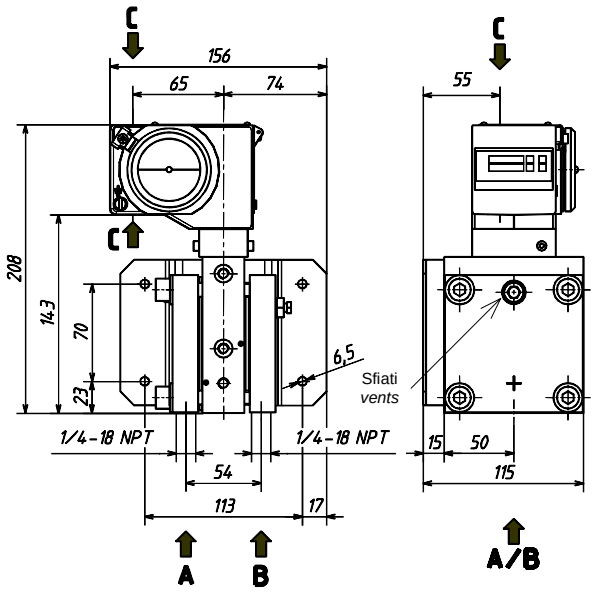
INSTRUCTION MANUAL

NI-223E
Rev. 2 11/02

COMPACT DIFF. PRESSURE SWITCHES SERIES DC & DE

WEATHERPROOF

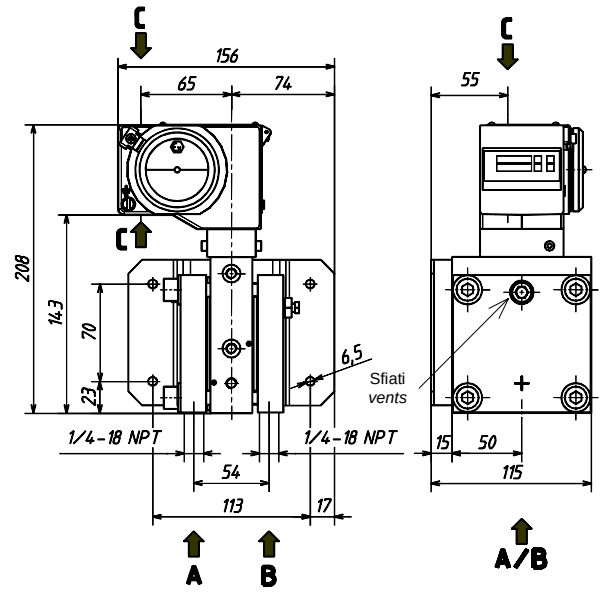
SERIES DC



A High pressure connection **C** Cable entry
B Low pressure connection
WEIGHT 5,4 kg dimensions in mm

EXPLOSIONPROOF

SERIES DE



A High pressure connection **C** Cable entry
B Low pressure connection
WEIGHT 5,4 kg dimensions in mm

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.

CONTENUTO

RELATED DOCUMENT

To authentified document with certificate
N° CESI 02 ATEX 119

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 -40° to +60°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.

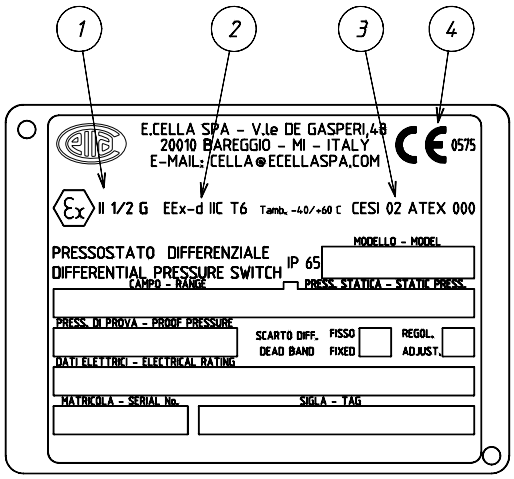
2 - OPERATING PRINCIPLE

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 - IDENTIFICATION PLATE AND MARKINGS

The instrument is fitted with a metal plate bearing all its functional characteristics and – in case of explosionproof execution (Series DE) – also the markings prescribed by standard CEI EN 50014. Fig. 1 shows the plate mounted on explosionproof instruments.

