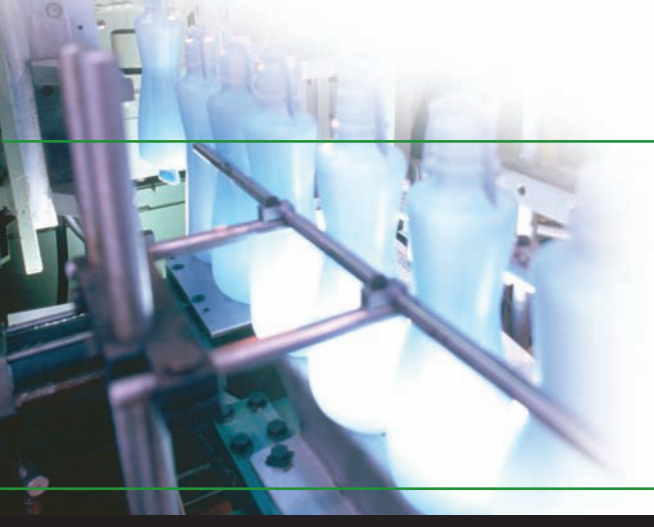

Selecting the right thermometer for the job

ENVIRONMENTAL ANALYSIS

Scott Williams, Marcom Account Manager, Fluke Europe B.V.
Tel: +31 (0)40 2675107 Email: Scott.Williams@fluke.nl

Full-featured tools may carry a higher price tag, but in many cases they offer the most flexibility and are often the best way to measure temperature quickly, safely and accurately in a broader range of industrial applications.

Fig 1: Non-contact infrared thermometers offer a fast, safe and accurate method of measuring surface temperature.

WHY MEASURE TEMPERATURE? There are a number of reasons why we measure temperature. The negative consequences of improper temperature control on product yield, product quality, plant energy use, plant maintenance costs or equipment service life help one to realize the trade-off between the cost of proper temperature measurement and the cost of lost or poor product quality, higher energy use or premature equipment maintenance and reduced service life.

Many devices have been developed to accurately measure temperature in industrial and process applications, including both contact and non-contact thermometers. Contact thermometers are portable temperature sensing devices that have permanent temperature probes (or thermocouples) and a digital display. Non-contact infrared thermometers are useful in a variety of applications where direct temperature measurement is not possible, or for quick inspections. There are also measurement tools that combine both contact and non-contact thermometers into one, which allow you to compare surface temperature results of both measurement methods.

Fig 2: Fluke 50 Series II contact thermometers provide laboratory precision for industrial applications.

Contact Thermometers

Contact temperature sensors provide the most accurate means of temperature measurement. One infers the temperature of the object to which the sensor is in contact by assuming or knowing that the two are in thermal equilibrium, that is, there is no heat flow between them.

You should be careful when measuring temperature with a contact thermometer to ensure that the measuring instrument (thermometer, thermocouple, etc) is really the same temperature as the material that is being measured. Under some conditions, heat from the measuring instrument can cause a temperature gradient, so the measured temperature is different from the actual temperature of the object being measured. In such a case the measured temperature will vary not only with the temperature of the object, but also with the heat transfer properties of that object. As a result, some measurements take minutes using standard contact thermometers due to poor thermal conductivity of the item being measured.

Non-Contact Temperature Measurement

Infrared (IR) thermometers on the other hand are becoming standard tools for measuring surface temperature in industrial and process applications. They enable easy temperature measurements in seconds of objects that would otherwise be difficult or impossible to measure using contact thermometers. Moving conveyers and webs, live electrical contacts, rotating electrical equipment, and overhead steam lines or traps are just a few of the common applications.

Infrared thermometers: How they work

Any object radiates infrared energy if its temperature is above absolute zero. This energy travels in all directions. An infrared thermometer is pointed at the measurement target, and its lens collects and focuses the IR energy onto a sensor. The sensor produces a small voltage output, proportional to the target temperature, which is processed and shown in the thermometer's display.

Advantages of infrared thermometry

IR thermometers are the fastest and safest way to measure critical temperatures of hot or hazardous, moving, and hard-to-reach targets. Simply point the thermometer at the target, pull the trigger, and read the temperature in the display. This non-contact measurement technique has a number of benefits, including:

- Avoids risk of contamination or mechanical effect on the target
- Measures higher surface temperatures not possible with contact thermometers
- Saves inspection time, allowing for more measurements and accumulation of data

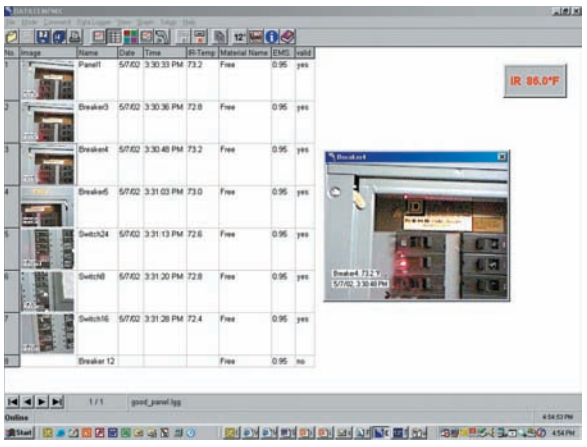

Fig 3: The Fluke 576 IR thermometer takes digital photos of measurement targets, which are stamped with location name, time, date and target temperature.

