

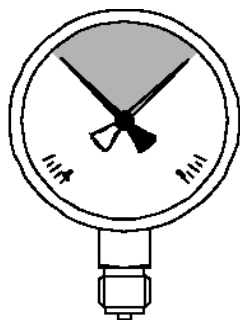
## Selection, Installation, Handling and Operation of Elastic Element Pressure Gauges

### Preface

**Please read the operating instructions prior to using the pressure gauge.**

In each case the user needs to ensure that the proper pressure gauge was selected with regard to reading range and design (resistance of the materials used against the pressure medium, atmosphere and temperature as well as resistance against overpressure, for instance). The optimum selection of the scale is given if the operating pressure is in the middle third of the scale range.

See sketch:



The pressure gauge should be installed such a way as to avoid exposure to heat and vibration and to enable easy observation of the dial indication.

The pressure connections have to be sealed.

It is common practise to install the pressure gauge by means of an isolating device to facilitate replacement while the system is pressurised and to set the gauge inoperative when reading is not required.

### Shut-off Fittings

Depending on the application either shut-off cocks or shut-off valves are being used.

**Shut-off cocks** have three positions:

*Vent* The supply line is shut off and the gauge is connected to the atmosphere.

The zero setting may be checked.

*Operation* The supply line is open, the gauge is pressurised.

*Blow-out* The supply line is open, the pressure medium is allowed to escape into the atmosphere.

The gauge is not working.

**Pressure gauge valves** without or with test connector (DIN 16 270 or 16 271) are equipped with a venting plug between valve body and pressure connection. Release of the venting plug enables controlled venting through the thread. Local safety codes such as for pressure gauge. The test connector of the pressure gauge valve according to DIN 16272 can be closed with an additional shut-off device.

### Mounts for the pressure gauge

If the line to which the gauge is connected is not strong enough to support it without introducing vibrations, then a suitable mount for the pressure gauge should be provided.

### Damping of vibration

If the pressure gauge is exposed to vibration or pulsating pressure or both, then a liquid-filled pressure gauge may provide superior performance and readability.

### Effects of temperature

The operating temperature of the pressure gauge, resulting from the effects of pressure medium, ambient temperature and possibly heat radiation must not exceed the temperature span the pressure is intended for. Suitably shaped tailpipes or siphons with water filling may be used to separate the pressure gauge and its isolation device from hot pressure media.

### Overload protection for pressure elements

Should the measuring media be subject to rapid fluctuations in pressure, or pressure surges have to be taken into account, these must not be allowed to act directly on the pressure element. The pressure surges must be restricted in their effect, for example, by fitting integral restrictor screws (to reduce the cross-section in the canal) or by using adjustable snubber devices.

In cases where it is necessary to select a range less than the maximum pressure which could occur in the system, in order to obtain a high reading resolution, the pressure element must be protected against damage. Some pressure gauges are provided with in-built over pressure safety to high pressures.

If the pressure gauge does not have the capability to withstand high overpressure a separate overpressure protection valve must be fitted. The valve will immediately isolate the system in the event of sudden surges in pressure, or gradually close in the event of slow pressure increases. The setting for the valve be adjusted according to its anticipated usage.

### Pressure tapping points

To ensure correct operation the gauge should be located at a point of undisturbed and continuous flow, and it should be fitted via an isolating device.

### Tail pipes

The tail pipe, that is the connecting line between pressure tapping point and pressure gauge, should be of sufficiently large diameter ( $\geq 6$  mm) to avoid clogging by possibly suspended matter. Horizontal lines of considerable length should be sloped (recommended inclination 1 : 15). With gaseous pressure media the line should feature a draining provision at its lowest point, whereas the line of a liquid medium should feature an air bleeding provision at its highest point. A filter or separator that enables cleaning without being removed should be provided where the pressure medium contains suspended matter. Generally, the **line** should be dimensioned and fastened such as to withstand mechanical vibration or thermal expansion and provide safe operation under normal service conditions.

If a static head of liquid is acting on the gauge, then this causes a zero offset  $\Delta p$ , where  $\Delta p$  is the pressure resulting from specific gravity and height of the liquid head.

