The test instrument shall be traceable to a national or international standard. Test method may be either by comparing selected indications with the pressure to be applied at these indications or by comparing selected pressures with resultant indications of the gauge under test. The test shall be made with rising and falling pressure.

The number of test points shall be evenly distributed over the entire scale as follows :

Classes	0,1 ; 0,25 and 0,6	: a minimum of 10 points
Classes	1 ; 1,6 and 2,5	: a minimum of 5 points
Class	4	: a minimum of 4 points

Each point shall be tested with rising and falling pressure. The maximum scale value is a test point. Zero is a test point when it is free.

The reading shall be obtained after the gauge has been lightly tapped. Pressure readings shall be interpolated between 1/4 and 1/10 of the distance between two scale marks.

The hysteresis is calculated from the difference in applied pressure for the same indication point or the difference in pressure indication for the same applied pressure on falling and rising pressure.

The values of measured error and hysteresis shall not exceed the values given in 9.1 and 9.2.

10.3 Temperature effect

The gauge to be tested will be subjected to the maximum and minimum ambient temperature from 9.5.1 in steps of 20 °C from reference temperature to the maximum and minimum ambient temperature. After having attained thermal equilibrium the tests described in 10.2 are carried out.

10.4 Endurance

The tests for the requirements given in 9.4 are as follows :

10.4.1 Gauges suitable for maximum steady working pressure 75 % of the maximum scale value

10.4.1.1 Steady pressure

The gauge shall be pressurized up to the maximum scale value and the pressure maintained for 12 h.

10.4.1.2 Over-pressure

The gauge shall be pressurized according to the requirements of 9.4.1.2 and maintained for 15 min.

10.4.1.3 Cyclic pressure

The gauge shall be subjected to a pressure fluctuating approximately sinusoidally between $(30 \pm 5)\%$ and $(60 \pm 5)\%$ of the maximum scale value at a frequency of between 20 and 60 cycles per minute for the number of cycles stated in 9.4.1.3.

If the available equipment will not operate at the minimum frequency of 20 cycles per minute when testing gauges above 1000 bar the frequency may be reduced to 1 cycle per minute minimum.

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

10.4.2.1 Steady pressure and over-pressure

The gauge shall be pressurized up to 1,3 times the maximum scale value and the pressure maintained for 12 h.

10.4.2.2 Cyclic pressure

The gauge shall be subject to a pressure fluctuating approximately sinusoidally between $(30 \pm 5)\%$ and $(95 \pm 5)\%$ of the maximum scale value at a frequency of between 20 and 60 cycles per minute for the number of cycles stated in 9.4.2.2

If the available equipment will not operate at the minimum frequency of 20 cycles per minute when testing gauges above 1 000 bar the frequency may be reduced to 1 cycle per minute minimum.

10.4.3 Accuracy after endurance test

After completion of the endurance testing the gauge should be left undisturbed for 1 h. Then the error when tested in accordance with 10.2 shall not exceed 1,2 times class.

For ranges 0 bar to 1 000 bar and 0 bar to 1 600 bar the error shall not exceed 1,5 times class.

10.5 Rated temperatures in service

The pressure element assembly is to be placed in a climatic chamber for 24 h at the upper temperature extreme at a pressure of 2,5 times maximum scale value with maximum scale value up to 1 000 bar and 1,5 times maximum scale value with maximum scale value above 1 000 bar respectively.

Afterwards the leak test is carried out at ambient room temperature as 10.10. After this test measuring performance is not required.

10.6 Rated storage temperatures

The complete, unpressurized gauge is to be placed in a climatic chamber for minimum 24 h at each temperature extreme.

Inspect immediately for any changes in appearance and, after 1 h at reference temperature test for accuracy and hysteresis, and leakage to 10.2 and 10.10.

After the test the gauge shall satisfy the requirements given in 9.1, 9.2 and 9.5.2 for accuracy, hysteresis and no change of appearance shall occur.

10.7 Protection against ingress of water and foreign particles (Degree of protection)

As specified in EN 60529.

