Safety for Industrial Process

USER MANUAL FOR BOURDON TUBE TYPE PRESSURE GAUGE

M* 000

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CE 0045

Notes according to Pressure Equipment Directive 2014/68/EU

* The pressure gauges are "pressure accessories" in accordance with article 1, paragraph 2.1.4.

* The volume of the pressure bearing housings of pressure gauges is < 0.1 L.

* The pressure gauges carry the EU marking for fluid group 1G in accordance with annex 2, table 1 when their permissible working pressure exceeds 200 bar.

Pressure gauges that do not carry the EU marking are manufactured in accordance with article 3, paragraph 3 "Sound Engineering Practice (SEP)".

Reference standards:

EN 837-1	Bourdon tube pressure gauges, Dimensions, metrology, requirements and testing
EN 837-2	Selection and installation recommendations for pressure gauges

1. Safety instructions

The user must ensure that the appropriate pressure gauge with regard to scale range and performance and the appropriate wetted material (corrosion) for the specific measuring conditions of the respective application is selected. In order to guarantee the accuracy and long term stability specified, the corresponding load limits are to be observed. Specifications: see catalogue data sheet

Only qualified persons authorized by the plant manager are permitted to install, maintain and service the pressure gauges.

Dangerous pressure media such as Oxygen, Acetylene, flammable gases or liquids, toxic gases or liquids as well as for refrigeration plants or compressors requires attention above the standard regulations. Here the specific safety codes or regulations must be considered.

After an external fire pressure media can leak out particularly at soft solder joints. All gauges have to be checked and, if necessary, replaced before re commissioning the plant.

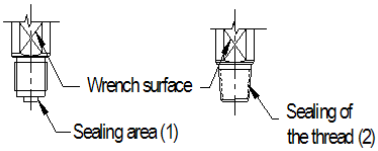
Serious injuries and/or damage can occur should the appropriate regulations not be observed.

Our Gauges are not suitable for the event of external fire.

2. Mechanical connection

According to the general technical regulations for pressure gauges, respectively (i.e. EN 837-2), when screw-fitting the gauges the force required for this must not be applied through the case or terminal box but just through the spanner flats (with suitable tool) provided for this purpose.

Correct sealing of pressure gauge connections with parallel thread (1) shall be means of a suitable sealing ring, sealing washer. 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).



The torque depends on the seal used. 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. When a blow out device is fitted to a pressure gauge, it shall be resistant to blocking by debris and dirt.

With safety pattern gauges (see dial symbol "S") you need to pay attention to the fact that the free space behind the blow-out back will be at least 15 mm.

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2.1. Selection Criteria

Operating pressure range

The instrument Selected should have a full scale pressure range such that the operating pressure occurs in the middle half (between 25% and 75%) of the scale. The full scale Pressure of the gauge should be approximately two times the intended operating pressure. A black triangle symbol on the scale end of the dial indicates that the operating pressure may reach 90% for pulsating pressures and 100% for static pressures.

A424 – The following applications must be considered potentially dangerous and carefully specified:

Application	Paragraph
Systems containing compressed gas	WIL 20
Systems containing oxygen	WIL 21
Systems containing corrosive fluids in a liquid or gaseous state	WIL 22
Systems containing pressurized steam	WIL 23
Systems subject to dynamic or cyclical Pressures	WIL 24, WIL 25
Systems in which overpressures may accidentally be applied or in which low Pressure gauges may be installed on high pressure couplings	WIL 26, WIL 27
Systems which produce mechanical Vibrations	WIL 28, WIL 29, WIL 30, WIL 31,WIL 32

WIL20 - In systems containing compressed gas

it is advisable to select an instrument equipped with an adequate safety device. In the event of unexpected failure of the measuring element, the safety device allows the compressed gas to escape outside the case, thereby preventing the instrument from fracturing.

The safety patterns employed on instruments are designed type on S1 when they consist of a release valve which opens when the pressure inside the sealed case exceeds an established safety limit putting it in communication with the outside, and are designated type S3 when the safety consists of an entire blow out back and there is an added baffle wall separating the measuring element from the clear solid front, providing further protection to the operator. Select an instrument with an adequate level of protection, consulting the following tables (Table 1-2).

