

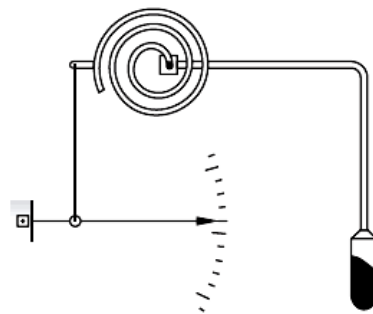
GENERAL INFORMATION ABOUT THERMOMETERS



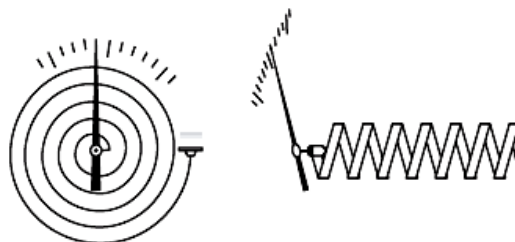
INTRODUCTION

The name is referred generally to an instrument for the measurement of temperature, but in practice it is an instrument to measure temperature changes by means of dimension variation (bimetal thermometer) or pressure variations (gas expansion thermometer) or electric resistance variations (resistance thermometers) resulting from temperature changes.

GAS EXPANSION THERMOMETER. The measuring principle of these thermometers is based on pressure variations caused by the expansion of a fluid or gas into a closed enclosure. The closed sensing element is made of a Bourdon tube pressure gauge connected to the thermometric bulb containing the liquid or the captor gas through a flexible capillary. Using a gas (Nitrogen or Helium), the temperature-volume-expansion is linear.



BIMETAL THERMOMETER. The bimetal temperature gauge relies on the difference between the thermal expansion of two different metals which are welded at one end and laminated together in a wound cylindrical or flat spiral.



DEFINITIONS

THE BULB is the vessel containing the sensing element (liquid, gas, bimetal) and it is put into the heat source.

THE WELL is used to contain the bulb to protect it against corrosion, abrasion, bending and breakage and to separate the process fluid from the ambient.

SPIRAL BOURDON SPRING is the indicator element able to pick up pressure variations caused by the thermal expansion of intermediary fluid contained in the bulb.

FLEXING CAPILLARY TUBE is the transmission and connection element between bulb and spiral Bourdon tube. It is used to read temperature remote from the heat source.

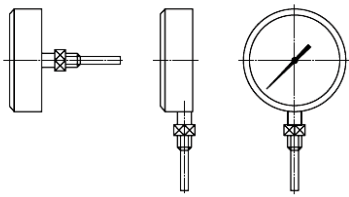
THERMOMETER SELECTION GUIDE

The following requirements must be considered when selecting a thermometer:

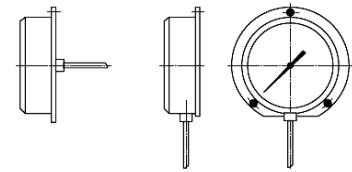
1. Position
2. Working conditions
3. Accuracy

These will be analyzed with the possible options for each requirement

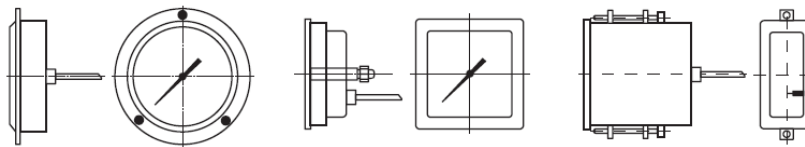
1. POSITION



Local mounting that is directly on the pipe

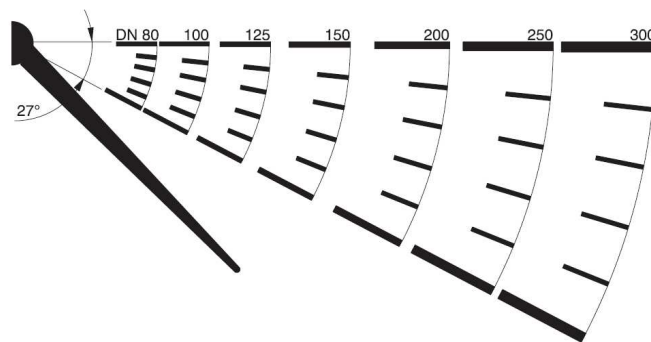


Panel mounting through a 3 hole rear flange



Panel mounting through a 3 hole front flange or rear bracket

Instrument diameter must be chosen in relation to distance between installation point and reading position to ensure the operator can see the graduated scale reading. This is a representation of real legibility of scale subdivisions in relation to instrument diameter.



