

1 - GENERAL NOTES

1.1 FOREWORD

The wrong choice of a models or a version, 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

Temperatures exceeding the working range can be **occasionally** tolerated provided they remain within the limits stated in the instrument features (proof temperature). **Continuous** temperatures 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 overranges 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 spurious trip. 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, heated cabinets) must be taken.

2 - OPERATING PRINCIPLE

The thermometric bulb is connected via capillary tubing to a pressure measuring element. This system is filled with gas, and its absolute pressure is proportional to absolute temperature. As a consequence, any change in bulb temperature causes a change in gas pressure acting on sensible element, causing its free tip to undergo an elastic deflection which is used to actuate one or two electrical microswitches adjusted at prefixed set point value. The microswitches are of the rapid release type with automatic rearm. When the temperature moves away from the set values, returning towards the normal values, the switch is rearmed. The dead band (gap between the set point value and the reset value) can be fixed or adjustable (letter R in the contact codes).

3 - MODEL CODE

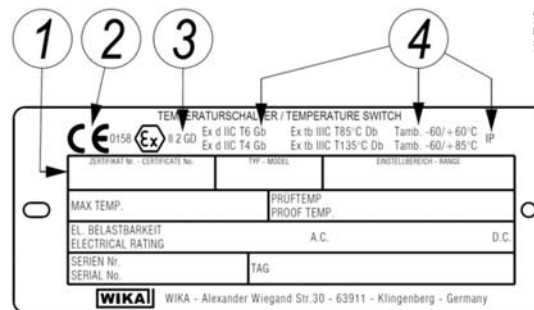
See Annex 1

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 Db
Dust	Zone 22	3D, 2D or 1D	Dc, Db or Da

5 - SET POINT REGULATION

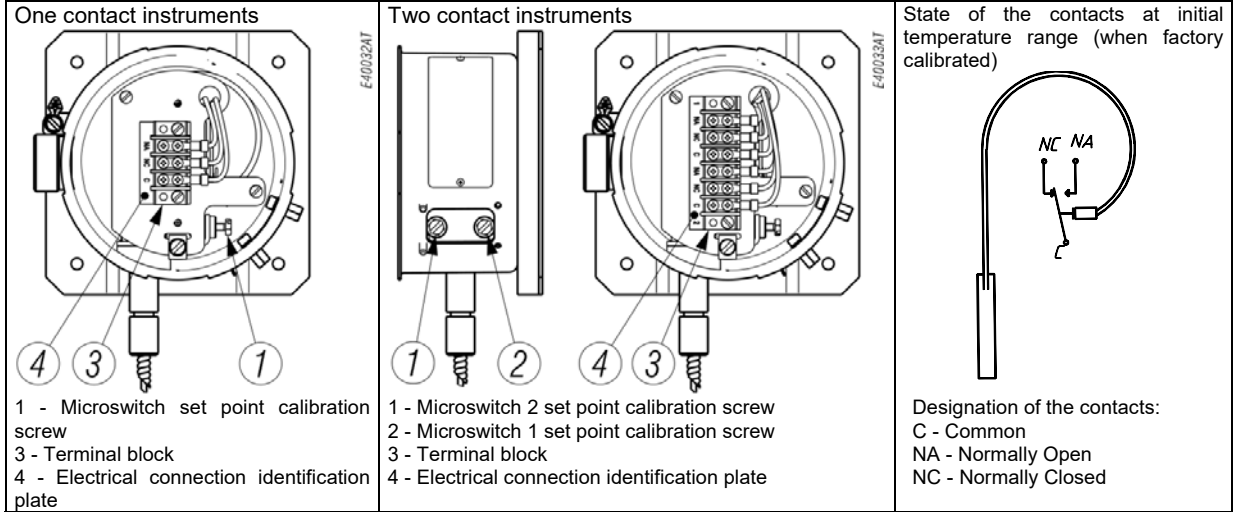
Each microswitch is independent and can be adjusted by means of a screw (for adjustment) to snap when the temperature reaches (increasing or decreasing) the desired value (set point). The instrument is usually supplied with the switches adjusted at the setting range value nearest to 0°C, or at the lowest setting range value if this is higher than 0°C (**factory calibration**). The instrument is supplied with a label showing the set point calibration value. With **factory calibration** the values are not indicated, 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 label.

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

The position of the adjustment screw is given in figure 2. The effect that the direction of rotation of the adjustment screw has is described on the label.



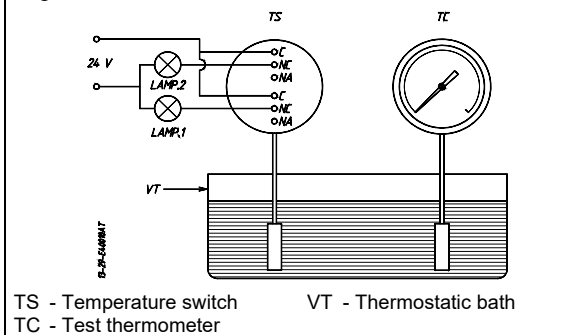
Fig. 2 - Electrical connections and adjustment screws



6 - SET POINT CALIBRATION

In order to proceed with the calibration and the periodical functional verification of the instrument a suitable **calibration circuit** (fig. 3) and an adequate heat source (thermostatic bath). The test instrument should have a measurement range approximately equal to or slightly wider than the temperature switch range and should have an accuracy consistent with the accuracy required to calibrate the set point.

