# Using the Fluke 66 and 68 Infrared Thermometers

## for electrical troubleshooting and predictive/preventive maintenance

Application Note


With so many interconnected systems and delicate load balances in industrial plants these days, any number of things can go wrong. By instituting regular predictive and preventive maintenance, you can spot trouble before it happens and greatly reduce the chances of system failure.

The trick is finding a way to *efficiently* monitor all of those systems. That's where infrared thermometers come in handy. Changes in heat often indicate failure, and infrared thermometers make it easy to take frequent, quick temperature measurements.

This application note explains how to use a high performance, infrared thermometer for electrical troubleshooting and predictive maintenance.

### Infrared thermometry basics

An infrared thermometer can make quick, non-contact temperature measurements from some distance away. This allows you to easily measure objects that are hazardous to the touch, such as high energy, caustic or rotating targets.

Infrared thermometers such as the Fluke 66 and Fluke 68 measure the invisible infrared emissions from an object and hold the measurement on the display until another measurement is taken. These measurements can also be stored in memory, to be recalled later.

The key differentiator between infrared thermometers is the **distance to spot ratio**, or from how far away the thermometer can accurately measure

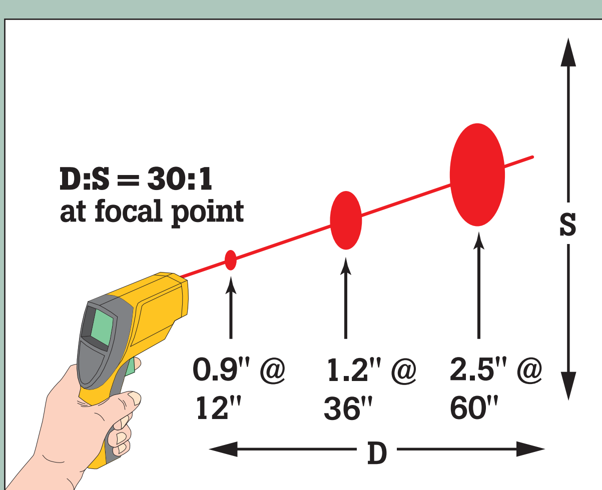


**Figure 1.** Use the Fluke 66 within 5 m (15 ft.) of the intended target. At greater distances, the measured area will be larger (approximately the distance divided by 30).

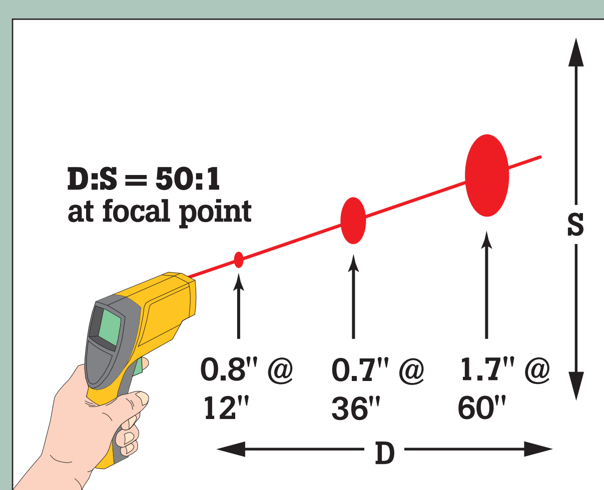


**Figure 2.** Use the Fluke 68 within 8 m (25 ft.) of the intended target. At greater distances, the measured area will be larger (approximately the distance divided by 50).

a particular target area. In high performance thermometers, the ratio between the distance to target and the measurement spot size is as large as possible. The higher the ratio, the lower the chance of measuring unintended areas around the target.

More information on the basics of infrared temperature measurement can be found in the Fluke application note “Non-contact temperature measurements using IR thermometers”, Fluke literature number 1989119.

## Infrared thermometer applications in electrical and process maintenance

- Finding faulty terminations in high power electrical circuits
- Locating overloaded circuit breakers in a power panel
- Identifying fuses at or near their current rated capacity
- Identifying problems in electrical switch gear
- Monitoring and measuring bearing temperatures in large motors or other rotating equipment.
- Identifying “hot spots” in electronic equipment
- Identifying leaks in sealed vessels
- Troubleshooting steam traps
- Finding faulty insulation in process pipes or other insulated processes
- Capturing process temperature readings

## Identifying overloaded circuit breakers

1. Non-contact temperature measurements can make it easy to find a circuit breaker at or near capacity. If you are measuring high energy electrical circuits, use extreme caution and wear proper protective equipment.
2. Scan the switches in a circuit breaker panel and take measurements.