$27^\circ = 1/10$ of the angular scale extension

2. WORKING CONDITIONS

It is important to know the working conditions the thermometer will be operating in. Things to consider are:

- **Fluid nature**
- **Fluid pressure**
- **Ambient temperature**
- **Mechanical vibration**

The thermometers efficiency and life depend on knowing the above conditions.

Fluid Nature

Inert: it is applied to whole range of instruments in standard constructions.

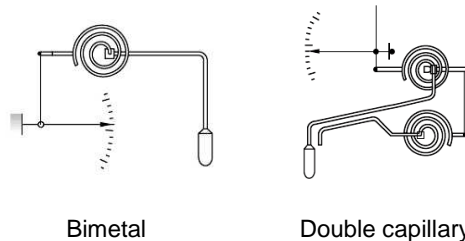
Corrosive: it is applied the whole range of instruments but manufactured with materials suitable to resist the corrosion.

Fluid pressure

Fluid pressure in the temperature sensors must be considered for the bulb joints in order to prevent leaks. Average error due to external pressure on inert gas thermometers is +/- 1° every 40 bar.

Ambient temperature

The ambient temperature during the calibration of the instrument is 20°C +/- 2°C, so every ambient temperature variation from this value will influence the precision of the thermometer. In inert gas or liquid filled thermometers the quantity of gas or liquid contained in the capillary and spiral Bourdon tube reacts to the ambient temperature and alters the indication. This influence on spiral tube must be cancelled by means of a bi-metallic auto-compensator installed between spiral tube and the amplifying mechanism. This auto-compensator is suggested when the ambient temperature varies by least 10°C from the thermometer calibration temperature. The error resulting from liquid contained in capillary, is equal to 0,2% of F.S.V. for an ambient temperature of 10°C and for every meter of capillary tube. Therefore capillary liquid filled thermometers are recommended for taking temperatures at a maximum distance of 6 meters, exceptionally capillaries with a maximum length of 10 meters are permissible on condition that ambient temperature is constant. For capillaries of exceptional lengths which are considerably influenced by ambient temperature it is necessary to use double compensation thermometers so that reading precision will not be modified by inconsistent and random values. Bi-metallic cylinder propeller thermometers are free from error resulting from ambient temperature variations.



Mechanical vibration

If possible, it is better to avoid mechanical vibrations. It is necessary to anchor instrument to a rigid wall and to sense temperature by means of a capillary. We suggest interposing a vibration-proof rubber element between wall and case. In moving installations and on marine engines we suggest mounting the elastic suspension type.

3. ACCURACY

In relation to reading precision we have the following classes:

- Class 1: test thermometers
- Class 2: precision thermometers
- Class 3: commercial quality thermometers.
- Glass laboratory thermometers belong to Class 1.

Dial thermometers belong to classes 2 and 3. Admitted tolerance for class 2 is +/- 1% of f.v.s.

Admitted tolerance for class 3 is +/- 2% of f.s.v.

The best application conditions are obtained with working temperature inclusive in the middle of graduated scale. When ordering instruments, please specify accuracy class.

FUNCTION

The following points about working conditions must be considered.

1. Avoid over temperatures exceeding following values:
 - a. 20 times max. scale for scale ranges lower or equal to 150°C.
 - b. 15 times max. scale ranges between 150°C and 400°C.
 - c. 10 times max. scale for scale ranges higher than 400°C.
2. Mechanical vibrations must not exceed normal values
3. Minimum level of the fluid in temperature must always cover sensing bulb for a minimum length of 50mm. for max. scale equal to or higher than 150°C. 80mm for max. scale of 100°C, 120 mm for max. scale of 60°C and lower;
4. Heat source must be well shielded so as not to influence capillary