$\Delta p$  in bar =  $(\rho_M - \rho_L) \cdot g \cdot \Delta h \cdot 10^{-5}$  (bar) where

$\Delta h$  = Level difference in metres (m)

$\rho_M$  = S.G. of pressure medium in kg/m<sup>3</sup>

$g$  = Gravity acceleration in m/s<sup>2</sup>  
(standard value 9,81 m/s<sup>2</sup>)

$\rho_L$  = S.G. of ambient air in kg/m<sup>3</sup>  
(standard value 1.205 kg/m<sup>3</sup> at 20 °C)

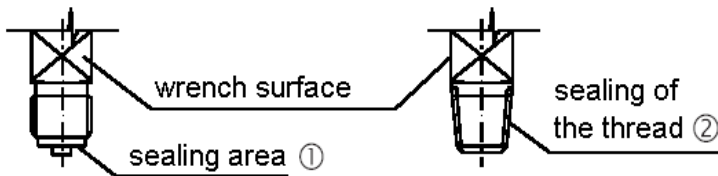
The corresponding indication will be lower by the value of  $\Delta p$ , if the gauge is mounted above, but higher by the value of  $\Delta p$  if the gauge is mounted below the pressure tapping point. Normal gauge position will have the dial facia in its vertical plane. Calibration of the gauge in a position other than vertical will be indicated by a corresponding symbol on the dial.

## Installation and operation

The installation of pressure gauges is to be left to skilled staff. During installation or removal do not apply force to the case of the pressure gauge; instead, use the proper wrench to the wrench flats.

Correct sealing of pressure gauge connections with parallel thread shall be means of a ① suitable sealing ring, sealing washer or WIKA profile seals. The sealing of tapered threads (i.e. NPT threads) is made by providing the thread ② with additional sealing material like, for example, PTFE tape (EN 837-2).

① Parallel and ② tapered thread connection



With standard G-type pipe thread, gauge connection by means of a union nut or a LH-RH adjusting nut is recommended to simplify correct orientation of the gauge.

The tightening or loosening torque applied to the connection should be by means of the spanner flats provided on the stem and should not be by means of grasping the case as this may damage the gauge.

The connecting tail pipe should be thoroughly cleaned prior to fitting of the gauge. For internal pressure compensation, some pressure gauges types are provided with lockup pressure vent with the inscription CLOSE and OPEN. This pressure vent is closed at time of supply (lever in CLOSE position). Prior to inspection and/or after installation and prior to initial operation, the gauges have to be vented (lever in OPEN position).

No pressure higher than indicated by the working pressure symbol  $t$  (final value) must be applied to the gauge during hydrostatic pressure test of the system (EN 837-1 and EN 837-3). Otherwise the gauge must be isolated or removed during this operation.


With regard to diaphragm gauges, care should be taken not to accidentally loosen the bolts that retain upper and lower diaphragm housing.

Do not remove a pressurised gauge. The pressure system must be entirely vented, if the gauge cannot be otherwise isolated.

Process media remaining in the pressure element may be hazardous or toxic. This has to be considered when handling or storing a gauge which has been removed from the process.

### Pressure gauges in service

Always open isolating devices gently, never abruptly, since this may generate sudden pressure surges which, in turn, may damage the gauge. The maximum working pressure for which the pressure gauge is suitable, or also the minimum working pressure in the case of vacuum or compound gauges, is indicated on the dial by corresponding symbols (EN 837-1 and EN 837-3). Fluctuating pressure reduces the maximum working pressure of the gauge. Refer to the respective data sheet of the pressure gauge model.

Correct zeroing may be checked by closing the isolating device and relieving the gauge from pressure. The pointer must fall within the thickened portion of the zero mark .

Unless the gauge temperature is considerably higher or lower than 20°C, a pointer not returning to zero may indicate serious damage of the gauge.

On-site testing of the pressure gauge is feasible by means of special isolating devices enabling connection of a test gauge together with a suitable pressure source.

### Specified Usage

The usable range for static loads is indicated by ▼ on the dial of many pressure gauges (refer to EN 837-1, EN 837-3).