10.8 Effect of mechanical shock

Shock test equipment as given in EN 60068-2-27. Tests with 150 m/s^2 half sinewave in the two directions of three rectangular axes. Perform three shock loads in each plane, this being 18 shocks altogether. The gauge shall be pressurized with 50 % of maximum scale value and be mounted in its normal manner. After the test the gauge shall satisfy the requirements for accuracy and hysteresis as given in 9.1 and 9.2.

10.9 Effect of mechanical vibration

The gauge shall be mounted on a vibration test equipment as given in EN 60068-2-6 in its normal manner and tested at conditions as described in 9.5.5. It shall be pressurized to 50 % of the maximum scale value. After the test the error shall not exceed 1,5 times class.

10.10 Leak test

The leak test shall be conducted at maximum scale reading. Gauges with maximum scale reading up to 25 bar shall be tested on gas. Above this the test may be conducted with liquid.

10.11 Mounting position

The gauge shall be mounted inclined forwards at 5° to its normal position and tested for accuracy and hysteresis in accordance with 10.2. The change in indication shall not exceed 0,5 times class. It shall then be tested similarly inclined backwards, to right, and to left.

10.12 Safety

10.12.1 Gauges with blow-out devices

10.12.1.1 Constructional requirements

The existence of the blow-out device shall be verified by inspection.

10.12.1.2 Blow-out test

The operation of the blow-out device or blow-out back shall be verified, and the pressure at which it occurs recorded, by pressurizing the case through the pressure gauge connection (with the bourdon tube removed). Leakage points other than the blow-out device shall be sealed with a low strength sealant. Gauge cases intended for liquid filling shall be tested filled and unfilled. When tested in the filled condition the case may be inverted. When connected to a gas supply of increasing pressure (and flow rate if required) the blow-out device shall be expelled or open without failure of the window, expulsion of the window or any other component.

The blow-out device or back will then be blocked and the burst pressure of the window will be measured.

10.12.2 Safety pattern gauge

10.12.2.1 Constructional requirements

Constructional requirements of 9.7.2.2, 9.7.2.3 and 9.7.2.4 shall be verified by visual inspection.

10.12.2.2 Energy release test

All sizes of safety pattern gauges shall be subjected to a high pressure gas release test as follows :

a) For safety pattern gauge without a baffle wall (designated by S2)

- gas shall be released into the case of the pressure gauge with energy (pressure x volume) of 1,5 times the energy contained in the pressure element at maximum scale value.

b) For safety pattern gauges with a baffle wall (designated by S3)

- gas shall be released into the case of the pressure gauge with energy (pressure x volume) of 2,5 times the energy contained in the pressure element at maximum scale value for pressure ranges up to and including 1000 bar and of 1,5 times the energy contained in the pressure element at maximum scale value for pressure ranges above 1 000 bar.

- The high pressure gas shall enter the case through the standard pressure gauge connection with bore size increased to 5 mm minimum for nominal sizes up to and including 63 and to 10 mm minimum for larger size pressure gauges. Gas used for the energy release test shall be stored in a volume within the test equipment pressurized to give the correct energy level. The storage volume will be connected to the pressure gauge case connection via a valve operated at high speed. Valve and any connecting pipes or drillings shall have a flow cross-section not less than 28 mm². The length of any connecting piping or bores shall not exceed 65 mm. The time to open the valve shall not exceed 50 ms or alternatively the pressure at the pressure gauge connection shall reach its maximum value in not more than 30 ms.

On pressure gauge cases normally intended for liquid filling the case shall be tested in its filled and unfilled condition. When testing in the filled condition the gauge inlet to the case may be sealed with a temporary sealant (which is blown out completely during the test) or alternatively the instrument may be tested in the inverted position. The air bubble size in the case shall either be correct or the case shall be fully filled with liquid and an auxiliary volume of the same value as the intended air bubble, shall be placed in the flow path between the fast operating valve and the gauge inlet. The flow path shall not be increased by more than 50 mm nor reduced in cross-section to less than 28 mm².

The design of the test equipment for the energy release test shall include guards to prevent injury to the operator(s).

10.12.2.3 Performance of safety pattern requirements

The performance of the safety pattern gauge will be judged satisfactory if during the above energy release test no particles or fluids are projected in a forward direction.

