Thermal Imaging Cameras Explained – Quick Tips

Thermal imaging cameras are devices that translate thermal energy (heat) into visible light in order to analyze a particular object or scene. The image produced is known as a thermogram and is analyzed through a process called thermography. Thermal imaging cameras are sophisticated devices that process the captured image and display it on a screen. These images can be used for immediate diagnosis or processed through specialized software for further evaluation, accuracy and report output. Thermal imaging cameras take measuring temperature to the next level; instead of getting a number for the temperature you get a picture showing the temperature differences of a surface.

What Do Thermal Imaging Cameras See?

Visible light is what we see around us every day. It is the only part of the electromagnetic spectrum that we can see. Visible light only takes up a small area in the electromagnetic spectrum and infrared radiation (IR) represents a larger percentage. If we want to see what’s going on in other parts of the spectrum we need specialized equipment.

All objects absorb, reflect and sometimes transmit energy at different levels. Different materials will give off heat or cold energy at different rates. It’s this energy that can be detected by infrared equipment and displayed as images.

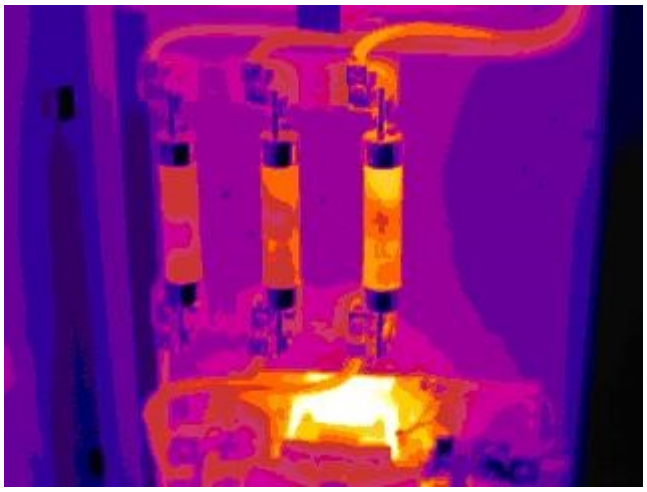
Thermal Imaging Camera Applications and Uses

Originally developed for military use during the Korean War, thermal imaging cameras have migrated into other fields and have found many uses. Firefighters use them to see through smoke, find people and localize hotspots of fires. Law enforcement uses the technology to manage surveillance activities, locate and apprehend suspects, investigate crime scenes and conduct search and rescue operations. Power line maintenance technicians locate overheating joints and parts to eliminate potential failures. Where thermal insulation becomes faulty, building construction technicians can see heat leaks to improve the efficiencies of cooling or heating. Physiological activities, such as fever, in human beings and other warm-blooded animals can also be monitored with thermographic imaging. They are also common tools used by home inspectors.

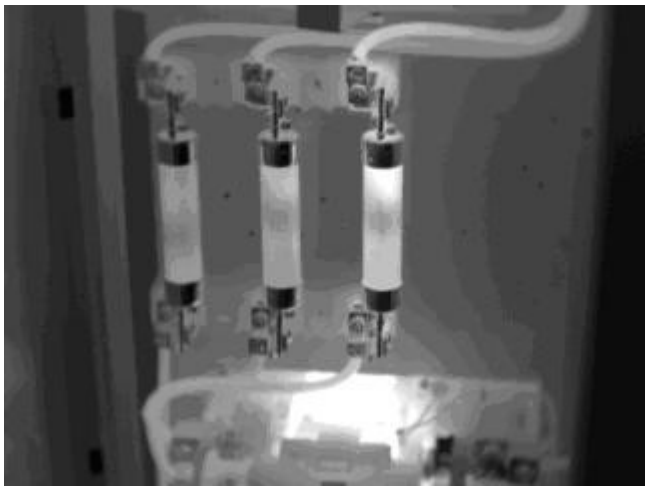
Thermal Imaging Camera Features

Thermal imaging cameras can be purchased with the bare minimum of features that only read the temperature of the fixed center crosshairs on the display or with multiple features that allow the user to select multiple moveable crosshairs and draw

