# Installation, Operation & Maintenance of Pressure Gauges

## Recommendations on the selection and installation of Pressure Gauges, regarding (ATEX) 2014/34/EU Equipment Group II for Zones 1, 2, 21, 22.

STEWARTS

### FOREWORD

This manual is an integral part of the supply, please read carefully before using this product.
Keep it in a safe place for reference as may be required.
The user should make it available to local I.O.M. trained personnel.

### 1 – GENERAL

**1.1** The sudden and uncontrolled release of pressure to atmosphere (particularly of gas and steam) represents a potential danger.
**1.2** Fire, explosion, fatigue, corrosion etc. within a pressure system can lead, in some instances, to complete disintegration or melting of the instrument with violent effects.
**1.3** It is the responsibility of both the manufacturer of pressure containing components and the user to protect operators from this danger by ensuring the system is properly designed, constructed from suitable materials and is correctly installed, maintained and operated by technically competent persons.
**1.4** In the UK, these responsibilities are covered by Government legislation, in the European Union the PED and ATEX Directives are applicable, (EU-OSHA is the European Union information agency for occupational safety and health).
(i) **Health and Safety at Work Act**, 1974.
(ii) **Pressure Systems Safety Regulations 2000** (SI 2000 No.128), L122 second Edition 2014.
(iii) **Pressure Equipment (Safety) Regulations 2016** (SI 2016 No.1105), implementing the **Pressure Equipment Directive (PED) 2014/68/EU**.
(iv) **The Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016** (SI 2016 No. 1107) implementing **(ATEX) Directive 2014/34/EU**.
(v) **The Dangerous Substances and Explosive Atmospheres Regulations 2002** (**DSEAR**), L138 second Edition 2013, implementing **(ATEX Workplace Directive) (ATEX 137) Directive 99/92/EC**.
You are advised to be familiar with this legislation and any that apply in countries out with the UK where these products may be used.
**1.5** Pressure Gauges whose failure or being out of calibration could lead to danger must be maintained in good working order and calibration. They must not be isolated from the system (except for repair, replacement or re- calibration).
**1.6** In view of the wide variety of operating conditions where these components may be installed, it is impossible to stipulate an exact period for calibration checks. Depending upon these operating conditions the user will have to determine, in the light of experience, what constitutes a reasonable period between calibration checks. This may vary from daily to several months but we would recommend a maximum period of three months between checks and immediate action taken to replace or remedy any instrument that is damaged or does not meet the accuracy requirements.
**1.7** The accuracy of Pressure Gauges should be checked against a Deadweight Tester or a Master Gauge of known and certified accuracy traceable to National Standards.
**1.8** These notes have been prepared to assist in the selection and installation of Pressure Gauges, to ensure, as far as possible, they give safe and satisfactory service in the purpose for which they are intended. They are based largely on European Standard ***EN 837*** for Pressure Gauges. Reference to this Standard should be made for further information.
**1.9** It is essential the manufacturer be advised of any arduous or non-standard conditions under which these instruments may operate so that the correct product can be offered. In the absence of any information to the contrary, instruments of standard ATEX materials of construction will be supplied.
If any doubt exists, it is imperative the Manufacturer is consulted.

