

COMPACT DIFF. PRESSURE SWITCHES SERIES DC & DE

WEATHERPROOF AND INTRINSICALLY SAFE: SERIES DC		FLAMEPROOF: SERIES DE	
A High pressure connection B Low pressure connection C Cable entry	WEIGHT 5,4 kg dimensions in mm	A High pressure connection B Low pressure connection C Cable entry	WEIGHT 5,4 kg dimensions in mm
For surface mounting use four screws M6 .			

NOTE: dimensions and weights are not binding unless released on certified drawings.

CAUTION

- Before installing, using or carrying out maintenance on the instrument it is necessary to **read** and **understand** the indications given in the attached Instruction Manual.
- The instrument must only be installed and maintained by **qualified personnel**.
- INSTALLATION IS TO BE CARRIED OUT ONLY AFTER CHECKING THAT INSTRUMENT CHARACTERISTICS ARE CONSISTENT WITH PROCESS AND PLANT REQUIREMENTS**
- The functional **features** of the instrument and its degree of protection are shown on the identification plate fixed to the case.



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RELATED DOCUMENT

To authenticated document with certificate
 N° IECEx PRE 16.0071X
 N° IECEx PRE 16.0074X



SAFETY INSTRUCTIONS FOR USE IN HAZARDOUS ATMOSPHERES.



RECOMMENDATIONS FOR PRESSURE SWITCH SAFE USE.

All data, statements and recommendations supplied with this manual are based on information believed by us to be reliable. As the conditions of effective use are beyond our control, our products are sold under the condition that the user himself evaluates such conditions before following our recommendations for the purpose or use foreseen by him.

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1. GENERAL NOTES

1.1 FOREWORD

The wrong choice of a series or a model, as well as the incorrect installation, lead to malfunction and reduce instrument life. Failure to follow the indications given in this manual can cause damage to the instrument, the environment and persons.

1.2 ALLOWED OVERRANGE

Differential pressure exceeding the working range can be **occasionally** tolerated provided they remain within the limits stated in the instrument features (vacuum or proof pressure). **Continuous** differential pressure exceeding the working range can be applied to the instrument, provided they are clearly stated in the instrument features. The current and voltage values stated in the technical specifications and ratings must **not** be exceeded. Transitory over-ranges can have a destructive effect on the switch.

1.3 MECHANICAL VIBRATIONS

Can generally lead to the wearing of some parts of the instrument or cause false actuation. It is therefore recommended that the instrument be installed in a place where there are no vibrations. In cases where this is impossible it is advisable to take measures to lessen the effects (elastic supports, installation with the pin of the microswitch positioned at right angles to the vibration plane, etc.).

1.4 TEMPERATURE

Due to the temperature of both the environment and the process fluid, the temperature of the instrument could exceed the allowed limits (normally from -20° to +85°C). Therefore, in case it does, suitable measures (protection against heat radiation, fluid separators, cooling coils, heated lockers) must be taken. The process fluid or its impurities must not in any case solidify inside the instrument chambers.

2. OPERATING PRINCIPLE

The differential pressure, acting on the sensitive diaphragm element, determines its elastic deformation which is used to actuate **one or two simultaneous release electric microswitches**. The microswitches are of the snap acting type with automatic reset. When the pressure moves away from the set values, returning towards the normal values, the switch is reset.

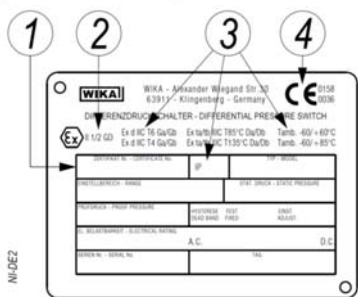
3. MODEL CODE

See Annex 1

4. IDENTIFICATION PLATE AND MARKINGS

The instrument is fitted with a metal plate bearing all its functional characteristics and in case of flameproof or intrinsic safety execution also the markings prescribed by standard IEC/EN-60079-0. Fig. 1 shows the plate mounted on flameproof instruments.

Fig. 1 - Flameproof instruments plate



- 1 Notified body that issued the type certificate and number of said certificate.
- 2 CE marking and identification number of the notified body responsible for production surveillance.
- 3 Apparatus classification according to ATEX 2014/34/EU directive.
- 4 Type of protection and ambient temperature limits of operation.

The following table gives the relationship between hazardous areas, Atex Categories and Equipment Protection Level (EPL) listed on the flameproof instrument nameplate.

Hazardous area		Categories according to 2014/34/EU Directive (ATEX)	EPL
Gas, vapours, fog	Zone 0	1G	Ga
Gas, vapours, fog	Zone 1	2G or 1G	Gb or Ga
Gas, vapours, fog	Zone 2	3G, 2G or 1G	Gc, Gb or Ga
Dust	Zone 20	1D	Da
Dust	Zone 21	2D or 1D	Db or Da
Dust	Zone 22	3D, 2D or 1D	Dc, Db or Da

5. SET POINT REGULATION

Adjustment is made by turning a screw that makes the switch/switches activate when the pressure (increasing or decreasing) reaches the desired value (set point). The instrument is usually supplied with the switches set at the setting range value nearest to zero (**factory calibration**). The instrument is supplied with an adhesive rating plate showing the set point calibration value. With **factory calibration** the values are not indicated on the ratings as these are temporary and will be modified with the definitive values. Prior to installation the instrument must be **calibrated** and the definitive calibration values written on the adhesive rating plate using a suitable indelible ink pen.