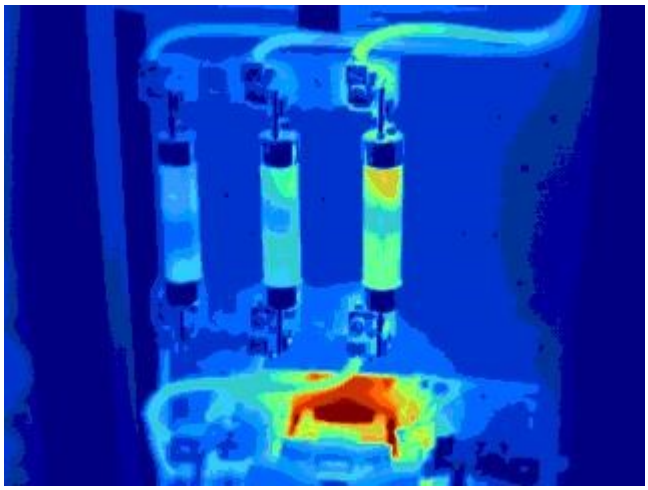
comparisons between them to show the high, low and average temperatures on the display. Thermal imaging cameras have user-selectable multiple color palettes, such as black/white, iron or rainbow. The iron palette is most commonly used by home inspectors. The black/white palette helps identify details on an image, and the rainbow palette has the best thermal sensitivity for displaying the differences in temperature. See sample images below of some color palettes.



Iron palette of fuse bus bar

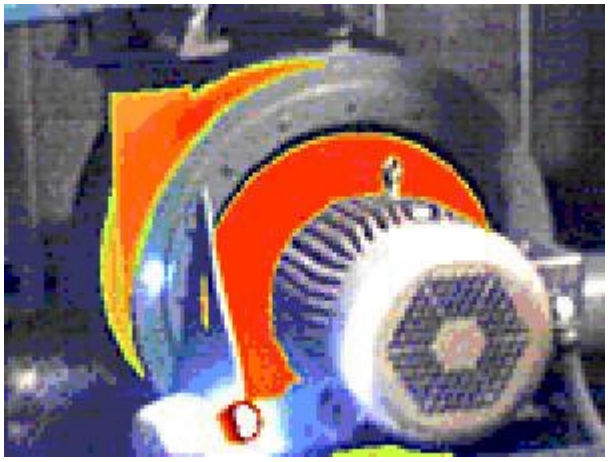


Black/white/gray palette

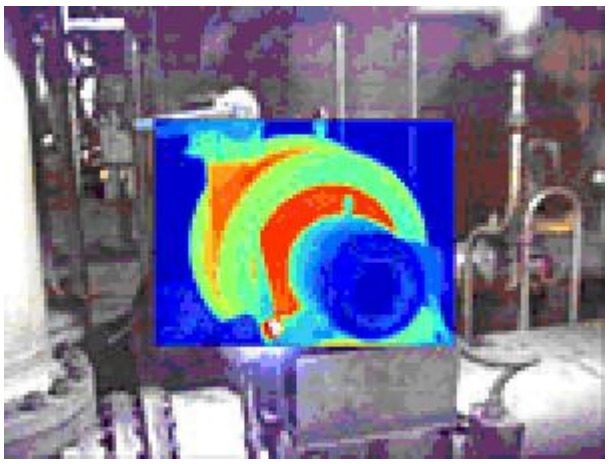


Rainbow palette

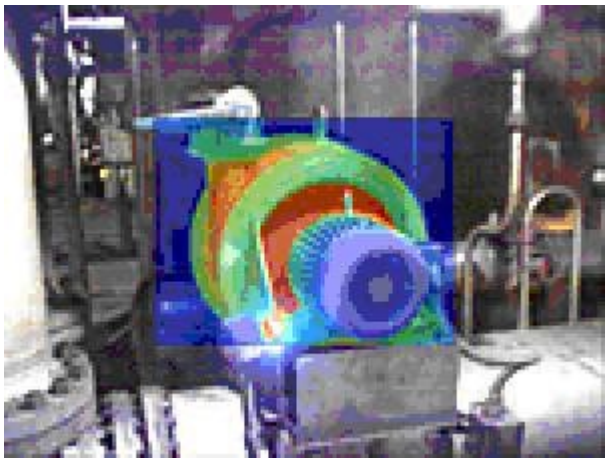
More sophisticated cameras may include:



A color alarm feature that allows the user to select a temperature. The camera will only display a color thermal image of anything that is either above or below the selected temperature.



