

INDUMART THERMOMETERS

This section of our catalogue is designed to categorize all Indumart thermometers to make it easier for our customers to order exactly the type of thermometer they need. For a careful selection of your required thermometer, the following specifications must be stated:

- Measurement Element
- Accuracy
- Ambient Temperature Compensation
- Range and Unit of Measurement
- Mechanical Shocks and Pulsations
- Dial, Case and Window
- Mounting & Connection Position
- Pressure Connection

Measurement Element

The two methods described in this catalogue are the most widely used ways for temperature measurement without utilizing electricity: (1) bimetallic strip, and (2) volume expansion of gases.

1) Bimetal Thermometers

The principle of temperature measuring method of a bimetal thermometer is to account for the variation in expansion of two pieces of different metal which are welded together and have different thermal expansion coefficients. Any temperature variation will change the length of the metal strips, and since the expansion or contraction of the metal strips are not equal to each other, therefore the bimetal system will bend to the sides. Increasing temperature will cause the bimetal bend toward the metal strip with the smaller thermal expansion coefficient, and decreasing temperature causes the bimetal strip to be inclined toward the higher thermal expansion metal. The bimetal system is placed inside the bulb/stem of the thermometer. The bimetal spiral is attached to an axis which rotates and this movement is translated to the temperature value indicated by the pointer on the dial of the thermometer.

2) Gas-filled Thermometers

The measuring method of a gas-filled thermometer is the expansion of an inert gas in a closed system. Changes in the process temperature will alter the pressure of the gas inside the thermometer stem, and this causes the bourdon tube or spiral tube of the thermometer to move, and this displacement is transmitted to the pointer via the movement mechanism parts, indicating the temperature on the dial.

Accuracy

Accuracy class is the maximum permissible error of indication at a reference temperature expressed as a percentage of the span. Defined accuracy classes of Indumart thermometers are 1.0%, 1.6% and 2.0%. If a liquid filling like glycerine or silicon oil is required, the accuracy will drop at least one class compared to the class of the dry execution.

Ambient Temperature Compensation

Ambient temperature changes may affect the instrument's accuracy, since the ambient calibration temperature is $20 \pm 0.4^\circ\text{C}$. When the ambient temperature varies by $\pm 10^\circ\text{C}$, the indication error will be $\pm 0.2\%$ of the full scale.

For remote thermometers, the error associated with the ambient temperature can be compensated by a bimetallic link mounted inside the case.

Capillary length is also an important source of error at 0.2% of full scale for every extra meter of capillary. However, with a steady ambient temperature, this error can be reduced to its minimum. For example, the maximum advisable capillary length is 6 meters (20 feet), but for a uniform temperature environment this may be extended to 10 meters (30 feet). Therefore, longer capillary is still possible, but compensation capillary and a double differential spiral tube should be utilized for ambient temperature correction.

Range and Unit of Measurement

Indumart thermometers are offered as single or double scale instruments. The scale subdivisions are in accordance to the instrument diameter. The preferred units of temperature are °C or °F. Other temperature units, such as K (Kelvin) are also available on request.

$$^{\circ}\text{F} = 1.8 \times ^{\circ}\text{C} + 32 \quad ^{\circ}\text{C} = (^{\circ}\text{F} - 32)/1.8 \quad \text{K} = ^{\circ}\text{C} + 273.15$$

Standard °F Ranges for Bimetal and Gas Filled Thermometers

Scale Range (°F)	Effective Scale (°F)
-40 +120	-20 +100
0 +200	+20 +180
0 +250	+20 +220
+25 +125	+40 +100
+50 +300	+80 +270
+50 +400	+80 +350
+50 +550	+80 +500
+50 +750	+80 +650
+200 +1000	+250 +900

Standard °C Ranges for Bimetal and Gas Filled Thermometers

Scale Range (°C)	Effective Scale (°C)	Error in °C	
		Class 1	Class 1.6
-40 +60	-30 +50	1	2
-40 +40	-30 +30	1	2
-30 +50	-20 +40	1	2
-20 +60	-10 +50	1	2
-20 +40	-10 +30	1	2
0 +60	+10 +50	1	2
0 +80	+10 +70	1	2
0 +100	+10 +90	1	2
0 +120	+20 +100	2	4
0 +160	+20 +140	2	4
0 +200	+20 +180	2	4
0 +250	+30 +220	3	5
0 +300	+30 +270	5	10
0 +400	+50 +350	5	10
0 +500	+50 +450	5	10
0 +600*	+100 +500	10	15
0 +650*	+100 +530	10	15
+50 +650*	+100 +530	10	15