11 Packaging for transportation

In consideration of the means of transportation selected, gauges shall be packed so as to preserve measurement properties, exclude damage and maintain accuracy within the limits of permissible error.

12 Designation

	Pressure gauge	EN 837	-	10	B	100	G1/2B	HP	0/160 bar	-	1,6	-	S3
Description													
Standard main number													
Type of mounting													
Type of pressure responsive element (Bourdon)													
Nominal size													
Screwed connection													
High pressure shank (if existing)													
Pressure range (without plus and minus sign)													
Accuracy class													
Safety designation S1, S2 or S3 (if existing)													

NOTE 1 : Designation for combined pressure and vacuum ranges and for vacuum ranges without plus and minus sign (e.g. 1/0,6 ; 0,6/0).

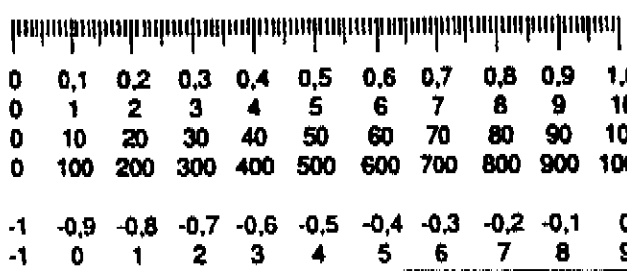
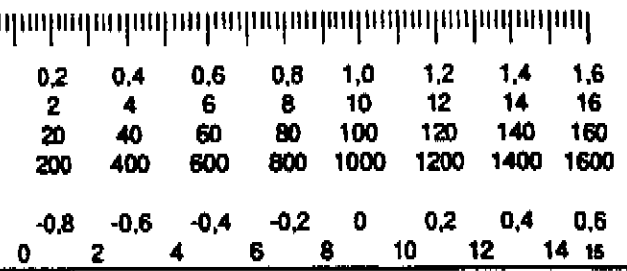
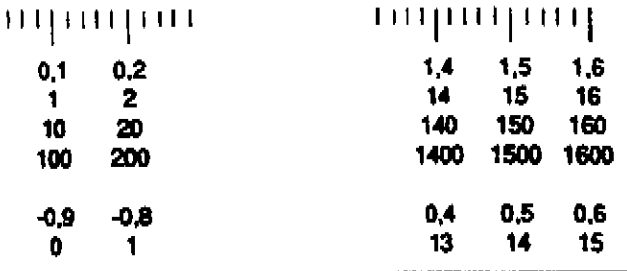
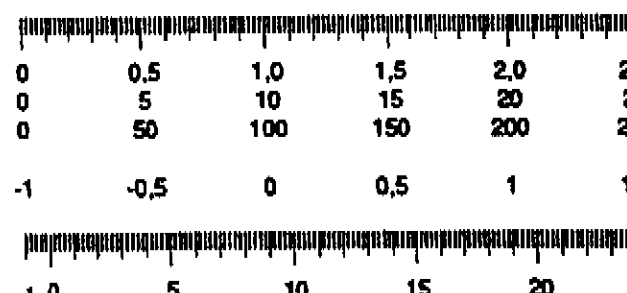
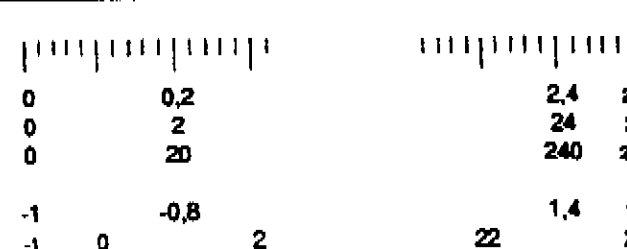
NOTE 2 : Safety designation :

- S1 Gauges with blow-out device
- S2 Safety pattern gauge without baffle wall
- S3 Safety pattern gauge with baffle wall

Annex A (informative)

Examples of scale numbering for accuracy classes from 0,6 to 4

Table A.1 : Nominal ranges, scale spacing and scale numbering of pressure gauges of class 0,6

