Application Notes for Pressure Gauges

Pressure gauges
Information on their application, selection, installation and operation

Definition of a pressure gauge

A pressure gauge is an instrument used to measure and indicate the pressure of a medium (liquid, gas etc.) based on atmospheric pressure.

Pressure gauges are pressure accessories within the meaning of Article 1, paragraph 2.1.4 in the European Pressure Equipment Directive 97/23/EC. The measuring system's volume is less than or equal to 0.1 liter in these pressure gauges. The CE marking is implemented according to Fluid Group 1 G in Annex II for a permissible operating pressure 200 bar or higher. A CE marking must not be affixed to pressure gauges under 200 bar. These pressure gauges are designed and manufactured according to the Sound Engineering Practice (SEP) according to Article 3, paragraph 3.

Relevant standards and guidelines:

EN 837-1 · Bourdon tube pressure gauges; dimensions, metrology, requirements and testing

EN 837-2 · Selection and installation recommendations for pressure gauges

EN 837-3 · Diaphragm and capsule pressure gauges; dimensions, metrology, requirements and testing

EN 29539 · Notes concerning materials for oxygen and acetylene

EN 60529 · Degrees of protection provided by enclosures

VDE 0100 · Low-voltage electrical installations

Scope

These Application Notes apply to pressure gauges with elastic elements (C-shaped bourdon tubes).

Operating conditions

Observe the selection and installation recommendations specified in EN 837-2 (formerly DIN 16005, Parts 1 and 2) as well as in these application notes on selecting a pressure gauge suitable for a particular application.

The use of pressure gauges that are not suitable for particular operating conditions may lead to considerable damage as a result.

Pressure gauge design

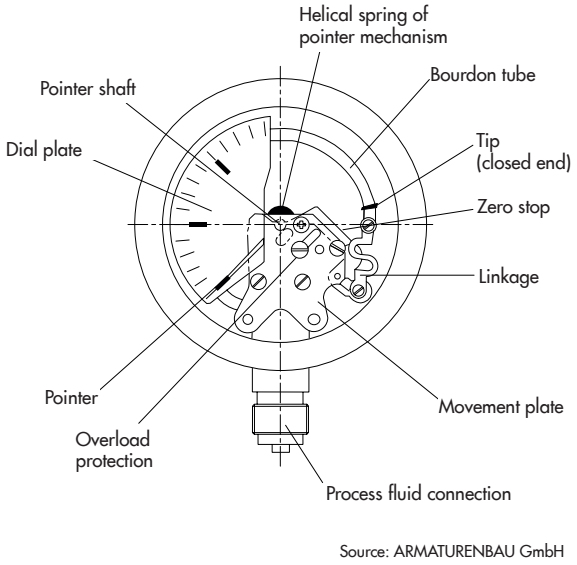

Fig. 1: *C-shaped Bourdon tube pressure gauge*

Selection criteria

Important criteria, such as material compatibility with the process medium, atmosphere and temperature as well as overpressure and indication range, need to be taken into account on selecting a pressure gauge. The operating pressure to be expected must be within the middle third of the indication range.

Furthermore, the type and location of the connecting thread (process fluid connection) must be considered.

Observe the regulations that apply for a particular application and the specifications of EN 837-2.

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Table 1: *Selection criteria for pressure gauges (safety considerations) according to EN 837-2*

Medium	**Liquid**							
Housing	Dry				Filled with liquid			
Nominal size	NG 40/50/63/80		NG 100/160/250		NG 40/50/63/80		NG 100/160/250	
Indication range	≤ 25 bar	> 25 bar	≤ 25 bar	> 25 bar	≤ 25 bar	> 25 bar	≤ 25 bar	> 25 bar
Minimum safety design code	0	0	0	0	S1	S1	S1	S1
Medium	**Gas or steam** · NOTICE Does not apply to oxygen or acetylene							
Housing	Dry				Filled with liquid			
Nominal size	NG 40/50/63/80		NG 100/160/250		NG 40/50/63/80		NG 100/160/250	
Indication range	≤ 25 bar	> 25 bar	≤ 25 bar	> 25 bar	≤ 25 bar	> 25 bar	≤ 25 bar	> 25 bar
Minimum safety design code	0	S2	S1	S3	S1	S2	S1	S3

Meaning of codes
0 Pressure gauges without blow-out device
S1 Pressure gauges with blow-out device
S2 Safety pattern gauges without baffle wall
S3 Safety pattern gauges with baffle wall (providing a higher level of safety)

Notes

- Pressure gauges for oxygen and **acetylene** must be designed as safety pattern gauges
  NG 40 – 80: **S2**
  NG 63/100/160: **S3**
  Safety pattern gauges (S2 and S3) must only be used. All materials of parts that come into contact with oxygen or acetylene must conform with EN 29539. The bourdon tube and other parts that come into contact with the gas must be free of oil and grease. Only use lubricants suitable for oxygen at the maximum operating pressure.
- Glycerine-filled gauges must not be used with oxygen or other strong oxidizing process fluid. For such applications, highly fluorinated and chlorinated liquids (e.g. halocarbons) can be used.
- Table 1 indicates the normal safety design code. Users must have knowledge of their special requirements and can use safety pattern gauges at pressures lower than 25 bar.