* Gas-filled Thermometers only

Standard °C+°F Ranges for Bimetal and Gas Filled Thermometers

Headscale (°C)	Innerscale (°F)	Error in °C	
		Class 1	Class 1.6
-50 +50	-60 +120	1	2
-40 +120	-40 +250	2	4
-40 +60	-40 +140	1	2
-30 +130	-20 +250	2	4
-20 +140	0 +300	2	4
0 +60	+32 +140	1	2
0 +100	+32 +200	1	2
0 +120	+32 +250	2	4
0 +160	+32 +300	2	4
0 +200	+32 +400	2	4
0 +300	+32 +570	5	10
0 +400	+32 +750	5	10
0 +500	+32 +900	10	15
0 +650*	+32 +1200	10	15

Mechanical Shocks and Pulsation

Shocks and vibrations reduce life and accuracy of thermometers. Therefore, mechanical vibration on the measuring system of the thermometer should be prevented. If measuring temperature in a vibrating area is inevitable, applying the followings will improve the temperature reading:

- use of a rubber shock dampener,
- remote measurement by means of a capillary,
- filling the thermometer case with glycerine or silicon oil (temperature dependant).

Dial, Case and Window

One important factor in selecting the dial size is the distance between the installation point and the reader's position. The nominal sizes of standard thermometers are 63, 80, 100, 125 and 160 mm.

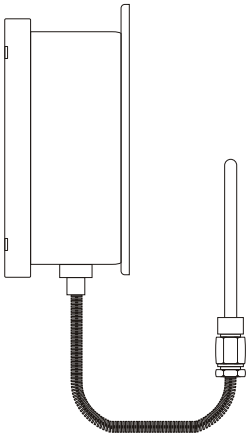
Decision making about the preferred case material is usually based on the installation environment. Indumart offers plastic, aluminum, painted steel and stainless steel cases.

Selection of the window material is based on the installation environment and the fluid state and its characteristics (safety measures). Three types of windows to choose from are: (1) flat instrument glass, (2) laminated safety glass, (3) acrylic / plexiglas. It should be noted that not all window types might be available for a particular thermometer.

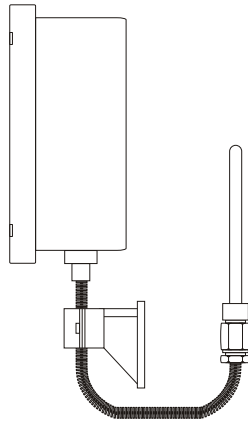
Mounting & Connection Position

Indumart offers direct and remote mounting thermometers. For direct mounting, one should apply a tightening torque to the connection by means of a spanner and not by grasping and turning the case. For remote mounting, sudden bending of capillary which causes restrictions and cracks to the line should be avoided, and surplus capillary should be wound up with a diameter of about 30 cm (1 ft).

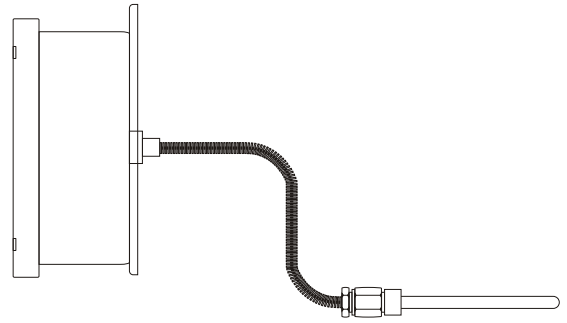
Remote Mounting Types



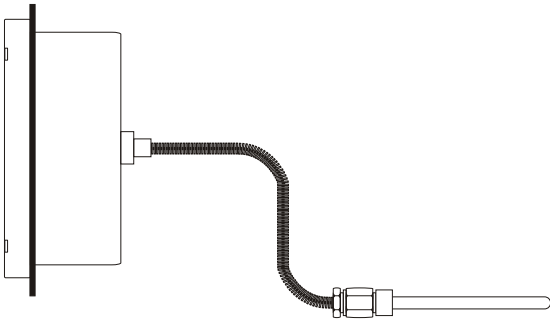
Wall Mounting
Back Flange
Bottom Connection