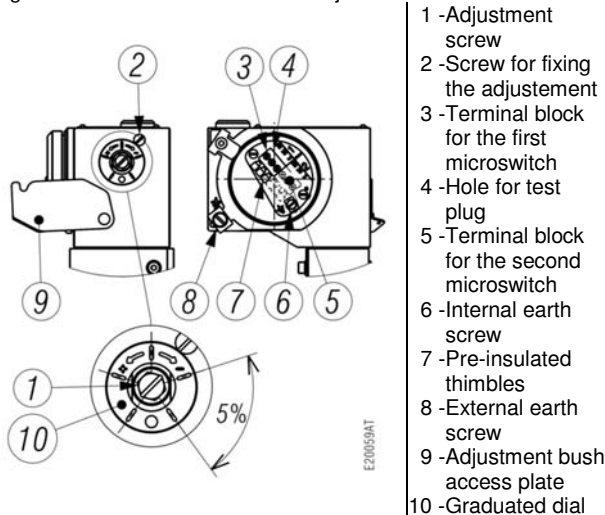
If the instrument has been ordered with a **specific calibration**, it is a good rule to check the calibration values marked on the relevant adhesive label, prior to installation.



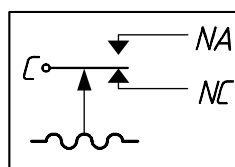
The adjustment screw (fig.2), which acts on the switch, is part of the transmission system for shifting the sensor element. The adjustment must therefore be made very carefully. To facilitate the calibration operation (§ 5.2), its seat is provided with a graduated scale; each increment of this scale equals approximately 5% of the full range of the differential pressure switch. Therefore, using the slot on the top of the adjustment screw as a reference, the screw can be turned to obtain a certain value.

The effect that the direction of rotation of the adjustment screws has is described on the adhesive plate.

Fig.2 - Electrical connections and adjustment screws



Condition of the contacts at atmosphere pressure



Designation of the contacts:
 C – Common
 NA – Normally open
 NC – Normally closed

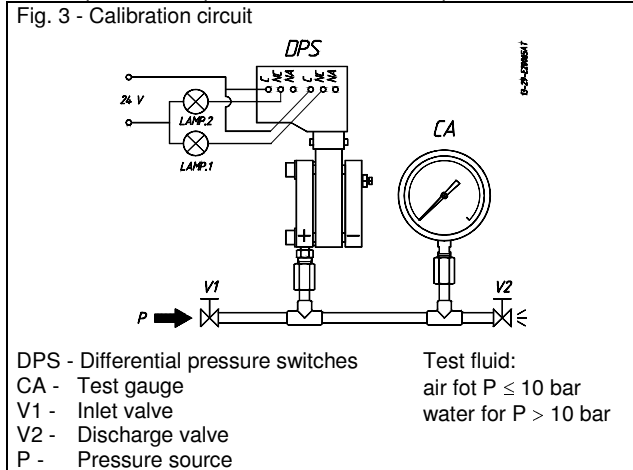
6. SET POINT CALIBRATION

In order to proceed with the calibration and the periodical functional verification of the instrument a suitable **calibration circuit** (fig.4) and an adequate pressure source is required.



Warning: Instrument models DCC e DEC. These instruments are designed to measure cleaned gas or not condensing vapours inside the instrument. The calibration of set point have to be done using air or gas.

The test instrument should have a measurement range approximately equal to or slightly wider than the differential pressure switch range and should have an accuracy consistent with the precision required to calibrate the set point.

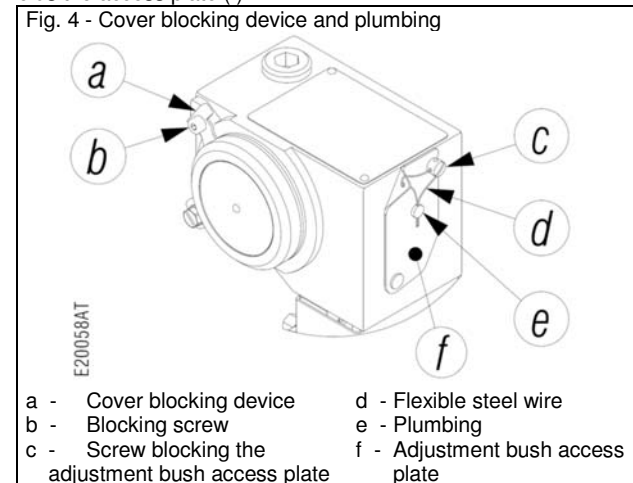


6.1 PRELIMINARY OPERATIONS



WARNING: Instrument series DE, flameproof.
Before open the cover or the cable gland check the absence of explosive atmosphere and check that the instrument is **not energized**.

With reference to fig.4 unscrew the screw (b) until the blocking device (a) can be turned 180°; then unscrew the cover. Clear the access to the adjustment bush by loosening the screw (c) which holds the access plate (f).



