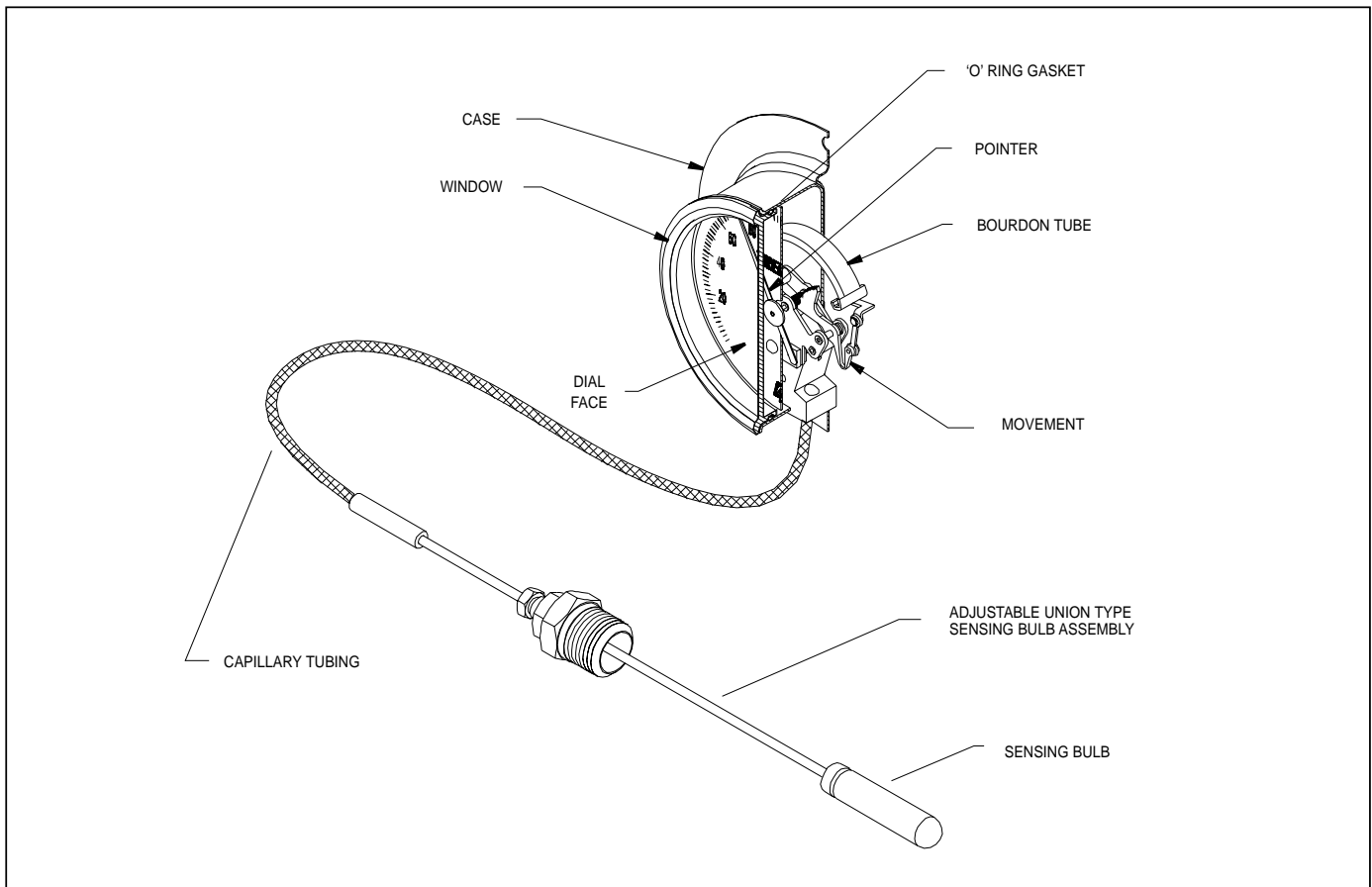


What is a Dial Thermometer?