Pressurized fluid liquid								
Case filling	None				Liquid filled			
DN	<100		≥ 100		<100		≥ 100	
Range (bar)	<25	>25	<25	>25	<25	>25	<25	>25
Safety code	0	0	0	0	S1	S1	S1	S1
Pressurized fluid gas or steam								
Case filling	None				Liquid filled			
DN	<100		≥100		<100		≥ 100	
Range (bar)	<25	>25	<25	>25	<25	>25	<25	>25
Safety code	0	S2	S1	S3	S1	S2	S1	S3

WIL 21 – Explosive Failure

This occurs as a result of the violent release of thermal energy due to a chemical reaction, such as adiabatic compression of oxygen in the presence of hydrocarbons. It is generally accepted that the effects of this type of failure can not be anticipated. Even the use of solid-front instruments does not exclude against the projection of fragments towards the front of the instrument.

Pressure gauges suitable for use with oxygen are marked ''Oxygen-Use no Oil" and / or with a crossed out oil can symbol on the dial. The instruments are supplied already washed and degreased using appropriate products and packed in polyethylene bags. The user must take the necessary precautions to ensure that the pressure gauge has been unpacked.

WIL 22 – Corrosion Failure

This occurs when the material of the measuring element is weakened through attack by the corrosive chemicals present either in the media inside or the environment around it. Failure may occur as a pinhole leakage or early fatigue failure due to stress cracking brought about by the chemical deterioration of the material. In such a case the use of a fluid separator may influence the sensitivity or accuracy or both. As an alternative to a fluid separator, it is possible to consider choosing a measuring element made from AISI316 or Monel 400, rather than phosphor bronze.
The measuring element is generally characterized by its thinness and therefore works under considerable mechanical stress. Chemical compatibility with the pressure fluid must therefore be taken into account. None of the commonly used materials can be considered immune to chemical attack, and various factors can influence its extent: Concentration, temperature and the type of mixture of the various chemical substances. Chemical attack can rapidly lead to corrosion failure.

WIL 23 – High temperature

Regardless of the material with which the unit has been made or welded (connection to the process, Bourdon tube, and terminal) it is not advisable to use the pressure gauges at temperature exceeding 65°C (150°F).

It is recommended to use a trap in cases where the pressure gauge is used with steam or liquid media at high temperatures. A trap or similar device should always be fitted near the instrument and filled with condensed fluid before pressurizing the system, so as to prevent the hot fluid from reaching the instrument during the initial pressurize.

The fluid should not be allowed to freeze or crystallize inside the measuring element. However, if the instrument is used for measuring points at high temperature, it is recommended to use a hose with inside diameter of at least 6mm to connect it to the pressure coupling. A hose about 1.5-2 meters long reduces the effective operating temperature to approximately ambient level. If the type of fluid does not permit the use of a small section hose, it is often necessary to insert a separator between the process fluid and the instrument, provided that the transmission fluid is suitable for temperature of the process fluid.

WIL 24 - Dynamic or cyclical pressures

These are generally encountered when the instruments are installed on pumps, and result in a significant reduction in the lifeline of the measuring element and the amplifying mechanism of the pressure gauge. Such pressures are generally indicated by broad fluctuations of the pointer. It is necessary to minimize this type of pulsating pressure by fitting a snubber between the source of the pressure and instrument. Filling the case with a damper liquid can also reduce the harmful effect of pulsations on the moving parts of the pressure gauge. Incorrect selection of the instrument may result in fatigue failure.

WIL 25 - Fatigue Failure

This is caused by mechanical stress resulting from the pressure and takes the form of a small crack from the inside to the outside, generally along an edge. Such failures are more dangerous when the measured medium is a compressed gas rather than a liquid. Fatigue failures release the fluid gradually, and therefore the case pressure build-up is indicated by the opening of the relief valve. When measuring high pressures, the process operating is close to the maximum permissible stress limit, and can therefore result in an explosive failure. In this case a choke should be fitted on the instrument's coupling, in order to limit the flow of liquid.

WIL 26 - Overpressure

Any overpressure subjects the measuring elements to stress, with a consequent reduction in its lifespan and accuracy. It is therefore always advisable to choose an instrument whose full scale pressure is greater than the maximum operating pressure so that it is better able to withstand overpressures and pressure surges. Pressure surges can be handled in the same way as pulsating pressures. Over-pressures of longer duration can be handled by installing a pressure reducing valve on the pressure gauge line. The occurrence of even a single overpressure event can result in an overpressure failure.