Fig. 3 - Calibration Circuit

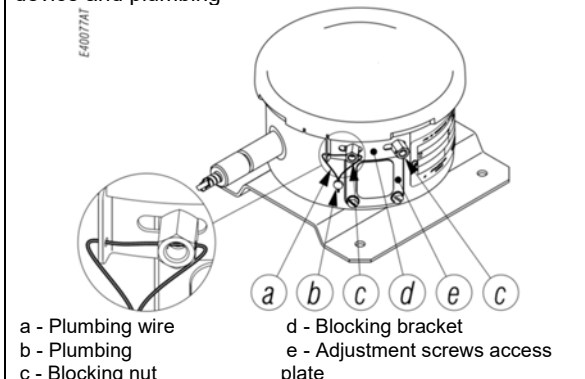


6.1 PRELIMINARY OPERATIONS

6.1.1 Weatherproof temperature switches (TWG)

Remove the blocking device fixed to the side of the instrument case and the adjustment screw access plate (Fig.4). Remove the cover by rotating it in an anticlockwise direction

Fig.4 - Weatherproof temperature switch cover blocking device and plumbing



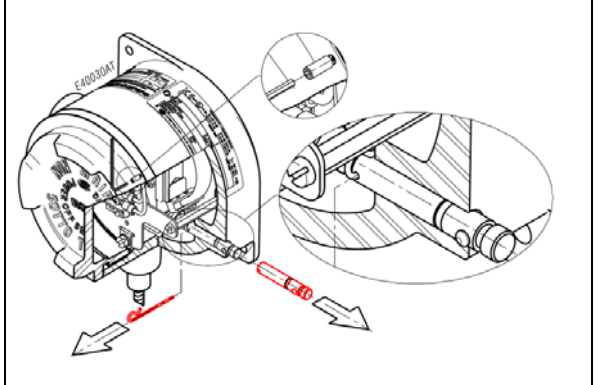
6.1.2 Flameproof temperature switches (TAG)

CAUTION: do not open the cover of pressure switches when energized, in explosive atmospheres.



Loosen the locking headless screw situated on the cover using a 1,5 hexagonal key then unscrew the cover (fig.5). Remove the internal blocking device inserted on the closure plugs and slide out the plugs.

Fig. 5 - Flameproof temperature switch cover blocking device



6.2 CALIBRATION CIRCUIT AND OPERATIONS

Prepare the calibration circuit as indicated in Fig.3. The warning lamps should be connected to contact 1 or 2 in the NO or NC position according to the required contact action.

Connection of C and NO terminals

- If the circuit is open at the working temperature, the switch **closes** the circuit as the temperature **increases** when the desired value is reached.
- If the circuit is closed at the working temperature, the switch **opens** the circuit as the temperature **decreases** when the desired value is reached.

Connection of C and NC terminals

- If the circuit is closed at the working temperature, the switch **opens** the circuit as the temperature **increases** when the desired value is reached.
- If the circuit is open at the working temperature, the switch **closes** the circuit as the temperature **decreases** when the desired value is reached.

The temperature switch must be mounted in the normal installation position, i.e. with the stem or the capillary outlet downwards.

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



CAUTION: if the switch is of the kind with adjustable dead band (letter R in the contact codes) before proceeding with the following operations it is necessary to proceed with the adjustment of the dead band.

Increase the temperature in the circuit up to the desired set point value for the first microswitch. Use a wide bladed screwdriver, as indicated on the label, turn the screw until the relative lamp turns on (or turns off).

- If the instrument is equipped with only **one contact** the calibration is complete.

- If it is equipped with **two contacts** continue in the following manner. Vary the temperature until the desired set point value for the second microswitch is reached. Act on the adjustment screw of the second contact.

Repeat calibrating operations on the first contact, then on the second contact, until the required set point accuracy is obtained. This is necessary due to the reciprocal influence which the microswitches have on the sensitive element of the instrument.



CAUTION: if the two set point are different they must be different for much of 5% of the adjustable span.

6.3 CHECK OF SET POINT

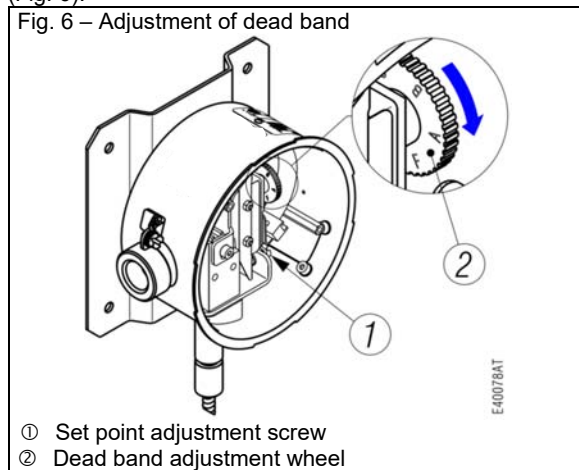
Generate the normal working temperature and wait the temperature stabilisation. Vary slowly the temperature into the circuit and record the set point value. Write the set point values on the adhesive label.