6.2 CALIBRATION CIRCUIT AND OPERATIONS

Prepare the control circuit as indicated in Fig. 3 by **connecting** the + (or H) port to the pressure source and leaving the - (or L) port open to the atmosphere.

The warning lamps should be connected to the contacts in the NA or NC (NA = Normally Open NC = Normally Closed) position according to the required contact action.

If the instrument is equipped with two microswitches, take into account that they actuate simultaneously within rated tolerances.

The warning lamps can either be connected by means of a thimble with a maximum diameter of 2.5 mm or by means of a test plug with a diameter of 2 mm to be inserted in the appropriate holes situated frontally beside the terminal screw (see fig.2).

Connection of C and NO terminals

• If the circuit is open at the working pressure, the switch **closes** the circuit as the pressure **increases** when the desired values is reached (**MAKE on Raise**).

• If the circuit is closed at the working pressure, the switch **opens** the circuit as the pressure **decreases** when the desired value is reached (**BREAK on Fall**).

Connection of C and NC terminals

• If the circuit is closed at the working pressure, the switch **opens** the circuit as the pressure **increases** when the desired value is reached (**BREAK on Raise**).

• If the circuit is open at the working pressure, the switch **closes** the circuit as the **pressure** decreases when the desired value is reached (**MAKE on Fall**).

The pressure switch must be mounted in the normal installation position, i.e. with the pressure connections downwards. Increase gradually pressure in the circuit up to the desired microswitch set point value (P_i).

If the switch activates during the aforesaid operation, turn the adjustment screw in the + direction until the switch activates again. If it does not activate, rotate the adjustment screw in the - direction until the switch activates.

Raise the circuit pressure to the normal working value.

Slowly return to the set point pressure value until the indicator lamp turns on (or off), and note the pressure value (P_r).

Calculate the difference between the set and noted pressure values ($P_i - P_r = D$).

Calculate what percent the difference D is of the full differential pressure range.

Annul the pressure difference, D, by turning the adjustment screw the appropriate amount and in the appropriate direction, using the graduated scale as a reference (§ 5 and fig.2).

Example: Instrument with 0-1 bar range.

Desired set point value: 400 mbar

Read set point: 415 mbar

Difference: $D = 400 - 415 = -15$ mbar

$$D\% = \frac{-15}{1000} \times 100 = -1,5\% \text{ of span}$$

Adjustment: Turn the adjustment screw in the pressure-reducing direction a distance equal to 1/3 of the division of the scale.

6.3 CHECK OF SET POINT

Generate the normal working pressure and wait the pressure stabilisation. Vary the pressure into the circuit and record the set point value. Write the set point values on the adhesive label fitted to the instrument.

Note: the repeatability should be checked verifying for three times the set point (P_i) starting always from the same pressure value (P_w). The pressure cycle should be slowly to give the possibility to record the set point with accuracy.

6.4 FINAL OPERATIONS

Disconnect the instrument from the calibration circuit.

With reference to fig.4 close the access to the adjustment bush by rotating the access plate (f) and tighten the relative screw (c). Take the cover, ensure that the sealing gasket is correctly fitted into its seat, insert the cover onto the case and turn it clockwise until the cover is closed. Turn the blocking device (a) 180° sliding the tongue into the appropriate seat in the cover; then tighten the blocking screw (b).

Mount on pressure connection and cable entry the protection caps supplied with the instrument.

Caution: The protection caps should only be definitively removed **during** the connection steps (see § 8).



7. INSTRUMENT PLUMBING

With reference to fig. 4 the plumbing, aimed as a guarantee against possible tampering of the calibration, can be carried out using a flexible steel wire (d) inserted into the holes in the screw (c) and the adjustment bush access plate (f) provided for this purpose.

8. SAFETY INTEGRITY LEVEL (SIL) INSTALLATION REQUIREMENTS

The pressure switch has been evaluated as Type A safety related hardware. It has an hardware fault tolerance of 0 if it is used in one out one configuration (1oo1). The installation has to be designed to allow a proof test to detect dangerous undetected fault using, as example, the following procedure:

- Take appropriate action to avoid a false trip
- Force the switch to reach a define max or min threshold value and verify that output goes into the safe state.
- Force the switch to reach a define normal threshold value and verify that output goes into the normal state.

- Repeat the check two times evaluating average set point value and repeatability,
- Restore the loop to full operation
- Restore normal operation

9. MOUNTING AND CONNECTIONS

9.1 MOUNTING

Surface mount the instrument by means of the holes provided, or pipe mount using the appropriate bracket (see fig.9). In case of surface or panel or rack mounting the instruments can be mounted side by side (see Fig.11).

Warning: Intrinsic safety instruments with aluminum enclosure. The instrument must be installed to prevent accidental impact of the housing.

The chosen position must be such that vibrations, the possibility of shocks or temperature changes are within tolerable limits. With gas or vapour process fluid, the instrument **must** be positioned higher than the pipe inlet (see fig. 15). With a liquid process fluid, the instrument can be positioned higher or lower, indifferently (see fig.14 and 15).

