FLUKE®

Fluke 570 Series Infrared Thermometers:

Adding more precision to non-contact temperature measurement

Application Note

The Fluke 570 Series of infrared thermometers meets the needs of maintenance professionals who want to make accurate or close up temperature measurements at a distance

This application note describes the Fluke 570 Series, the most advanced infrared (IR) thermometers available, and how to put their features to work in today's plants and facilities. In order to explain the capabilities of these thermometers, this note also explains some of the basics of IR thermometry.

Features professionals need

Ask experienced maintenance professionals what features they want most in an infrared non-contact thermometer, and the list would surely include accuracy. While some models are accurate to only ±1 % (or more) of reading, models in the Fluke 570 Series are accurate to ±0.75 % of reading. Other features important to maintenance pros include:

High optical resolution

Maintenance professionals want their IR thermometers to provide accurate temperature readings at some distance, as well as close up. For example, it's not unusual for them to log the temperatures of connections inside an open electrical panel one minute and then want to take the temperature of a conveyor drive motor 20 feet above the floor the next minute.

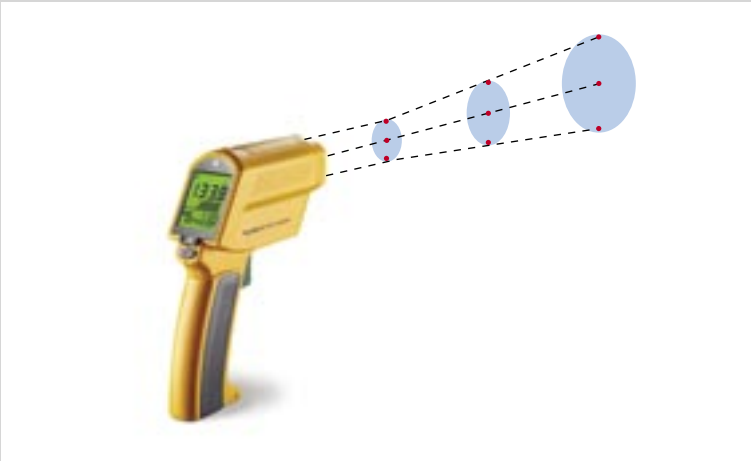
The optical systems of all IR thermometers collect infrared energy from a circular area or "spot" created by the infrared beam. Generally the farther from the instrument one gets, the larger the spot is. The optical resolution of an instrument is defined by the ratio of the distance from the instrument to the object compared to the size of the spot ("distance-to-spot" or D:S ratio) at its focus point; for other distances, this ratio is a useful approximation.

Some low-end or entry level instruments have a relatively low D:S ratio of 6:1 or 8:1. So, to measure a one-inch spot, the user must be six or eight inches from the target. The Fluke 570 Series has a distance-to-spot ratio of 60:1. This means that they can measure the same one-inch spot from a distance of approximately five feet. Remember, from five feet away, the entry-level instrument would be measuring a spot seven and a half to ten inches in diameter. Optical resolution is important in IR thermometry. In order to get a good reading, the

target must be larger than the spot size and ideally should be twice as large. For example, from the floor, a technician could not record the temperature of the conveyor motor described earlier using the instrument with a 8:1 D:S ratio. However, it is likely that she or he could get the job done with a Fluke 570 Series instrument with a 60:1 resolution. High optical resolution is also important when working closer up because it allows precise measurement of smaller targets from a safe distance.

Accurately measure surface temperatures of hot, hard-to-reach, energized or moving objects.

Advanced Sighting



Accurate measurements depend in part on accurately sighting a target. Fluke 570 series thermometers are the only thermometers with a sighting system designed to precisely track the infrared path as seen by the sensors. This enables the advanced coaxial three-dot laser sighting to accurately show both the center and the edges of the spot being measured, regardless of the thermometer's distance from the target.

This laser sighting also appears twice as bright to the human eye as normal lasers (while maintaining the same safety rating as less bright lasers), making precise sighting easier in a variety of lighting conditions and distances.

Laser sighting

Many models of IR thermometers have a laser beam for sighting a target, but a single beam in the middle of a spot only tells the user where the center of the spot is. Fluke 570 Series units have a three-dot sighting system that reveals to the user not only where the center of the spot is, but where its edge is. So, the technician measuring the temperature of the aforementioned conveyor motor will know if the entire IR spot is on the target (motor housing). The Fluke 570 Series laser sighting also features a special laser that appears twice as bright to the human eye (while maintaining the same safety rating as less bright lasers), making accurate sighting easier in a variety of lighting conditions and distances.

Wide temperature range

Maintenance pros want instruments that will measure a wide range of temperatures. They may have to track the temperatures of refrigeration coils one day and check the oil level in a transformer the next. Also, in some manufacturing settings, production personnel use handheld IR thermometers to monitor very hot products such as (hot steel or plastic). Thermometers in the Fluke 570 Series measure from –30 °C to 900 °C (–25 °F to 1600 °F), a large range that provides many uses in process quality control.

Adjustable emissivity

IR thermometers calculate the surface temperature of an object using the amount of energy emitted by the object, and the efficiency with which the surface material of that object is known to emit that energy—its emissivity. Since the emissivity of most organic materials and painted or oxidized surfaces is 0.95, many IR thermometers use this factor in all temperature calculations. However, certain materials, such as concrete and metals, are poorer emitters, so using an emissivity setting of 0.95 in calculating surface temperatures of these objects will not yield an accurate result.

Users of thermometers in the Fluke 570 Series can adjust the emissivity setting of their instruments. This feature makes readings more accurate, and it, like the high temperature range, allows these units to be used in process quality assurance as well as PDM.