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

6.4 ADJUSTMENT OF DEAD BAND (LETTER R ON THE MODEL CODE)

The dead band can be adjusted only on the instrument is equipped with a microswitch, which allows adjusting (Letter R on the model code). Adjustment may be obtained by rotating the wheel placed on the microswitch (Fig. 6).

Fig. 6 – Adjustment of dead band



In order to carry out this operation it is advisable to use a blade screwdriver.

WARNING: rotate the wheel without pushing too much the blade against it.

The instrument is normally delivered adjusted on the **minum value** of its range (factory calibration).

6.4.1 Calibration of dead band

The calibration of the dead band is obtained using the following procedure:

- 1 - Raise temperature in the circuit until reaching the set point and record its value (Ti).
- 2 - Reduce temperature in the circuit until reaching the reset point and record its value (Tr).
- 3 - The difference $T_i - T_r = V_a$ represents the dead band factory adjusted value.
- 4 - Rotate the adjustment wheel in the sense shown in Fig. 6 placing the red notch in horizontal position
- 5 - Repeat operations 1 and 2 and measure the new dead band Vb.
- 6 - By comparing the values Va and Vb approximately determine the color of the wheel notch to be placed on the mark.
- 7 - Place the notch and measure the obtained dead band.
- 8 - Proceed by successive approximations until reaching the desired dead band value with enough accuracy.
- 9 - Then proceed with the set point calibration

Example: The dead band increase corresponding to the rotation from A to B is given by: $V_b - V_a = I$

The desired dead band V will be approximately in the position indicated by the value $K = V/I$ which expresses:

- By units, the wheel notches (1=one black notch, 2=one red notch, 3=one yellow notch, 4=one blue notch, 5=one green notch, 6=two black notches).
- By decimal digits, the percentage middle position between the located notch (of units) and the following one.

6.5 FINAL OPERATIONS

Disconnect the instrument from the calibration circuit. Pay attention the bulb can be hot.

6.5.1 Weatherproof temperature switches (TWG)

Take the cover, ensure that the sealing gasket is correctly fitted into its seat, and insert the cover onto the case, with the blocking gap positioned in correspondence to the blocking bracket.

Turn the cover clockwise closing it tightly. Mount the blocking device as in Fig. 4. Mount on pressure connection and cable entry the protection caps supplied with the instrument.

6.5.2 Flameproof temperature switches (TAG)

Insert the closure plugs of the adjustment screw access holes, **block** them using the internal device and if necessary seal them with plumbing. Screw on the cover and **block** it using the headless screw with which it is equipped (Fig. 5)



6.5.3 Final operations

Mount on the cable entry the protection caps supplied with the instrument.

Caution: The protection caps should only be definitively removed **during** the connection steps (see § 7).



7 - MOUNTING AND CONNECTIONS

7.1 MOUNTING

Surface mount the instrument by means of the holes provided, or **pipe** mount using the appropriate bracket or mount directly on process **in a vertical position** (with the stem or capillary outlet pointing downwards) (Fig.23 and Fig.24). In case of surface or panel or rack mounting the instruments can be mounted side by side (see Fig.21). The chosen position must be such that vibrations, the possibility of shocks or temperature changes are within tolerable limits. The above also applies to direct mounting instrument (code B into the model code).

7.2 BULB AND CAPILLARY

With reference to figure 7 **unscrew** the fitting (3) from the seal press (2) and slide it off from the bulb (5).

Mount the fitting (3) on the thermowell (4) and tighten it using the appropriate key. Rid the capillary from the armored by pulling the bulb (5) with one hand while holding the stuffing nut with the other (2).

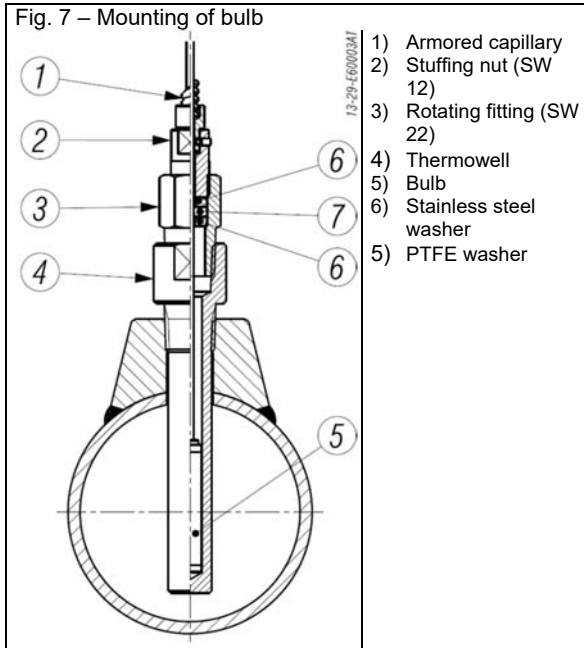
Insert the bulb (5) into the thermowell (4) after covering it with the paste to improve the transmission of heat.

Verify that the bulb touches the bottom.

Insert the PTFE seal with the relative stainless steel washers into the fitting (3).

Screw the seal press (2) onto the fitting (3) taking care not to bend the capillary and relative sheath and tighten until the PTFE seal is tight on the capillary tube.