9.2 INSTRUMENT WITH DIAPHRAGM SEALS

When the pressure switch is equipped with capillary diaphragm seal and the set point is less than 10 bar, the gap between each diaphragm seal and instrument generates a column of liquid, whose pressure equivalent constitutes a drift of set point. The set point has to be adjusted consequently to these gap.

9.3 PRESSURE CONNECTIONS

Connecting lines are an integral part of the instrument in transmitting the measured variable from the measuring point to the instrument.

For a correct installation it is necessary to:

Mount a shut-off valve with drain (root valve) on each process pipe inlet to allow the instrument to be excluded and the connection tubing to be drained. It is recommended that said valve has a capstan blocking device aimed at preventing it being activated casually and without authorisation.

Mount a 3 valve manifold near the instrument to permit possible functional verification on site and removal of the instrument. It is recommended that the manifold is made up of two service valves, one by-pass valve and two suitably connected drain plugs.

Mount a three piece joint onto the threaded connections of the instrument to permit the easy mounting or removal of the instrument itself.

Carry out the connection using a flexible tube in such a way that variations in the temperature of the tube itself do not force the instrument connections.

Ensure that all the pressure connections are airtight. It is important that there are no leakage in the circuit.

Close root valves, the two service valves, drain plugs and open the by-pass valve.

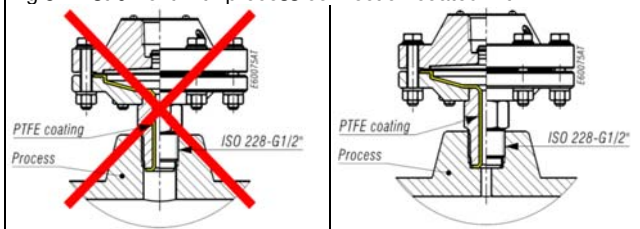
NOTE: if the instrument is used for **level control** in tanks under pressure it is recommended that installation is carried out according to the diagram in fig.16 and 17,

In case of installation as per fig 16 (wet leg condition) ensuring that the seal pot SB has a sufficient capacity to maintain the liquid level at the maximum height over time

9.4 INSTRUMENTS WITH DIAPHRAGM SEALS EQUIPPED WITH PROCESS CONNECTION COATED WITH PTFE

The pressure connection must be made in such a way that the part protruding from the instrument have to be used as a sealing ring.

Fig.5 - Instrument with process connection coated with PTFE



9.5 ELECTRICAL CONNECTIONS

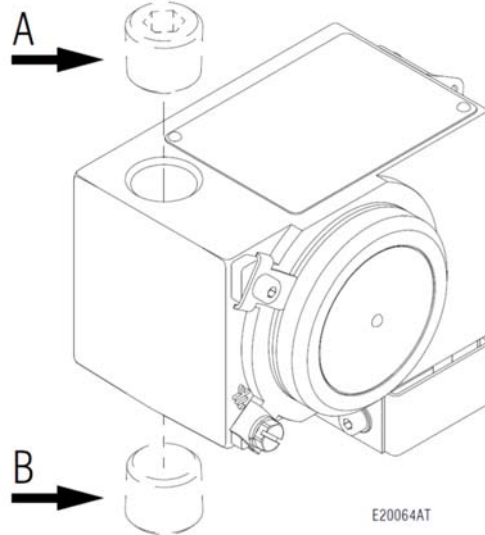
It is recommended to carry out the electrical connections according to the applicable standards. In case of flameproof or intrinsic safety instruments see also the Standard IEC-60079-14.

If the electrical connection is carried out in a protected tube, it shall be made so that condensate is prevented from entering instrument enclosure.

The arrangement shown in fig. 14 or 15 is therefore recommended.

WARNING: the cable entry not used **must** be plugged and sealed using the plug supplied with the instrument, in order to prevent rain water or other liquids from entering the enclosure.

Should the enclosure be flameproof the Ex d degree of protection is NOT guaranteed unless the plug is correctly mounted and blocked in such a way that it cannot be removed. Furthermore, in order to guarantee the degree of protection IP66 and the unlocking of the blocking joint or cable gland from the enclosure, the coupling thread **must** be sealed with the same anaerobic sealing used for the plug on the unused cable entry (e.g.: Loctite ® 648)



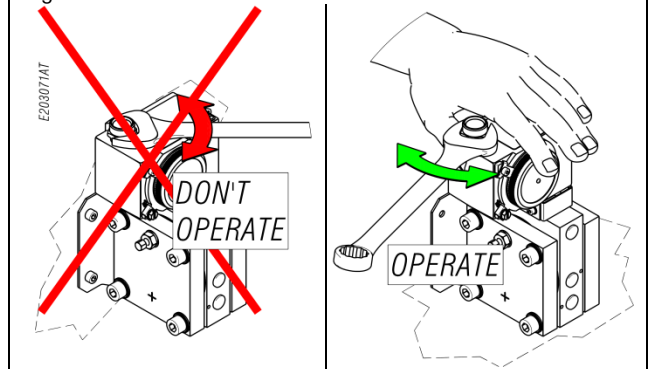
CAUTION: fittings used for the electrical connection of the flameproof instruments shall be certified according to the IEC or EN standards and shall guarantee instrument degree of protection (IP66).

