FLUKE®

Monitoring Electrical Systems with Fluke Infrared Thermometers

Application Note

Light, rugged, and easy to use, Fluke's new line of non-contact infrared thermometers provides precise readings with 1 to 2% accuracy from distances up to 20 meters (depending on model). They require no set-up and have a response time of less than a second. They are therefore the perfect choice for a host of troubleshooting applications including: finding hotspots, preventing arcing and insulation damage, locating grounds in circuits, pinpointing sources of nuisance tripping, spotting energy-loss sources, protecting electric motors and checking transformers.

The value of temperature monitoring

Infrared thermometers are proven money-saving tools for diagnostic and predictive inspection of electrical systems and equipment. Used in electrical maintenance for over 40 years, infrared non-contact thermometers allow the test engineer to quickly gather important temperature information that can be used to predict potential equipment failure. In one survey of electrical service and maintenance personnel, 100% of those using infrared thermometers reported preventing unnecessary downtime and repair expenses through detection of hotspots.

In fact, insurance companies are encouraging their customers to implement preventive infrared scanning.

Measuring electrical components

Non-contact infrared thermometers measure the surface temperature of an object from a safe distance, which makes them an indispensable tool in any electrical maintenance operation.

Since an infrared thermometer measures surface temperature, accurate results are obtained only when the target is visible. Remove covers and enclosures to expose the object to be measured. Motors and oil-filled transformers and circuit-breakers can be measured directly because the surface temperatures of their enclosures generally correlate to the internal temperature.

Make the following applications part of a comprehensive maintenance program to prevent equipment failures and unscheduled down time.

Connectors

Normal on/off current loading and environmental temperature changes result in repeated heating (expansion) and cooling (contraction) of connections. Over time, this gradually loosens the connectors. Because a loose connector has higher resistance to current flow, it dissipates power and generates heat. Similarly, direct, carbon, deposits and corrosion in connections also cause higher resistance.

When evaluating connections, it is important to know the temperature differential between the connector and the ambient temperature. If ambient temperature is unknown, it can be quickly determined with the non-contact thermometer. An increase of 10 °C from ambient temperature indicates a poor connection, a ground in circuit, or an unbalanced load. Most experts agree that a temperature reading of 30 °C or more above ambient indicates a serious problem.

Electric motors

Industrial plants often have hundreds of polyphase motors in operation. To help maintain a motor's life span, temperatures must be monitored to verify balanced phase-to-phase power distribution and proper operating temperatures. There are recommendations for the power balance to prevent damage or motor burn-out, and IR thermometers can be used to inspect supply-power connections and circuit breakers (or fuses) for excessive temperatures that may signal problems.

Certain standard test procedures require knowledge of the motor's temperature to obtain accurate results. In such cases, an IR thermometer with a digital, absolute temperature output is invaluable (Fluke models 574/576).

IR thermometers are also effective in determining the source of the problem when a thermal overload protection device does not work and the motor shuts down.

Motor bearings

Heat is generated when bearings break down, causing the motor to vibrate and become off-centered. Scanning bearing temperatures helps to determine whether they exceed rated maximums. The life of normal winding insulation is about 10 years. The following illustrates how operating temperatures affect winding insulation life:

Studies by electrical maintenance professionals show that winding surface temperatures are typically 10 °C lower than internal (motor surface) temperatures.

Max temp rating	Insulation life
Exceeds 10 °C	1/2 of normal
Exceeds 20 °C	1/4 of normal
Exceeds 30 °C	1/8 of normal

Phase-to-phase measurement

High-voltage, three-phase power circuits are common in industrial electrical systems. They are particularly important for induction motors, large computers and other equipment that requires balanced phase-to-phase power. If the power balance is not maintained because of an overload or ground in the circuit, damage and downtime can result. Checking cables and connectors with a non-contact thermometer for equal phase-to-phase temperatures will quickly show if there's difference of 5 °C or more, indicating a problem.

Transformers

Maximum permissible operating temperatures are usually listed on the transformer. The windings of air-cooled units can be measured directly with an infrared thermometer to verify overall temperature. Any hotspots indicate winding flaws.