### Temperature

If the temperature of the sensing element, located at the measuring point, deviates from the acceptable operating temperature, a syphon, a remote seal transmitter with capillary tube, or a sufficiently long measuring lead has to be added. Please note that readings of the device temperature will then deviate from +20°C.

### Sensing elements that are highly viscous, crystallising or containing solid matter

It is recommended to use either diaphragm pressure gauges or Bourdon tube pressure gauges with attached remote seal transmitter.

Bourdon tube pressure gauges having a nominal size of 100, 160 or 250 may be subjected to the respective full scale pressure if the load is static. If the pressure load is of a pulsating nature, pressure peaks amounting to only 0.9 of the full scale pressure are permissible, and for the pressure ranges of 0/2500 bar and 0/4000 bar pressures amounting only to 2/3 of the full scale pressure may be applied. Bourdon tube pressure gauges can be overloaded up to 1.3 of their full scale value (instruments 0/2500 bar and 0/4000 bar can only be overloaded up to their full scale value!), Bourdon tube pressure gauges having a nominal size of 40, 50, 60, 63, 80 and 72x72 may only be subjected to pressures up to 3/4 of the full span if the pressure is static and if the pressure is of a pulsating nature the maximum load is restricted to 2/3 of the full scale value, and the full scale pressure may be applied only briefly.

Bourdon tube pressure gauges are used for both fluid and gaseous substances that neither crystallise nor become viscous nor contain solid matter.

Bourdon tubes have a relatively low restoring force. This has to be taken into consideration when using additional accessories like indicating pointers, limit switches or potentiometric transducers since these will affect the readings obtained.

Pressure gauges with a Bourdon tube can normally only be protected in a limited way against overloading by supporting the elastic element at a specific pressure limit. The influence of temperature changes on the indication depends chiefly on the temperature coefficient (TEC = change in stiffness caused by change in temperature) that is specific for the elastic modulus of the Bourdon tube. Depending on the material used, the accuracy error caused by temperatures differing from the reference temperature will amount to between 0.3 % and 0.4 % per 10 K.

### Safety pressure gauge

Pressure gauges utilised within the uniform system of the chemical industry have to meet tough conditions posed by the industry's requirements for gauging pressure in chemical production plants. Using premium materials, for instance stainless steel, for both measuring unit and the gauge's body accomplishes durability against aggressive substances and resistance to environmental influences.

The safety pressure gauge comprises break-proof divider, laminated safety glass, and a blow-out backplate (in accordance with EN 837-1/S3).

Please note that due to the gauge's blow-out backplate the gauge is to be mounted in such a way that, in the event of excess pressure, the backplate will entirely disintegrate from the body. Therefore, sufficient space behind the gauge's backplate is required to ensure safety in the event of disintegration.

### **Chemical Seals**

In the case of aggressive, hot, highly viscous or crystallising pressure media, chemical seals may be used as separating means ahead of Bourdon gauges in order to prevent the ingress of such pressure media into the elastic element. A neutral fluid serves the purpose of transmitting the pressure to the elastic element. The fluid must be selected depending on the measuring range, temperature, viscosity and other influences. Special emphasis must be placed on the compatibility of the fluid with the pressure medium. The connection between the pressure gauge and the chemical seal must not be separated. Potential sources of inaccuracy by installing a chemical seal ahead of the pressure gauge need to be considered.

In the case of **diaphragm pressure gauges with a vertical diaphragm pressures** up to the full scale value may be applied if static, and if the pressure is of a pulsating nature, the limit will be 0.9 of the full scale level. Diaphragm pressure gauges with a horizontal diaphragm can sustain overpressure up to five times their full scale value (custom-built instruments even more), but a pressure of 40 bar must never be exceeded. For this reason the influence of additional accessories is less compared to gauges using Bourdon tubes. Through the annular fixing arrangement for the diaphragm it is less sensitive to vibrations. By supporting means it is possible to protect the diaphragms against severe overloading. By means of coatings or foils in front of the diaphragm, the diaphragm itself may be protected against corrosive pressure media. Diaphragm gauges may be used with advantage also for highly viscous and crystallising pressure media since through extended connection bores, open connection flanges or purge holes optimum cleaning conditions may be provided for.