In case of armoured cable gland it is suggested to use the upper electrical connection or verifying, preliminary, its dimensions in case of use of the lower electrical connection.

In the case of Gk threads, this is made in accordance with standard UNI-EN 60079-1 (Italian national variant).

The installation of the cable gland or three-piece joint should be as per fig.6.

Fig. 6 – Installation of electrical connection



With the instrument into the final position provided that the electric line is not energize, remove the cover and make the electrical connection to the terminal block (see Fig. 2)

If the ambient temperature exceeds 60 °C is recommended to use cables suitable for operating temperatures of at least 105 °C.

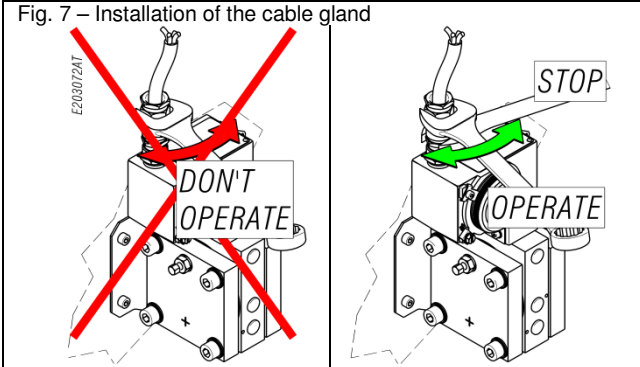
Flexible cables with a maximum section of 1,5 mm² (16AWG) are recommended using the pre-insulated thimbles

Warning: The instrument may be equipped with micro switches SPDT or DPDT. All the electrical connection must be part of intrinsically safe circuits. The relevant parameters for intrinsic safety are listed on the nameplate of the instrument.

Ensure that no deposits or wire ends remain inside the case.



Warning: When inserting cables into the enclosure pay attention not to force the microswitch with cable or tools, otherwise instrument calibration or even its operation could be compromised. The microswitch has been factory mounted and positioned in order to obtain the best performances. Any tampering made on site without following instructions authorised by the E. CELLA SPA may result in instrument malfunction. The tightening of the cable gland or the three-piece joint must be performed as shown in Fig. 7



Once the connection operations have been completed, replace the cover and ensure that it is properly sealed and blocked (see fig. 4).

9.6 GROUNDING CONNECTIONS



The instrument is supplied with two grounding connections, one external and one internal. The external connection is suitable for a earthing wires of 4 mm² section, the internal connection up to 2,5 mm² section (fig. 2).

10. PUTTING INTO OPERATION

The instrument comes into operation as soon as the electrical line is energized and the root valves are opened and then, afterwards, the service valve attached to the instrument + or H inlet pipe is opened, the by-pass valve closed and the service valve attached to the instrument - or L inlet pipe is opened. Any possible drainage of the connection tubing can be carried out by opening the drains fitted the instrument.



Do not dispose of the process fluid into the environment, if this can cause pollution or damage to people

NOTE: : if the instrument is used for level control in tanks under pressure and is installed according to the fig. 16 proceed as follows.

Close the root valves V₁ and V₂ open the valves V₃ V₄ V₅ (the service and by-pass valves). Fill with the process fluid, from plug S_B positioned on the seal pot B, bleeding air from the plug S positioned on the seal pot near the V₂ valve. Then close S and top up the liquid in B. Remove air from the breather plug S₊ and S positioned on the instrument, topping up the liquid in B. Close the plug S_B and the by-pass valve V₅ and open the root valves V₁ and V₂. The instrument is ready for use.

If the instrument is installed according to Fig. 17 close the root valves V₁, V₂ and V₅, open the valves V₃ and V₄. Open the draining D. Fill with the process fluid, from plug B bleeding air from the plug S₊. Vent carried out, the instrument will read pressure $\Delta p = \gamma \cdot h1$ corresponding to zero level in the vessel. Close plugs S and D. First open valve V₂ slowly, then V₁. The instrument is ready to operate.

11. VISUAL INSPECTION

Periodically check the external condition of the enclosure. There should be no trace of leakage of process fluid outside the instrument.

In case of flameproof or intrinsic safety instruments, inspections of the electrical installation are to be carried out also according to customer procedures and at least in accordance with Standard EN-60079-17.



The flameproof and the intrinsic safety instruments installed in explosive atmospheres for the combustible dust presence, must be periodically cleaned up externally in order to avoid dust accumulating.

11.1 INSTRUMENTS WITH DIAPHRAGM SEAL EQUIPPED WITH PROCESS CONNECTION COATED WITH PTFE

These instruments are usually installed on process with high corrosion resistance requirements. To verify the condition of PTFE the process connection is equipped with an inspection hole. During the visual inspection check the absence of fluid from the inspection hole. On the contrary the instrument have to be replaced.

12. FUNCTIONAL VERIFICATION

This will be carried out according to the Customer's control procedures and because of their particular operating principle, have to be functional inspected every year as minimum if used as an alarm of max pressure.

Series DC/DE instruments can be verified on the plant if installed as illustrated in fig.14 or 15.