### 2 – PRESSURE GAUGES

**2.1 MATERIALS**
**2.1.1** Wetted parts used in the construction of standard gauges are made from bronze or brass and similar non-ferrous materials. Such gauges are suitable for use on Air, Oil and Water and other non-corrosive fluids.
**2.1.2** For corrosive fluids, alternative materials, e.g. stainless steel, should be specified.
**2.1.3** For special applications, e.g. when the pressure medium may solidify in the tube or may contain solids in suspension, alternative Pressure Gauges such as Diaphragm or Chemical Seal types should be used.
**2.1.4** Environmental conditions should be taken into account when considering suitable material for cases etc. Stainless Steel weatherproof cases are available for corrosive atmospheres and outside installations.
**2.2 SAFETY ON STEAM AND GAS PRESSURE MEASUREMENT**
**2.2.1** For steam and gas applications with pressure ranges above 25 bar, Safety Pattern Type Gauges must be used. (***EN837*** safety designation S3).
**2.2.2** These must incorporate a solid baffle between the dial and the pressure element, a splinter-proof glass window and a blowout release.
**2.2.3** Surface Mounted Gauges with a blowout release at the back must be mounted at least 20mm away from the surface panel by means of distance pieces.
**2.2.4** Pressure Gauges for use on Oxygen applications, Safety Pattern type must be used for all ranges.
They are supplied cleaned and degreased, sealed in polyethylene bags and must be kept free from oil contamination.
Materials in contact with Oxygen must comply with ***EN ISO 9539***.
**2.2.5** Pressure Gauges for use on Acetylene applications, Safety Pattern Type must be used for all ranges.
Acetylene in conjunction with silver or copper containing materials may form an explosive compound and these materials should not be used in this application.
Materials in contact with Acetylene must comply with ***EN ISO 9539***.
**2.2.6** For Steam and Gases, other than oxygen or acetylene, gauges of normal construction may be used for pressure ranges up to 25 bar but a blowout release should be incorporated. (***EN837*** safety designation S1).
**2.2.7** For Gauges with liquid filled cases on gas / steam applications we recommend that where the range exceeds 1.0 bar then a safety pattern type gauge must be used. (***EN837*** safety designation S3).
**2.3 GAUGES FOR USE WITH OXIDIZING AGENTS**
**2.3.1** Do not use Glycerine filled gauges in any application which has present any strong oxidizing agents including (but not limited to) Chlorine, Nitric acid and Hydrogen Peroxide.
**2.4 MAXIMUM WORKING PRESSURE**
**2.4.1** Whilst gauges will withstand a full-scale pressure, it is recommended that the working pressure should not exceed 75% of the scale range for steady pressures, 65% of the scale range for fluctuating pressures and 50% of the scale range for Gaseous fluids.
**2.4.2** Under no circumstances should Pressure Gauges be subject to a constant pressure greater than the dial scale of the instrument unless an Over-Range Gauge Protector is fitted. See 2.9.5 for more information.
**2.4.3 Pressure Equipment Directive** (**PED**) **2014/68/EU** specifies categories for essential safety requirements based on Medium, Pressure and Volume. (see 9.1 table of PED category limits).
**2.4.4 PED 2014/68/EU**; Pressure gauges have an internal volume below the lower limit (0.1 litre) shown in the **PED** charts. (see 9.1.1).
**2.5 PRESSURE READINGS AT BEGINNING OF DIAL SCALE**
**2.5.1** Pressure Gauges should not be used for measuring pressures less than 10% of span or for indicating that a pressure system has been completely evacuated to atmosphere.
**2.5.2** Depending upon the accuracy and range of the gauge (particularly high- pressure instruments) dangerous residual pressure may be present in the system even though the gauge is showing zero or low reading.
**2.5.3** A vent valve must be used to ensure all pressure has been exhausted.
**2.6 VIBRATION, PRESSURE SURGES, PRESSURE PULSES, OVERPRESSURE**
**2.6.1** All these factors can create stress in the pressure responsive element and can lead to rupture, loss of accuracy and premature failure. The manufacturer should be consulted where these conditions are present.
**2.6.2** It should be appreciated that the pressure responsive element in a pressure gauge is subjected to high internal stresses and if any of the above conditions are present, fatigue failure is liable to occur.
**2.6.3** Fatigue failure normally manifests itself as leakage from the Bourdon tube caused by cracks appearing along the edge radius of the tube and / or round the joint where the tube enters the socket. The instrument may also exhibit excessive wear on the bearing surfaces of the movement.
**2.6.4** If an installed gauge fails and exhibits the symptoms described in para.2.6.3. it is almost certain the wrong type of gauge has been used for that particular application and it is essential the Manufacturer be consulted.
**2.6.5** See also paras 2.16.2 to 2.16.4 under Maintenance.
**2.7 THREADS AND JOINTING (INSTALLATION)**
**2.7.1** All pressure connections should be leak tight and should be tested when first applying pressure.
**2.7.2** Recommended maximum pressure for each size of thread and type of material must not be exceeded. (See Standard ***EN 837*** which stipulates the maximum pressures). Please note the stated pressures represent the maximum applied pressure including any overload pressure that may be applied during testing and calibration. If in doubt, consult the manufacturer.
**2.7.3** Care must be taken to ensure mismatch of threads does not occur.
**2.7.4** Mating female connections must have a pressure rating that is compatible with the pressure range of the gauge.
**2.7.5** Gauges with parallel threads must have the seal made on the flat seating using a washer of material compatible with the pressure medium.
**2.7.6** Gauges with tapered threads have the joint made by mating of the threads. It is common practice to apply jointing material to the male thread. This must be compatible with the pressure medium and applied in the correct quantity to ensure non-interference with the mating of the threads.
**2.7.7** The joint must be made by tightening the gauge by means of a spanner on the hexagon or square provided on the screwed socket. Do not tighten by grasping the case of the instrument as this can lead to pointer shift and loss of calibration accuracy. When tightening the pressure connection of a gauge mounted by means of a front flange, the tightening torque applied to the connection must be opposed by a second spanner applied to the spanner flats on the socket of the gauge.
**2.7.8** NPT and other tapered thread forms when manufactured to the standard specification may not be adequate to offer sufficient thread engagement for safe use under pressure.
Our tighter tolerance threads ensure sufficient thread engagement.
Please consult our Datasheet Ref.QA125.20B for further information.
**2.7.9** The instrument connecting thread, correctly installed, will form an Ohmic contact with the mating process connection, ensuring electrical continuity. (Also, for clamp or bolting of a flange connection).
**2.8 OPERATING TEMPERATURE**
**2.8.1** Ambient and fluid temperatures acting upon the gauge should be within the range -20°C to +60°C, as specified in ***EN837***.
(ATEX class T6, 85°Cmax)
**2.8.2** Temperature error as specified in ***EN837*** is defined as ±0.4% accuracy for every 10°C above or below 20°C reference temperature.
**2.8.3** The maximum surface temperature of an instrument assembly, **not due to mechanical working**, can be equal to the process temperature. If a Syphon or Chemical Seal unit is fitted to protect the gauge, this can be up to 200°C at the point of the process connection. (see 9.2 table of ATEX Pressure Gauge temperature limits).
**2.8.4** To protect the gauge from a fluid that is too hot, a syphon or similar device must be installed close to the gauge to provide a condensate fluid in the pressure responsive element. The syphon must be filled previously with the condensate before the system is pressurized. (also see 2.11).
**2.8.5** The fluid in the pressure responsive element must not be allowed to freeze or crystallise as this will lead to a rupture of the element. (see 2.11).
**2.8.6** The housing must be ventilated, if label indicates, after installation.
**2.9 GAUGE COCKS, NEEDLE VALVES, MANIFOLDS & OVER-RANGE GAUGE PROTECTORS (OPERATION)**
**2.9.1** In order to safely remove the gauge for checking or any other purpose, a gauge cock, needle valve or a similar device must be fitted.
**2.9.2** These cocks or valves must be opened or closed slowly to avoid sudden changes of pressure in the gauge.
**2.9.3** Care should be taken to ensure residual pressure is vented before removing the gauge from the system.
**2.9.4** Procedures should be established to ensure the cocks and valves are secured in the open position during normal operation.
