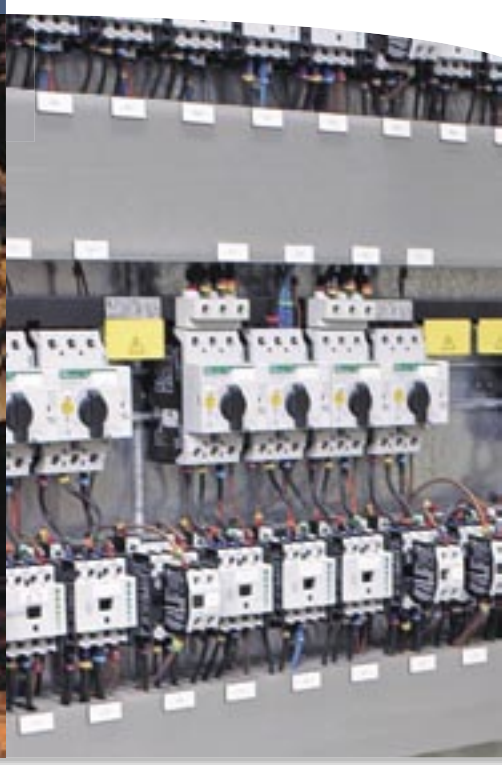
FLIR APPLICATION STORY



"Immediate Repair"? Defining and applying severity criteria for infrared maintenance inspections

Thermal imaging has evolved into one of the most valuable diagnostic tools for Predictive Maintenance. By detecting anomalies often invisible to the naked eye, thermography allows corrective action to be taken before costly system failures occur.

Finding out what the problem is, the scale and consequences of a possible shut-down of a production line, analyzing, reporting and taking connective action, are only a few of the questions that can rise when using infrared thermography. This document provides the answers to frequently asked questions regarding this matter.

"How should I report my findings in such a way that maintenance will be done as required?" An important question for the thermographer after his inspection rounds. "How do I get to know what's really urgent? And what's less urgent?" he is echoed by his customer.

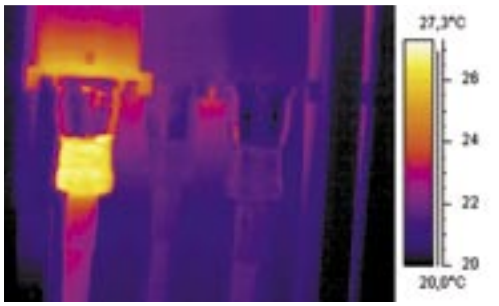
Finding hot spots is one thing, but assessing them is another issue; inspection results have to be classified and put into some kind of formal structure to allow a decision about how - and especially when - to take corrective action.

The Infrared Training Center, an independent infrared training institute which also provides certification, suggests the following severity criteria for electro-technical components and installations. Many thermographers take it as a guideline.

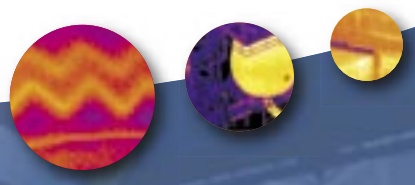
Class "A"
A very serious anomaly that requires immediate attention

Class "B"
A serious anomaly that requires attention as soon as possible

Class "C"
An anomaly that requires monitoring and a check-up at the earliest convenient time.



To decide whether a hot-spot is a real problem or not, you need to be aquainted with the installation.



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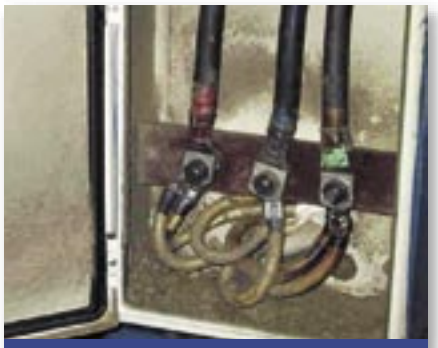
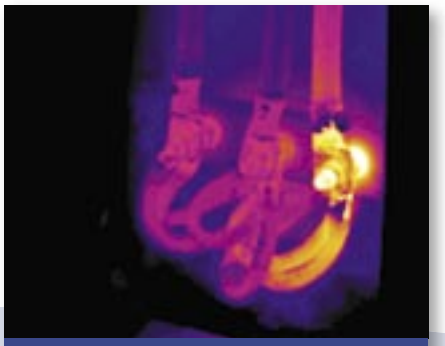


See it



Measure it

Report it

The shutdown problem: is the hot spot of strategic importance or not ?

Severity criteria fulfil the need to prioritize findings in such a way that the most serious problems are dealt with first. Direct, immediate repair of all detected anomalies in a plant are virtually impossible, as this would be too costly and inefficient to do. The task of a thermographer and his customer or boss, is to keep a plant running in a profitable mode with as few interruptions as possible and at the lowest cost, while maintaining a safe operation in terms of worker, property, and environmental safety. This explains why a classification or hierarchization of faults is a logical consequence and is by all means mandatory.