Fig. 1 - Explosionproof instruments plate



1 CE marking and identification number of the notified body responsible for production surveillance.
2 Apparatus classification according to ATEX 94/9 CE directive.
3 Type of protection and ambient temperature limits of operation.
4 Notified body that issued the type certificate and number of said certificate.

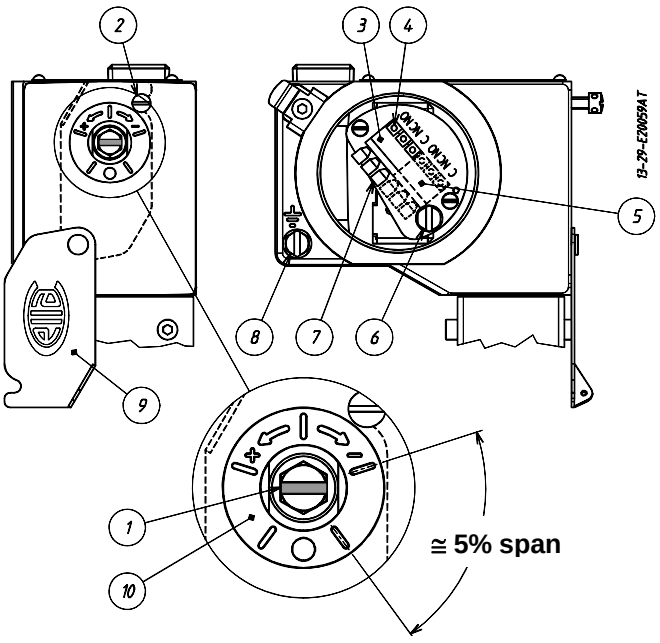
4 - SET POINT REGULATION

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.

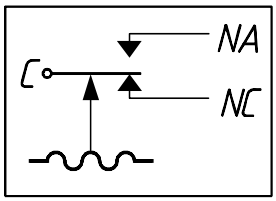
The adjustment screw (fig.2) , which acts on the switch, is part of the transmission system for shifting the sensor element. The adjustment must therefore be made very carefully. To facilitate the calibration operation (§ 5.2) , its seat is provided with a graduated scale; each increment of this scale 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 adjustament screws with one or two contacts instruments



1 - Adjustment screw
2 - Screw for fixing the adjustement
3 - Terminal block for the first microswitch
4 - Hole for test plug
5 - Terminal block for the first microswitch
6 - Internal earth screw
7 - Pre-insulated thimbles
8 - External earth screw
9 - Adjustment bush access plate
10 - Graduated dial

Microswitch electrical circuit.
State of the contacts at atmospheric pressure



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

5 - SET POINT CALIBRATION

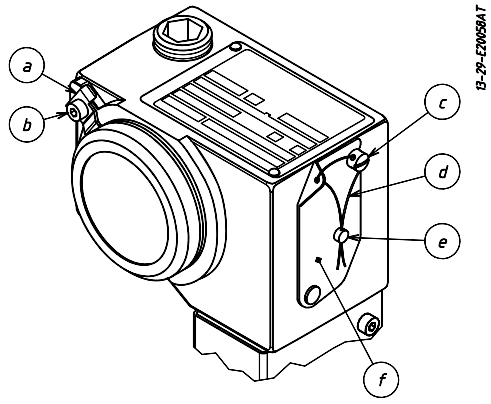
In order to proceed with the calibration and the periodical functional verification of the instrument a suitable **calibration circuit** (fig.4) and an adequate pressure source is required.

5.1 PRELIMINARY OPERATIONS

CAUTION: do not open the cover of explosionproof pressure switches (Series DE) when energized, in explosive atmospheres.

With reference to fig.3 unscrew the screw (b) until the blocking device (a) can be turned 180°; then unscrew the cover.

Fig. 3 - Cover blocking device and plumbing



a - Cover blocking device
b - Blocking screw
c - Screw blocking the adjustment bush access plate
d - Flexible steel wire
e - Plumbing
f - Adjustment bush access plate

5.2 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

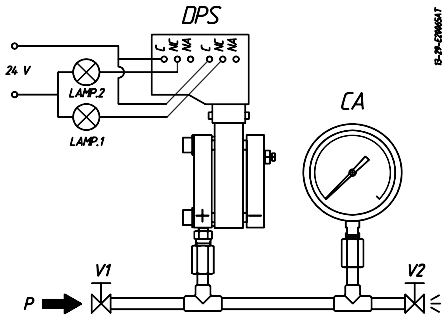
• If the circuit is closed at the working pressure, the switch **opens** the circuit as the pressure **increases** when the desired value is reached **(BREAK on Raise)**.