**2.9.5** If an Over-range Gauge Protector is fitted to a gauge, it must be remembered that when the Protector becomes operational the pressure reading on the dial will be the cut-off pressure and the gauge at that point is isolated from the system and is not functioning. It is possible therefore; a much higher pressure may be present in the system than may be apparent from taking a gauge reading. The safety implications of this should be taken into consideration when designing the system. We recommend the fitting of an additional instrument that will indicate the actual full system pressure.
**2.9.6** Over-range Gauge Protectors should only be used to protect the calibration of the instrument and must not be used as "Safety Accessories" as described in the **Pressure Equipment (Safety) Regulations 2016** (SI 2016 No.1105) implementing the **Pressure Equipment Directive (PED) 2014/68/EU**.
**2.10 DIFFERENTIAL GAUGES**
**2.10.1** The Differential Pressure range and the maximum static pressure shown on the dial must not be exceeded.
**2.10.2** Equalising valves must be incorporated to protect these instruments.
**2.10.3** Care must be taken to ensure pipework is connected to the appropriate connection on the gauge. The connections will be denoted as high or low (signified by + or -).
**2.11 CHEMICAL SEAL GAUGES**
**2.11.1** The filling of a chemical-seal gauge and chamber should be carried out by the manufacturer and the two component parts must never be uncoupled.
**2.11.2** No attempt should ever be made to obtain pointer movement or check the gauge by pushing the pressure responsive diaphragm by means of finger or implement. This will certainly damage the diaphragm and invalidate the warranty.
**2.12 HEAD ALLOWANCE (LIQUID COLUMN)**
**2.12.1** Where the gauge is used on a liquid and is mounted substantially above or below the pressure point, a head allowance may be necessary.
**2.12.2** The manufacturer should be advised if any static head of liquid is acting on the gauge and an allowance will be made for this during calibration.
**2.13 MOUNTING**
**2.13.1** All gauges should be mounted in a vertical position unless otherwise agreed with the manufacturer.
**2.14 STORAGE**
**2.14.1** Gauges should be stored in dry, clean conditions within the temperature range of -40°C to +70°C. Because of a possible build-up of internal pressure, liquid filled cases must be stored in the upright position and at temperatures not exceeding +50°C.
**2.14.2** They must be protected against any impact damage. This could affect the calibration or correct operation of the instrument without visible damage. Pressure Gauge calibration should always be confirmed prior to installation.
**2.15 TRANSPORT**
**2.15.1** Although care is taken in packing these instruments for shipment, it is possible they can sustain transit damage.
**2.15.2** They should be checked for damage before use. (see also 2.14.2)
**2.16 MAINTENANCE**
**2.16.1** The function of the gauge does not require any special maintenance procedures, but frequent checks must be made to ensure the instrument is still working correctly and accurately. Check any blowout device has not been accidentally obstructed. Check for visual signs of damage to the instrument. (Broken Window, Missing Blow-out Plug or Blow-out Backplate reduce the ***IP*** rating of gauge).
The instrument should be replaced if found not to be functional as specified. A good maintenance program will ensure safe operation.
**2.16.2** Rupture of the pressure responsive element is often (but not always) preceded by signs that the gauge is entering a phase where there are increased risks of rupture.
**2.16.3** This may take the form of pressure readings becoming increasingly higher or lower than the value of the pressure being measured.
**2.16.4** Any shift in pressure readings greater than twice the tolerance of the instrument must be investigated and the immediate replacement of the gauge if it is faulty.
**2.17 REPAIRS AND SPARE PARTS**
**2.17.1** The repair and recalibration of gauges should be undertaken only by competent personnel who have at their disposal the necessary facilities.
**2.17.2** We do not recommend the carrying of spare parts but advise the carrying of complete instruments which will allow quick replacement and ensure the system continues to operate within the requirements of the law.
**2.17.3** Where the cost is justified, gauges should be returned to the manufacturer for any remedial work. Certified clean for safe handling.



