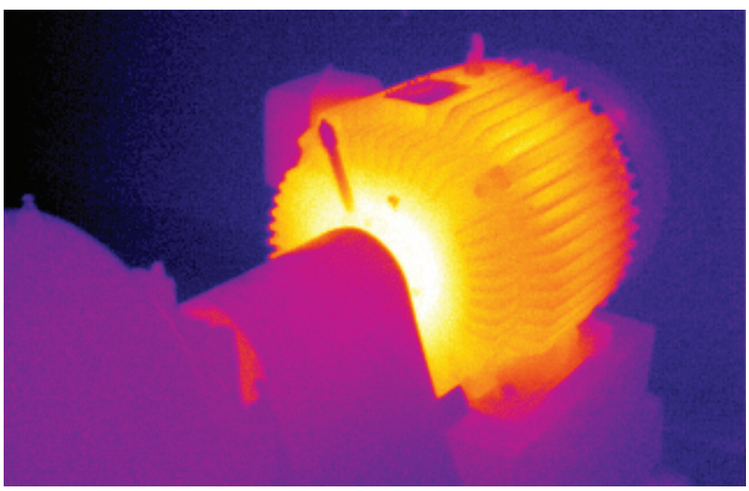
Thermography

What is thermography and what are its advantages?

Thermography uses energy from the infrared portion of the electromagnetic spectrum to produce images - like a digital camera that uses energy from the visible spectrum.

All objects (with a temperature above absolute zero) emit infrared energy. The amount of this energy depends on the temperature and other factors. An infrared camera detects and measures the infrared energy emitted by an object and its surroundings and can calculate the temperature differences. Because infrared cameras make differences in surface temperature visible, they often reveal problems hidden from the naked eye.



Infrared thermography offers the possibility to detect small or developing problems before they lead to failures. In industrial applications, some problems show up through unusual vibrations or noises, but other problems do not show these symptoms. Many electrical problems can be identified by their thermal patterns, which, if not detected, can lead to equipment failure or an even more serious electrical hazard.

In all these cases, a thermal imaging camera can speed up diagnosis and reduce or even prevent helping you to:

- Build of baseline for most types of equipment
- Capture data in hazardous areas from a safe distance
- Quickly scan large areas, such as walls, ceilings, and roofs
- Data acquisition without interrupting production
- Quick detection of irregularities at specific positions
- Detect problems before actual failure

These advantages result in several specific benefits for problem-solving and preventive and predictive maintenance:

- Increased safety. Technicians can often perform an inspection without having to touch the equipment or interrupt its operation. They can also check pipes and ceilings, in many cases without climbing ladders or use a lifting device
- Improved reliability. With more accurate information, maintenance teams can more easily fix problems before they cause widespread losses, significantly reducing unscheduled downtime
- Greater certainty in repairs. By quickly scanning a repaired component or load-bearing area with a thermal imaging camera, the technician can be satisfied that the repair was completed successfully. If not, they can identify further repair work through any anomalies still present
- Higher production capacity and quality. By using infrared thermography for preventive or predictive maintenance, it is possible to avoid equipment malfunctions and failures and maintain an optimal level of production efficiency and safety
- Monitor deterioration in the operating characteristics of equipment. You can use a thermal imaging camera to monitor the condition and characteristics of your equipment against pre-determined tolerances. This allows you to anticipate potential faults or failures so that you can repair or replace deteriorated components before they fail completely and cause unwanted dow

Detecting energy wastage in industrial applications with thermal imaging cameras

Thermography cannot be used directly to find energy wasters. However, when paired with an energy logger, which records the performance of a plant for a specified time, the evaluation of the data from these two tools tells us what energy consumption the plant had.

No, thermography should be an integral part of preventive maintenance. Because many causes can lead to energy waste or even breakdowns. Let's summarize the five most important causes to find energy waste or prevent failures by means of thermal imaging.

1. Detecting loose or corroded electrical connections (Fig. 1)

Thermography is a particularly suitable method for detecting incipient problems in electrical connections in advance. New electrical components and connections deteriorate over time. No matter what load is applied to a circuit, electrical connections will become loose due to vibration, material fatigue, and ageing. Or they will become corroded due to environmental conditions.

In short, all electrical connections will fail sooner or later. If not found and repaired, these faulty connections can lead to malfunctions. When loosened or corroded, the resistance of the connection increases and the current flowing through this resistance generates heat energy at that point. For this reason, a faulty connection can be detected with the help of a thermal image even before a failure occurs.