Note: If the circuit breaker body is obscured by a cover plate within the breaker panel, you may need to remove the plate to gain optical access the measurement target. To measure a small area, it’s important to get reasonably close to the target For example, the Fluke-68 measures a 0.8" spot at 36" from the measurement target.

3. Look for a temperature variation from one breaker to the next. A circuit breaker with a measured temperature of approximately 5 °F greater than the other breakers in a panel is likely to be heavily or fully loaded.
4. An additional test with a clamp meter can measure the actual current load and help to determine for certain if a larger breaker or rewiring is required.

## Finding bad or failing electrical connections

Failures in industrial electrical wiring are frequently caused by loose or corroded terminations and poorly crimped or aging wire connections. These bad connections generally create a resistive connection, and with current flow they generate heat ($P = I^2R$), often leading to open circuit conditions that can cause electrical fires and other safety hazards.

Use extreme caution and wear proper protective equipment when working near high energy electrical circuits.

A termination that measures 5 °F more than similar terminations indicates a connection in need of attention.


## Using infrared thermometers to troubleshoot steam systems and steam traps

Steam is a common source of heating in many manufacturing processes and facilities. Boilers are the most common method of generating steam.

Another method utilizes combustible by-products from a process, incinerating the by-product to fire a boiler, or superheated water piped through the incinerator. The steam is

then piped, often over great distances, to be used in the process areas. Even though the pipes are insulated, the heat of the steam drops over distance, causing condensation in the pipes.

Condensate (water) in the steam lines reduces the effective energy of the steam and can cause difficulties in many steam driven processes. Steam traps are specifically designed to remove condensate from steam lines.

**Insulation testing:** To check piping and boiler insulation for hot spots, make a survey with either the Fluke 66 or 68.

1. Set the IR thermometer to MAX mode by depressing the MODE button until the lower display reads MAX.
2. Depress the measurement trigger and scan the insulation on the piping or boiler. The maximum measurement will be captured and displayed in the lower display. An uninsulated area can reveal maximum temperatures of 400 °F or more.
3. Once you've found the hot spot, correct the insulation to reduce heat loss and burn hazard.

**Steam traps:** If a steam trap fails while open, it will leak steam, causing an energy loss. If it fails while closed, it won't remove condensate from the steam line, making it inefficient. An faulty steam trap can cost a plant $500 or more per year, and in any given year, 10 % of all industrial steam traps fail. Since many large process plants have upward of 1,000 traps, they can quickly become a high value maintenance target.

Ideally, the steam trap has an input of steam and an intermittent output of condensate.

1. To verify whether a steam trap is working properly, measure the input side of the steam trap first.
2. As you measure from input to output, the temperature should drop significantly.
3. If the temperature doesn't drop, the steam trap has failed open and is passing superheated steam into the condensate line.
4. If the temperature drop is overly large, the trap may be stuck closed and is not passing heated condensate fluid.

## Tracking motor wear through bearing heat

Given the pressure to reduce operating costs, most plant technicians want to optimize the life cycle of their industrial motors. That's exactly where a high performance infrared thermometer can help, by predicting when motors need maintenance.

1. Start with a newly commissioned and freshly lubricated motor and take a measurement of the motor bearing housing while the motor is running. Use this measurement as a **baseline**.
2. As the motor and its lubrication ages, the bearings become worn and heat-producing friction develops in the motor bearing, causing the outside of the bearing housing to heat up.
3. Take additional measurements at regular intervals, comparing them to the baseline measurement to analyze the motor's condition.

**Measurement tips:** Tag the motor bearing with the baseline temperature measurement to facilitate comparison. Create a flat black target for consistent, accurate measurements.

4. When the measurement indicates an overheating bearing, generate a maintenance order to replace or lubricate the bearing housing and in turn reduce or eliminate the possibility of costly motor failure.

## Using the Fluke 66 and 68 Infrared Thermometers

To activate the Fluke 66 and 68 thermometer, simply squeeze the measurement trigger to start taking a reading. Release the trigger to freeze and view the last measurement. Power will automatically shut down after 7 seconds of non-use.

**Measurement Mode button:** Cycle the MODE button so that the secondary display reads the maximum (MAX), minimum (MIN), differential (DIF), average (AVG), high alarm (HAL), low alarm (LAL), emissivity adjustment (EMS) or temperature probe mode (PRB) secondary display modes.