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### 3 – CONSTRUCTION

**3.1 STANDARDS**

**3.1.1** Pressure Gauges are designed and constructed to comply with the requirements of international standards and legislative safety requirements. Full understanding of all obligations and compliance to these, are necessary for correctly specifying, installing, commissioning, operating and maintenance.

**3.1.2** Pressure gauges are manufactured in accordance with international standards such as, ***EN837*** and ***ASME B40.100***, and also to corporate global standards, which reference these, to facilitate ease of selection and use.

**3.1.3** Pressure Gauges must comply with legislation and directives in force in the UK, in Europe and elsewhere, as indicated in section 1.4.

**3.2. OPERATION PRINCIPLE**

**3.2.1** An elastic measuring element, Bourdon Tube, Diaphragm or Capsule, is subjected to a pressure and deflects. The linear deflection is proportional to the applied pressure and is transmitted, via link, to a rotary geared movement. The movement carries the pointer which indicates the pressure on a circular dial scale ≤270°, printed with graduations of appropriate pressure units.

**3.2.2** A Pressure Gauge has "**no source of ignition**" when not in use or when under normal operating conditions, but when operating in adverse conditions may "**during foreseeable malfunction**" develop an ignition hazard. Additional accessories or features can be specified to prevent these potential hazards.

**3.3 AMBIENT TEMPERATURE**

**3.3.1** Pressure Gauges are designed to operate in ambient temperatures of -20 to +60°C.

The instrument head and capillary (if fitted) should be protected from localised heat or cold sources as this can lead to indicating errors.

**3.3.2** In regions with high solar radiation or high external heat source, Gauges should be installed with protection to prevent high surface temperature.

**3.3.3** In regions with low ambient temperature, liquid filling is recommended to safeguard instrument from effects of frost on internal mechanism or window. Gauges may also be installed within an insulated, heated, (***IP6x***) enclosure.

**3.4 FEATURES**

**3.4.1** Pressure Gauges for ATEX have housings manufactured from Stainless Steel Case & Bezel (***IP6x***) or Aluminium Case & Brass Bezel (***IP5x***). The window is Laminated Safety Glass. Sealing gaskets and filler plug are Nitrile. Restrictor screw fitted, minimises fluctuating indicator from pulsating pressure. Safety features specified in ***EN 837***, S1 blow-out device, S3 blow-out back & solid wall baffle between pressure element and front of housing to protect operator from debris in event of (rare malfunction) pressure element rupturing.

ATEX hazard assessment based on ***EN ISO 80079-36*** and ***80079-37***.

**3.4.2** Materials of construction in accordance with **PED 2014/68/EU**.

### 4 – OPERATING PARAMETERS

**4.1 SPECIFICATION**

**4.1.1** Wetted materials must be compatible with process medium conditions.

**4.1.2** Pressure and temperature also have direct bearing on the correct material to be used and must be considered when specifying.

**4.1.3** The gauge housing must be compatible with local ambient conditions.

**4.1.4** The correct pressure units must be represented on the dial scale.

**4.1.5** If in any doubt, consult the manufacturer.

**4.2 TEMPERATURE LIMITS**

**4.2.1** See Pressure Gauges Para.2.8 for limitations on use.

**4.3 THREADS AND JOINTING**

**4.3.1** See Pressure Gauges Para.2.7 where same recommendations apply.

**4.3.2** Particular care must be taken to ensure the gauge has the correct pressure rating for the application.

**4.4 ADDITIONAL FEATURES**

**4.4.1** Gauges are available with enhanced features or accessories to minimise the hazards from known adverse process operating conditions.

**4.4.2** Pressure Pulsation; features include, restrictor in socket, Snubbagauge®, and liquid filled housing, to reduce movement wear and pointer fluctuation.

**4.4.3** System Vibration; Vibragauge® movement dampens pointer fluctuation. Remote mounting the instrument via capillary will avoid mechanical stresses.

**4.4.4** Hot Media; Syphon reduces process medium temperature to gauge inlet.

**4.4.5** Corrosive, Hot or Viscous Media; Chemical Seal unit protects gauge by providing a chemically compatible and thermal barrier to process mediums.

**4.4.6** Overpressure; Refer to specific pressure gauge datasheets for in-built overrange rating. Externally adjustable Overrange Protector can be supplied.

### 5 – GAUGES WITH ELECTRIC CONTACTS

**5.1** Recommendations and instructions contained in paras 2 and 3 also apply to these instruments, except window is Perspex and dial size is Ø100mm.