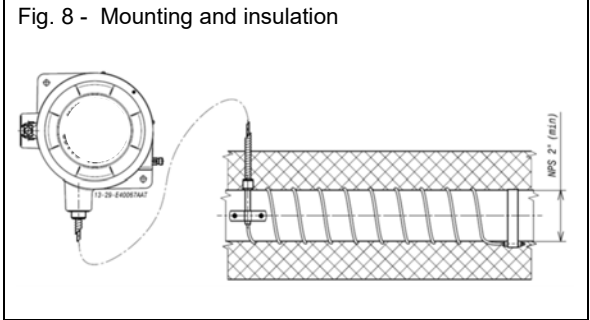
Run the capillary protected by the armor in the established direction, avoiding tight bends, and block using the stainless steel bands. If a large amount of capillary remains this should be rolled up and fixed tightly. The coil must not have a diameter of less than 200 mm.



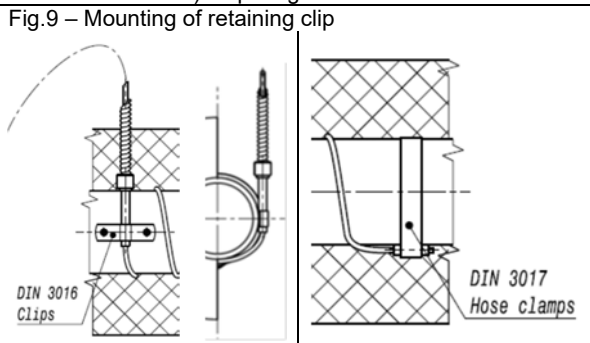
7.3 TEMPERATURE SWITCHES WITH CONTACT BULB.

The contact bulb is designed for mounting on pipes with external diameters greater than 50 mm.

During the installation must be guaranteed that the contact bulb is in contact with measuring point over its complete length. To minimise errors in measuring of temperature, the insulation of the pipe must be applied where the contact bulb has been mounted. A heat conductive paste can be used to optimize the heat transmission (see fig.8).



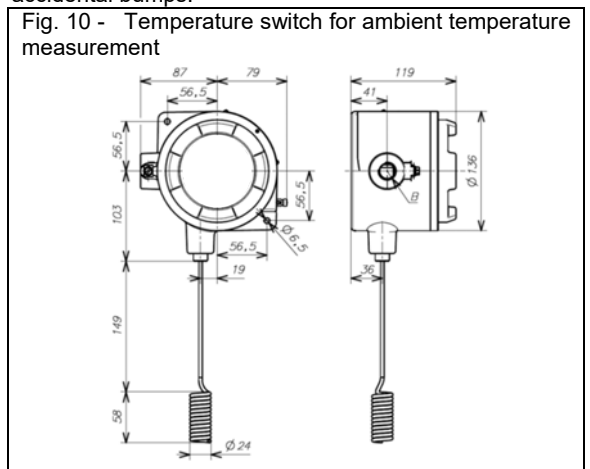
To fix the bulb to the pipe is suggest to use a retaining clips (using for example a retaining clamps according to DIN 3016 form C1) as per fig. 9.



During the installation of the bulb pay attention to the minimum bending radius of the bulb.

7.4 TEMPERATURE SWITCHES WITH HELICAL BULB

The temperature switch has to be installed protecting the sensing element (bulb) against heat radiation and accidental bumps.



7.5 ELECTRICAL CONNECTIONS

It is recommended to carry out the electrical connections according to the applicable standards.

In case of flameproof instruments and intrinsic safety instruments see also the Standard IEC/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.

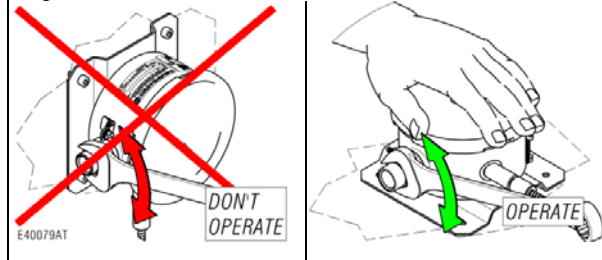
To guarantee the ingress protection IP66 and prevent loosening of the blocking joint or cable glands, it is prescribed to seal the threads with an anaerobic sealant. For example, use a sealant like Loctite ® 542.



CAUTION: fittings used for the electrical connection of the flameproof instruments shall be certified according the IEC or EN standards and shall guarantee instrument degree of protection (IP66).
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. 11.

Fig. 11 – 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 crimp ring terminal.

Do not touch the adjustment screws and do not bend the elastic microswitch supports in order to prevent the instrument calibration being altered.

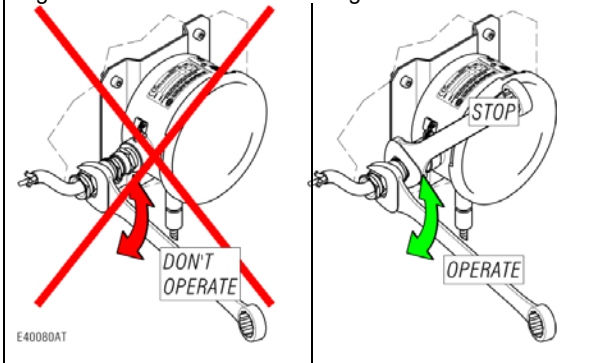
Ensure that no deposits or wire ends remain inside the case.