Do temperature limits define action ?

Preventive maintenance is based on comparative evidence. An infrared camera operator gathers quantitative and qualitative information about scanned objects. Quantitative information consists of a scanned object's temperature, while qualitative information applies to discovering, describing and locating the faults. Both are compared to "normal" temperature levels or function modes, within a certain range.

Measuring temperature levels becomes necessary to be able to decide how to deal with the problem once it is found. However, the thermographer of which we assume that he is acquainted with the apparatus he is inspecting, knows that different types of components with different functions, a well as identical components with varying functions can have different temperature limits.

So a temperature limits table is clearly not enough. And there are indeed no universally applicable severity criteria for a multitude of components. Of course, if an object is "too" hot, it is usually a sign that something should be done about it. But not always immediately. And not necessarily a repair.

It will, however, certainly require attention, which we can define as a stadium that alerts the concerned people, urging them to start the process of a short- or medium-term solution planning. Their outcome may of course be an immediate repair, but if it is not, some other actions may be decided such as, among others: lessening the load, applying additional cooling, ordering spare parts and labor, scheduling a time for shutdown and repair that will impact production the least, or doing additional measurements with other techniques for verification.

Developing criteria and guidelines

'Immediate repair' and 'attention' may be good indicators, but they are only a first step towards defining levels of urgency. There are three main sources of information to determine severity criteria: rules set by standards organizations, available literature about the inspected materials (operation manuals, construction plans etc.), and previous field experience (previous inspection reports, thermographer's experience in the sector).

Organizations will have to implement and consistently continue the following actions in order to be successful :

- Keeping up to date with what standards organizations and others publish: relevant standardization organizations are ISO (International Organization for Standardization), IEC (International Electrotechnical Commission), NETA (International Electrical Testing Association), IEEE (Institute of Electrical and Electronics Engineers, Inc.), DIN (Deutsches Institut für Normung), and other supranational or national standardization bodies.

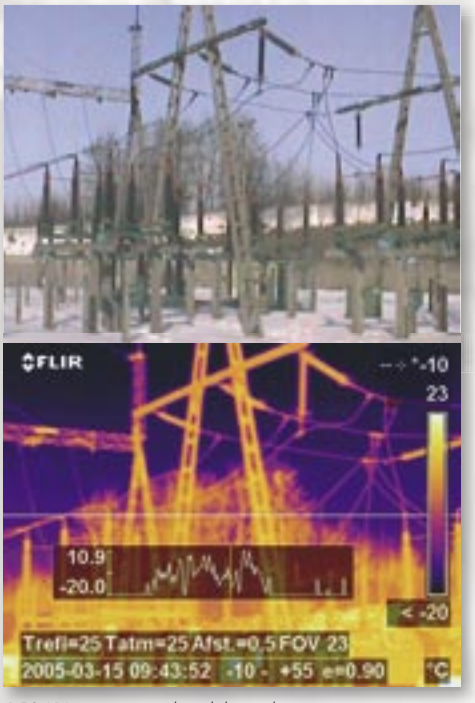
- Studying available literature about the inspected materials and components: manufacturers websites and manuals are an excellent source of information about materials and components for the thermographer.

- Documenting experience from the field: these data are of crucial importance to determine, adjust or even re-assess severity criteria. It is of utmost importance to preserve and store previous inspection reporting and keep it available in various media. Infrared camera manufacturers like FLIR Systems offer various software suites for easy, clear and transparent predictive mainenance inspection reporting.

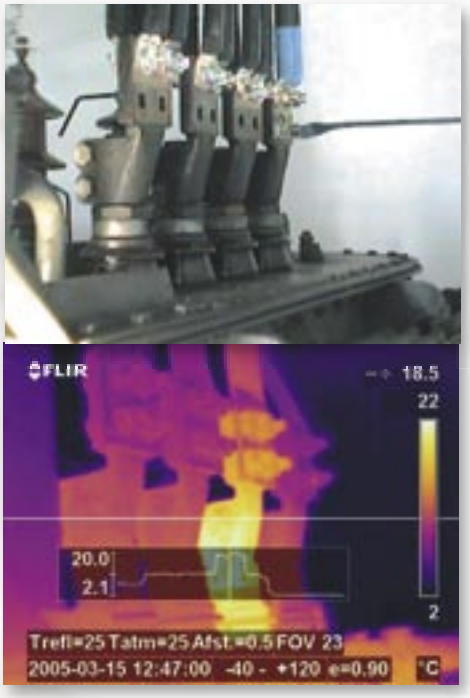
As a rule, criteria and guidelines should be kept alive by the accumulation of experience, gathered by thermographers.

How do some large organizations classify their findings?

Business sectors or organizations often develop their own set of criteria as part of their program guidelines and to cover their specific needs.