To avoid any risk it is recommended check the set point on site without open the cover and without dismount the cable gland and without unplugging the power cable.

The flameproof or intinsic safety instrument may be checked on site only if apparatus used are suitable for explosive atmosphere.



If this is not the case it is necessary remove the instrument from the plant, and carry out the verification in a testing room.

If the verification of the set point is performed unplugging the power cable from the terminal block it is recommended de-energize the instrument to avoid any electrical hazard.

WARNING: Instrument series DE, flameproof.

Before open the cover or the cable gland check the absence of explosive atmosphere and check that the instrument is **not energized**.



Verification consists in **checking the calibration value** and possibly regulating the adjustment screw (see par.5).

13. STOPPING AND DISMOUNTING

Before proceeding with these operations **ensure** that the plant or machines have been put into the **conditions** foreseen to allow these operations.

With reference to figures 14 and 15

Remove the power supply (signal) from the electrical line.

Close the service valve (2) and open the by-pass valve.

Carefully open the drains.

Do not dispose of the process fluid into the environment, if this can cause pollution or damage to people.



Unscrew the three piece joint (1).

WARNING: Instrument series DE, flameproof.

Before open the cover or the cable gland check the absence of explosive atmosphere and check that the instrument is not energized.



Unscrew the three piece joint (11) (electrical cable tubing).

Remove the instrument cover and disconnect the electrical cables from the terminal block and earth screws. Remove the screws fixing the case to the panel (or pipe) and remove the instrument, taking care to slide the electrical conductors out from the case.

Mount instrument cover. Insulate and protect cables around, if any. Temporarily plug pipes not connected to the instrument.

In case of flameproof or intrinsic safety instruments it is recommended to follow - at least - the standard IEC-60079-17 for the withdrawal from service of electrical apparatus.



14. DISPOSAL

The instruments are mainly made of stainless steel and aluminium and therefore, once the electrical parts have been dismantled and the parts coming into contact with fluids which could be harmful to people or the environment have been properly dealt with, they can be scrapped.

15. TROUBLESHOOTING

IMPORTANT NOTE: operations involving replacement of essential components must be carried out at our workshop, especially for instruments with flameproof certificate; this is to guarantee the user the total and correct restoration of the product original characteristics..

MALFUNCTION	PROBABLE CAUSE	REMEDY
Set point shift	<ul style="list-style-type: none"> ■ Air bubbles in the connection lines (condensation in the case of use of gas). ■ Solid particles deposited inside the measurement chambers of the instrument. ■ Permanent deformation of the sensitive element due to fatigue or non-tolerated over-ranges. ■ Variation of the elastic features of the sensitive element due to its chemical corrosion. ■ Leakage of filling fluid. 	<ul style="list-style-type: none"> ■ Drain using the appropriate plugs. ■ Dismount the measurement chambers and clean them (during the mounting phase the screw locking couple is 80 N•m). ■ Recalibrate or replace the sensitive element. ■ Recalibrate or replace the sensitive element with another made of a suitable material. If necessary apply a fluid separator. ■ Send to the manufacturer for checking.
Slow response	<ul style="list-style-type: none"> ■ Clogged or obstructed connection line. ■ Root or service valve partially closed ■ Too viscous fluid. 	<ul style="list-style-type: none"> ■ Check and clean line. ■ Open valve. ■ Provide instrument with suitable fluid separator (Return to the manufacturer).
No actuation or undue actuation	<ul style="list-style-type: none"> ■ Root or service valve closed. ■ By-pass valve open. ■ Microswitch contacts damaged. ■ Loosened electrical joints. ■ Interrupted or short-circuited electrical line. 	<ul style="list-style-type: none"> ■ Open the valve. ■ Close the valve. ■ Replace the microswitch. ■ Check all electrical joints. ■ Check the conditions of the electrical line.