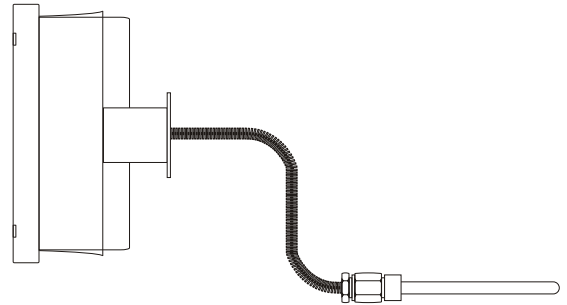
Wall Mounting
Console
Bottom Connection



Wall Mounting
Back Flange
Back Connection

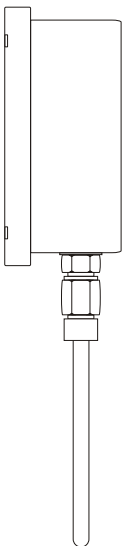


Panel Mounting
Front Flange
Back Connection

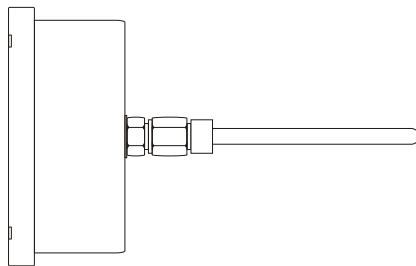


Panel Mounting
U-Clamp
Back Connection

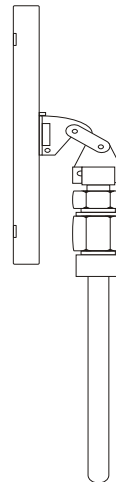
Direct Mounting Types



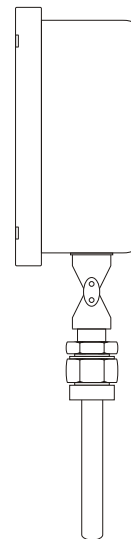
Bottom Connection



Back Connection



Bimetal Every Angle

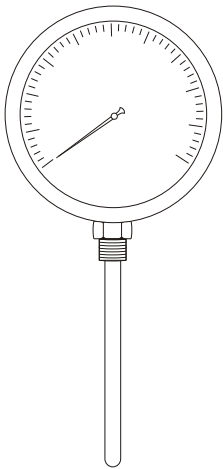


Gas-filled Every Angle

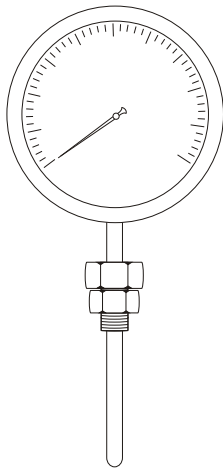
Process Connection

Indumart offers five types of connection (insertion) configurations as shown below.

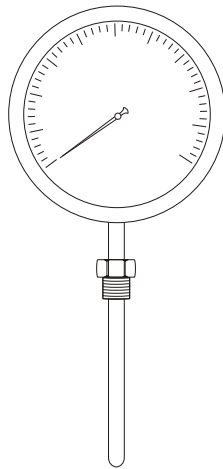
Insertion Types



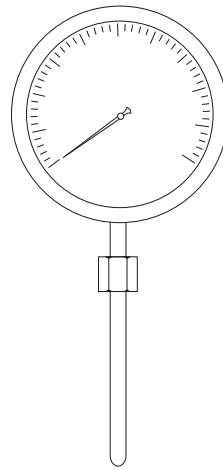
Fixed



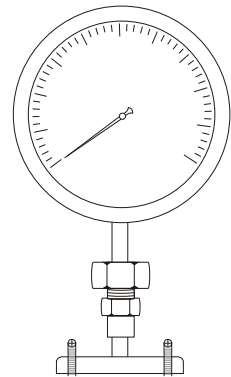
Sliding Adjustable



Rotating Male



Rotating Female



Surface Mounting

Indumart is your single source for all temperature and pressure instruments requirements.

- Dial & Digital Indicators
- Transmitters & Thermostats
- Recorders & Controllers
- Calibrators
- Manifolds & Thermowells
- Thermocouples & RTD's