**Storing and retrieving measurements:** The Fluke 66 and 68 can measure and store up to (12) readings.

1. To store a measurement, press and hold the measurement trigger.
2. Then depress and hold the MODE button until LOG appears in the lower left hand portion of the display.
3. Depress the log button to capture the measurement. A number under the LOG annunciator indicates which memory location (1-12) the measurement is stored.
4. To recall a stored measurement, depress and hold the MODE button; once the LOG annunciator is visible, use the up and down arrow buttons to scroll through the measurements.

## Emissivity settings — using the optional 80PR-60 RTD Probe

The adjustable emissivity settings on the Fluke 66 and 68 allow you to compensate for the effects of emissive objects. Emissive objects reflect infrared energy rather than absorb them. For example, flat black is a near perfect "Black Body" (see Figure 3) with an emissivity of 1.0.

1. To adjust the emissivity setting, cycle the MODE button until EMS (emissivity) is displayed. Use the up and down arrows to vary the setting.
2. Once the emissivity is adjusted, you can verify the setting with the 80PR-60 TRD probe. Select the Mode button until PRB is displayed.
3. Use the probe to measure the surface of the object.
4. Compare this measurement to the non-contact measurement to help verify the emissivity setting for future use. The 80PR-60 probe is handy for verifying emissivity settings. It can also be used for precise temperature measurements although it is not as fast as making an infrared measurement.

**Examples:**

- Polished Brass: 0.03
- Oxidized Brass: 0.61
- Roughly Polished Copper: 0.07
- Black Oxidized Copper: 0.78
- Black Lacquer Paint: 0.96
- Commercial Sheet Aluminum: 0.09
- Oxidized Lead: 0.43
- Rusted Iron: 0.78
- Oxidized Iron: 0.84

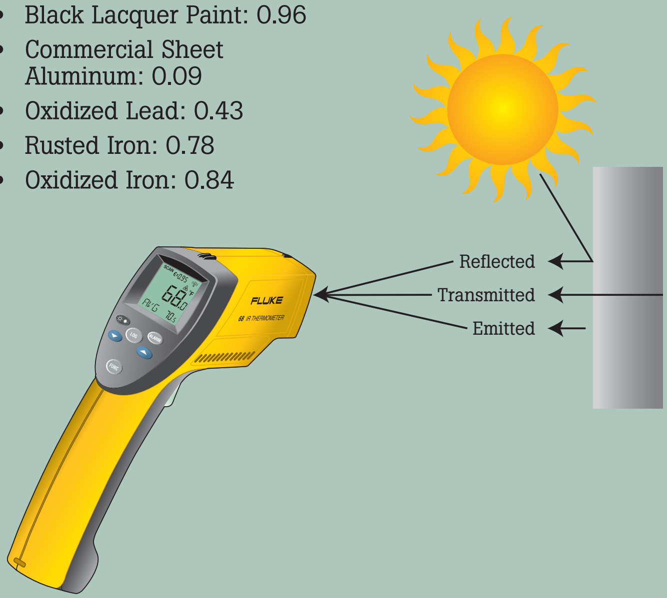


**Figure 3.**

## Best practices for infrared temperature measurement

To get the best non-contact measurements, follow these guidelines:

- Get as close as is safely possible to your target.
- When measuring at a distance, understand the size of the measured target based on the distance to spot ratio (see Figures 1 and 2).
- If you need to measure a reflective target often, mask the reflective surface with flat black paint or tape for best results. This also helps ensure the same spot is measured each time.
- Consider sources for reflective infrared radiation. Items that have shiny reflective surfaces and are *emissive* will reflect infrared energy from other nearby objects, including the sun. This can interfere with measurement of the target's radiated infrared energy
- Experiment with several angles to best capture the image. It might be possible to mitigate reflected energy from other infrared energy sources.
- Make emissivity adjustments to minimize measurement errors. Use the optional contact probe to verify your settings.

**Fluke.** *Keeping your world up and running.*

**Fluke Corporation**
PO Box 9090, Everett, WA USA 98206

Fluke Europe B.V.
PO Box 1186, 5602 BD
Eindhoven, The Netherlands

For more information call:
In the U.S.A. (800) 443-5853 or
Fax (425) 446-5116
In Europe/M-East/Africa (31 40) 2 675 200 or
Fax (31 40) 2 675 222
In Canada (800) 36-FLUKE or
Fax (905) 890-6866
From other countries +1 (425) 446-5500 or
Fax +1 (425) 446-5116
Web access: http://www.fluke.com


Printed in U.S.A. 6/2004 2278935 A-US-N Rev A