



Pyrometer and infrared camera - a perfect team

Industrial applications in which non-contact temperature measurement must take place range from Research & Development, through production to maintenance. In most cases, infrared temperature measurement technology is used. Selecting suitable devices is not totally straightforward. As well as the decision between pyrometer and infrared camera, many other boundary conditions must be taken into consideration.

Temperature is one of the most common measurement values which needs to be determined in industrial applications. In many cases the classic method of temperature measurement using a thermometer - typically a platinum resistance thermometer - is used. This however still requires contact between the medium whose temperature is to be measured and the thermometer. For this reason, this method is unsuitable for many applications, for example for delicate surfaces, for moving objects or if no direct contact is possible due to geometries. The measuring method is also relatively slow, since a thermal equilibrium always needs to be established between the measurement object and the thermometer.

Temperature measurement using infrared radiation

One method to achieve non-contact measurement of temperatures is based on the infrared radiation emitted by all bodies. Back in 1900, Max Planck described the spectral distribution of this electromagnetic radiation which depends on the temperature of the body in the law of radiation named after him. Up to temperatures of around 3,000 K, the maximum point of the radiated spectrum is

Using infrared cameras, not only can temperatures be measured without contact - they can also measure the temperature distribution within a measurement

within the infrared range. This is also the reason that incandescent lightbulbs are such inefficient light sources, and have now been almost completely banned from the EU market.

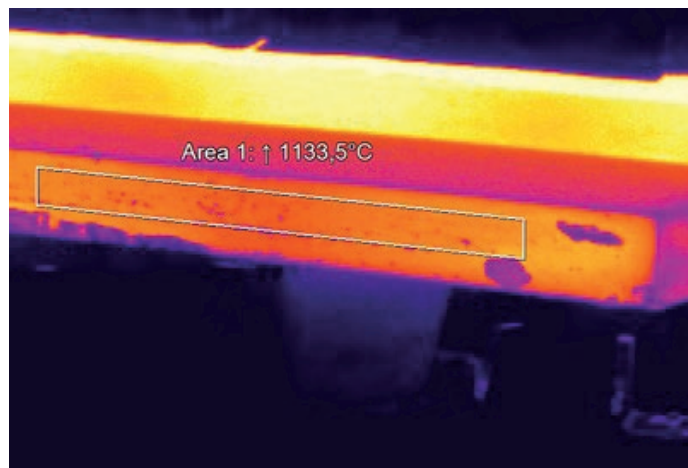
Planck's law of radiation is only valid however for ideal black body emitters. The real radiation energy emitted depends on the so-called emissivity, which in turn depends on the material, the surface condition of the body as well as the temperature and wavelength. To be able to use infrared radiation for temperature measurement, it may be necessary to correct the measurement taking into account the emissivity.

Different detector types

There are different types of detectors which determine the temperature of a body by using the infrared radiation emitted. The thermopile is based on the thermoelectric effect, which means that heating the junction of two different metals results in a voltage. Thermic elements for contact temperature measurement are also based on this effect. For this reason, detectors where the heating is created by infrared radiation are known as radiation thermic elements. A frequently used combination of materials in thermopiles is bismuth and antimony.

In a pyroelectric detector, the radiation-sensitive element consists of a pyroelectric material with two deposited electrodes. The pyroelectric effect, which can be compared to the piezoelectric effect, creates a surface charge which is converted into a measurable electric signal using a preamplifier. Since this detector element is not able to measure continuously, the irradiation must be inter-

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01 The wide spectrum of pyrometers allows non-contact measurement of temperatures in various industrial applications

02 Many applications require non-contact temperature measurement - metal is only one of many examples

rupted at regular intervals using a chopper. This allows a good signal-to-noise ratio to be achieved through frequency-selective amplification.

Another type of detector is the bolometer, which is based on the temperature dependence of a resistor. A signal voltage which drops with the bolometer resistance changes when infrared radiation is absorbed. This detector type can have a particularly high sensitivity if a material with a high temperature coefficient of resistance is used. Thermal imaging cameras where the temperature measurement takes place with a spatial resolution thereby allowing them to create a thermal image are generally based on bolometric detectors.

Point or area measurement

When selecting a suitable non-contact temperature measurement technology, numerous boundary conditions need to be taken into account. Depending on the requirement, the user then needs to decide whether they only need to measure the temperature at a single point, or whether the temperature distribution across the object is relevant. The former will apply if the temperature is homogeneous across the surface or no location-dependent temperature information is required. Temperature sensors which can only record the temperature at one point are described as pyrometers. In contrast, an infrared or thermal imaging camera provides significantly more information and can for example also be used to determine the hottest or coldest point within the measuring area. The temperature distribution within a measurement area is normally shown in a false color image. An infrared camera is however much more complex and produces a very large amount of data, which must be processed, and depending on the application, stored. An infrared camera generally also has a higher price.

Pyrometers and infrared cameras for every application

Optris GmbH is one of the market leaders in the infrared temperature measurement technology sector. "We are a globally active business headquartered in Germany. Our product range includes both stationary and portable industrial thermometers, as well as compact infrared cameras. This wide product range is our unique selling point", as Dr. Ing. Ulrich Kienitz, CEO of Optris GmbH says. The company offers high quality "Made in Germany" at contemporary prices. A large part of the Optris product range is based on components from the semiconductor industry which can be produced cost-effectively in large quantities. The product range is rounded off with a comprehensive range of accessories, such as brackets, cooled housings, exchangeable lenses and much more.

Selection made easy with the online configurator

Infrared temperature measurement technology is a comparatively complex measurement process, in which many boundary conditions must be considered. Infrared sensors use different wavelength regions of the infrared spectrum depending on the temperature range to be measured. The lens is also important, which for pyrometers defines the maximum distance between sensor and measuring point for a specific object size. On the Optris website, online configurators are available, which help the user to find the correct product. For selecting a suitable pyrometer, the parameters of material, temperature range, distance to the object and size of the measurement spot can be entered in a dialog box. The configurator then shows the products which are applicable. Using the spot size calculator, the size of the measurement spot can be calculated for a specific pyrometer and distance. There is also a similar configurator for infrared cameras. An additional optics calculator is available here, using which the suitable lens can be selected for the camera. After entering the distance and selecting a lens, the calculator determines the exact dimensions of the measurement area as well as the pixel size.

Qualified Optris application engineers support customers who still need assistance despite the configurators and calculators. In addition, the company also holds regular workshops on the topic of infrared temperature measurement technology, where the fundamentals of non-contact temperature measurement are delivered in an easily digested way.

Photographs: Optris

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About Optris

Optris has been developing and manufacturing innovative infrared measurement devices for non-contact temperature measurement, including handheld thermometers, stationary industrial thermometers, and infrared cameras for point and area measurement, for more than 10 years. A large network of distributors all over the world ensures worldwide sales of products as well as fast and qualified regional customer services.

