

NON-CONTACT TEMPERATURE MEASUREMENT – PART 2

This is the continuation of Pentronic News' series on IR pyrometry. In the previous issue we described the fundamental concepts and technology underlying the measuring process. In this issue we will describe some examples of applications where adaptations and special products can enable more stable and more reliable measurements in various processes.

SUMMARY OF PART 1

In Part 1 we read about the importance of the emission factor (ϵ). The emission factor describes the radiation properties of the object you want to measure. A low, or in the worst case an unknown emission factor, can cause major problems with your measuring process. We also noted that for IR pyrometry there is not one single "camera" for all applications. Instead, you need to select the correct instrument based on the material you want to measure, the temperature range and the environment.

WHEN DO WE USE AN IR PYROMETER?

As explained in Part 1, an IR pyrometer is not the most accurate instrument for measuring temperature. However, many applications make it impossible to measure using a fixed contact sensor such as a thermocouple or a resistance type sensor. Here is a list of some common factors that can lead to a recommendation to use an IR pyrometer:

- Mobile measurement objects
- Electrically disruptive environments e.g. induction heating
- The requirement of a short response time (at the millisecond level)
- The requirement of a thermally unloaded measurement object
- Aggressive environments where contact sensors quickly deteriorate
- Very high temperatures

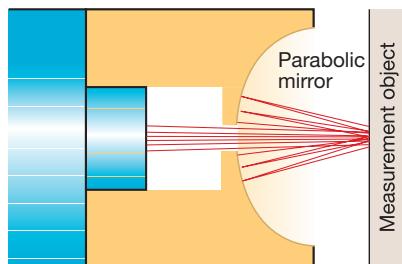
MEASURING SHINY METALS

For understandable reasons, processes involving shiny, rotating steel rollers often require non-contact signal transmission. The reflective surface causes a radiation pyrometer to perceive more reflected radiation from the surroundings than that emitted by the roller itself; the emission factor ϵ goes towards 0. The measurement error becomes very large and can also vary over time. One elegant



The Heitronics CT13 is a rugged and accurate IR pyrometer which is also available in the "CT13 Chemistry" version for use in extremely demanding environments.

IR pyrometer with lens (blue)



The emissivity amplifier is a parabolic mirror which focuses the measurement object's heat radiation back to the measurement surface. The proportion of emitted radiation apparently increases and external radiation is suppressed.



The Heitronics LT13EB is a practical example of an IR pyrometer with emissivity amplifier (gold coloured).

way to get rid of the reflections from a shiny surface is to exploit the principle of a black body, which has $\epsilon = 1$ for varying temperatures and wavelengths (see figure). By

imitating the black body's function, we can create an emissivity amplifier. The dish-shaped reflector section with a gold-coated inside surface is placed out to stand by itself a few millimetres from the roller's surface. The parabolic reflector focuses the roller's radiation back to the measurement surface through multiple reflections, while the disruptive external radiation beams are not focused and will therefore only make up a fraction of the total radiation that reaches the lens.

SEVERAL WAVELENGTH RANGES

Sometimes a two-colour or quotient pyrometer is recommended as the solution to tricky measuring situations. The quotient pyrometer determines the temperature by measuring the radiation at two or more closely adjacent wavelengths and the temperature is calculated from the quotient. The advantage is that we can actually ideally disregard the emission factor (although this assumes that the emission factor is the same for the various wavelength ranges). The quotient pyrometer is also preferred in environments where the pyrometer's sightline is partly obscured – such as in smoke-filled environments or where there is a large risk that the view glass will get dirty.

Using a quotient pyrometer requires the following:

- Emissivity is the same at all wavelengths.
- Transmission through the atmosphere and any view glass is the same for all wavelengths.

In practice this means that a quotient pyrometer is used for metallic materials and high temperatures. However, it is worth noting that quotient pyrometers now exist for many varieties of applications and are even available as hand-held pyrometers.

GAS TEMPERATURES AND TRANSPARENT MATERIALS

Normally IR is used to measure solid materials or the surfaces of liquids. However, it is also possible to measure gas temperatures and materials that appear totally transparent. Doing so relies on the previously discussed knowledge about emittance at different wavelengths.

Hot gases and flames, for instance inside furnaces, are detected via the presence of such substances as CO and CO₂, which emit in known wavelengths in narrow bands, e.g. around 4.66 and 4.26 micrometres respectively. Measuring CO₂ and CO can be done well at temperatures between 300 and 2,500 °C. A minimum volume of the gases to be measured is required, but industrial

incinerators, for example, are often large enough.

The same principle can be exploited for such materials as plastic films if you know the material's specific properties.

KNOWLEDGE IS NECESSARY

Factors fundamental to all pyrometry (except for quotient pyrometers) include: that the measurement object is larger than the measurement spot, that no extraneous radiation is reflected together with the desired radiation, and that the view glass and lens have consistent properties for the wavelength in question.

If you as the customer tell us the temperature range, the measurement surface's size and distance, the required response time, and the measurement object's properties plus the surrounding environment, we will help to specify a pyrometer system that gives you reliable and repeatable temperature measurements with sufficient accuracy.

Knowledge is everything in measurement technology, and this applies to IR pyrometry just as much as to thermocouples and Pt100 sensors.



The Capella C3 from SensorTherm is an example of a quotient pyrometer.



The Heitronics TRT, the world's most accurate IR pyrometer.