• 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 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.

The differential pressure switch must be mounted in the normal installation position, i.e. with the pressure connections downwards.

Fig. 4 - Calibration circuit



DPS	Differential pressure switches	Test fluid:
CA	Test gauge	air for P ≤ 10 bar
V1	Inlet valve	water for P > 10 bar
V2	Discharge valve	
P	Pressure source	

Avoid forcing the microswitch by hand or with tools. This could affect the instrument functioning.

With reference to fig.3, clear the access to the adjustment bush by loosening the screw (c) which holds the access plate (f).

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 intervention pressure 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 (§ 4 and fig.2).

Check the pressure calibration value by appropriately varying the circuit pressure. Note this value on the adhesive label using an indelible ink pen.

Example: Instrument with 0-1 bar range.
Desired set point value: 400 mbar
Read set point: 415 mbar
Difference: D = 400-415 = - 15 mbar

Correction: Turn the adjustment screw in the pressure-reducing direction a distance equal to 1/3 of the full-scale reading of the graduated scale.

5.3 FINAL OPERATIONS

Disconnect the instrument from the calibration circuit.
With reference to fig.2 close the access to the adjustment bush by rotating the access plate (9) and tighten the relative screw (2). 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. With reference to fig.3 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 connections and cable entry the protection caps supplied with the instrument. The protection caps should only be definitively removed **during** the connection steps (see § 7).

6 - INSTRUMENT PLUMBING

With reference to fig. 3 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.

7 - MOUNTING AND CONNECTIONS

7.1 MOUNTING

Surface mount the instrument by means of the holes provided, or pipe mount using the appropriate bracket (see fig.8). 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. 7). With a liquid process fluid, the instrument can be positioned higher or lower, indifferently (see fig.6 and 7).

7.2 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.

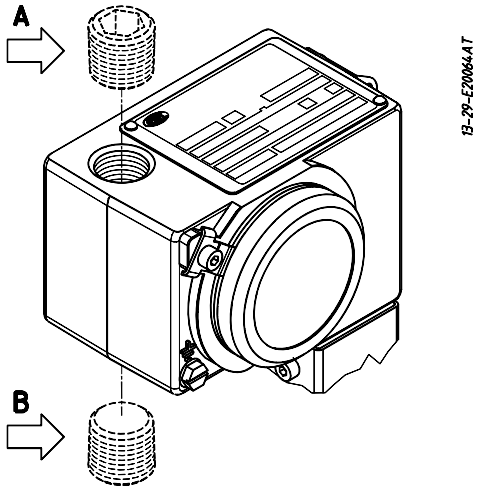
Close root valves, the two service valves, drain plugs and open the by-pass valve.

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.9; ensuring that
- the distance K is greater than 0,5 m
- the seal pot B has a sufficient capacity to maintain the liquid level at the maximum height over time.

7.3 ELECTRICAL CONNECTIONS

It is recommended to carry out the electrical connections according to the applicable standards. In case of explosionproof instruments (Series DE) see also the Standard EN-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. 6 or 7 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 explosionproof the EEx-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 IP65 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 pressure switch Series DE (explosionproof) shall be certified to Standards EN 50014 and 50018, and shall guarantee instrument degree of protection (IP65).

Check that there is no power in the lines.
Remove the cover and carry out the cabling and connections to the terminal block (see fig.2). Flexible cables with a maximum section of 1,2 mm^2 (16AWG) are recommended using the pre-insulated thimbles with a maximum diameter of 2,5 mm supplied with the instrument.

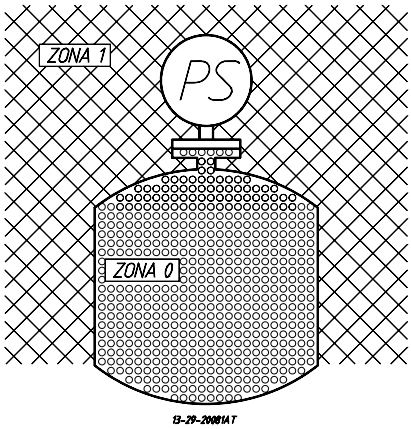
When inserting cables into the enclosure pay attention not to force the microawitch with cable or tools, otherwise instrument calibration or even its operation could be compromised. The microswitch has been factory mounted and positioned in order to obtain the best performances. Any tampering made on site without following instructions authorised by the E. CELLA SPA may result in instrument malfunction.