Speed

A thermometer that records readings quickly will record accurate readings even in situations where target temperatures are changing rapidly. Short response times of IR thermometers mean that serious problems can be diagnosed even when temperatures are changing rapidly or require fast scanning. Furthermore, there is no need to shut down equipment to take a reading. The Fluke 570 Series has a very fast 250 mSec response time.

All of the features of the Fluke 570 Series mentioned so far are available on all units. In addition, all have backlit liquid crystal displays for viewing in poorly lit areas and store the last 10 readings and display them on a bar graph for easy comparison of readings. Each also has a high alarm warning that is both audible and visible, making it effective even in loud plants. In addition, each model can be ordered as a close-focus unit with a 50:1 distance-to-spot ratio. This latter option is especially useful for close-up troubleshooting of electrical compoents in which targets tend to be relatively small [since the close focus unit has a minimum measurement spot size of 0.24" (6mm)].

Download temperature measurements and target photo locations for analysis and reporting.

The power of data logging

When a user holds a Fluke 572 thermometer, all of the capabilities mentioned are at his or her fingertips, but a move to the Fluke 574 adds the power of 100-point data logging. With this capability plus software for logging, graphing and analyzing temperature data on a PC and an RS232 connection to move the data from the thermometer to the PC, the time used to transcribe and analyze data

is minimized. Furthermore, analysis is streamlined. Reports get written faster and more accurately, and needed repairs are more likely to happen before equipment fails.

Along with their data logging capability, the more advanced members (Fluke 574 and 576) of the Fluke 570 Series have easily accessible preset emissivity settings for common materials. Using this feature, saves the user time in not having to look up the proper emissivity setting before taking a reading. Also, these advanced models have customizable features such as log names, high and low alarms, emissivity values for special conditions, etc. A technician can customize an instrument to conform to his or her inspection route.

To all of this, the Fluke 576 adds digital photography capabilities and a USB connection (instead of RS232) for PC hookups. When a temperature reading is recorded, the instrument records the temperature on the photo of the target along with the date and time of the measurement. Having photographic documentation of measurement is a powerful documentation and reporting tool.

Walking a route

Let's return to the electrical panel mentioned earlier and imagine checking its temperature with the Fluke 576 as part of a predictive maintenance route. The technician begins by aiming the camera on the part of the panel to be measured. If the area is dark, the thermometer will automatically illuminate the area with a built-in flash. With the thermometer in "log mode," the technician will pull and release the trigger. Having recorded the temperature and image, the camera then automatically prepares to record the next temperature and image on the route.

At the end of the route, the technician uploads the collected data and images to a PC. At this point, the technician has several options. The data and photo from the electrical panel can be compared to data and photos recorded earlier. Questions can be asked and answered: Was the inspection done properly? Was this measurement consistent with earlier ones in terms of location and temperature recorded? Is the temperature of an electrical connection trending upward?

The technician can see the electrical panel's data in tabular view with photos beside temperature data; tailor high or low alarms to this location; view the panel's minimum, maximum and average temperatures; graph the data to reveal trends and more. If warranted, a report on the status of the electrical panel can be created with photos for added impact or to help guide repair personnel to the location. Then, the report may be distributed electronically or printed for physical distribution or even posted on a company's intranet.

Close focus models and coaxial laser sighting aid small target measurements.

Temperature measurement strategies

In general, there are three ways to use any kind of infrared, non-contact thermometer:

1) *To measure the absolute temperature at a spot.* This type of measurement is used to measure and

Routinely monitor equipment for temperature changes indicitive of possible equipment problems.

track temperature at a single spot. It is useful for trending the temperature of an object or comparing a measurement to a specification, and a repeatability of ±0.5 % for the Fluke 570 Series makes this way of using these thermometers quite consistent.

2) *To compare the temperature differential of two spots.* This type of measurement might be used to check the functioning of a steam trap by measuring the temperature of the inlet and outlet. No change indicates the trap has failed open. A very large change indicates the trap has failed closed.
3) *To scan an object and detect changes within a continuous area on it.* This capability allows the user to find hot or cold spots on housings, panels and structures. For example, one can check the heat sink of air-cooled transformers for cool tubes that indicate a restricted flow or a lack of flow.

Suggested applications

Throughout the preceding discussion, suggestions have been made for using infrared thermometry for plant predictive and preventive maintenance, electrical applications, process monitoring, quality assurance and other applications. Special mention should be made here of hazardous environments where the presence of flammable gasses or vapors make operating most electrical devices very dangerous. A model of the Fluke 574 has been tested by Factory Mutual, a US organization, and has received a nonincendive (Class I, Division 2) approval. Check that this approval is appropriate for your application and is accepted in your country. Be aware that the nonincendive model is not available with the close-focus option.

For industries where calibration is a matter of concern, units are available with a NIST calibration certificate. In addition, here are some additional suggestions for areas where an IR non-contact thermometer will prove useful:

Electrical Maintenance

Check for heat buildup created by loose connectors. Troubleshoot problems in battery banks and power panel terminations, ballasts, switch gear and fuse connections. Identify hot spots in the output filters on DC battery connections.

Equipment Maintenance

Check moving parts and housings in motors and gearboxes for hot spots. Temperature change can indicate developing problems in many types of equipment, from ovens and boilers to freezers. Routine temperature audits of generators and their bearings can prevent expensive repairs.

Building Controls

Monitor HVAC/R components for quick energy audits and room balancing in a short time. A 60:1 distance-to-spot ratio makes elevated vents and returns very accessible.

Process/Product

Monitor process lines. Check the temperature of different products on production lines. They can vary from rubber tires to plastic, from concrete to chocolate bars.

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