Definition

A thermometer is an instrument designed to measure and indicate the temperature of a specific application or condition. A Dial Thermometer (filled system thermometer) can either be read at the point of measurement or from a remote location using a desired length of capillary tubing.



Principles of Operation

Terice Dial Thermometers operate using a filled thermal system. This system consists of capillary tubing and a sensing bulb, which are filled with an expandable chemical compound. The fill is contained within the sealed thermal system, and is affected (expands or contracts) by temperature changes at the sensing bulb. As temperature increases, expanding fill travels via the capillary tube system to the bourdon tube within the instrument's case. The expansion causes the bourdon tube to flex and the resulting motion is transmitted as a temperature measurement through a mechanical movement to the pointer and dialface.

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Selecting a Dial Thermometer

All Trerice Filled System Dial Thermometers should be carefully selected to meet the demands of the particular application. The information contained in this catalog is offered only as a guide to assist in making the proper selection. Improper application may cause failure of the instrument, resulting in possible personal injury or property damage. For applications where the process media may be corrosive or contained under pressure, the use of a thermowell is required to prevent damage to the thermometer and facilitate its removal from the process.

Thermal System Actuation

Trerice Dial Thermometers are available in one of three system actuation fills: Vapor, Liquid, and Mercury.

Vapor Actuation

Trerice Vapor Actuated Dial Thermometers are the industry standard and are noted for their economical cost and excellent speed of response. The physical principles of vapor actuation require that the dialface be printed with a nonlinear, progressively graduated temperature scale. These instruments are available for direct mounting, or for remote mounting with capillary lengths up to 100 feet. Sensing bulb length is dependent upon the capillary length selected (a longer capillary length will require a longer sensing bulb length). Vapor Dial Thermometers are available in temperature ranges up to 450°F (232°C). **Note: Erratic performance may be encountered if the measured process temperature rapidly crosses ambient temperature.**

CAUTION: Vapor Dial Thermometers should be installed with the case, capillary tubing, and sensing bulb located at a similar elevation to avoid measurement inaccuracies. If the sensing bulb must be installed at a different elevation than the case, please advise the factory when ordering so that the instrument can be calibrated accordingly.

Liquid Actuation

Trerice Liquid Actuated Dial Thermometers have a good response time and are furnished with a temperature scale of linear graduation. These instruments are available for direct mounting, or for remote mounting with capillary lengths up to 20 feet. Sensing bulb length is consistent and not affected by capillary length or temperature range. Liquid Dial Thermometers are available in temperature ranges up to 300°F (150°C) and are ideally suited for measuring process temperatures which routinely cross ambient. However, care should be taken to insure against the exposure of the capillary to temperatures above or below the factory calibration temperature of 75°F (24°C).

CAUTION: Temperature indication error will be introduced whenever the capillary tubing is exposed to ambient temperatures above or below 75°F. The following formula MUST be considered when specifying liquid actuation:

Where: S = thermometer range span in °F
L = capillary length in feet
T = capillary temperature variation from 75°F

$$\text{Error} = 0.000082 \times S \times L \times T$$

Example: S = 210 (30 to 240°F)
L = 20
T = 10 (85°F)

$$\text{Error} = 0.000082 \times 210 \times 20 \times 10 = 3.4^\circ$$

Mercury Actuation

Trerice Mercury Actuated Dial Thermometers provide an average speed of response and are designed for high temperature applications (up to 1000°F) or those requiring extreme accuracy (optional accuracy of $\pm 1/2$ scale division). These instruments are available for direct mounting, or for remote mounting with capillary lengths up to 100 feet. Capillary lengths over 50 feet require a special temperature compensated capillary, which reduces any ambient temperature error. Sensing bulb length is dependent upon the temperature range span

CAUTION: Temperature indication error will be introduced whenever *NONCOMPENSATED* capillary tubing is exposed to ambient temperatures above or below 75°F. The following formula MUST be considered when specifying liquid actuation without compensated capillary tubing:

Where: S = thermometer range span in °F
L = capillary length in feet
T = capillary temperature variation from 75°F

$$\text{Error} = 0.000015 \times S \times L \times T$$

Example: S = 210 (30 to 240°F)
L = 20
T = 10 (85°F)

$$\text{Error} = 0.000015 \times 210 \times 20 \times 10 = 0.6^\circ$$

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selected (a narrower range span will require a longer sensing bulb length). Mercury Dial Thermometers are furnished with a temperature scale of linear graduation.