Warning: The instrument may be equipped with one or two micro switches SPDT type. 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.

The tightening of the cable gland or the three-piece joint must be performed as shown in Fig. 12

Fig. 12 – Installation of the cable gland

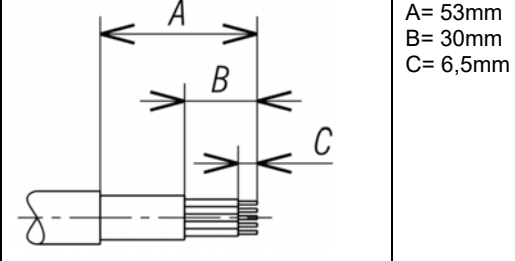


As soon as connection steps are completed, mount the cover on and make sure it is tight and blocked (See fig 4 and 5).

7.6 CONNETTOR 7 POLES TYPE MIL-5015 FOR WEATHER PROOF INSTRUMENT

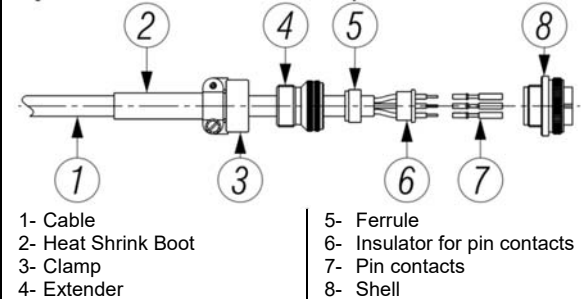
The free connector, supplied with the instrument, is able to accept multicore cables with maximum outer diameter 11 mm. It is recommended flexible cables with single-conductor with a maximum section of 1.5 mm² (16AWG). The cable have to be prepared as per fig. 13

Fig. 13 – Cable preparation



The single stripped conductor has to be crimped with each contact pin. For the electrical connections and for the assembly follow Fig.14.

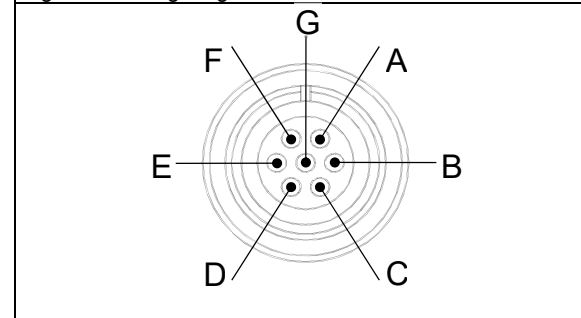
Fig. 14 – Free connector assembly



- 1- Cable
- 2- Heat Shrink Boot
- 3- Clamp
- 4- Extender
- 5- Ferrule
- 6- Insulator for pin contacts
- 7- Pin contacts
- 8- Shell

The wiring diagram is according Fig.15.

Fig. 15 – Wiring diagram MIL C-5015



CONTACT	FUNCTION	
A	1-NA	Micro 1: Normally open
B	1-NC	Micro 1: Normally closed
C	1-C	Micro 1: Common
D	2-NA	Micro 2: Normally open
E	2-NC	Micro 2: Normally closed
F	2-C	Micro 2: Common
G	Ground	Internal grounding connection

Once the crimping and assembly activities of the free connector are finished, make sure that all the parts are tight. Screw the bayonet and tighten it to assure the instrument degree of protection

7.7 GROUNDING CONNECTIONS

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



8 - INSTRUMENT PLUMBING

8.1 Weatherproof temperature switches (TWG)

The plumbing, aimed as a guarantee against possible tampering of the calibration and electrical connections, can be carried out using a flexible steel wire (a) inserted into the holes in the screw (c) and the bracket (d) provided for this purpose (see Fig. 4).

8.2 Flameproof temperature switches (TAG)

Plumbing is not necessary as the cover is blocked with a headless screw the closure plugs of the adjustment screw access holes are blocked by means of the internal blocking device and the instrument **does not** have to be opened when installed (see Fig. 5).

9 - PUTTING INTO OPERATION

The instrument comes into operation as soon as is energized

10 - VISUAL INSPECTION

Periodically check the external condition of the enclosure. 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 - FUNCTIONAL VERIFICATION

This will be carried out according to the Customer's control procedures and as minimum yearly. The instruments can be verified on the plant if installed as illustrated in Fig. 23 and 24.

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 intrinsic safety instruments may be checked on site only if the 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 models TAG, 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 **check the calibration value** and possibly regulating the adjustment bush (see §6).

12 - 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 7, 23 and 24

Remove the power supply (signal) from the electrical line. Loosen and remove the seal press being careful not to bend the capillary and protective sheath (Fig.7).

Warning: Do not touch the bulb and the parts in contact with the thermowell if hot.

Loosen and remove the fitting (3) then extract the bulb (5) from the thermowell (4) holding it by the capillary tube (1), without bending it.

With reference to figures 23 and 24

WARNING: Instrument models TAG, 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 (8) (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 the thermowell.

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

13 - 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.