A picture-in-picture feature that will display a color thermal image (which is a quarter of the size of the display) inside a standard digital image. Temperature readings are limited to the thermal portion of this feature.



A fusion or blending feature allows the user to blend either the maximum, minimum or average temperature of the thermal image with a standard digital image.

What to Look for in a Thermal Imaging Camera

There are a number of components that contribute to both the quality and the cost of a thermal imaging camera. The two most important factors are the detector resolution and the thermal sensitivity.

The detector resolution describes the number of pixels. The most common resolutions are 160 x 120, 320 x 240 and 640 x 480 pixels. A 320 x 240 detector produces an image

composed of 76,800 pixels. Since each pixel has a temperature associated with it that is 76,800 temperature data points. Higher resolutions also produce visibly clearer images.

Thermal sensitivity is the smallest temperature difference the camera can detect. A sensitivity of 0.05° means the camera can distinguish between two surfaces with only a five-hundredths of a degree temperature difference.

Another important factor to consider is the thermal imaging camera's temperature range. The range tells what the minimum and maximum temperatures are that the camera can measure (-4°F to 2200°F is typical).

To obtain the best thermal image to analyze, there are four adjustments that can be made to most cameras: focus, emissivity setting changes, reflective temperature setting changes and thermal tuning. Each of these adjustments must be considered when selecting a thermal imaging camera.

Just like a standard camera, the lens of the thermal imaging camera needs to be focused to enhance the clarity of the image. Most cameras can be focused by twisting the lens. More sophisticated cameras have a push-button focus.

Emissivity is the amount of radiation emitted from an object compared to that of a perfect emitter of radiation when both are at the same temperature. Adjusting the emissivity is important when taking temperature measurements or when comparing the temperatures of two different objects. Not all cameras allow the user to input reflective temperature.

The reflective temperature setting allows the user to compensate for surrounding objects' temperature reflecting on an object. Just like emissivity, reflective temperature is important when taking temperature measurements or comparing two objects' temperatures. Not all cameras allow the user to input reflective temperature.

Thermal tuning the camera involves adjusting the span or temperature range that the camera sees while in manual viewing mode. Manual mode allows the user to adjust the span to a desired range, and the camera will always display this temperature range. Using the manual mode is best when used to bring out temperature differences of the object being viewed.

Thermal Imaging Camera Limitations

Because thermal energy can be reflected off shiny surfaces, thermal imaging cameras cannot see through glass. Thermal imaging cameras can be used to gather information about the inside of a wall, but they cannot see through walls. It is also important to know that thermal imaging cameras should not be used as the only deciding factor that a problem exists. Using other instruments should always be used to confirm the problem.

Commonly Asked Questions

Q: What is the biggest difference between a $3000 and $10,000 camera?

A: The biggest difference is typically resolution. The higher the resolution, the better the picture clarity. This translates to a better picture at a greater distance as well, similar to the megapixels of a regular digital camera.

Q: Can thermal imaging cameras see through objects?

A: No. Thermal imaging cameras only detect heat; they will not "see" through solid objects, clothing, brick walls, etc. They see the heat coming off the surface of the object.

Q: Is there a difference between night vision and thermal imaging?

A: Yes. Night vision relies on at least a very low level of light (less than the human eye can detect) in order to amplify it so that it can produce a picture. Night vision will not work in complete darkness whereas thermal imaging will because it only “sees” heat.

Q: Can rain and heavy fog limit the range of thermal imaging cameras?

A: Yes. Rain and heavy fog can severely limit the range of thermal imaging cameras because light scatters off of droplets of water.

Sources

Thermal Imaging Guidebook for Industrial Applications

Flir/Extech Thermal Cameras

Fluke Cameras