Wires and cables

Wires and cables can be monitored with a non-contact thermometer to identify heat caused by cracks, corrosion or deterioration. When comparing two cables, the one with the higher temperature is carrying the larger current.

Uninterruptible power supplies (UPS)

DC battery connections are susceptible to loosening and corrosion, which can create excessive heat. Hot localized connections in the UPS output filters can be identified with an infrared thermometer. A cold spot may indicate an open DC filter circuit.

Back-up batteries

Low-voltage batteries should be checked with a non-contact thermometer to ensure proper connections. Poorly attached cell strap connections in a battery string may heat up enough to burn the posts.

Ballasts

Ageing electrical components cause lighting fixtures to overheat. An infrared thermometer can detect an overheated ballast before it begins to smoke.

Utilities

Within the plant, infrared readings can quickly and effectively identify hot spots in connections, cable splices, transformers and other equipment. Routine temperature audits will help prevent the enormous costs that result from equipment failures and system shutdowns.

In the field, conducting electrical-utility inspections means taking regular temperature readings of transformers, wires, and other components located high above the ground and in other difficult-to-reach locations. Several Fluke models feature optical ranges of 60:1 or greater, bringing almost any target easily within reach.

Interpreting results

Once a temperature reading has been made, determining whether a problem exists or not becomes a combination of the service or maintenance technician's own experience with the equipment and the ratings provided by the manufacturer (who usually lists the maximum allowable temperatures on the rating plate).

For quick temperature checks

If you are looking for a basic non-contact thermometer for a variety of applications, the Fluke 62 Mini Infrared Thermometer is the tool for you. It is priced to fit any toolbox and is small enough to fit in your pocket.

Temperature range	-30 to 500°C
Response time	≤ 0,5 second
Best Accuracy	± 1.5% of reading
Distance to spot ratio	10:01

Fluke 62

The professional's Choice

The Fluke 63, 66 and 68 Infrared thermometers. These are the most popular non-contact thermometers in the world. It offers an ideal combination of precision and value for the technical professional. All these models feature laser sighting and are accurate, compact, reliable and easy to use, just what a professional needs.

Temperature range	Fluke 63 Fluke 66 Fluke 68	-32 to 535°C -32 to 600°C -32 to 760°C
Response time	≤ 0,5 second	
Best Accuracy	Fluke 63	For targets at: -32 to -26 °C ± 3 °C -26 to -18 °C ± 2,5 °C -18 to 23 °C ± 2 °C 23 to 510 °C ± 1% of reading or ± 1°C For targets above 510°C ± 1,5% of reading
	Fluke 66 and 68	For targets at: -32 to -26 °C ± 3 °C -26 to -18 °C ± 2,5 °C -18 to 23 °C ± 2 °C For targets above 23°C: ± 1% of reading or at ± 1°C
Distance to spot ratio	Fluke 63 Fluke 66 Fluke 68	12:1 30:1 50:1

Fluke 68

Fluke 66

Fluke 63

FLUKE®

For those who demand maximum performance

The Fluke 572 and 574 Precision Temperature Infrared Thermometers feature a True Dimension™ laser sighting system, which precisely outlines the target measurement area. With its unique combination of features and DataTemp software these models can adapt to any work environment.

Also available special purpose model (Close Focus) which measures very small targets.

Temperature Range	-30 to 900 °C
Response time	250 ms
Best Accuracy	± 0.75% of reading
Distance to spot ratio	Standard: 60:1 Close focus: 50:1

Fluke 572

Fluke 574

Photographic Infrared Thermometer

The Fluke 576 takes snapshots automatically of temperature measurements which are superimposed with temperature, date, time as well as additional measurement data – ideal for the documentation of inspection results. With its unique combination of features and DataTemp software, the Fluke 576 can adapt to any work environment. Also available is the Fluke 576 close focus special purpose model, which measures very small targets.

Temperature Range	-30 to 900 °C
Response time	250 ms (95% of reading)
Best Accuracy	± 0.75% of reading
Distance to spot ratio	Standard: 60:1 Close focus: 50:1

Fluke 576

Fluke. *Keeping your world up and running.*

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