We recommend these are built-in housing type (***IP6x***) with liquid filling.

**5.1.1** Instructions regarding setting of contacts and wiring which accompany the instruments must be adhered to strictly.

**5.1.2** Ensure the correct voltage and current are supplied.

**5.1.3** All wiring should be either clipped to a solid surface or run in conduit piping. Avoid running close to a heat source or naked flame.

**5.1.4** Different types of contacts are available to meet ATEX requirements, intrinsically safe or pneumatic contacts.

If in doubt, contact the manufacturer.

**5.1.5** Where there is danger of explosion, intrinsically safe contacts, relay and cabling must be used. (Refer to Wiebrock and Pepperl+Fuchs datasheets).

**5.1.6** Inductive contact switches to ***IEC 60947-5-6*** (NAMUR) with slot type proximity sensors certified to **2014/34/EU** (ATEX) and **2014/30/EU** (EMC).

**5.1.7** We recommend a relay should be used in all applications, as this will give a more efficient and safer installation.

Switch amplifier WE 77/Ex. Types, certified to **2014/34/EU** (ATEX), **2014/30/EU** (EMC) and **2014/35/EU** (LV).

**5.1.8** Instruments supplied with electric contacts must not be used as "Safety Accessories" as described in the **Pressure Equipment (Safety) Regulations 2016** (SI 2016 No.1105) implementing the **Pressure Equipment Directive** (**PED**) **2014/68/EU**, unless the design has been subject to third party approval.

For further information contact the manufacturer.

**5.2 MAINTENANCE**

**5.2.1** Always disconnect power supply before carrying out maintenance work.

**5.2.2** Drain housing fill fluid prior to and re-fill after maintenance.

**5.2.3** Check all electrical wiring and joints for any wear or damage.

**5.2.4** Refer to contacts' label or diagram attached to the instrument.

### 6 – POTENTIAL MALFUNCTIONS

**6.1 FAILURE MODES**

**6.1.1** Fatigue Failure.

**6.1.1.1** Caused by pressure-induced mechanical stress, causing the element to develop cracks that propagate along highly stressed areas of the element.

**6.1.1.2** Fatigue cracks usually release the medium slowly. Housing blow-out device will eject to relieve slow build-up pressure to surrounding environment.

**6.1.1.3** This failure mode is more critical with a high-pressure gas medium and can result in explosive failure of the pressure element. Fitting a restrictor in the gauge inlet connection will reduce the effect of pressure surges and fluid flow.

**6.1.2** Overpressure Failure.

**6.1.2.1** Caused by the application of pressure greater than the rated limit of the elastic element. More critical in compressed gas than liquid-filled systems.

**6.1.2.2** Safety pattern design provides the most protection to an operator by reducing the possibility of forward projectiles in the event of this failure mode.

**6.1.2.3** Short duration pressure pulses can occur in systems when valves open or close and their magnitude may be many times the normal operating pressure causing immediate elastic element failure or incorrect indication of pressure on the dial scale. Fitting a restrictor in the gauge inlet connection may reduce the magnitude of pressure transmitted to the elastic element or also consider Snubbagauge®.

**6.1.2.4** Fitting an adjustable Overrange Protector prior to the gauge, set to limit the inlet pressure to just above the full-scale range of the gauge, will protect the gauge from overpressure failure. Overpressure must be advised.

**6.1.3** Corrosion Failure.

**6.1.3.1** Caused when corrosive chemicals in the medium or environment, attack and weaken the elastic element. Initial failure may occur as pinhole leakage or fatigue failure due to stress cracking, by chemical deterioration of the material. A diaphragm (chemical) seal constructed with materials compatible with the corrosive media will protect the elastic element from chemical deterioration.

**6.1.4** Explosive Failure.

**6.1.4.1** Caused by a sudden release of explosive energy generated by a chemical reaction, such as adiabatic compression of oxygen in the presence of hydrocarbons. The magnitude or effects of this type of failure cannot be predicted and even the solid-front or baffle-wall safety pattern S3 type case may not prevent projection of fragments towards the front of the instrument.

**6.1.4.2** Care should be taken not to contaminate connections on instruments marked "Oxygen", "Use no oil", after unpacking, before and during installation.

**6.1.5** Vibration Failure.

**6.1.5.1** The most common mode of vibration failure is wear of movement parts due to high cyclic loading caused by vibration, which results in gradual loss of accuracy and ultimately failure of the pointer to indicate any pressure change.

**6.1.5.2** Vibration can be subdued by Vibragauge® feature or Liquid Filled case option.

**6.1.6** Vibration-Induced Fatigue Failure.

**6.1.6.1** Large amplitude vibrations may in some instances result in high loading of the pressure element which could cause fatigue cracks in the element or welded or soldered joints. (see also 2.6).

Resulting pressure build-up inside the case may be slow or fast, but could also be explosive.

**6.1.7** Clogging of internal pressure passages.

**6.1.7.1** Clogging can occur when process media contains particulate matter or is highly viscous, resulting in failure of the pointer to indicate pressure change.

A diaphragm seal with a wide bore should be considered for these conditions.

**6.2 OPERATING FAULTS**

**6.2.1** No Pressure Indicated. (Pointer on zero).

**6.2.1.1** Can be caused by, closed valve, leaking element or inlet connection.

*Operator; check isolate valve is open and no pressure leaks are evident. Remove gauge for further inspection if cause is not identified.*

**6.2.2** Safety Device Activated.

**6.2.2.1** Blow-out Plug or Blow-out Backplate are dislodged from the case. (Missing Blow-out Plug or Backplate reduce ***IP*** rating of gauge).

**6.2.1.2** Can be caused by, leaking element or a build-up of internal pressure within the case due to ambient or process temperature rise.

*Operator; check for pressure leaks, close isolate valve and remove gauge for further inspection or re-fitting of Blow-out Plug or Backplate.*

**6.3.1** Over-Pressure Indicated. (Pointer outside graduated scale).

**6.3.1.1** Can be caused by permanent excess pressure or temporary surge of higher-pressure causing pointer-shift. (see also 6.1.2).

*Operator; close isolate valve and remove gauge for calibration check.*

**6.4.1** Pressure Indication error. (Pointer outwith accuracy class)

**6.4.1.1** Calibration has been affected by an unidentified malfunction.

*Operator; close isolate valve and remove gauge for calibration check.*

**6.5.1** Rapid Pointer Oscillation.

**6.5.1.1** Instrument is being subjected to harmful system pulsation or vibration. Possible incorrect gauge specification, requires features to subdue oscillation. Liquid filled case, Restrictor in socket, Snubbagauge® or Vibragauge®, (see 2.6).

### 7 – INSTALLATION

**7.1** Pressure Gauges must be installed in accordance with European Standard EN837-2, connections must be made pressure tight.

**7.1.1** Mounting must not create mechanical stress at the process connection, remote flange mount the gauge via flexible hose or tubing.

**7.1.2** Do not hold the gauge housing to install, use spanners on flats provided on the gauge process connection and system connection.

**7.1.3** Fit an Isolate valve prior to the gauge to facilitate maintenance.

**7.1.4** System features should be employed to reduce the effects of Gaseous media, Adiabatic Compression can cause rapid pressure or temperature changes affecting calibration and surface temperatures.

**7.1.5** Protect the gauge from high process or ambient temperatures. Fit a Syphon, Chemi-Seal or impulse tubing to reduce temperature, use an enclosure or sunshade to reduce ambient temperature effect.

### 8 – MAINTENANCE

**8.1** A planned maintenance program should be in place and operated by trained personnel. Scheduled maintenance should be conducted to ensure no damage has occurred during operation and that the window, gaskets and safety blow-out plug or back-plate are intact.

**8.1.1** Do not allow dust to deposit on the gauge thicker than 5mm, the gauge should be cleaned using a cloth with water and soap solution.