Fig. 8 – Mounting of brackets for 2" pipe

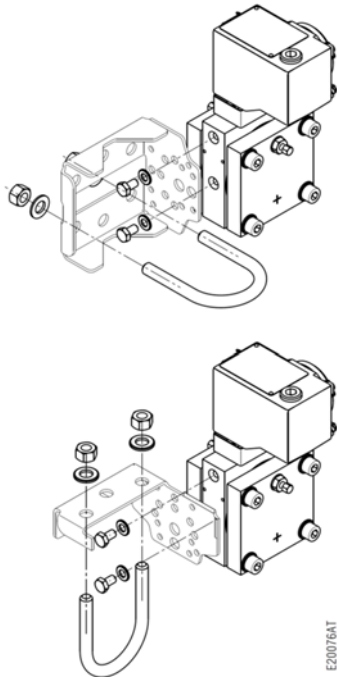


Fig. 9 – Typical Mounting

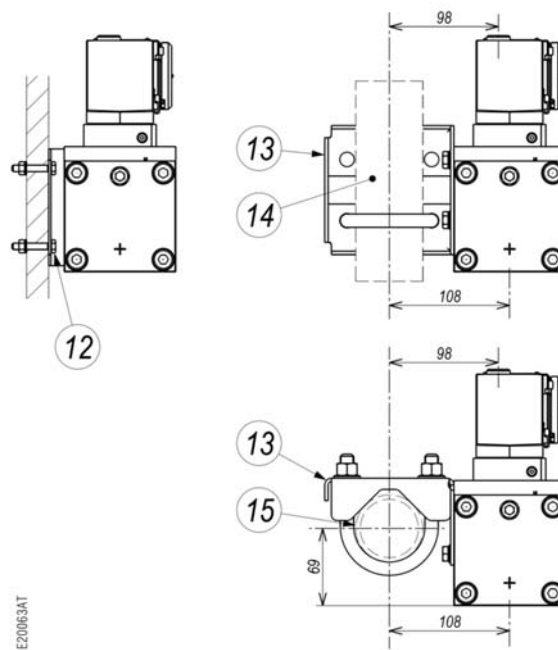


Fig. 10 – Switch equipped with capillary diaphragm seals

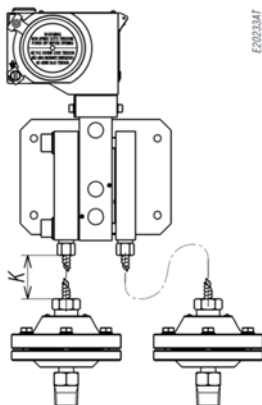


Fig. 11 – Cabinet and rack

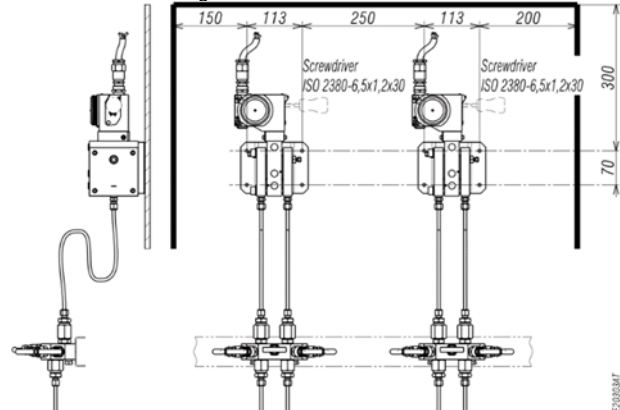


Fig. 12 – Assembly with flanged manifold valve

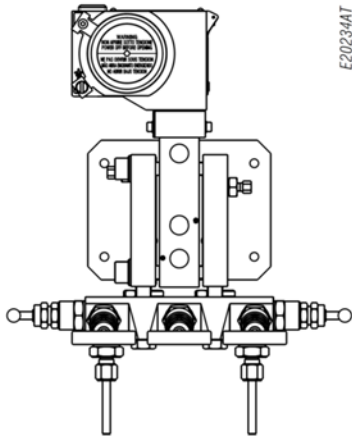


Fig. 13 – Assembly with swivel 1/2G manifold valve

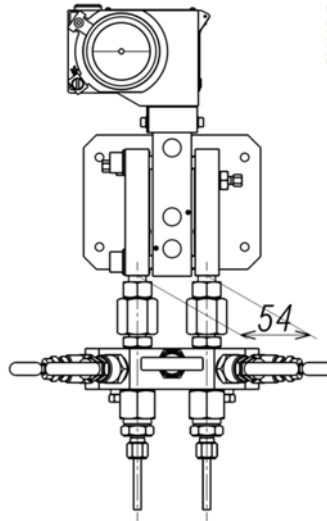


Fig. 14 - Typical installation

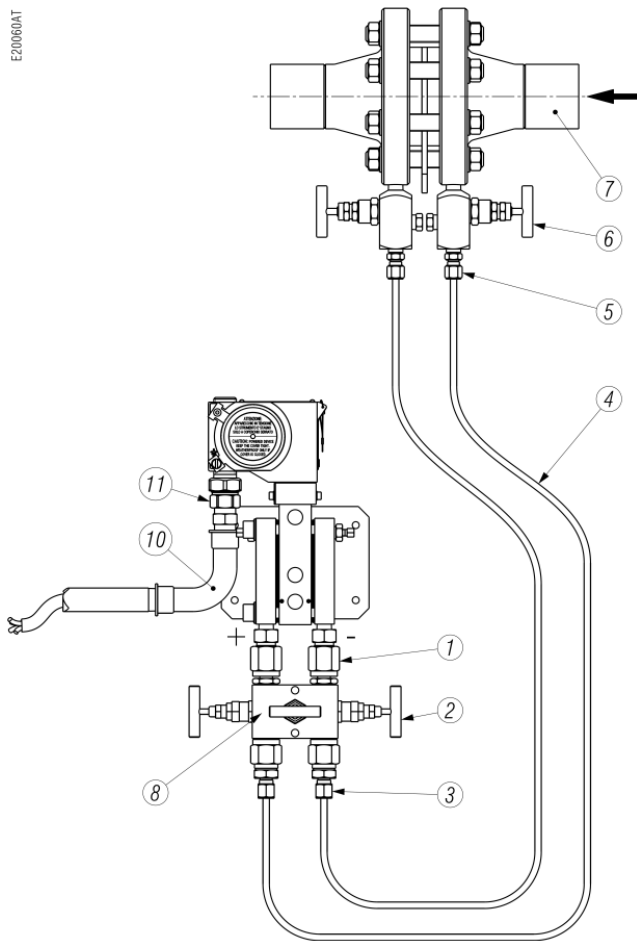
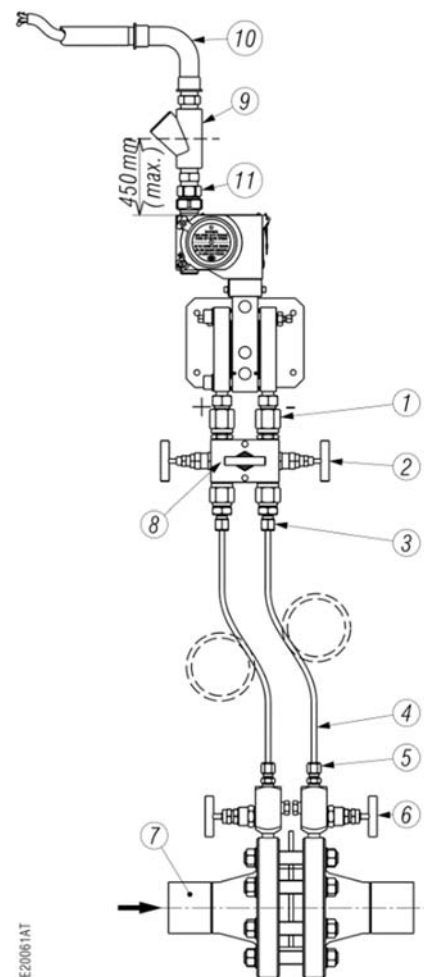