Ensure that no deposits or wire ends remain inside the case.
Once the connection operations have been completed, replace the cover and ensure that it is properly sealed and blocked (see fig. 3).

7.4 SPECIAL NOTE FOR INSTALLATION OF CATEGORY 1 / 2 G PRESSURE SWITCHES

Explosionproof pressure switches (Series DE) can be installed on processes requiring apparatus of group II category 1 in an ambient requiring apparatus of group II category 2 (see Fig. 5).

Fig. 5 - Installation of Group II Cat. 1 / 2 G instruments



8 - PUTTING INTO OPERATION

As the signal transmitted by the instrument is used in a complex system, it is necessary that the means of putting it into operation are established by personnel in charge of the plant.

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

In case of explosionproof instruments (Series DE), initial inspections are to be carried out according to customer procedures and at least in accordance with Standard EN-60079-17.

NOTE: : if the instrument is used for level control in tanks under pressure and is installed according to the diagram in fig.9 proceed as follows. Close the root valves V_1 and V_2 open the valves V_3 V_4 V_5 (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 V_2 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 V_5 and open the root valves V_1 and V_2. The instrument is ready for use.

9 - FUNCTIONAL VERIFICATION

This will be carried out according to the Client's control procedures. Series DC instruments can be verified on the plant if installed as illustrated in fig.6 or 7.

The instruments Series **DE** may be checked on site only if apparatus suitable for explosive atmosphere are used and provided that **the electric line is not energized**

If this is not the case it is necessary to stop operation, dismount by means of the three piece joints and carry out the verification in a test room.

CAUTION: do not open the cover of explosionproof pressure switches (Series DE) when energized, in explosive atmospheres.

Verification consists in **checking the calibration value** and possibly regulating the adjustment screw (see par.5).
In case of explosionproof instruments (Series DA), 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.

10 - TROUBLESHOOTING

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

MALFUNCTION	PROBABLE CAUSE	REMEDY
Set point shift	■ Air bubbles in the connection lines (condensa-tion in the case of use of gas). ■ Solid particles deposited inside the measure-ment 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.	■ 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	■ Clogged or obstructed connection line. ■ Root or service valve partially closed ■ Too viscous fluid.	■ Check and clean line. ■ Open valve. ■ Provide instrument with suitable fluid separator (Return to the manufacturer).
No actuation or undue actuation	■ Root or service valve closed. ■ By-pass valve open. ■ Microswitch contacts damaged. ■ Loosened electrical joints. ■ Interrupted or short-circuited electrical line.	■ Open the valve. ■ Close the valve. ■ Replace the microswitch. ■ Check all electrical joints. ■ Check the conditions of the electrical line.
Undue actuation	■ Accidental shocks or excessive mechanical vibrations.	■ Modify the mounting.

11 - 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 6 and 7
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).

CAUTION: do not open the cover of explosionproof pressure switches (Series DE) when energized, in explosive atmospheres.

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.

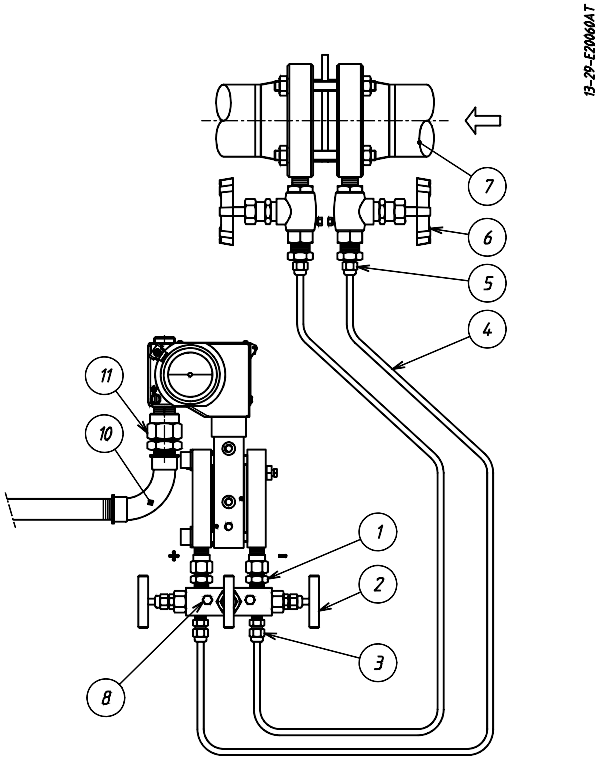
Mount instrument cover. Insulate and protect cables around, if any. Temporarily plug pipes not connected to the instrument. In case of explosionproof instruments (Series DE) it is recommended to follow - at least – the standard EN-60079-17 for the withdrawal from service of electrical apparatus.