**Capsule** pressure gauges can also be operated at their specified full scale pressure provided the pressure is static. If the pressure pulsates, the maximum load is only 0.9 times the full scale value. Just like Bourdon tube pressure gauges they are able to sustain overpressure up to a factor of 1.3 (custom-built instruments can handle even higher overpressure). Ten-fold immunity to excess pressure, however, is optional. Capsule pressure gauges are not suited for liquid pressure media. The deviation in the readings in response to temperature changes amounts to between 0.3 % and 0.4 % per 10 K depending on the material used.

### **Maintenance and servicing / Repairs**

Mechanical pressure gauges do not require maintenance or servicing. Tests should be carried out on a regular basis to guarantee the measuring accuracy of the pressure gauge. The tests or re-calibrations have to be carried out by qualified staff and with the appropriate equipment. It is recommended to have a diagnosis performed once a year. Dangerous pressure media such as Oxygen, Acetylene, flammable gases or liquids, toxic gases or liquids as well as for refrigerating plants or compressors requires attention above the standard regulations. The specific safety codes or regulations have to be considered.

The devices may only be repaired by the manufacturer. Do not open or dismantle the device! To ensure accuracy of measurement we recommend having the display checked regularly.

In the unlikely event a device requires repair or maintenance, please contact your supplier or our manufacturing plant and await our written consent.

In succession to our consent, we request you clean the device, package it well, and mail it to our manufacturing plant.

In the event of reassigning or returning a device, the customer is obliged to strictly and precisely obey the current hazardous materials regulations.

Condensation may occur. This is no justification to file a complaint!

**Please do not tamper with or otherwise manipulate the device. Failure to comply will void the warranty!**

## Storage and Handling

The following points should be noted for preventing damage during storage and handling of measuring device/pressure gauges until assembly:

- Permissible storage temperature  $-20...60^{\circ}\text{C}$   
Permissible storage temperature may deviate depending on the model of the measuring device and is noted in the data sheet.
- Measuring device/pressure gauges must be protected from mechanical damage, humidity and dust during transportation and storage. It should remain in the original packaging until being used.
- Avoid vacuum (i.e. transportation by plane) and very quick changes in temperature (measuring device/thermometer in a cold state being introduced to a very hot environment). The glycerin could be sucked out of the housing.
- The packaging may be disposed of as paper. The measuring device/pressure gauges must be packaged adequately to protect it from damage for further transportation.

The standard packaging is only designed for transportation within a parcel service vehicle (cargo compartment with spring suspension, such as a Sprinter) within Germany and not for transportation within a truck or a trailer. The measurement devices are very sensitive and the introduction of vibrations due to transportation by truck should be avoided. Special packaging able to absorb vibrations may be used to provide better protection during transportation. If necessary, the package should be marked with a transportation indicator ("Shockwatch").

If you have special requirements regarding transportation, packaging or storage, please contact us.

## Notes according to Pressure Equipment Directive 97 / 23 / EC

The Pressure gauges are „pressure accessories“ in accordance with article 1, paragraph 2.1.4.

The volume of the pressure bearing measuring systems of BMG pressure gauges is  $< 0.1 \text{ L}$ .

The pressure gauges carry the CE marking for fluid group 1, category I, module A, in accordance with annex 2, table 1 when their permissible working pressure exceeds 200 bar.

Pressure gauges that do not carry the CE marking are manufactured in accordance with article 3, paragraph 3 "sound engineering practice."

## Reference documents in DIN and EN 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 recommendation for pressure gauges

### EN 837-3

Pressure gauges; part 3: Diaphragm and capsule pressure gauges; Dimensions, metrology, requirements and testing

### DIN 16 270

PN 250 and PN 400 valves without test connection for pressure gauges

### DIN 16 271

PN 250 and PN 400 valves with test connection for pressure gauges

### DIN 16 272

PN 250 and PN 400 valves with blocking test connection for pressure gauges

### **Discontinuation of operation**

To discontinue operation, please remove the device entirely from its usage site. Ensure that neither pipe nor container are under pressure. Follow the notes given in **Maintenance and servicing / Repairs**.

### **Disposal**

Please help protect the environment by either properly disposing of or recycling used materials according to your country's legal regulations on waste disposal.

Subject to change without prior notice.