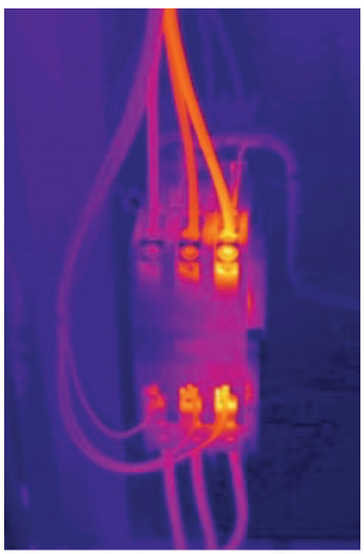


Fig.1

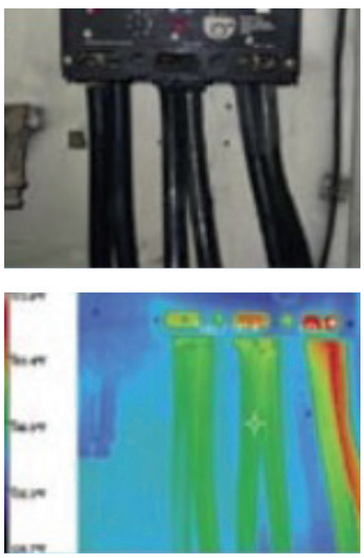


Fig.2

2. Recognizing asymmetry and overloads (Fig. 2)

There are various reasons for unbalance. Power distribution problems, low voltage on a line branch, or insulation breakdown in the motor windings. Even a small voltage unbalance can lead to a deterioration of the connection and thus a drop in the supply voltage. In these situations, motors and other loads draw excessive current, deliver less torque (with mechanical stress increasing) and fail sooner. If the unbalance is severe, a fuse may blow, causing one phase to fail. Meanwhile, the unbalanced current on the neutral returns and loads fail. Phases with the same load should have the same temperatures. In case of unbalance, the phases

with the higher load have a higher temperature because more heat energy is generated by the higher current.
However, unbalanced load, overload, faulty connections, and unbalanced harmonics create a similar picture. Thus, the currents in all phases must be measured, with a current clamp, for example, when diagnosing the problem.

3. Inspection of bearings (Fig. 3)

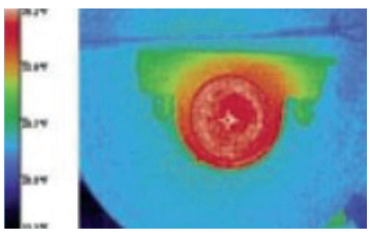
In many preventive maintenance programs, thermography is used to monitor the temperature of operational equipment using thermal energy to detect and prevent equipment failure.
Thermal imaging cameras allow technicians to capture two–dimensional infrared images of bearing and housing temperatures. Comparing the current operating temperature to reference values, and identify potential defects. In general, vibration analysis is the best method for monitoring large, easily accessible bearings at relatively high speeds as part of a preventive maintenance program. However, this method is only safe if accelerometers can be fitted (close) to the bearings. If the bearings are relatively small (e.g., in conveyor belt rollers), have low speeds, or are difficult or impossible to access safely during operation, thermography is a useful alternative or supplement to vibration analysis.

4. Checking electric motors (Fig. 4)

With the help of a thermal imaging camera, you can capture the temperature profile of a motor in pictures. From the surface temperature of an electric motor on a thermal image, you can infer the operating conditions. This type of condition monitoring is an important measure to prevent many unexpected motor failures in central systems in the manufacturing, commercial, and public sectors. Preventive measures are extremely important, as the failure of a critical system inevitably incurs costs.

The normal operating temperature of a motor is usually on the nameplate. And, although a thermal imaging camera cannot directly detect the internal temperature, the surface temperature allows you to draw appropriate conclusions when the temperature likely isn't matching the nameplate. When the temperature inside the engine increases, the surface temperature also increases. A thermography expert, who is also familiar with engines, can read from a thermal image, for example, indentifying insufficient air flow, imminent bearing failure, problems with the shaft coupling, or deterioration of the rotor or stator insulation.

Fig.3



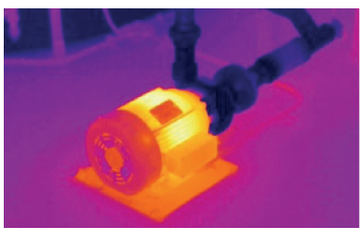


Fig.4

5. inspection of steam systems (Fig. 5)

Steam is, all in all, an extremely efficient way of transporting thermal energy. Generating steam from water requires a lot of heat energy, and steam is easy and inexpensive to distribute through pressurised piping systems. When the steam reaches the point of consumption and releases some of the heat energy it contains to the environment or a work process, it condenses into water, which must be returned to the boiler to be converted back into steam. There are a number of different methods to monitor steam systems and check that they are working properly, including infrared thermography. In this method, technicians use a thermal imaging camera to record the surface temperature of machines and buildings. Thermal images of steam systems reflect the relative temperature of the system components, indicating how effectively and efficiently the components are working.

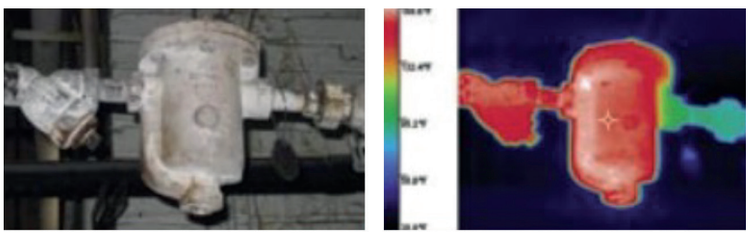


Fig.5

Thermography can help with a large number of different applications and is an indispensable part of these tasks.