12 - DEMOLITION

The instruments are mainly made of stainless steel and aluminium and therefore, once the electrical parts have been dismounted 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.

WEATHERPROOF

Fig. 6 - Example of connections



EXPLOSIONPROOF

Fig. 7 - Example of connections

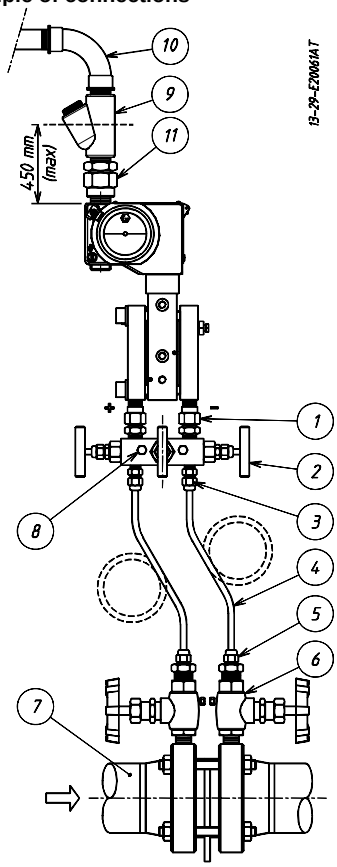


Fig. 8 - Example of mounting -

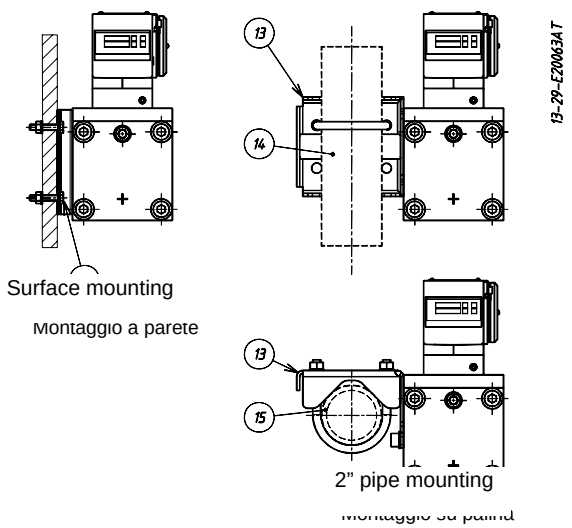
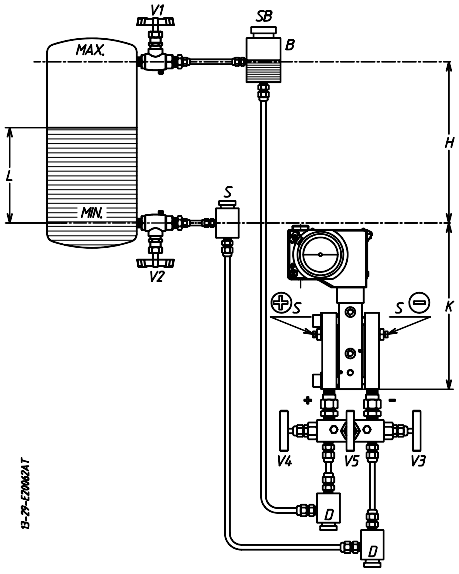


Fig. 9 - Level check of tanks under pressure –



1 - Three piece fitting	6 - Root valve with drain	11 - Three piece fitting
2 - Three valve manifold	7 - Filter or nozzle	12 - M6 screws (No. 4)
3 - Three piece fitting	8 - Check inlet and drain plug	13 - Bracket for 2" pipe
4 - Piping	9 - Blocking joint	14 - Vertical pipe
5 - Three piece fitting	10 - Curve	15 - Horizontal pipe

NOTE With gas or vapour process fluid, the instrument **must** be positioned higher than the pipe inlet (see fig.7). With a liquid process fluid, the instrument can be positioned higher or lower, indifferently (see fig.6 and 7)