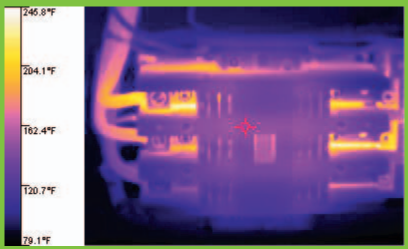
Applications for Thermal Imagers

FLUKE®

Motor control centers

Application Note

Thermal imaging can be used to evaluate the operating condition of the components within motor control centers (MCCs) by comparing their relative temperatures under load. Key components include bus bars, controllers, starters, contactors, relays, fuses, breakers, disconnects, feeders, and transformers.



As with most electrical connections, scan MCC components for hot spots indicating overly loose or tight connections, corrosions, overloading, unbalance, harmonics, or other problems.

A typical MCC[1] is a standalone arrangement with one or more combination motor control units for controlling an AC motor in a specific application. Each unit has an external disconnect, branch-circuit and motor over-current protection and a magnetic motor starter along with pilot devices located on the panel door. Underwriters Laboratory (UL) allows panel boards and switchboards for branch circuit-protection within an MCC, provided they do not constitute a major portion of the center. That means a complex MCC can contain bus bars, controllers, starters, contactors, relays, fuses, breakers, disconnects, feeders, and transformers.

Thermal imagers can indicate the operating condition of the components within MCCs by comparing their relative temperatures under load.

What to check?

Use your thermal imager to scan all components and connections within MCCs with the enclosures open and the equipment running. Measure the load at the time of each scan so that you can properly evaluate your measurements against normal operating conditions. **Caution:** Only authorized and qualified personnel using the appropriate personal protective equipment should open electrical panel covers. When a panel is open and energized, because of the possibility of arc-flash, keep all unprotected personnel behind a calculated and clearly delineated arc-flash boundary.

For more information on Thermal Imagers go to **www.fluke.com/thermography**

To keep the task manageable, begin by scanning only MCCs associated with *critical* assets—those whose failure would threaten people, property or product.

What to look for?

In general, look for components that are hotter or cooler than similar components under similar loads. Doing this may identify broken or undersized wires, defective insulation, faulty (corroded, too loose or over tightened) connections and electrical unbalance among phases.

Be aware that connection-related hot spots usually (but not always) appear warmest at the spot of high resistance, cooling with distance from that spot. One source[2], reports that 25 % of all miscellaneous electrical apparatus failures are caused by loose electrical connections. Unbalance, whether normal or out of specification, will appear equally warm throughout the phase or part of the circuit that is overloaded. Harmonic unbalance creates a similar pattern. (**Note:** a cooler-than-normal circuit or leg might signal a failed component.)

Also be aware that all electrical currents produce some heat. Heat alone, then, is not an indicator of problems. Equally warm conductors in all three phases represent a "good" pattern. Differentiation between phases should be investigated.

A sound practice is to create regular inspection routes that includes all key electrical panels, including MCCs. Save a thermal image and associated temperature data of each one on the computer and track your measurements over time. That way, you'll have a baseline for comparisons in order to determine whether a hot spot is unusual or not, and to help you verify a repair's success.

What represents a "red alert?"

Equipment conditions that pose a safety risk should receive the highest repair priority. Also, guidelines provided by the NETA (InterNational Electrical Testing Association) say that when the difference in temperature (ΔT) between similar components under similar loading exceeds 15 °C (27 °F) immediate repairs should be undertaken. The same organization recommends the same action when the ΔT for a component and ambient air exceeds 40 °C (72 °F).

Another approach is to treat the imminent failure of any piece of critical equipment as a red alert. The same key operations, maintenance and safety personnel who determine which production assets are critical should play important roles in quantifying "warning" and "alarm" levels for those assets. Then, alarm levels for specific equipment can be set on your Fluke thermal imager.[4]

What's the potential cost of failure?

Since MCCs vary so much in complexity, it's difficult to put firm figures on costs for repairs and replacements. However, one source[3] says that the average MCC repair is between US $10,000 and US $70,000 with replacements costing US $80,000 to US $100,000.

Follow-up actions

When you discover a problem using a thermal imager, use the associated software to document your findings in a report that includes both a digital photograph and a corresponding thermal image of the equipment. That's the best way to communicate the problems you find and any suggestions for correcting them. Following corrective action, a new thermal image can be used to assess a repair's effectiveness and evaluate the materials and techniques used. With this information, you can continuously improve your maintenance program for MCCs.

[1]According to National Electrical Manufacturers Association (NEMA) standards, a motor control center (MCC) is "a floor-mounted assembly of one or more enclosed vertical sections having a horizontal common power bus and principally containing combination motor control units." The standard goes on to say, "These [motor control] units are mounted one above the other in the vertical sections," and are connected to the common power supply by either vertical buses or suitable wiring. NEMA "Industrial Control No. ICS-322" as quoted at www.enm.com/training/siemenscoursedownload.asp?course=mcc_2.

[2]On the Web site of the Academy of Infrared Thermography at www.infraredelectrical.com/infraredelectrical_15.html.

[3]Ibid.

[4]Model depending.

An imaging tip:

When you are working with low electrical loads, the indications of a problem may be subtle at best. A minimum of 40 % of design load is recommended (National Fire Protection Association NFPA 70B), and the higher the load, the better. When you must inspect in low-load situations, be sure to note *all* possible problems, even if they reflect only a small temperature difference. As a load increases, it's a certainty that temperatures will increase, too. When a problem exists, expect greater temperature differences at higher loads.

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