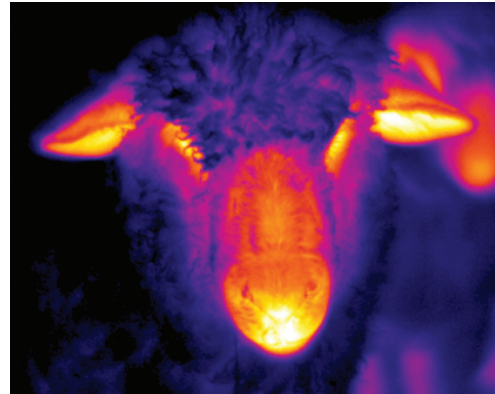


### Infrared Thermography: A tool for utility energy conservation programs

**I**nfrared light is a form of electromagnetic radiation whose primary source is heat or thermal radiation. The human eye cannot see infrared light. However, an infrared camera can detect radiation of heat from the surface of an object, translate the information into temperatures, and then display the temperatures as colors that the human eye can see (see Figure 1 in which various colors represent various temperatures).

This can give valuable information about the source of heat loss, which can be used to diagnose problems and determine how to conserve energy.



*Figure 1. A thermograph of a sheep shows that wool is a good insulator.*

### What are common applications of infrared thermography?

**I**nfrared thermography is a tool that can save energy in residential, commercial and industrial situations. The list of uses is virtually up to the imagination and creativity of the auditor. The following applications demonstrate its unique abilities to troubleshoot problems.

#### Insulation effectiveness

Insulation is used to stop the transfer of heat from one place to another. Infrared thermography shows its effectiveness. When used to survey roofs and walls,

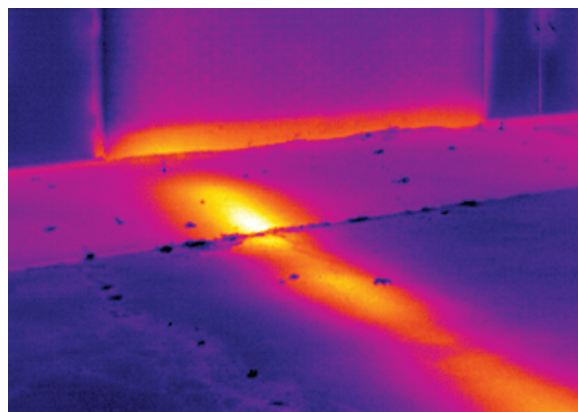
missing insulation can be found quickly (see Figure 2). Places where walls lack insulation, leaks in door seals, heat loss from process heating applications and more can be found and then corrected.

#### Leaks

Whether leaks are from steam, water or air, they waste energy. An infrared camera can locate leaks that would normally be undetectable (see Figure 3).



*Figure 2. The infrared picture of this house (taken on a cold winter day) shows inadequate roof insulation, an uninsulated basement, a door seal leak and poor wall insulation behind a baseboard heater under the window (see studs).*



*Figure 3. This infrared picture shows a steam leak that is four feet under the ground.*

## Electrical problems

Loose wiring, overloaded circuits and grounding problems are just some of the electrical issues quickly found with infrared thermography (see examples in Figures 4 and 5). Loose wiring and grounding issues waste energy, but more importantly, may be a safety and reliability issue that can cost thousands of dollars in down time, damage, fire and/or loss of life.

## Rotating equipment

In industrial applications, infrared thermography can pinpoint equipment problems with motors, pumps and compressors. As motor windings begin to fail, the mo-

tors use more energy, and this energy is lost to heat (see Figure 6). This overheating can damage motor insulation and cause arcing and eventual failure of the motor. Without infrared detection, most motor problems are only determined after the motor has failed. At that point, the failure has already wasted significant energy and affected production.

Bearings wear from use and contamination, and can eventually fail. As bearing friction increases, the motor uses more energy to overcome friction. While the increase in energy may be detected, the cause may not be known. Infrared thermography can help determine the cause (see Figure 7).

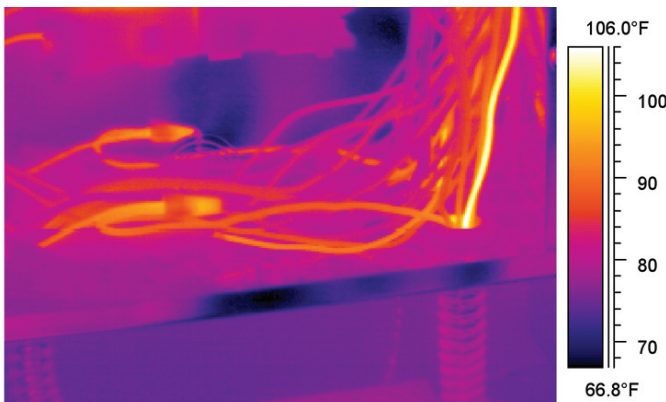


Figure 4. A ground wire short is detected with an IR camera. The ground wire is carrying 20 amps.

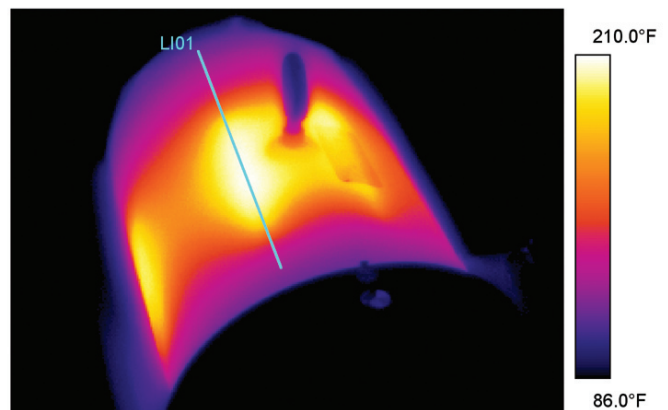


Figure 6. The beginnings of motor winding failure.