Fig. 15 - Typical installation



- 1 - Three piece fitting
- 2 - Three valve manifold
- 3 - Three piece fitting
- 4 - Piping
- 5 - Three piece fitting

- 6 - Root valve with drain
- 7 - Filter or nozzle
- 8 - Check inlet and drain plug
- 9 - Blocking joint
- 10 - Curve

- 11 - Three piece fitting
- 12 - M6 screws (No. 4)
- 13 - Bracket for 2" pipe
- 14 - Vertical pipe
- 15 - Horizontal pipe

NOTE With gas or vapour process fluid, the instrument **must** be positioned higher than the pipe inlet (see fig.15). With a liquid process fluid, the instrument can be positioned higher or lower, indifferently (see fig.14 and 15)

Fig. 16 - Level control wet leg condition

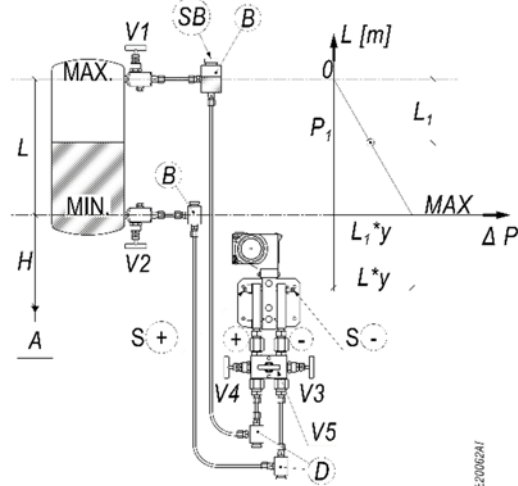
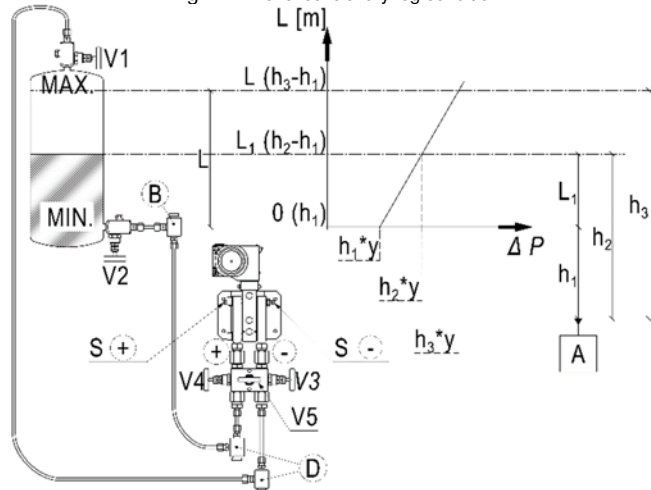


Fig. 17 - Level control dry leg condition



ANNEX 1 – Model Code

1	MODEL CODE	D						For further information see datasheet
1.1	Ignition protection mode	C						Weatherproof Ex d (Ga/Gb Da/Db)
1.2	Line (static) pressure		C	L	M	H	A	Max. line pressure 25 bar Max. line pressure 40 bar Max. line pressure 100 bar Max. line pressure 160 bar Max. line pressure 250 bar
1.3	Differential cell code			L	H	V	S	Low ranges Medium ranges High ranges With diaphragm seals
1.4	Enclosure material code					2	4	Aluminium alloy 316 s.s.
1.5	Type of Electric Contact						A	Silver SPDT Silver SPDT argon sealed Gold SPDT argon sealed Silver DPDT Silver DPDT sealed
2	Options	Example: Intrinsic Safety execution						