

Unraveling the Tangled World of Digital Thermometers

| Type of Device | How Much? | Uncertainty | Durability | Range of Use | Benefits | Downfalls |
|---|--|--|---|------------------|--|--|
| STANDARD PLATINUM RESISTANCE THERMOMETERS | \$6,000 or More  | Excellent To Within 0.0001°C  | Low  | -200°C to 650°C | <ul style="list-style-type: none"> Highly Accurate | <ul style="list-style-type: none"> High Cost Susceptible to Damage Readings tend to drift |
| INDUSTRIAL PLATINUM RESISTANCE THERMOMETERS | \$200 to \$2000  | Good 0.02 to 0.1°C  | Mediocre  | -200°C to 650°C | <ul style="list-style-type: none"> Great Accuracy More rugged than SPRT Reasonable cost | <ul style="list-style-type: none"> Somewhat susceptible to damage Readings tend to drift |
| THERMISTORS | \$200 to \$2000  | Great 0.01 to 0.1°C  | Good  | -5°C to 90°C | <ul style="list-style-type: none"> Great Accuracy Rugged | <ul style="list-style-type: none"> Limited Range of use |
| THERMOCOUPLES | \$100 to \$1000  | Mediocre Over 1°C  | Great  | -200°C to 1800°C | <ul style="list-style-type: none"> Rugged Low Cost | <ul style="list-style-type: none"> Problems with Accuracy Readings tend to drift |
| INFRARED THERMOMETERS | \$30 to \$200  | Poor Over 2°C  | Fair  | -50°C to 1100°F | <ul style="list-style-type: none"> Low Cost Non-Contact Measurement | <ul style="list-style-type: none"> Problems with Accuracy User Error Likely |

2011 DIGITAL

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Purchasing a Digital Thermometer

There are numerous choices available, with prices ranging from just a few bucks to thousands of dollars. So, which one of these devices is right for you?

Thermistors

If you are looking for great accuracy and fast response time at a reasonable price, you're in luck—thermistors offer just that. Unfortunately, their ultra-limited range of use makes them suitable only for measurements near room temperature. Bead-in-glass elements offer greater stability than disc-type elements and are more suitable for high-precision applications.

Standard Platinum Resistance Thermometers

The golden standard, SPRTs are used by the National Institute of Standards and Technology (NIST) to calibrate other thermometers. While they offer an incredible degree of accuracy, these devices are generally not practical for laboratory use due to their high cost and susceptibility to damage.

Thermocouples

While versatile in range of use, and generally inexpensive, thermocouples tend to have inaccuracy problems and high measurement uncertainties. Thermocouples should only be used when one or more degrees of error in temperature measurement is acceptable. Exposed junction thermocouples have the fastest response time, but are not appropriate for use with liquids, or under pressurized conditions. Grounded thermocouples have a slower response time than ungrounded ones, but are also less susceptible to errors caused by electrical interference. Thermocouples come in several types. The type of thermocouple is dependent upon the materials of which they are made. Types available include B, C, E, J, K, N, R, S, and T. Type K thermocouples are most commonly used for laboratory and industrial applications, and offer reliability and longevity. Choose a probe-type thermocouple with a protective metal or ceramic tube, especially if measuring the temperature of liquids. Bead-type thermocouples are more susceptible to damage, but can be used in situations where a probe-type device is not suitable.

Industrial Platinum Resistance Thermometers

Also called resistive thermal detectors (RTDs), these devices have low measurement uncertainty (and therefore greater accuracy) at a high cost. They offer versatility in their range of use, but are easily susceptible to damage that can occur if the device is dropped or subjected to vibration. IPRTs should only be used in situations where shock or vibration is unlikely, and should always be handled with extreme care. Choose a probe with a 3- or 4-wire configuration. While slightly less accurate, film IPRTs offer greater stability and are less prone to damage, and therefore may be a good option for some applications. Go for a probe-type sensing element, and not a bare element, unless the device is used in a permanently fixed location. Be sure to check the manufacturer's specs to ensure that the immersion depth fits your needs. Before purchasing, ensure that the IPRT conforms to the requirements of ASTM E 1137.

Infrared Thermometers

Infrared thermometers offer a non-contact method of temperature measurement, and can only be used to measure surface temperature. Infrared is the least-accurate form of temperature measurement available for materials testing, having a measurement uncertainty that can exceed 5°C. Temperature measurement of uneven surfaces, such as asphalt mixtures, soils, and aggregates can cause increased inaccuracies. These types of thermometers are not recommended for most laboratory applications, and should only be used on smooth, flat surfaces.