FLUKE®

Why thermography is good for your business

Application Note

Thermography used to be expensive, difficult, and primarily used by large industrial facilities and the military.

These days, it's become much more affordable, easier to use, and more broadly applied. That means your customers have heard of it.

It's a very impressive technology. Since the tool, a thermal imager, works by producing thermal (heat) pictures of the equipment, your customer can immediately see the benefits. In one pass through a facility, you can usually find at least one component about to fail. This makes for a powerful demonstration and an easy business builder.

Your advantage as a contractor is having broad experience with many types of equipment and failure scenarios—just like any other troubleshooting situation, the person behind the imager needs to draw on experience to help analyze the readings. If this part of the panel is hot, should I investigate the connections or the load?

Last of all, if you're already signed-on for regular maintenance and troubleshooting, adding thermography makes sense. You already know the facility and which units are critical to performance. You can simply add thermal inspection to your regular visits and have the tool available during troubleshooting calls. Plus, as an electrician, you're uniquely qualified to work in live voltage situations—specialty thermographers are not and require client assistance.

Typical applications

Electrical contractors typically use thermal imagers for predictive maintenance and troubleshooting, and sometimes during installation.

For predictive maintenance, the contractor takes thermal images of key units (panels, drives, motors, etc.) at least once a year if not more often, and compares those images with each visit. Hot spots that weren't there last time indicate problems in the making to investigate before they cause failure. Software on the thermal imager helps you align your images time after time, so that you're making consistent comparisons.

When selling this idea to a client, here are some additional things to consider:

- Most equipment's failure mechanisms involve a significant rise in operating temperature long before catastrophic failure occurs.
- Thermal images are best taken while equipment is operational. No shutdowns needed.
- Thermal images are taken at a safe distance. Minimal safety risk (except for live voltage—that still requires full electrical safety precautions).
- Thermal images can access components and units not otherwise measurable, such as ceiling runs.
- Thermal measurements help detect imminent failures in nearly all types of equipment, from electrical to mechanical, process, electronic, and so on.
- Because thermal inspections are fast, they can cover more ground and find problems in areas that would typically be ignored.

For troubleshooting, taking a thermal image of a malfunctioning unit can often identify the source of the problem—electrical hotspots can tell you which phase or connectors to check, motor hotspots can narrow it down to bearings, and so forth. Then, after repairs, follow up with another thermal image and verify that the component is no longer overheating—or that something else isn't now overheating, instead.

Here's a summary of principle applications.

- Electrical power distribution systems: Three-phase systems, distribution panels, fuses, wiring and connections, substations, electrical vaults, etc.
- Electro-mechanical equipment: Motors, pumps, fans, compressors, bearings, windings, gear boxes, and conveyors
- Process instrumentation: Process control equipment, pipes, valves, steam traps and tanks/vessels
- Facility maintenance: HVAC systems, buildings, roofs, insulation

How it works

Today's entry-level thermal imagers are compact and easy to use with minimal training. The camera automatically scans the unit in range and produces a constantly updating thermal image on screen. To capture a specific thermal image, in most cases, simply squeeze the trigger. When you're done, connect the thermal imager to your computer, upload the images to the thermal software, analyze them more closely, and create a report documenting your findings.

Here are some of the more complicated concepts involved in taking a good image and analyzing it correctly.

Emissivity

When you measure surface temperature, you're actually reading the infrared energy emitted by that object. Emissivity tracks how thoroughly the surface emits energy. The standard emissivity of most organic materials and painted or oxidized surfaces is 0.95. However, certain materials, such as concrete and shiny metals, are poorer emitters—their emitted energy doesn't accurately reflect their real surface temperature. To get an accurate thermal measurement of things like bus bars and any large metal electrical connectors, you need to adjust the emissivity value on the imager.

Emissivity values for many materials are published in charts. If you can look up the emissivity value for an object, you can adjust the imager appropriately. Or, you can learn to adjust the emissivity while you're taking the image. For example, for shiny fuse caps the emissivity might be only 0.6. If you know that, you can change the imager's emissivity from 0.95 to 0.6 and see the real temperature.

Level and gain

When the image field includes a wide range of temperatures, level and gain help you focus on the most important temperatures.