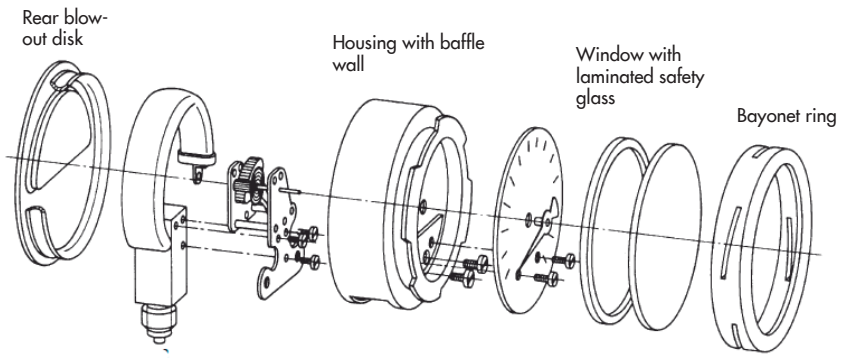

Fig. 2: *Safety pattern gauge according to EN 837-1, S3*

Source: ARMATURENBAU GmbH

Safety

The use of pressure gauges for gases or liquids under high pressure increases the risk of injury to operators in the event of pressure gauge rupture.

Pressure gauges for such applications have a laminated safety glass window and/or a rear blowout disk. As a result, personal injury cannot occur from any pressure-bearing parts if the gauge ruptures. Pressure gauges conforming to EN 837-1 in this case provide relative safety for operators.

For hazardous media, e.g.

- Oxygen
- Acetylene
- Flammable substances
- Toxic substances

Observe the relevant regulations. For example, pressure gauges filled with liquid must have a blow-out device according to paragraph 9.7 of EN 837-1 (S1 or also S2/S3 according to EN 837-1).

Mounting position

The following points must be observed during the installation of pressure gauges:

- Pressure gauges must only be installed by properly trained staff.
- On installing or removing the pressure gauge, do not apply any force to the housing. Therefore, always use a suitable wrench at the wrench face of the connection.
- By mounting a coupling sleeve or nut at the threaded connection, the pressure gauge dial can be moved to the right position to allow the pressure to be read properly.
- The joints must be leak tight. Therefore, use suitable seals which are resistant to the process media at the joints. Observe the maximum plant pressure as well as the medium and ambient temperature on selecting suitable seals.
- The pressure limit identifying mark on the dial applies as the upper pressure limit while testing the pressure of pipelines or tanks. Similarly, the specified steady pressure limit must not be exceeded.
- Before removing the pressure gauge from the pipeline, depressurize the relevant plant section. On doing so, be aware that residual medium in the pressure gauge can pose a risk to staff, equipment and the environment. Therefore, take sufficient precautions before dismantling the pressure gauge.

Start-up and operation

Avoid fast changes in temperature as well as pressure surges. As a result, slowly open the upstream shut-off equipment.

Scope of application

A pressure limit identifying mark on the dial (see EN 837-1 and EN 837-3) in many pressure gauges marks the steady pressure range.

Bourdon tube pressure gauges in nominal size 100 (160 and 250) can withstand a steady pressure up to the maximum scale value. Merely 0.9 times this pressure is permissible as the peak pressure when cyclic pressure occurs.

Bourdon tube pressure gauges are designed to withstand an overpressure up to 1.3 times of the maximum scale value.

Bourdon tube pressure gauges in nominal sizes 40, 50, 60, 63 and 80 can withstand a steady pressure up to ¾ of the maximum scale value as well as a cyclic pressure up to ⅔ of the maximum scale value and briefly up to the maximum scale value.

Pressure gauges used in hazardous areas must have a type examination certificate (ATEX). Additionally, they must be grounded, e.g. over the screw fitting.

Checking zero

To check zero while the pressure gauge is in operation, close the shut-off equipment and depressurize the pressure gauge. The pointer must be located within the range marked with 'I' at zero. If the pointer is located outside this range, the measuring element may be distorted permanently. In this case, the pressure gauge needs examining more closely to prevent accidents caused by measuring errors. Replace the pressure gauge and, if necessary, return the gauge to the manufacturer to be repaired.

Checking the reading

To check the reading during operation, isolate the pressure gauge from the process by closing the shut-off equipment fitted with a test connection and apply a test pressure. In this case, the permissible error limits in accordance with EN 837-1 and EN 837-3 apply.

Permissible temperature range

Observe the permissible operating temperatures. The permissible operating temperature range is generally within the range from –40 °C to +60 °C (see EN 837-1 and EN 837-3).

Dry pressure gauges with hard-soldered bourdon tubes can withstand medium temperatures up to +100 °C. Pressure gauges with shield-welded bourdon tubes in CrNi steel housings are even suitable for medium temperatures up to +200 °C.

NOTICE: The temperatures specified are merely based on the temperature range of the materials and soldering or weld seams.

Specifications concerning indication errors due to deviation from the reference temperature must be additionally taken into account!

Maintenance and repair

Pressure gauges are generally maintenance-free. Repairs must be performed by the manufacturer only. Before returning a pressure gauge to the manufacturer, carefully clean all wetted parts, especially when the pressure gauge comes into contact with hazardous substances.

Attach a description of the process medium or a declaration of contamination to the repair order.

Additional electrical equipment

Observe the national and international safety regulations (e.g. VDE 0100 in Germany) on installation, start-up and operation of the pressure gauges.

- Installation and electrical connection must only be performed by trained staff. Pressure gauges with additional electrical equipment have a special nameplate describing the electric wiring. The wiring must be performed correspondingly.
- Observe the electrical load limits. Damage may occur if they are exceeded.

Storage

The storage temperature range is –40 to +60 °C (see EN 837-1 and EN 837-3).

Leave the pressure gauges in their original packaging until they are installed. Store them in a place where they are protected from being damaged by external factors.

Specifications subject to change without notice

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