14 - TEMPERATURE SWITCHES, EXECUTION FOR SAFETY LOOP (SIL EXECUTION)

14.1 FOREWARD

The temperature switches of models TWG and TAG, with execution for Safety circuit, are instruments equipped with two electrical contacts, sealed in inert atmosphere and connected in models. The first contact can be set in the whole setting range of the temperature switch; while the second is not usable by the customer (safety contact). The instrument must be installed so that it opens an electrical circuit when the temperature reaches the set point. The safety contact has the function to open the electrical circuit if the capillary of the temperature sensor has been accidentally cut or if the instrument has a leak. Moreover this contact is used to detect a random dangerous failure (cutting of capillary or failure on the temperature sensor) producing a safety spurious trip.

14.2 ELECTRICAL CONNECTION

The instrument has one terminal block with three poles and a calibration screw as explained in fig.16 e 17

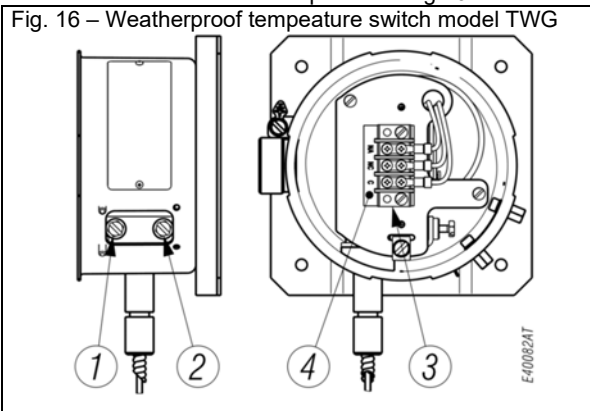
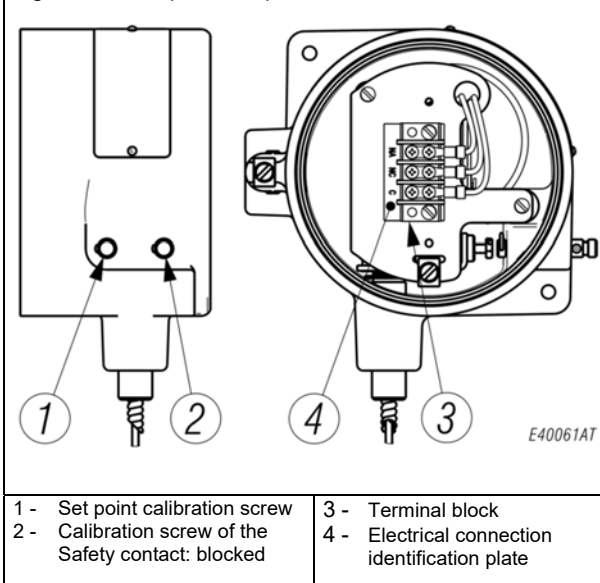


Fig. 16 - Weatherproof temperature switch model TWG



Fig. 17 – Flameproof temperature switch model TAG



The calibration screw indicated with ② is blocked; while the calibration screw indicated with ① is accessible for the set point calibration.

The instrument must be connected to the control system to "positive Safety" in such a way to open the electrical circuit in case of:

- accidental break of the circuit.
- accidental cut of capillary

14.3 SAFETY INTEGRITY LEVEL (SIL) INSTALLATION REQUIREMENTS

The temperature 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

The installation requirements, the useful life and the failure of the switch is discussed in the Failure Modes, Effects and Diagnostic Analysis Report

15 - TROUBLESHOOTING

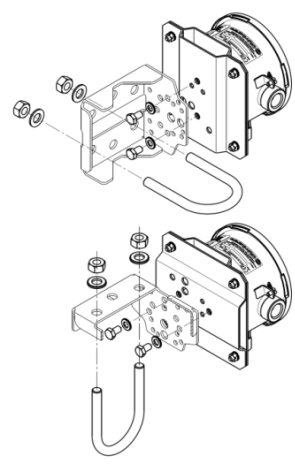


IMPORTANT NOTE: operations involving replacement of essential components must be carried out at our workshop, especially for instruments with flameproof certificate; this is to guarantee the user the total and correct restoration of the product original characteristics.



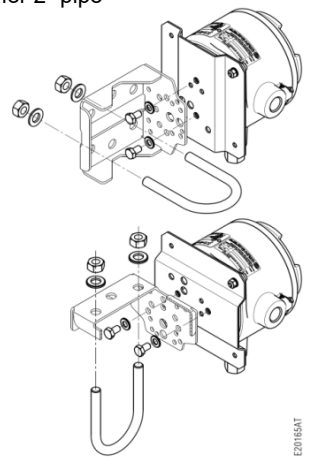
MALFUNCTION	PROBABLE CAUSE	REMEDY
Set point shift	<ul style="list-style-type: none"> ■ Wear of contact surfaces between microswitch pin and sensing element tip. ■ Wear of contact surfaces between microswitch cradle and adjustment screw. ■ Possible encrustations or corrossions on above listed surfaces. ■ Permanent deformation of the sensitive element due to fatigue or non-tolerated over-ranges. ■ Loss of filling fluid. 	<ul style="list-style-type: none"> ■ Recalibrate. ■ Recalibrate. ■ Clean surfaces and recalibrate. Check housing tightness. ■ Recalibrate. ■ Replace instrument.
Poor Repeatability	<ul style="list-style-type: none"> ■ Assembling screws loosened. 	<ul style="list-style-type: none"> ■ Check terminal screws, microswitch, electrical subassembly, fastening screws.
Slow Response	<ul style="list-style-type: none"> ■ Encrustations on bulb or thermowell. 	<ul style="list-style-type: none"> ■ Check and clean encrusted surfaces.
Failed or Undue Actuation	<ul style="list-style-type: none"> ■ Microswitch contacts damaged. ■ Electrical joints loosened. ■ Electrical line interrupted, or short circuit. 	<ul style="list-style-type: none"> ■ Replace microswitch. ■ Check all electrical joints. ■ Check state of electrical line.
Undue Actuation	<ul style="list-style-type: none"> ■ Accidental impacts or excessive mechanical vibrations. 	<ul style="list-style-type: none"> ■ Modify installation arrangement.