150 KV station, visual and thermal images



Top of transformer; low-voltage connection

At the Eaton Group, an automotive supplier with twenty-six plants all throughout Europe, thermography inspection results are classified according to a four-level fault rating system:

- "minor problem" is usually sorted out during the regular maintenance rounds by one of the group's fifty preventive maintenance employees
- "intermediate problem" demands repair within two weeks after the inspection
- "serious problem" requires a repair within one to two days following the survey
- "critical problem", at the end of the scale, requires immediate intervention as well as an additional thermographic inspection on site straight after the repair work

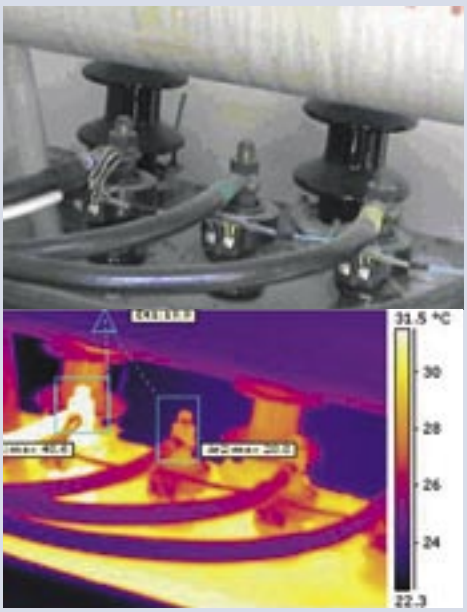
These uniform criteria for electrical installations have been worked out for the European Eaton Group subsidiaries by a consultancy. "They are based on a long-term experience and they cover all our needs", says Peter Koelewijn, Field Service Supervisor and the group's chief thermographer. "But that does not exclude taking my previous inspection reports with me when I'm surveying in a plant", he adds.

e·on | Bayern

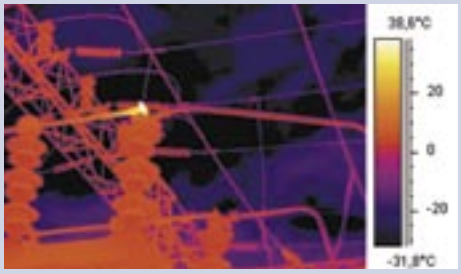
E.ON Bayern, a big European regional utility provider overseeing a 175,000 km long network, has defined the following severity criteria to maintain its 43,000 low and middle voltage installations:

- L1 stipulates a repair at the next annual, or other long-term regular inspection
- L2 requires a reparation within 6 months
- L3 urges repair within one working week

However, Uwe Thomas, Measurement Engineer and responsible for the thermography inspections at E.ON Bayern, underlines that these criteria serve as orientation values rather than as clear-cut directives and that specific local conditions, such as climate or other atmospheric influences can alter the criteria. "These criteria are not static, they are dynamic values with room for growth, re-assessment and if needed, change", says Uwe Thomas.



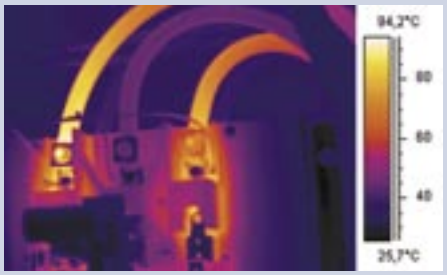
Electrical connection



Bad high voltage connection

Overheated connection

Internal fuse damage



Poor connection and internal damage

Determining whether a hot-spot is too hot and if it will cause problems needs to be done by the thermographer and/or the facility manager.

I am the criterion: What can thermographers do ?

Can a thermographer, as the prime gatherer of information, determine the severity of a problem correctly? Yes, but he/ she will have to know "his" installations more than thoroughly. As a matter of fact the thermographer should be able to interpret the anomaly with regard to its impact on the entire operation or machinery unit. Similar or identical hot spots on two identical components do not necessarily have identical consequences!

But only this, often unattainable, in-depth knowledge about the surveyed objects, empowers the thermographer to decide about the severity criterion.

This is a fact that is not often recognized, but good thermographers do understand this. They know that identical or different types of components with different functions have different temperature limits and they use their knowledge and experience to come up with reasonable solutions and reporting, within the framework of the customer's guidelines, when available.

In addition, it should be pointed out that severity criteria are not only important as structure for classification of faults but also as a formalized communication tool between the thermographer and his customer, who is often expert and decision-maker about further measures and actions.

Conclusions

Severity criteria are guidelines. They are useful indicators but they are insufficient as they should be developed for each type of industry, company, operation, and even material and component. The application of severity criteria should be a continuously evolving, dynamic process that takes new experience into account.

Much depends, as always, not only on the user skills of the thermographer, but also on his/ her knowledge of and expertise in a relevant business sector.

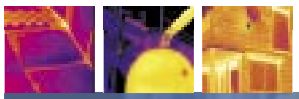
References

CRONHOLM, Michael : Severity Criteria: How Hot is too Hot? in: InfraMation 2005 Proceedings, Infrared Training Center, Billerica, Ma, USA, p. 239 - 247

Thanks to Gilbert Rentmeesters, Senior Service Manager, FLIR Systems Belgium, for providing additional information.

ThermaCAM P65

ThermaCAM E320



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