But has something possibly not been considered? At the moment, we have not yet taken into account a major topic that also belongs to energy efficiency or has to do with energy production.

Photovoltaic systems and renewable energies are more important today than ever before, as the demand for energy is constantly growing. Photovoltaics systems are becoming more common worldwide, and if we look at the growth figures in Europe, they are remarkable. In 2021, new PV construction in Europe increased by about 34 percent compared to the previous year.

But what do PV systems have to do with energy efficiency? Just as in the topics already described, there are typical causes of improper operation in PV systems. In addition to electrical safety checks, most problems in a PV system also have a thermal effect.

But how does thermography help us in trouble-shooting? What are the most common causes?

- Temperature changes during operation
- Defective modules
- Defective PV cells (within a module)
- Defective bypass diodes, solder contacts
- Connection problems on cables and plugs

Image caption

A thermal imaging camera simultaneously captures a fully radiometric thermal image and a visual image. These images are superimposed pixel by pixel. In the process, the degree of blending is adjustable. The resulting image shows a palette of user-definable colours, each representing a different temperature. It also shows a visual image that can be used to identify the zones of the elements. Because of the thermal image, it is possible to see how the defective cells are overheating. The most favourable conditions for detecting such problems are when the module is powered on, usually at midday on a cloudless day. Under such conditions, cells can quickly reach temperatures of up to 111 °C.

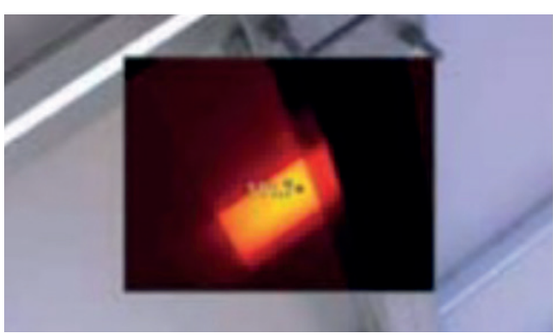


Image caption

Depending on how the solar module is constructed and whether the cells are connected in series to achieve the voltage required by the inverter, a fault in one of the cells can lead to a complete or partial power failure of a solar module. Such a problem results in lower power output from the module, which means it takes longer to reach the desired profitability. In addition, the problems associated with overheating can cause neighboring cells to operate less efficiently or fail altogether, spreading the issue throughout the entire module. With the help of a thermal imaging camera, a technician can monitor solar modules from both the front and the back. The latter has the advantage of avoiding problems related to solar reflections or reflections due to the low emissivity associated with the crystalline surface of the module.

With a thermography, you can quickly identify modules with hot spots from a distance.

But which thermal imaging camera is right for my application?

Technicians and service providers who need high-quality images and great functionality for an affordable price to capture images quickly and/or perform occasional examinations.





	PTi120	TiS20+	TiS55+	TiS60+	TiS75+
Key Features					
Infrared Resolution	120 x 90	120 x 90	256 x 192	320 x 240	384 x 288
NETD	60mk	60mk	40mk	45mk	40mk
FOV	50°H x 38°V	50°H x 38°V	28°H x 20°V	34.1°H x 25.6°V	42°H x 30°V
IFOV	7.6 mRad	7.6 mRad	1.91 mRad	1.86 mRad	1.91 mRad
Temp Range	-20 to 400°C	-20 to 150°C	-20 to 550°C	-20 to 400°C	-20 to 550°C
Focus	Focus-free	Focus-free	Focus-free + Manual	Focus-free	Focus-free + Manual
Display	3.5″	3.5″	3.5″	3.5″	3.5″
Touchscreen	Yes	Yes	Yes	No	Yes
Battery	2 hours	5 hours	3.5 hours	4 hours	3.5 hours





	Ti300+	Ti401 PRO	Ti480 PRO	TiX501	TiX580
Key Features					
Infrared Resolution	320 x 240	640 x 480	640 x 480	640 x 480	640 x 480
NETD	75mk	75mk	50mk	75mk	50mk
FOV	34°H x 24°V	34°H x 24°V	34°H x 24°V	34°H x 24°V	34°H x 24°V
IFOV	1.85 mRad	0.93 mRad	0.93 mRad	0.93 mRad	0.93 mRad
Temp Range	-20 to 650°C	-20 to 650°C	-20 to 1000°C	-20 to 650°C	-20 to 1000°C
Focus	Advanced manual + LaserSharp	Advanced manual + LaserSharp	Advanced manual + LaserSharp	Advanced manual + LaserSharp	Advanced manual + LaserSharp
Display	3.5″	3.5″	3.5″	5.7″	5.7″
Touchscreen	Yes	Yes	Yes	No	Yes
Battery	3 hours	3 hours	3 hours	3 hours	3 hours

For corporate thermographers and service or maintenance technicians who need high-quality images, advanced features, and higher resolution for different use cases.

At the end of the day, you can make great strides in energy efficiency in your facilities and buildings with these simple and proven techniques. Individually each of these methods offers added value, but when combined, they can lead to high energy savings.

Fluke. *Keeping your world up and running.*™

www.fluke.com