Fig. 18 – TW Mounting of the bracket for 2" pipe



13- M6 screws
14- Bracket for 2" pipe

Fig. 19 – TA Mounting of the bracket for 2" pipe



15- Vertical pipe
16- Horizontal pipe

Fig. 20 – Typical installation

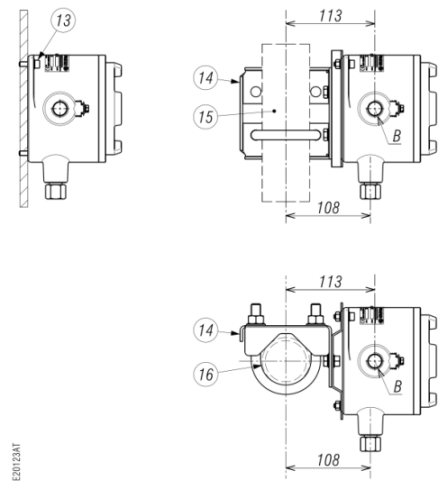


Fig. 21 – Rack mounting

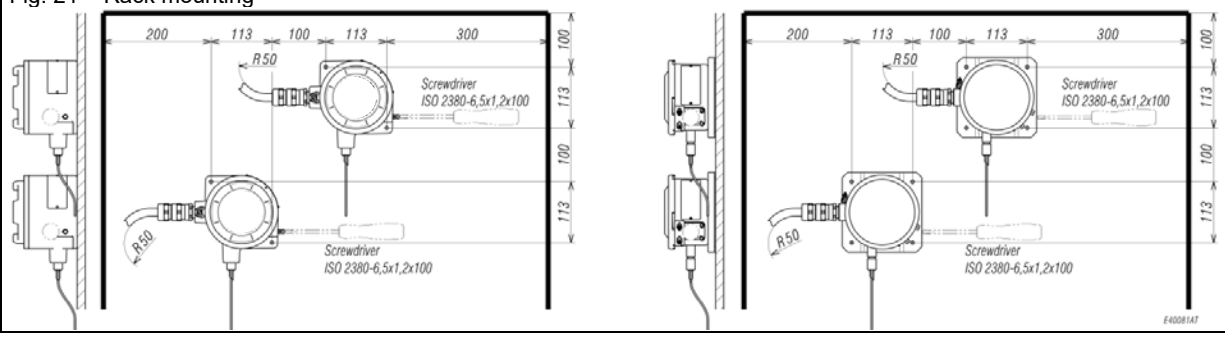
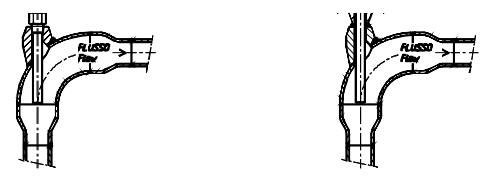


Fig. 22 - Thermowells: example of installation

Minimum dimension 3": for lesser dimensions provide for an increase in diameter up to 3"



Minimum dimension 6": for lesser dimensions provide for an increase in diameter up to 6"

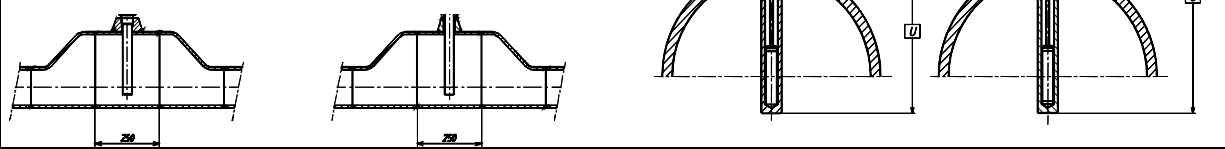
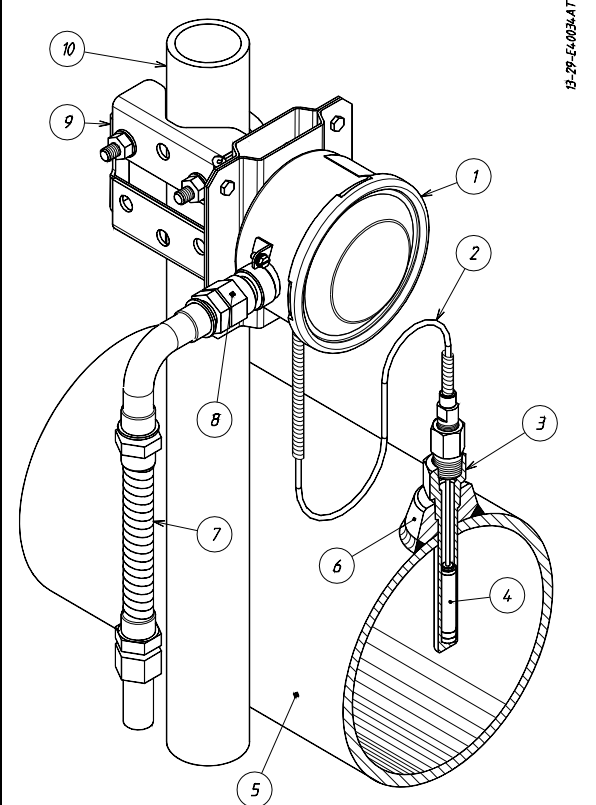