WIL 27 - Overpressure Failure

This is caused by application of internal pressure greater than the rated limits of the measuring element, and can occur when a low pressure gauge is installed on a high -pressure system. The effects of this type of failure, generally more serious in compressed gas applications, are unpredictable and may result in instrument fragments being projected in all directions. The opening of the safety device on the case does not always guarantee containment of the fragments. It is generally accepted that using an instrument with a solid front and

blow-out back reduces the possibility of fragments being projected toward the front of the instrument, where the operator stops to take readings. The clear front alone does not provide adequate protection, and in fact is the most dangerous component in such a case. Overpressure pulses of short duration (spikes) can occur in pneumatic or hydraulic systems, especially when valves are opened or closed.

The amplitude of such can be many times the operating pressure, and the great speed at which they occur prevents them from being read out on the instrument, making them invisible to the operator. They can result in definitive breakage of the instrument or a permanent zero error. A choke reduces the amplitude of the overpressure spike that reaches the measuring element. The use of pressure limiting valve protects the instrument from all pressures which exceed the calibration limit of the valve, thereby protecting the instrument form overpressures.

WIL 28 – Vibration Failure

The most common mode of vibration failure is that where the movement parts wear because of high cyclic loading caused by vibration resulting in a gradual loss of accuracy and ultimately failure of the pointer to indicate a pressure change.

WIL 29 – Vibration - Induced Fatigue Failure

Large amplitude vibrations may in some instances because fatigue cracks in the structure of the measuring element. In this case the pressure build-up may be slow or fast, or even explosive.

WIL 30 – Vibrations

When the pressure gauge support is subject to vibrations, various solutions may be considered, such as : a) the use of liquid-filled gauges;

b) If the vibration is strong or irregular, the instruments must be mounted at a distance and connected using a flexible hose or tubing. The presence of vibrations is indicated by continuous, often irregular fluctuations of the pointer.

WIL 31 – Liquid filled Cases

Liquid filling is generally used to dampen the vibrations of moving parts due to vibrations and / or pulsations. Great care must be taken in choosing the dampening liquid for instruments that will be used with oxidizing media such as oxygen, chlorine, nitric acid, hydrogen peroxide, etc. In the presence of oxidizing agents, there is possible risk of chemical reaction, ignition and explosion of the instrument. In this case it is necessary to use fluorine or chlorine based filling liquids. In order to contain the damping liquid inside the case, the pressure gauges are built and supplied in a sealed construction. In some cases, during installation it is necessary to ventilate the case following the instructions on the label affixed to the instrument itself. Special care must be taken with the type of filling liquid used and its usage limitations as a function of ambient used & its usage limitations as a function of ambient temp. (Table 3).

Filling liquids	Ambient Temperature
Glycerin (98%)	+15…+65°C (+60…+150°F)
Silicon Oil	-45…+65°C (-50…+150°F)
Fluoridated Liquid	-45…+65°C (-50…+150°F)

WIL 32 – Liquid filled Cases

In case of radial mounting, especially if the case is filled with dampening liquid and the vibrations are extensive, the possibility of failure resulting from considerable vibrating mass of the pressure gauge must be taken into account. In such cases a threaded 1/2" coupling to the process line is an essential minimum requirement.

2.2. Requirement for the installation point

To facilitate removal for maintenance purposes, a shut- off valve can be installed between the pressure gauge and plant. The pressure connection must be watertight. If the pressure connection has a cylindrical thread, the seal is achieved using an O-ring clamped between the two flat sealing surfaces, one on the pressure connection and the other on the instrument's process connection. If the pressure connection has a tapered thread, the seal is achieved by simply screwing the connection onto the coupling, through the mating of the threads. It is common practice to wrap PTFE tape around the male thread before coupling.

In both cases the torque must be applied using two hexagonal spanners, one on the flat faces of the instrument

/ process coupling and the other on the pressure connection. Do not use the case as a means of tightening as this may cause damage to the instrument. When pressurizing the system for the first time, check the tightness of the connection seal. All instruments must be mounted in such a way that the dial is vertical, unless otherwise indicated on the dial itself. When the instrument includes a safety device, this must be at least 20 mm from any other object. For wall or panel mount instruments, make sure that the pipe conveying the pressurized fluid is connected to the instrument coupling without exerting torsion or force.

For this reason, these instruments should not to be used for measuring residual pressures inside large volume containers such as tanks, surge tanks and the like. In fact, such containers may retain pressures that are dangerous for the operator, even when the instrument indicates a zero pressure. It is recommended to install a ventilation device on tanks in order to achieve zero pressure before removing covers or connections, or performing similar tasks.

Ambient Temperature - It is difficult to insulate the instrument from ambient temperatures that are too high or too low. One solution is to position it further away from the source of cold or heat, when this is possible. If an instrument of accuracy class 0.6 or higher is used at an ambient temperature different from the reference value (20°C ± 2°C), It is necessary to make a correction. It is not advisable to successively install instruments on systems with different operating media, to avoid initiating chemical reactions that may cause explosions resulting from contamination of the wetted parts. If the instrument dial indicates a fixed pressure for a prolonged time, make sure this is not due to an obstruction of the pressure element supply pipe. Especially in the case of a zero pressure reading, make sure that there is effectively zero pressure inside the instrument before removing it, by isolating it using the shut-off valve.

EN 837-2 "Selection and installation recommendations for pressure gauges" should be complied with.

3. Admissible ambient and working temperatures

When installing the pressure gauge it has to be ensured that, taking the influence of convection and heat radiation into consideration, no upper or lower deviation from the permissible ambient and medium temperatures can occur. The influence of temperature on the class accuracy is to be observed.

4. Storage

The pressure gauge should remain in its original packing until installation. The gauge should be protected from external damage during storage. Storage temperature: -40 °C …. +70 °C.
Pressure gauges removed from service should be protected from dust and humidity.

5. Maintenance and servicing / repairs

The general safety of an installation often depends on the operating conditions of the instruments which it contains. It is essential that the measurements indicated by these instruments are reliable. Therefore, any instrument which appears to give an abnormal readout if necessary. Maintenance of accuracy should be confirmed by routine checks & must be carried out by competent personnel using suitable testing equipment. Every 3/6 months after installation, check the accuracy and the wear on moving parts and the state of corrosion on the measuring element. For instrument used on plant subject to demanding conditions (vibrations, pulsating pressures, corrosive media, sediments etc) replace them after the time intervals indicated in the plant procedures. The calibration and testing must be compatible with the measured media in the pressurized system.
Fluids containing hydrocarbons must not be used when the measured medium is oxygen or any other oxidizing substance. Instruments kept in their original standard packing (cardboard box) must be stored in a closed area and protected from moisture: in this case no special attention is required. If the instruments are packed in special materials (wooden crates lined with tar paper or barrier bags) it is preferable to store them in a closed room if possible, or in any case in an area protected from the elements; the condition of the packed materials should be checked every 3-4 months, especially if the crates are exposed to the elements. The temperature of the storage area should be between -20 and +65°C, except where otherwise specified on the catalogue data sheets.
Mechanical stress - Pressure gauges must not be subjected to mechanical stress. If the installation points are subject to mechanical stresses, the instrument must be installed at a distance and connected using flexible

hoses. The instruments selected must be of the surface, wall or panel mount type. The characteristics of the instruments may be must affected during transport, despite adequate packing, and must be checked before use. Correct calibration can be checked by excluding the instrument from the process by means of the shut-off valve and checking that the pointer returns to the zero mark unless the temperature varies greatly from 20°C. Failure of the pointer to return to zero indicates serious damage to the instrument.

Remainder of the pressure medium contained in the pressure element may be hazardous or toxic. This should be considered when handling and storing the removed pressure gauge.

6. Trouble shooting

No indication in pressure gauge – Remove pressure gauge from mounting location and check process connection inlet location for any choke or blocking.

7. Do and don't do

DO

1)	Pointer should be at zero position before installation.
2)	Periodically remove pressure gauge and calibrate.

DON'T

WARNING

1)	Do not remove the gauge when the system is in pressurized condition.
2)	Do not use the gauges in any hazardous atmosphere and service.
3)	Do not use the gauges on oxygen or acetylene service unless stated by manufacturer.

CAUTION

1)	Do not tighten by grasping the case of the gauge as this may cause damage.
2)	Do not use in external fire process.

Safety for Industrial Process

« Designed, developed and manufactured in France. »

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