Non Contact Temperature Measurement

Tempsens white paper

Tempsens Instruments Pvt. Ltd.

Non contact temperature measurement refers to measurement of the temperature of a body utilizing the infra red rays emitted by it. It is a preferred technique for small, moving, or inaccessible objects; dynamic processes that require fast response. Understanding the basics of temperature measurement technology, its parameters and different features available can help to select the best noncontact temperature measurement device for a particular application. A non contact thermometer estimates the surface temperature of an object by measuring the Infra red radiation emitted by it. Infra red is the portion of the electromagnetic spectrum beyond the visible response of the human eye. IR wavelengths extend from 0.75 μm to 1000 μm.

Temperature plays an important role in various industries, in manufacturing, quality control, medical industries etc. Accurate temperature monitoring improves product quality and increases productivity. Infrared technology has been utilized successfully in industrial and research settings for many years. But new technical innovations have reduced costs and attracted many users and applications. The main advantages of noncontact IR thermometry are speed, lack of interference, and the ability to measure in high temperature ranges to 3000°C. Infra red thermometers can be used for moving and inaccessible objects too. Infra red technology can only be used to measure surface temperatures though.

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General Introduction

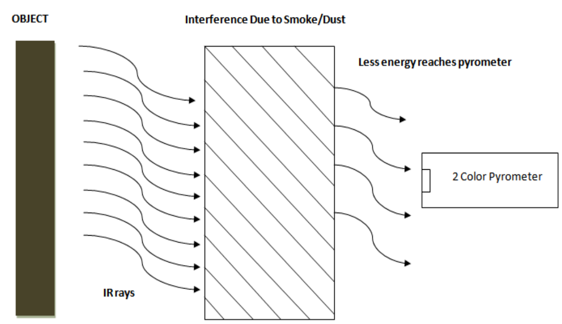
Depending on its temperature every form of matter emits infra red radiation when it is above absolute zero. Temperature of an object depends on the intensity of its molecular movement. The infra red radiations emitted by the target can be utilized to estimate the temperature of its surface. Pyrometers or infra red thermometers are used to collect these infra red radiations and determine temperature. Depending on the various applications there is a variety of pyrometers available and manufactured today.

Emissivity and Radiation Thermometer

Emissivity defines the fraction of radiation emitted by an object as compared to that emitted by a black body at the same temperature. Emissivity depends on the type of material and its surface conditions. It can vary from close to zero to almost one for certain materials. Knowledge of emissivity of an object is required to determine its correct temperature. Emissivity values are listed in the literature for a variety of materials and spectral bands or these values can be determined as well.

Single color pyrometer measure and evaluate the intensity of the intercepted infrared radiations. Intensity is measured in the narrow wavelength band. Wavelength band selection depends on the temperature range and the type of the material to be measured.

Two color pyrometers or ratio pyrometers measures temperature on the basis of two (or more) discrete wavelengths. The main advantage of ratio pyrometer is that the measurement is independent of emissivity and hence emissivity fluctuations have no effect on the temperature measurement. Temperature measurement in this case is dependent on the emissivity ratio of the material on the two discrete wavelengths.



Accurate Measurement

Temperature measurement accuracy is largely dependent on the appropriate setting if the required parameters. Emissivity setting is one of the critical point.

Thermal target radiation always contains stray radiation emitted by the environment surrounding the target area and reflected by the target's surface. Generally the ambient temperature is frequently presumed to be the same as the temperature of the sensor. If the target is exposed to a different ambient condition, e.g., inside a heated furnace, inside a hot chamber, adjustments are necessary for accurate measurement. Gases, water vapor, dust, and other particles in the sight path of a sensor may affect the temperature reading. Since both optical channels are equally affected, ratio pyrometers are generally immune to sight path obscuration, and the signal color ratio remains unaffected.

Radiation thermometers are strongly affected by ambient temperature changes. To maintain high measurement accuracy, precise compensation of this temperature drift is required.

Optics

Optics in radiation thermometers are usually of fixed-focus type. The target area which is measured by a pyrometer is called its spot size. For accurate measurement in single color pyrometer the spot size should be smaller than the object. However a ratio pyrometer can measure the temperature of an object whose size is smaller than its spot size. The details about the spot size and optics of the pyrometer are always available with the manufacturer of the pyrometer. With the given details about the field of view of the pyrometer, spot size at a particular distance can be calculated and hence measuring distance of the pyrometer can be decided. The FOV allows easy calculation of the minimum target size for each working distance. A convenient measure is the distance-to-target ratio, e.g., 50:1, indicating a minimum target of 1 mm at a 50 mm measuring distance.

Pyrometer with fiber optics is used for applications involving strong electrical or magnetic interference fields. It makes possible to place the electronic system outside the danger zone. Fiber optics permits a physical separation of the lens assembly from the detector and signal processing electronics.

Measuring Objects

Radiation thermometers are widely used nowadays in different industries in various applications. They are used to measure temperature of metals, plastics, glass and also in medical industries.

Since metals often reflect they tend to have low emissivity. Low emissivity means very low energy is being emitted from the metal surface, which can cause unreliable results. Selecting an instrument which measures the infra red radiation at a particular wavelength and within a particular temperature range at which the metals have the highest possible emissivity can minimize errors. The optimal wavelength for high temperatures in the case of metals is, at around 0.8 to 1.0 μm. Wavelengths of 1.6, 2.2, and 3.9 μm are also possible.

When measuring the temperature of glass with an infrared thermometer, both reflectance and transmittance should be taken into account. By carefully selecting the wavelength, it is possible to measure temperature of both the surface and at a depth. When taking measurements below the surface, a sensor for 1.0, 2.2, or 3.9 μm wavelength should be used. A sensor for 5 μm for surface temperatures in glass is recommended. Since glass is a poor conductor of heat, and can change surface temperature rapidly, a measuring device with a short response time is recommended.

Pyrometer Enquiry Form:

Request from - Name: Company Name : Address:
Object/Target material : Material description/ Material Surface description :
Possible measuring distance (in mm) :
Size of the Object (in mm) :
Temperature range to be measured :
Ambient conditions (Ambient temperature/Humidity) :
Output :
Additional Details/ Drawings/ Photographs of the Site: