

# INFRARED THERMOGRAPHY

## for PREDICTIVE MAINTENANCE

Thermal imaging has evolved into one of the most valuable diagnostic tools used for predictive maintenance (PM). Thermal imaging, also called thermography, is the production of non-contact infrared, or "heat" pictures from which temperature measurements can be made. By detecting anomalies often invisible to the naked eye, thermography allows corrective action before costly system failures occur. Portable infrared (IR) imaging systems scan equipment and structures, then instantly convert the thermal images to visible pictures for quantitative temperature analysis.

### THERMACAM PM SYSTEMS

**FLIR Systems ThermaCAM®** family of thermal imaging systems have set the standard for thermographic inspections, offering unique camera and software capabilities to facilitate easy, fast and accurate predictive maintenance tasks.

**ThermaCAM** features simple "point and shoot" operation, state-of-the-art detector technology, portability, and ease-of-use, making it an invaluable tool for predictive and preventive maintenance. Lightweight, cordless operation and low power consumption assure long hours in the field. Innovative features for instant recognition of critical temperatures and alarm conditions, as well as digital image, text and voice annotation, assure fail-safe inspections.

**ThermaCAM** systems detect temperature differences as small as 0.07°C. Since typical industrial electrical or mechanical problems occur when there is a temperature increase of 10°C or more, **ThermaCAM** "sees" these problems well in advance of a failure. Accurate temperature measurements allow prioritization of repairs to be made.

**ThermaCAM** is also an ideal infrared camera for predictive maintenance when working in extreme and

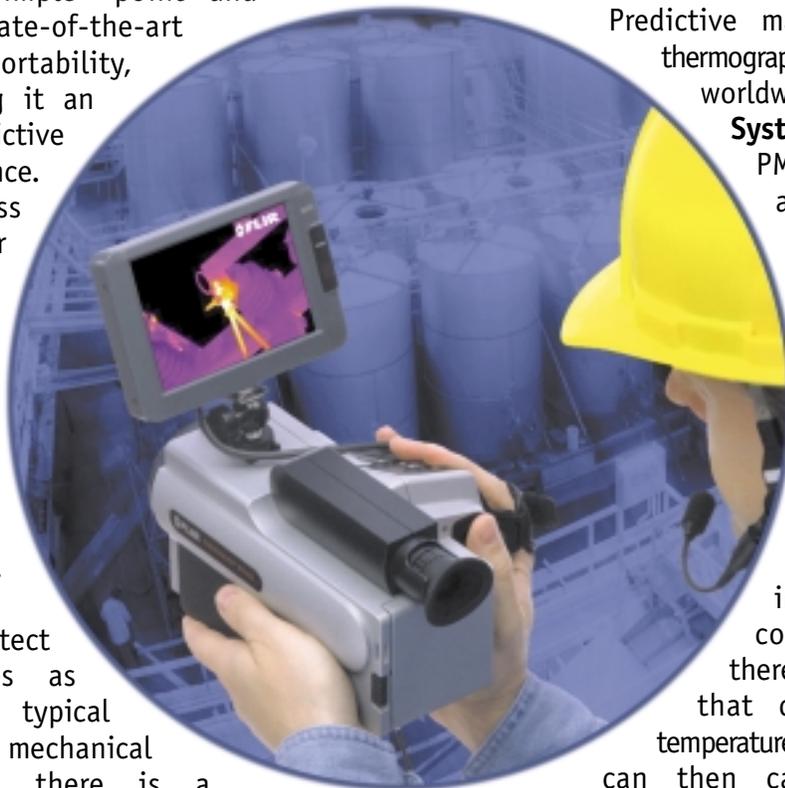
potentially hazardous conditions. Weighing less than four pounds, **ThermaCAM's** rugged one-piece design requires no cables and operates for more than two hours on a single charge. In addition, while the **ThermaCAM** looks like a standard camcorder, the system has been fully sealed and hardened for use in harsh environments.

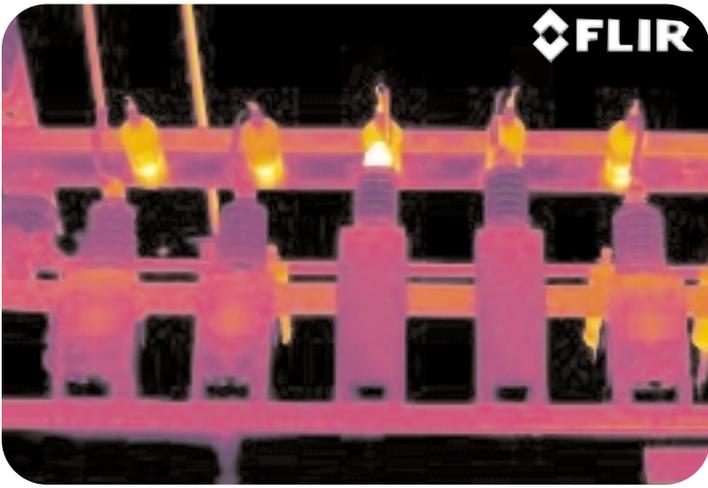
### THERMOGRAPHY APPLICATIONS

Predictive maintenance applications for thermography are numerous. Companies worldwide have incorporated **FLIR Systems ThermaCAM's** into their PM programs for inspecting and monitoring electrical and mechanical systems and equipment. Moreover, new and sophisticated applications continue to emerge.

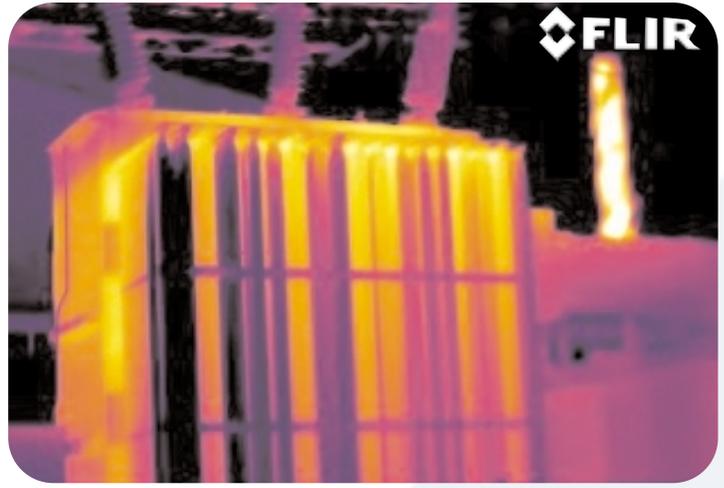
### ELECTRICAL SYSTEMS

Thermographic systems are commonly used for electrical inspections. As electrical connections become loose, there is a resistance to current that can cause an increase in temperature. This increased temperature can then cause components to fail, potentially resulting in unplanned outages and injuries. In addition, the efficiency of an electrical grid becomes low prior to failure, thus energy is spent generating heat, causing unnecessary losses. If left unchecked, heat can rise to a point that connections melt and break the circuit; as a result, fires may occur.





*Bad connections on a capacitor bank*



*Plugged cooling fins on 13.8KV transformer*



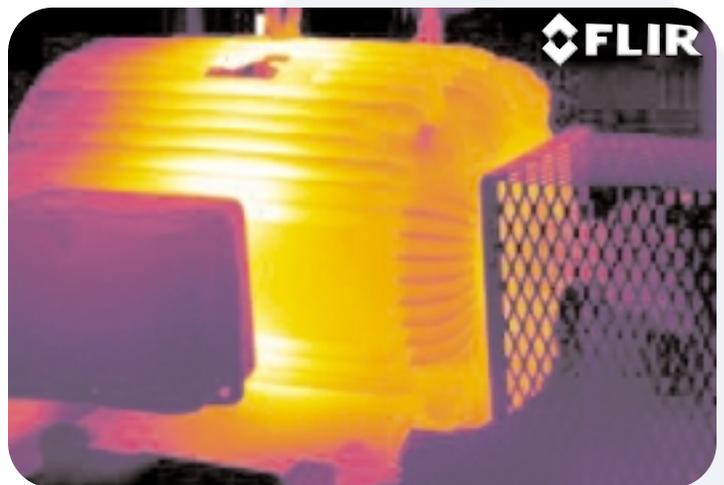
Besides loose connections, electrical systems suffer from load imbalances, corrosion, and increase in impedance to current. Thermography can quickly locate hot spots, determine the severity of the problem, and help establish the time frame in which the equipment should be repaired.

Additionally, outdoor components, substations, switchgear, transformers, and outdoor circuit breakers can be inspected quickly and efficiently with thermal imaging.

Another benefit of thermography is the ability to perform inspections while electrical systems are under load. Since thermography is a non-contact diagnostic method, a thermographer can quickly scan a particular piece of equipment from a safe distance, leave the hazardous area, return to his office and analyze the data without ever putting himself in harms way.



*Connection problem on 200 Amp disconnect*



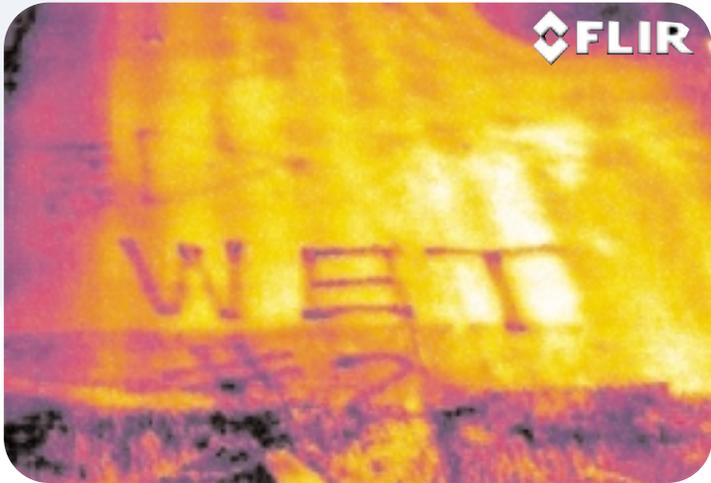
*Overheated windings in a motor*



Thermography is very useful when inspecting indoor components such as motor control centers, breaker panels, disconnect switches, and transformers.

## MECHANICAL SYSTEMS

In many industries, mechanical systems serve as the backbone of operations. Typically, when mechanical components become worn and less efficient, the heat emitted will increase. Consequently, the temperature of faulty equipment or systems will increase rapidly before failure. Typical mechanical systems monitored in a predictive maintenance infrared program include bearings, motors, pumps, compressors and conveyor idlers. Most mechanical systems will heat up if there is improper lubrication or misalignment.



*Wet insulation on a flat roof*

Thermographic data can be an invaluable source of complimentary information to vibration studies in this area of equipment monitoring. Electric motors can be observed for brush contact-wear and armature shorts, both of which typically produce excess heat but not necessarily vibration, prior to failure.

## BUILDING DIAGNOSTICS

**ThermaCAM** can also provide useful data in building maintenance studies. Evaluation of built-up roofing systems for water leakage is a common application. Since water has a higher thermal mass than the rest of the roofing material it retains the heat longer and can be easily detected with a thermal imaging system at night after the rest of the roof has cooled. **ThermaCAM** allows maintenance personnel to quickly locate and mark any wet areas for cost-effective

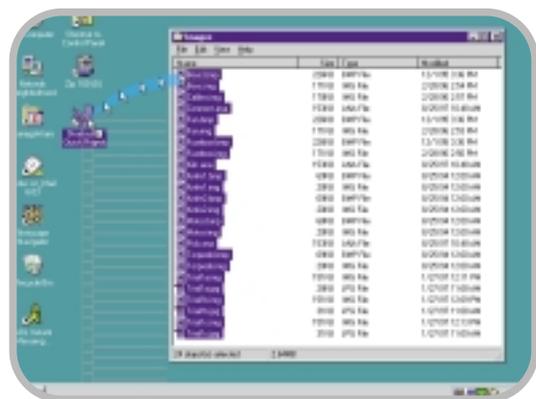
repairs. Tremendous savings result when wet areas of a roof can be repaired rather than replacing the entire roof.

Other applications involving plant structures include issues related to heating and cooling the building. Building envelope studies can be conducted where heat losses can be detected and analyzed. Steam generation and distribution systems can be monitored for clogged passages and open steam traps. Even underground steam lines can be viewed and many times leaks can be detected. Furnace condition monitoring is another common application. Refractory breakdown can be detected from the exterior of the furnace and tracked with a digital image database storage package.

## REPORTING AND ANALYZING INSPECTION RESULTS

Windows-based image analysis and reporting software integrated with modern IR cameras allow thermographers to create quick reports, make critical decisions and recommend repair action about the equipment and facilities inspected. Wizard-guided reporting software allows even occasional users to automatically generate both simple and complex reports. Another common feature of predictive maintenance software programs is the ability to embed IR images gathered by the inspection camera directly into Word and Excel files.

Additionally, **FLIR Systems** has developed numerous camera features specifically designed to automate the reporting process. Analysis functions, text, and voice comments can be digitally stored on removable data storage cards with camera images taken in the field, then automatically downloaded and embedded into result tables and report text.



### *Easy as Click, Drop, Print.*

*ThermaCAM QuickReport™ allows users to create standard reports instantly. Simply drag image files to the QuickReport icon, send the completed file to any printer, and you have a professional, high-impact report in minutes.*

## RETURN ON INVESTMENT

Thermography has proven to be an invaluable resource combined with, or in place of, other forms of predictive maintenance. ThermaCAM systems locate problems well in advance of failure resulting in an immediate payback on investment and avoiding plant shutdowns. Studies have shown that dollar for dollar, investments in predictive maintenance and product quality programs yield immediate, positive returns to a plant's "bottom line".

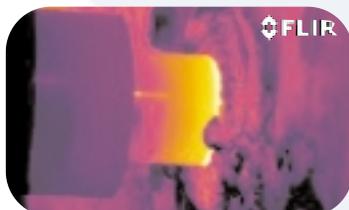
- Regular surveys of a steel mill's substations potentially save the company tens of thousands of dollars per year. A major steel company discovered a significant temperature rise in one of their 69 KV breakers. If this problem had gone undetected it could have cost the company \$50,000 per hour in lost time due to shutdown because of the casters. Total loss of power to a mill is estimated to be over \$250,000 an hour.
- At a large public electric utility company, a routine thermographic survey indicated one of the output filter capacitors of a station battery charger was considerably cooler than the others. As a result, the capacitor in question was tested and found to have failed. Replacement of the failing capacitor avoided an outage, saving an estimated \$500,000.

Many **ThermaCAM** users report full payback of their camera investment within the first six months or less. Typically, the savings resulting from incorporating IR into a predictive maintenance program far outweigh the initial camera investment.

When incorporated into predictive maintenance programs, **ThermaCAM** systems can literally save millions of dollars by locating problems in advance of failure. **ThermaCAM** is an easy-to-use, self-contained, rugged system designed to operate in harsh environments. Whether the application involves electrical equipment, mechanical systems, building diagnostics, or general maintenance, **ThermaCAM** will provide maintenance personnel with the accurate thermal information necessary to make critical decisions about equipment repair, replacement and efficient plant operations.



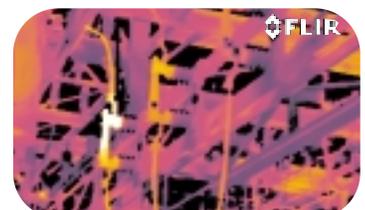
*Loose bolted connection*



*Overheated bearing on gearbox*



*Single pane window installed among double pane windows*



*Disconnect problem in a substation*



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