These measurements are very practical to monitor the condition and performance of industrial assets, as well as in process quality control. For example, using infrared thermometry as part of a comprehensive condition monitoring program can save repair costs, avoid unplanned production downtime, and reduce product and energy waste.

The bottom line for users is that they will have lower maintenance costs, less equipment downtime, and more customer satisfaction through higher product quality.

Proper use of IR technology

Although IR temperature measurement is not as accurate as a calibrated contact temperature device, a typical reading will be within 1 °C of the actual temperature when the instrument is properly applied. For inspection applications that do not require precise measurement, this level of accuracy is more than adequate. Putting IR technology to use is easy, and there is a wide variety of IR thermometers to select from, including several low-cost alternatives. However, before you make your selection based only on price, there are a number of performance parameters that must be understood to ensure proper and consistent temperature measurements.

Fig. 4: The Fluke 561 multipurpose thermometer combines a contact and non-contact (infrared) thermometer into one portable tool.

For starters, understanding the optical resolution and emissivity ratings of your IR thermometer and the target you plan to measure will help you avoid inaccurate measurements.

Optical resolution

Optical resolution refers to the sample area the IR thermometer is measuring at a given distance. Optical resolution is also referred to as the "distance-to-spot-size ratio" or "field-of-view." The farther an IR thermometer is from its target, the larger the target area will be. For example, a device with a 4:1 optical resolution cannot effectively be used to measure the temperature of a small object 1.5 m away – even if the laser beam sighting projects at that distance. Many erroneous readings are taken because the technician unknowingly samples an area larger than the object that is being measured. Try to determine how you are going to apply the IR thermometer before purchasing. Then buy a tool that provides the appropriate optical resolution for the application. Generally speaking, a narrower field of view requires better optics, available at a higher cost. Low cost, general-purpose units may have D/S ratios of 4:1 or less, while premium models can be as high as 180:1. For example, if you are measuring the temperature of overhead or distant pipes and cables, the added investment makes practical sense.

Emissivity

Emissivity indicates the ability of an object to emit infrared energy. Emissivity is determined by the material from which the object is constructed and its surface finish.

Some items reflect infrared radiation as well as emit it. For example, a shiny or polished metal surface will reflect energy; a flat or dull material tends to reflect very little energy. An item with no reflective property would be said to have an emissivity of 1. Reflective items have lower emissivity levels. The least sophisticated thermometers have fixed, or non-adjustable emissivity, usually set at 0.95, which is limiting if you also need to measure materials with lower emissivity. Premium, full-featured IR thermometers often include adjustable emissivity, allowing you to measure a broader range of material surfaces with greater flexibility. These also often include a built-in emissivity table, which allows you to automatically scroll to the emissivity setting for common materials without having to look them up in a separate table.

Target sighting

Another important consideration in selecting an infrared thermometer is the method available for locating and marking targets from a distance. The simplest thermometers have no sighting mechanism and are intended for close-in targets. As you move farther from the target, you need a sighting guide to ensure accurate measurements. There are a number of sighting mechanisms, including a gun-sight notch or through-the-lens sighting. However the most practical method of marking a target from a distance is laser sighting. These red sighting lasers are now available on some lower cost units. Typically they emit a single beam which accurately indicates the center of the target area, or as in the case of more high-end units, multiple laser beams effectively show the actual diameter of the measurement spot at all distances, reducing the chance of misdiagnosis associated with inaccurate temperature readings.

More features, greater flexibility

Other considerations to make before you invest in an infrared thermometer include temperature range, response time, information display capability, and whether you require data logging and professional documentation. For example, the wider the temperature range, the more applications you can use the tool for, especially in the area of process monitoring. Quicker response times down to 250 mSec, which are inherent in high-end thermometers, ensure accurate readings, especially when target temperature is changing rapidly. In addition, the more information made available to you in the display, such as MIN/MAV/AVG temperatures plus visual alarms if temperatures exceed user-defined levels, the quicker you will be able to diagnose problems. Lastly, most premium units also enable you to log data collected on inspection routes and download it later to a PC for trend analysis and reporting. Quite uniquely, the Fluke 576 IR thermometer, for example, even documents temperature measurements with digital images showing the measurement target, and are stamped with the location name, time, date and target temperature. The

Fig 5: Fluke 570 Series IR thermometers provide high-performance capability for more accurate and professional temperature measurements.

requirement for these features depends mostly on your application, but the investment in a more full-featured tool will enable you to use it with greater flexibility in a broader range of industrial applications than most basic, low-cost alternatives.

Quality is key

Most importantly, be sure to select your temperature measurement devices from credible manufacturers with a good track record for delivering quality tools. These companies generally provide you with reliable product service and application support in your local language. They also tend to offer a more varied and full-featured product line to satisfy the temperature measurement needs of all your applications. This is more evident when you compare the cost of having to replace a low-cost tool that either fell short of your expectations or did not deliver reliable results with having selected a more accurate and full-featured tool from a respectable source in the first place.

Fluke offers a complete range of quality test tools for contact and non-contact temperature measurement. Fluke also provides a complete line of professional air quality monitoring tools for measuring not only temperature, but also humidity, air velocity, air particle levels, as well as carbon dioxide and carbon monoxide levels. For further information, visit the company's website at **www.fluke.com**.

About Fluke

Fluke's mission is to be the world leader in compact, professional electronic test tools. The company's products are used by technicians and engineers in service, installation, maintenance, manufacturing test, and quality inspection in a variety of industries throughout the world. Fluke, founded in 1948, currently has offices in 13 European countries and distributes its products to over 100 countries internationally.