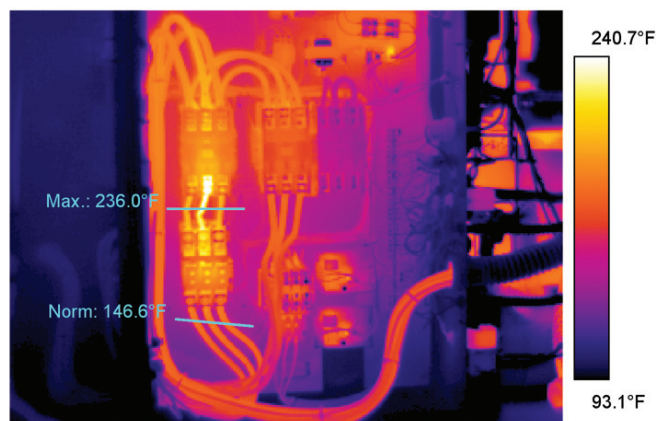


Figure 5. Loose wire on second phase of a compressor control panel.

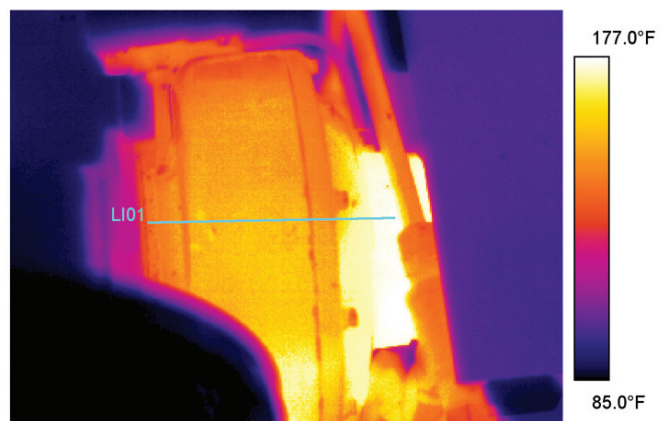


Figure 7. The beginning of bearing failure on a compressor motor.

# General guidelines for using infrared thermography

**I**t's not enough to purchase or borrow an infrared camera and just start taking pictures. Here are some guidelines for getting accurate, meaningful results.

## Training

Training is available through seminars, literature, Internet resources and classes. It's important to have a solid grasp of infrared theory to correctly interpret the results of an infrared thermograph. There are many certification programs, but understanding the basics is the key.

## Experience

After you understand how infrared thermography works, experience is the next step. The more time you spend looking at infrared pictures and working behind a camera, the more you learn. This experience will help you determine whether there is really a problem or not. As an example, the picture may show that the wire is hot compared to other wires, but it may just be because it is the only circuit "on" in the panel.

## Experimentation

Experimentation is the key to becoming a good thermographer. Just as your eyes become accustomed to visual light over the years and this allows you to interpret what you see, experimentation with infrared cameras will allow you to interpret and diagnose thermographs.

## Focus

Focus is the single most important aspect of a good infrared picture. Just like focus is important for clarity in a photograph, focus is important for accurate temperature measurement in a thermograph. A blurred image makes the temperature become only an average over an area instead of the temperature at a single point. The other aspects of a thermograph, such as span, emissivity, maximum and minimum temperatures and color palette, can be modified later. But poor focus can never be fixed.

## Pitfalls

Understanding emissivity is very important. The emissivity of an object is its ability to radiate energy. When you are looking in the infrared spectrum, a piece of aluminum or a piece of glass is like a mirror to infrared. So a hot spot in the image may actually be a reflection of the body heat of the thermographer and not actually a problem.

The camera needs to be adjusted to account for emissivity, background temperature, air temperature and distance from the target to get an accurate temperature measurement.

Interpreting the results of a thermograph when you are not the photographer can be difficult. Usually, it is best for the person who is going to interpret the results to be the one taking the pictures. At the very least, a standard (non-infrared) photograph should also be taken of the object to get perspective.

## Additional resources

### Training and Certification Programs

Infrared Training Center, <http://www.infraredtraining.com/>  
Academy of Infrared Training, Inc., <http://www.infraredtraining.net/>  
Snell Infrared, <http://www.snellinfrared.com/>  
Infraspection Institute, <http://www.infraspection.com/>  
Colbert Infrared Services, Inc., <http://www.colbert-infrared.com/>

### Cameras

Electrophysics, <http://www.electrophysics.com/>  
FLIR Systems, <http://www.flirthermography.com/>  
Infrared Solutions, <http://www.infraredsolutions.com/>  
ISG Thermal Systems, <http://www.isginfrared.com/>  
Land Instruments International, <http://www.landinst.com/>  
Mikron, <http://www.irimaging.com/>  
Raytek-Fluke, <http://www.raytek-northamerica.com/>  
Thermoteknix, <http://www.thermoteknix.com/>

### Equipment Loan

Western Energy Services Equipment Loan Program, <http://www.wapa.gov/es/loan/eqlist.htm>



**Energy Services Web site**  
[www.wapa.gov/es](http://www.wapa.gov/es)

**Western's Power Line:**  
1-800-POWERLN  
(1-800-769-3756)

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