Most users work in automatic mode, where the thermal imager automatically assigns a temperature range based on the thermal scene it sees. If the imager senses a range from 80 to 120 degrees, the camera will automatically display a temperature range between 75 and 125 degrees.

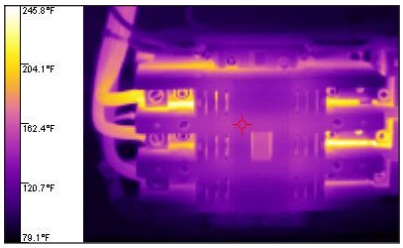
If, however, you look at a scene in automatic mode with something cool in the foreground and something very hot in the background, the color palette will be spread across a wide range of temperatures and the resolution will be poor. In such cases, you can manually adjust the level and gain to view just the temperatures of the hot or cool object.

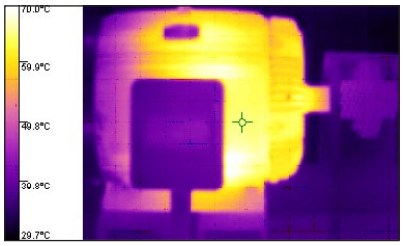
Choosing an imager

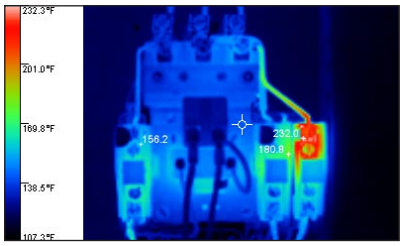
Obviously, there are many kinds of thermal imagers to choose from. Here are some factors to consider when deciding what kind of imager best fits your business model.

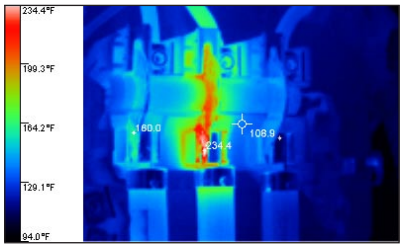
Radiometric

When you look at an image on a digital screen, you're really looking at thousands of individual little points of color. In the same way, radiometric thermal imagers capture temperature data for each of the thousands of points in a thermal image. A non-radiometric imager only provides temperature data for a few focal points. Why does this matter? Well, back at the computer, you can zoom in and out of a radiometric image, exploring any part of the image in more detail, and you can also change the emissivity or temperature range, to better analyze the results. That means you don't have to get the perfect image on-site, which is a big time-saver.









Thermal (temperature) sensitivity

Unless your customers produce very complicated, small components or have very heat sensitive applications, you very likely do not need the top models on the market. Most contractors do fine with a thermal sensitivity range of -10 °C to 350 °C (14 °F to 662 °F).

Pixel resolution

A high resolution screen and image looks nicer and is more impressive. However, those pixels cost money—the higher resolution your image output, the more the thermal imager is going to cost. If you're primarily looking for hotspots in electrical and mechanical applications, chances are, you don't really need the highest resolution available. You need enough resolution to compare one unit to another or to previous images, and that's what the entry-level units are designed to do.

Other basic features

Any imager you buy should offer the following:

- Adjustable emissivity
- Selectable temperature (C or F),
- Level and gain control
- Accuracy within ± 2 % or ± 2 °C
- Repeatability within ± 1 % or ± 1 °C
- Rechargeable battery pack (minimum 3 hour life)
- Laser sighting and a protected lens
- One year warranty

Many imagers also include the ability to set alarms for problematic temperature levels and to upload previous images for on-site comparison.

Training

Most entry level imagers come with a user manual and some form of interactive training, and that's usually all you'll need to get started on an entry-level imager. Medium to high end imagers are more complicated and should therefore include at least two days of in-person training from a reputable training firm. Beyond that, you can take full training courses to become certified in thermography—Level I is basic, and at Level II and III you can start calling yourself a thermographer.

Software

You're going to need software with any thermal imager you buy, so here are the key points to consider. Is the software included in the price? Are future updates free of charge as well? Do you have to buy licenses for multiple team members to load it? Does it easily create good-looking reports for customers? These questions are important because good software is essential for maintaining the client relationship.

Summary

Really, there's nothing holding you back. Contractors can readily purchase affordable thermal imagers, quickly train on the basics, and immediately start using the tool to improve their client services. The more you use it, the more skilled you become.

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