### 9 – CE MARKED EQUIPMENT

**9.1** Where design and materials of construction allow, Pressure Gauges supplied with a CE mark have been designed and tested for use on applications up to and including Category III as described within the **Pressure Equipment (Safety) Regulations 2016** (SI 2016 No.1105) implementing the **Pressure Equipment Directive** (**PED**) **2014/68/EU**. It is extremely important that we are advised of any changes, which you envisage or have made which would result in the product being elevated to a higher category.

If in any doubt the manufacturer should be consulted.

**9.1.1 PED 2014/68/EU**; A vessel with a volume ≤ 0.1 litre, refer to PED Guidelines A-05 and A-06 relating to Pressure Gauges.

PED category limits for Pressure Gauges shown in the table below.

| Range (Bar) | Medium | Group | Category | Available | CE mark |
|---|---|---|---|---|---|
| PS > 1000 | GAS | 1 | **IV** | **NO** | ----- |
| 1000 ≥ PS > 200 | GAS | 1 | III | YES | YES |
| 200 ≥ PS | GAS | 1 | SEP | YES | NO |
| PS > 3000 | GAS | 2 | **IV** | **NO** | ----- |
| 3000 ≥ PS > 1000 | GAS | 2 | III | YES | YES |
| 1000 ≥ PS | GAS | 2 | SEP | YES | NO |
| PS > 500 | LIQUID | 1 | II | YES | YES |
| 500 ≥ PS | LIQUID | 1 | SEP | YES | NO |
| PS > 1000 | LIQUID | 2 | I | YES | YES |
| 1000 ≥ PS | LIQUID | 2 | SEP | YES | NO |

Stewarts do not offer Category IV instruments to **PED 2014/68/EU**.

**9.2** Pressure Gauges supplied with a CE mark in accordance with essential Health & Safety requirements of **(ATEX) Directive 2014/34/EU** for Equipment Group II, Categories 2G, 3G, 2D & 3D, suitable for use in Zones 1, 2, 21 & 22. *Not suitable for Zone 0 or 20.*

Process fluid entering **ATEX** Pressure Gauge to be within limits below.

<table>
<tr><th rowspan="2">Class</th><th rowspan="2">T max [°C]</th><th colspan="3">(EN IEC 60529) Instrument Case [°C]</th></tr>
<tr><th>(IP5x) Dry</th><th>(IP6x) Dry</th><th>(IP6x) Filled</th></tr>
<tr><td>T6</td><td>85</td><td>70</td><td>70</td><td rowspan="6">60</td></tr>
<tr><td>T5</td><td>100</td><td>85</td><td>85</td></tr>
<tr><td>T4</td><td>135</td><td rowspan="4">100</td><td>120</td></tr>
<tr><td>T3</td><td>200</td><td rowspan="3">150</td></tr>
<tr><td>T2</td><td>300</td></tr>
<tr><td>T1</td><td>450</td></tr>
<tr><td colspan="2">Marking to ATEX</td><td>CE Ex II 2G</td><td colspan="2">CE Ex II 2GD</td></tr>
<tr><td colspan="2">Marking to IECEx (Gas)</td><td>Ex h IIC Tx Gb X</td><td colspan="2">Ex h IIC Tx Gb X</td></tr>
<tr><td colspan="2">Marking to IECEx (Dust)</td><td>-----</td><td colspan="2">Ex h IIIC Tx Db X</td></tr>
</table>

**9.3** Pressure Gauges may be CE marked for (**ATEX**) **Directive 2014/34/EU** only, but may also come under category **S.E.P** (Sound Engineering Practice) as described within Part 1 Paragraph 8 of the **Pressure Equipment (Safety) Regulations 2016** (SI 2016 No.1105) implementing the **Pressure Equipment Directive** (**PED**) **2014/68/EU.** Refer to labelling affixed to each Instrument.

**WARNING: Misuse or misapplication of these products is potentially dangerous and could lead to personal injury. Do not use without first reading and understanding the Installation and Operation Instructions contained within. If in any doubt consult the manufacturer.**





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