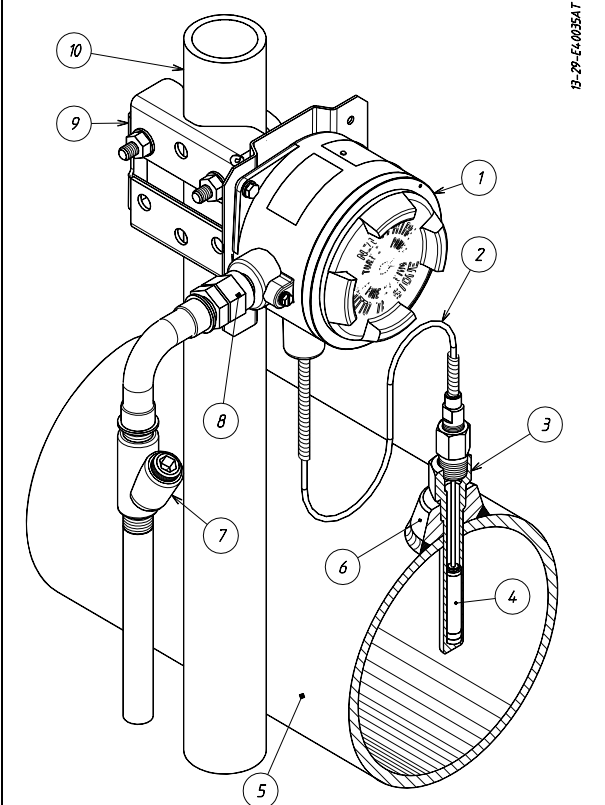
Fig. 23 - Example of connections



13-ZP-E-0034-AT

- | | |
|---|------------------------|
| 1) Weatherproof temperature switch models TWG | 6) Derivation |
| 2) Capillary | 7) Flexible armour |
| 3) Thermowell | 8) Cable gland |
| 4) Bulb | 9) Bracket for 2" pipe |
| 5) Process piping | 10) 2" pipe |

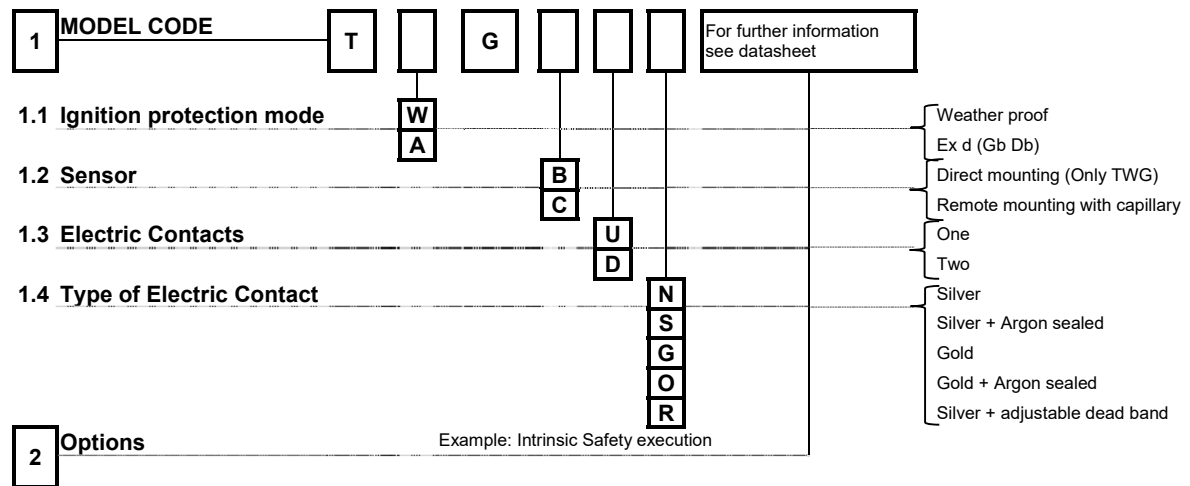
Fig. 24 - Example of connections



13-ZP-E-0035-AT

- | | |
|---|------------------------|
| 1) Flameproof temperature switch models TAG | 6) Derivation |
| 2) Capillary | 7) Blocking joint |
| 3) Thermowell | 8) Cable gland |
| 4) Bulb | 9) Bracket for 2" pipe |
| 5) Process piping | 10) 2" pipe |

Annex 1 – Model Code



12/2018 WIKA based on 12/2016 CELLA