Nominal ranges	Scale	Number of minor scale division	Scale interval	Scale spacing and scale numbering
100 to 250	0 to 1 0 to 10 0 to 100 0 to 1000 -1 to 0 -1 to 9	100	0,01 0,1 1 10 0,01 0,1	 0 0,1 0,2 0,3 0,4 0,5 0,6 0,7 0,8 0,9 1,0 0 1 2 3 4 5 6 7 8 9 10 0 10 20 30 40 50 60 70 80 90 100 0 100 200 300 400 500 600 700 800 900 1000 -1 -0,9 -0,8 -0,7 -0,6 -0,5 -0,4 -0,3 -0,2 -0,1 0 -1 0 1 2 3 4 5 6 7 8 9
100	0 to 1,6 0 to 16 0 to 160 0 to 1600 -1 to 0,6 -1 to 15	80	0,02 0,2 2 20 0,02 0,2	 0 0,2 0,4 0,6 0,8 1,0 1,2 1,4 1,6 0 2 4 6 8 10 12 14 16 0 20 40 60 80 100 120 140 160 0 200 400 600 800 1000 1200 1400 1600 -1 -0,8 -0,6 -0,4 -0,2 0 0,2 0,4 0,6 -1 0 2 4 6 8 10 12 14 15
150 to 250	0 to 1,6 0 to 16 0 to 160 0 to 1600 -1 to 0,6 -1 to 15	80	0,02 0,2 2 20 0,02 0,2	 0 0,1 0,2 1,4 1,5 1,6 0 1 2 14 15 16 0 10 20 140 150 160 0 100 200 1400 1500 1600 -1 -0,9 -0,8 0,4 0,5 0,6 -1 0 1 13 14 15
100	0 to 2,5 0 to 25 0 to 250 -1 to 1,5 -1 to 24	125	0,02 0,2 2 0,02 0,2	 0 0,5 1,0 1,5 2,0 2,5 0 5 10 15 20 25 0 50 100 150 200 250 -1 -0,5 0 0,5 1 1,5 -1 0 5 10 15 20 24
150 to 250	0 to 2,5 0 to 25 0 to 250 -1 to 1,5 -1 to 24	125	0,02 0,2 2 0,02 0,2	 0 0,2 2,4 2,5 0 2 24 25 0 20 240 250 -1 -0,8 1,4 1,5 -1 0 2 22 24

(continued)

Table A.1 (concluded)




Nominal ranges	Scale	Number of minor scale division	Scale interval	Scale spacing and scale numbering
100 to 250	0 to 4 0 to 40 0 to 400 -1 to 3	80	0,05 0,5 5 0,05	 0 0,5 1 1,5 2 2,5 3 3,5 4 0 5 10 15 20 25 30 35 40 0 50 100 150 200 250 300 350 400 -1 -0,5 0 0,5 1 1,5 2 2,5 3
100	0 to 0,6 0 to 6 0 to 60 0 to 600 -1 to 5 -0,6 to 5	120	0,005 0,05 0,5 5 0,05 0,005	 0 0,1 0,2 0,3 0,4 0,5 0,6 0 1 2 3 4 5 6 0 10 20 30 40 50 60 0 100 200 300 400 500 600 -1 0 1 2 3 4 5 -0,6 -0,5 -0,4 -0,3 -0,2 -0,1 0
150 to 250	0 to 0,6 0 to 6 0 to 60 0 to 600 -1 to 5 -0,6 to 0	120	0,005 0,05 0,5 5 0,05 0,005	 0 0,05 0,55 0,6 0 0,5 5,5 6 0 5 55 60 0 50 550 600 -1 -0,5 4,5 5 -0,6 -0,55 -0,05 0

Table A.2 : Nominal ranges, scale spacing and scale numbering of pressure gauges of class 1, 1,6, 2,5 and 4

