FLUKE®

Pumps, fans and compressors

Application Note

Pumps, fans, compressors and other motor-driven rotating equipment are essential to manufacturing, commercial and institutional enterprise, from fluid handling systems in petro-chemical plants to large air comfort systems in shopping malls.

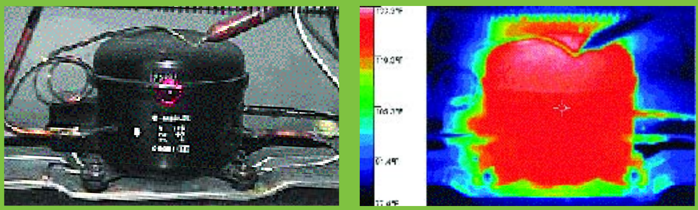
Many facilities monitor this type of equipment on a regular basis, because often a simple problem like lubrication can be spotted and fixed inexpensively, before the entire unit burns out. Such strategies fall under the general heading of predictive maintenance (PdM).

Thermal imaging is especially useful for monitoring rotating equipment, since many impending failures are accompanied by overheating. This predictive technique uses a handheld thermal imager to capture two-dimensional images representing the apparent* surface temperatures of equipment. Thermography can also be used together with other predictive technologies such as oil analysis, vibration monitoring and ultrasound.

What to check?

While it is in operation and under load, monitor rotating equipment that is critical to your operations, i.e., equipment whose failure would threaten people, property or production. Be sure to scan the equipment's drives—electric motors and gearboxes (if any)—and follow the guidelines for monitoring these units spelled out in earlier Fluke Application Notes. Also, on pumps and fans, get thermal profiles of the housings—scans that are likely to reveal any problems with bearings or seals—as well as scans of shaft couplings or drive belts and sheaves. For a compressor, use several images, if necessary, to get a thermal profile of the entire unit.

*Apparent temperature can differ significantly from actual temperature, due to the emissivity of a material's surface.



On compressors, belt slippage on cooler fans, shaft misalignment and bearing problems will all appear as abnormal hot spots.

What to look for?

In general, look for hot spots and pay special attention to differences in temperature between similar units operating under similar conditions. For example, if a bearing in one fan in a bank of similar fans is running hotter than rest, the hotter one may be trending toward premature failure.

On a pump, a difference in temperature along a seal or gasket is the "signature" of a failure. A hot spot on the housing adjacent to a bearing may signal an impending bearing failure, although the root cause probably will not be ascertainable from a thermal image alone. Perhaps there's a lubrication problem or maybe misalignment in the drive. An overheating bearing on a fan also signals a problem but a thermal image of it alone is non-definitive. Again, the root cause could be lack of lubrication, the wrong lubrication, drive misalignment or unbalance in the fan itself. Further investigation is required.

Many industrial and most building-system fans are belt-driven, as are some pumps. According to one source[1], a belt-and-sheave drive that is designed and installed correctly generates very little heat, and the belt moving through the air tends to cool it to near ambient temperature. Overheating, detected by thermography, reflects a problem with the drive's design or installation, perhaps mismatched belt and sheaves or misalignment. Vibration analysis and/or an alignment check will confirm the latter condition.

Since a compressor is a "heat machine", a thermal imager can quite literally "see" a compressor work as compression produces heat while expansion cools[2]. To check the efficiency of compressors, look for belt slippage on cooler fans, shaft misalignment, bearing problems, and blocked or leaking valves.

A good approach is to create a regular inspection route that includes all critical rotating equipment. Then, save a thermal image and associated data of each unit scanned on a computer and track the measurements over time. That way, you'll have a baseline for comparisons with subsequent images. They will help you determine whether a hot spot is unusual or not, and, following repairs, help you verify that the repairs were successful.

Fluke thermal imagers now include IR-Fusion®*, a technology that fuses a visual, or visible light, image with an infrared image for better identification, analysis and image management.

*The Fluke Ti20 comes with InSideIR™ analysis and reporting software with free updates for the life of the product.

What represents a "red alert?"

Equipment conditions that pose a safety risk should take the highest repair priority. However, the imminent failure of any critical pump, fan or compressor represents a red alert. Consider using key safety, maintenance and operations personnel to quantify "warning" and "alarm" levels for these assets. Then, you can set alarm levels for specific equipment on your Fluke thermal imager[4].

What's the potential cost of failure?

Because pumps, fans and compressors are key to productivity in so many industries, it is difficult to speak generally about the cost to a company from the failure of a critical unit. However, a failed pump at one automotive facility cost more than US $15,000 to repair while lost labor costs totaled US $600 per minute and lost production opportunities amounted to US $30,000 per minute[3]. Try developing similar figures for a critical equipment failure in your operations. It may help you justify thermal imaging to your managers.

Follow-up actions

Whenever you use a thermal imager and find a problem, use the associated software to document your findings in a report that includes a digital photograph as well as a thermal image. That's the best way to communicate the problems you find and to suggest repairs. If a catastrophic failure appears imminent, the equipment must either be removed from service or repaired immediately.

[1]From the Web site of John Snell & Associates www.snellinfrared.com/tt/TT5_05%20Web%20Version.pdf.

[2]Go to www.gmrc.org/gmrc/2004finalpapers/Optimized%20Compressor%20Efficiency%20through%20Thermography.pdf.

[3]Source: the Web site of the Academy of Infrared Thermography, specifically at www.infraredmechanical.com/mechanical_5.html.

[4]Model depending.

An imaging tip:

Winds (or air currents inside) in excess of even a few miles per hour will reduce the surface temperatures you are seeing, causing real problems to seem less significant or even making them invisible. Inside plants air currents are often 10-15MPH! Buy a good quality wind meter and record the wind speed when you record the apparent temperature. When you must inspect in high convection situations, note all problems for a follow-up inspection. Even those with small temperature increases may become critically hot when the airflow is reduced.

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