Thermal System Actuation Comparison

Consideration	Vapor Actuation	Liquid Actuation	Mercury Actuation
Price	Economical	Midrange	Premium
Response Time	Excellent	Good	Average
Dialface	Non-linear	Linear	Linear
Maximum Temperature Range	450°F (232°C)	300°F (149°C)	1000°F (538°C)
Cross Ambient Applications	Not recommended	Recommended	Recommended
Available Thermal Systems	All (except averaging)	All	Stainless steel only (averaging not available)
Bulb Size	Dependent on capillary length	Consistent	Dependent on temperature range
Maximum Capillary Length	100 feet	20 feet	100 feet (compensated capillary required over 50 feet)
Accuracy	±One scale division	±One scale division	±One scale division standard ±1/2 scale division optional

Case

Cases are made from stainless steel or cast aluminum, in sizes from 3 1/2" through 8 1/2". Trerice Dial Thermometers can be directly mounted, or remotely mounted using capillary tubing, so that the measurement can be read from a convenient viewing location. Direct mounted thermometers are available with adjustable angle or universal angle connections, while remote mounted thermometers can be ordered for almost any surface or panel mounting requirement.

Window and Ring

The window is normally held in place by a ring or snapped directly to the case of the thermometer. Plastic and clear glass are typical window materials. Ring styles include threaded, friction and hinged, depending upon the case type chosen.

Accuracy

The accuracy of a dial thermometer is expressed as a variance (plus or minus) in scale divisions. All Trerice Dial Thermometers are accurate to within one scale division of the measured range. Mercury Actuated Dial Thermometers can be ordered with an optional accuracy of ±1/2 of one scale division at additional cost. Ambient temperature conditions and elevation variances may effect measurement accuracy.

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Measurement Range and Dial

Trerice Dial Thermometers are available in Fahrenheit, Celsius, and Dual Scale temperature ranges from -40°F through 1000°F. Ranges are indelibly presented in black figures and markings upon a white finished aluminum dialface. The physical principles of vapor actuation require the dialface to have a non-linear, progressively graduated temperature scale; therefore, the temperature range should be selected so that the intended measuring point falls within the upper two-thirds of the range scale. Both Liquid Actuated and Mercury Actuated Dial Thermometers have temperature scales of linear graduation, thus, the intended measuring point should fall within the middle third of the range scale.

Thermal System

- **Bulb** – Trerice Dial Thermometers are furnished with copper, brass or stainless steel sensing bulbs, depending upon the system actuation and the requirements of the application. A fixed union connection is standard, with an adjustable union connection optionally available. The fixed union connection is furnished with a standard sensing bulb length of 1³/₄" to 5⁵/₈", depending upon the actuation, capillary length, and temperature range specified. The adjustable union connection may be adjusted over a 24-inch length prior to initial insertion. This allows the sensing bulb to be installed at any desired insertion length (U-length). Plain and Teflon covered bulbs are available for open tank applications. Other bulb styles, including averaging and air-sensing, can be furnished on some models. Please see the Dial Thermometer Sensing Bulb Section for complete bulb specifications.
- **Capillary** – Trerice Dial Thermometers can be specified with various capillary materials and special covers to meet the requirements of any application. Mercury Actuated Thermometers are supplied only with stainless steel tubing and can be specified with self-compensating capillary tubing (required on thermal system over 50 feet), which will reduce any ambient temperature error.

Thermowells

For applications where the process media may be corrosive or contained under pressure, the use of a Trerice Thermowell is required to prevent damage to the thermometer and facilitate its removal from the process. Thermowells are available in various lengths, connections, sizes, and materials. Please consult the Thermowell Section of this catalog.

To ensure minimum response time, Trerice Heat Transfer Paste should be applied to the sensing portion of the bulb before installation into a thermowell.

1 oz. tube: Item No. 107-0001