Nominal ranges	Scale	Number of minor scale division	Scale interval	Scale spacing and scale numbering	
40 to 63	0 to 1 0 to 10 0 to 100 0 to 1000	20	0,05 0,5 5 50	 0 0,2 0,4 0,6 0,8 1,0 0 2 4 6 8 10 0 20 40 60 80 100 0 200 400 600 800 1000	
	-1 to 0 -1 to 9		0,05 0,5	 -1 -0,8 -0,6 -0,4 -0,2 0 -1 0 2 4 6 8 9	
80 to 250	0 to 1,0 0 to 10 0 to 100 0 to 1000	50	0,02 0,2 2 20	 0 0,2 0,4 0,6 0,8 1,0 0 2 4 6 8 10 0 20 40 60 80 100 0 200 400 600 800 1000	
	-1 to 0 -1 to 9		0,02 0,2	 -1 -0,8 -0,6 -0,4 -0,2 0 -1 0 2 4 6 8 9	
40 to 250	0 to 1,6 0 to 16 0 to 160 0 to 1600	32	0,05 0,5 5 50	 0 0,4 0,8 1,2 1,6 0 4 8 12 16 0 40 80 120 160 0 400 800 1200 1600	
	0 to 1,6 0 to 16 0 to 160 0 to 1600		32	0,05 0,5 5 50	 0 0,5 1 1,5 1,6 0 5 10 15 16 0 50 100 150 160 0 500 1000 1500 1600
	-1 to 0,6 -1 to 15			0,05 0,5	 -1 -0,5 0 0,5 0,6 -1 0 5 10 15
0 to 1,6 0 to 16 0 to 160 0 to 1600	32	0,05 0,5 5 50	 0 0,2 0,4 0,6 0,8 1,0 1,2 1,4 1,6 0 2 4 6 8 10 12 14 16 0 20 40 60 80 100 120 140 160 0 200 400 600 800 1000 1200 1400 1600		
-1 to 0,6 -1 to 15		0,05 0,5	 -1 -0,8 -0,6 -0,4 -0,2 0 0,2 0,4 0,6 -1 0 2 4 6 8 10 12 14 15		

2) The two different kinds of scale marks are acceptable variations at the manufacturer's discretion.

(Continued)

Table A.2 : (concluded)

Nominal ranges	Scale	Number of minor scale division	Scale interval	Scale spacing and scale numbering						
40 to 63	0 to 2,5 0 to 25 0 to 250 -1 to 1,5	25	0,1 1 10 0,1		0 0 0	0,5 5 50	1,0 10 100	1,5 15 150	2,0 20 200	2,5 25 250 -1 -0,5 0 0,5 1 1,5
80 to 240	0 to 2,5 0 to 25 0 to 250 -1 to 1,5 -1 to 24	50	0,05 0,5 5 0,05 0,5		0 0 0	0,5 5 50	1,0 10 100	1,5 15 150	2,0 20 200	2,5 25 250 -1 -0,5 0 0,5 1 1,5 -1 0 5 10 15 20 24
40 to 63	0 to 4 0 to 40 0 to 400 -1 to 3	20	0,2 2 20 0,2		0 0 0	1 10 100	2 20 200	3 30 300	4 40 400 -1 0 1 2 3	
80 to 250	0 to 4 0 to 40 0 to 400 -1 to 3	40	0,1 1 10 0,1		0 0 0	1 10 100	2 20 200	3 30 300	4 40 400 -1 0 1 2 3	
40 to 63	0 to 0,6 0 to 6 0 to 60 0 to 600 -1 to 5 -0,6 to 0	30	0,02 0,2 2 20 0,2 0,02		0 0 0 0	0,1 1 10 100	0,2 2 20 200	0,3 3 30 300	0,4 4 40 400	0,5 5 50 500 0,6 6 60 600 -1 0 1 2 3 4 5 -0,6 -0,5 -0,4 -0,3 -0,2 -0,1 0
80 to 250	0 to 0,6 0 to 6 0 to 60 0 to 600 -1 to 5 -0,6 to 0	60	0,01 0,1 1 10 0,1 0,01		0 0 0 0	0,1 1 10 100	0,2 2 20 200	0,3 3 30 300	0,4 4 40 400	0,5 5 50 500 0,6 6 60 600 -1 0 1 2 3 4 5 -0,6 -0,5 -0,4 -0,3 -0,2 -0,1 0