Technical Information Data Bulletin

How to Determine Emissivity Values

TEMPERATURE & PROCESS INSTRUMENTS INC

Infrared energy

Each body, at temperatures above the absolute zero (-273°C or 0K), emits energy in the form of electromagnetic radiation. As the temperature of the body rises, the intensity of this infrared energy increases. The temperature of the body can therefore be determined by measuring the intensity of this infrared energy. An equipment used to measure the temperature with this method is called "infrared thermometer" or a "non-contact thermometer" since the thermometer is not required to be in contact with the body in order to measure its temperature.

PTLST-20 Series Documenting Infrared Therermometer

Applications

The temperature measurement of liquids or gases is well accomplished using a thermoelectric sensor thanks to the good thermal exchange between the sensor and the fluid. When solid objects are to be measured it is difficult to obtain a good thermal exchange and the possibility of making an additional error should be kept into consideration. Temperature measurements with direct contact are often impossible to be carried out when the target is moving or is connected to dangerous electrical sources or when, for any other reason, it is impossible or difficult to touch it.

Emissivity

The infrared energy emitted by a body differs according to the composition of the body and to the physical condition of the surface. Non-contact thermometers are calibrated using a blackbody source (made with material that absorbs energy at all wavelengths) as a reference standard. However, to obtain the reading of the true temperature, it is necessary to compensate the thermometer for the actual emissivity of the object to be measured.

$$\text{Emissivity} = \frac{\text{Surface Radiation}}{\text{Blackbody Radiation}}$$

The emissivity values relevant to different materials and surface conditions are detailed below "How to Determine an Object Emissivity". The values from the above tables are reference values only: emissivity can in fact be slightly higher with a higher oxidation of the material .

Reflected energy compensation

The radiation perceived from the thermometer is the one emitted by the target plus the radiation reflected by the surface of the object itself. To obtain more accurate readings, particularly for measurements of low emissivity temperature objects, the energy reflected from the target should be considered; that energy changes according to the temperature of the surrounding environment.

How to Determine an Object Emissivity

Emissivity is the measure of an object ability to absorb, transmit, and emit infrared energy. It can have a value from 0 (shiny mirror) to 1.0 (blackbody). If a value of emissivity higher than the actual one is set, the output will read low, provided that the target temperature is above the ambient one. For example, if 0.95 is set in and the actual emissivity is 0.9, the reading will be lower than the true temperature when the target temperature is above the ambient one.

The emissivity can be determined by one of the following methods, in order of preference:

1. Determine the actual temperature of the material using a sensor such as a RTD, thermocouple or another suitable method. Next, measure the object temperature and adjust the emissivity setting until the correct value is reached. This is the correct emissivity for the measured material.

CS Series Fixed Mounted Infrared Therermometer

2. For relatively low temperature objects (up to 260°C or 500°F, place a piece of tape, such as a masking, on the object. Make sure the tape is large enough to cover the field of view. Next, measure the tape temperature using an emissivity setting of 0.95. Finally, measure an adjacent area on the object and adjust the emissivity setting until the same temperature is reached. This is the correct emissivity for the measured \material.

3. If a portion of the surface of the object can be coated, use a flat black paint, which will have an emissivity of about 0.98. Next, measure the painted area using an emissivity setting of 0.98. Finally, measure an adjacent area on the object and adjust the emissivity setting until the same temperature is reached. This is the correct emissivity for the measured material.

Temperature & Process Instruments Inc. **Visit us on the web at www.tnp-instruments.com**
1767 Central Avenue * Suite 112 * Yonkers * NY * USA * 10710 * Phone: (914) 673-0333 Fax: (866) 292-1456