INSTALLATION-USE-MAINTENANCE MANUAL FOR BOURDON TUBE– DIAPHRAGM-CAPSULE PRESSURE GAUGES (Brand: LR-GERMANY)

LR instruments are designed and constructed to comply with the safety requirements prescribed by the international regulations in force.
Under the terms of directive 97/23/EC (P.E.D.), LEITENBERGER pressure gauges are classified into 2 categories. **PS <=200 bar** these instruments do not have to meet the essential safety requirements, but must only be designed and constructed in accordance with "Sound Engineering Practice" and are not required to bear the CE mark.
PS > 200 bar these instruments must comply with the essential safety requirements prescribed by the PED, are classified as Category 1 and certified according to Form A. They must bear the CE mark illustrated below.

CE

The recommendations are excerpts taken from the text of the **EN837-1/2/3** and **ANSI B40.1** standards, which the user must be familiar with in order to safely put the instruments into service.
Safety results from the careful selection and installation of the instrument in the pressurised system, as well as from compliance with the maintenance procedures set out by the manufacturer. The user is entirely responsible for ensuring correct installation and maintenance.
The persons charged with the selection and installation of the instrument must be able to recognise the conditions that may negatively impact on the instrument's ability to perform its function and which may lead to premature failure.
In order to correctly specify the functional and constructive characteristics of the instruments, it is recommended to consult the most up-to-date version of the catalogue data sheets, available on-line at the website **http://www.Leitenberger.com**

SELECTION CRITERIA

A431 – 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	NF20
Systems containing oxygen	A4274
Systems containing hydrogen or fluids diffused with hydrogen	A4274
Systems containing corrosive fluids in a liquid or gaseous state	A4331, A4273
Pressurised systems containing explosive or flammable fluids	A4274
Systems containing pressurised steam	NF21
Systems subject to dynamic or cyclical pressures	E723, A4271
Systems in which overpressures may accidentally be applied or in which low pressure gauges may be installed on high pressure couplings	E724, A4272
Systems in which interchangeable pressure gauges may give rise to dangerous contamination	A4274
Systems containing toxic or radioactive fluids in a liquid or gaseous state	A4274
Systems which produce mechanical vibrations	A4275, A4276, E722, A4362, A3352
Systems with an operating temperature that differs from the ambient temperature	NF25

NF20 – 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 LEITENBERGER instruments are designated type 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 (Tab 1-2):

TAB1

Pressurised 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

Tab 2

Pressurised fluid	GAS OR STEAM							
Case filling	None				Liquid filled			
ND	<100		≥100		<100		≥100	
Range (bar)	≤25	>25	≤25	>25	≤25	>25	≤25	>25
Safety code.	0	S2	S1	S3	S1	S2	S1	S3

E723 - Dynamic or cyclical pressures - These are generally encountered when the instruments are installed on pumps, and result in a significant reduction in the lifetime 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 minimise this type of pulsating pressure by fitting a snubber between the source of the pressure and the 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.

A4271 - 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 pressure 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.

E724 - Overpressure - Any overpressures subject the measuring element 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. Overpressures 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.

A4272 – 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 pulses 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 a pressure-limiting valve protects the instrument from all pressures which exceed the calibration limit of the valve, thereby protecting the instrument form overpressures. -

A4331 - The measuring element is generally characterised 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.

A4273 - 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 made of suitable material must be considered. However the addition of a 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.

A4274 – 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 cannot be anticipated. Even the use of solid-front instruments does not esclude against the projection of fragments toward 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 connection and the elastic element are kept clean after the pressure gauge has been unpacked.

A4275 – 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.

A4276 – Vibration-Induced Fatigue Failure – Large amplitude vibrations may in some instances cause fatigue cracks in the structure of the measuring element. In this case the pressure build-up may be slow or fast, or even explosive. -

E722 - 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 vibrations are 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.

A4362 - 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 damping liquid for instruments that will be used with oxidising media such as oxygen, chlorine, nitric acid, hydrogen peroxide, etc. In the presence of oxidising agents, there is the 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 temperature (Tab.3).

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

A3352 - In case of radial mounting, especially if the case is filled with damping liquid and the vibrations are extensive, the possibility of failure resulting from the 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.

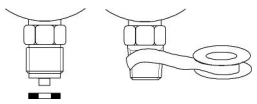
E721 - Mechanical stress - Pressure gauges must not be subjected to mechanical stress. If the installation points are subject to mechanical stresses, the instrument must be installed at a distance and connected using flexible hoses. - The instruments selected must be of the surface, wall or panel mount type.

NF21 - Regardless of the material with which the unit has been made or welded (connection to the process, Bourdon tube, terminal) it is not advisable to use the pressure gauges at temperatures 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 pressurising the system, so as to prevent the hot fluid from reaching the instrument during the initial pressure rise. The fluid should not be allowed to freeze or crystallise 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 6 mm to connect it to the pressure coupling. A hose about 1.5-2 metres 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 the temperature of the process fluid.

NF22 - The characteristics of the instruments may be 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.

INSTALLATION

E71 - To facilitate removal for maintenance purposes, a shut-off valve can be installed between the pressure gauge and the 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 (see Fig2).



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 pressurising 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 pressurised fluid is connected to the instrument coupling without exerting torsion or force.

E727 - Effect of liquid columns - The installer must be aware that, if the instrument is subjected to the load of a liquid column, it must be calibrated to compensate for this effect. In this case, the compensation needs to be indicated on the dial, and should therefore be communicated to LEITENBERGER when placing the order.

E8 – Putting into service - The instrument must always be put into service with care, to avoid pressure surges or sudden changes in temperature. **Shut-off valves must therefore be opened slowly.**

USE

A432 - It is not advisable to use the instruments for measuring pressures near zero, as in that range the accuracy tolerance can represent a significant percentage of the applied pressure. 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.

E7251 - 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.

A44 - 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.

NF45 – 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.

MAINTENANCE

E9 - 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 should be removed, checked and recalibrated if necessary. Maintenance of accuracy should be confirmed by routine checks. Checks and recalibrations must be carried out by competent personnel using suitable testing equipment.

NF40 - 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 instruments 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 -

A4332 - The calibration and testing fluid must be compatible with the measured media in the pressurised system. **Fluids containing hydrocarbons must not be used when the measured medium is oxygen or any other oxidising substance.**

NF41 - 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.

WARNING – Improper use may damage the instrument, resulting in failure and possible injury to persons or damage to the plant. Carefully read the above instructions before using this product