The Importance of Thermography Training

Now that the use of infrared cameras has become a regular feature of building moisture inspections and monitoring of water damage restoration projects, the necessity of training becomes more and more critical. Without appropriate training, an inexperienced thermographer may well misinterpret thermal images. For example, to clearly understand thermography, you need to understand the difference between light and heat. There are a number of questions that inevitably need to be asked and answered when a restorer is considering the addition of this technology to their business. Let's consider the answers to some of those questions.

QUESTION: What is a thermographer? A thermographer is one who is qualified to collect and interpret infrared (IR) images. One needs to be trained as a thermographer. On the other hand, an IR camera "operator" is one who has read the manual and has learned how to "operate" it. They can turn it on, change the palettes, snap images, etc. But, customers are not paying you to just "operate" your camera. Customers want answers to questions such as:

- Are my walls, ceilings, and floors wet and are they wet enough to support mold growth? If so, where?
- Is there any part of my home that is not properly insulated? If so, which areas are missing the insulation?
- Does my roof leak? If so, where is the leak?

A visual inspection is not adequate to answer these questions. A trained thermographer, on the other hand, is qualified to perform an investigation and successfully address these problems accurately and quickly. It does not require a degree in science to be a successful thermographer. It requires training and common sense. It is not hard. It is just different.

QUESTION: What should thermography training include? Any thermography training program should include an introduction to the physics of infrared and the principles of thermodynamics. In addition, a segment of the course should answer questions about camera operation and application. What's a span bar? What's the level? Which palette should I use? What is emissivity and background temperature? If you are performing moisture investigations then you would need to have some understanding of psychrometry. It would be very helpful to have an understanding of the construction of buildings if you are doing building envelope investigations. If you are performing roof investigations, trend analysis for motors, electrical investigations, mechanical investigations, etc. you would need additional training in that area.

Lack of training usually leads to incorrect interpretation of thermal images and therefore wrong conclusions. This can result in costly mistakes. What if, for example, you performed a building moisture investigation on the interior of a home and told the owner that he had moisture in his wall. You were using the red/blue palette and a 20° span (60°F

to 80°F). An area of the wall appeared blue (cooler). And you concluded it was moisture just by looking at the image on your camera. The home owner relied on your word as a professional. A further intrusive inspection of the wall cavity revealed that there was no moisture. Whoops! A trained thermographer would not have concluded that there was moisture. Remember, the IR camera is not a moisture meter. It is a thermal imaging device which means it detects surface temperature differences. So, what besides evaporative cooling could account for cooler temperatures in the above example? Cold air from the AC vent blowing on the wall would appear cooler. Missing insulation, compromised insulation or thermal bridging on a cold day would appear cooler? All three scenarios can look the same. The IR camera is an invaluable tool for quickly and accurately directing you to an "area needing further investigation". Moisture meters are used to confirm the presence of moisture. Borescopes can be used to look into a wall cavity, if necessary. All tools are just that – TOOLS. And tools are great as long as one understands how to use them and understands their limitations. An IR camera can be a very, very effective and profitable TOOL when it is used by a qualified trained thermographer.

QUESTION: Can an infrared camera see through walls? This is one of the most often asked questions and quite often it is answered incorrectly. A camera "operator" might say "Yes, I can see studs". A thermographer would say: "It depends on what the wall is made of." Is it made of thin plastic, like a plastic containment wall? Is it made of glass? Is it made of sheetrock? A long wave IR camera detects thermal radiation approximately in the 8-14 micron band width of the electromagnetic spectrum. (For the purposes of this discussion we are referring to thermal radiation in the 8-14 micron band width.) It is important to realize that IR cameras do not "see through" anything. They do not, for example, see studs behind sheetrock. Rather, they detect the thermal radiation *emitted* from or *reflected* off of the surface of the target object. Very few materials allow thermal radiation at this band width to be *transmitted* through them. An exception would be thin plastic. But here is the important thing to remember. At the 8-14 micron band width, most surfaces are opaque to infrared, including glass, meaning that the IR waves do not pass through them. From a thermography standpoint we can be glad that most surfaces do not allow infrared radiation to transmit through them. It would create tremendous confusion and render the value of current IR cameras useless. Why? Because everything emits thermal radiation! If IR waves could be transmitted through any wall we would not know what surface we are thermally detecting. You would not be able to determine whether you were reading energy wavesw emitted from the:

- paint on the surface;
- inside of the sheetrock;
- insulation in the cavity;
- inside of the exterior wall;
- exterior of the exterior wall; or
- building next door or down the street, etc.

How many layers of temperatures would you be detecting? Who knows? A good rule of thumb is to remember that the IR camera is detecting the same surface that your eyes are looking at.

QUESTION: What is emissivity? Is the temperature indicated on the thermal image the actual temperature of the surface that we are viewing? An untrained IR camera "operator" might assume that it is. A trained thermographer would correctly say: "Maybe, maybe not! It depends on the emissivity of the target surface among other things." For example, the side door of a car with an emissivity of 0.95 reads 146° F on a hot day while the chrome around the wind shield with an emissivity of 0.08 reads < -4° F. The reading on the door is very close to accurate but the reading on the chrome is not even close to its actual temperature. Why? In this particular case the polished chrome was reflecting the sky, which is very cold. So, an understanding of emissivity is very important to a thermographer? The accuracy of the temperature reading and the thermal difference presented in the image depend on the emissivity of the target surface. Total radiosity, the total infrared radiation coming from the surface, consists of three components: emissivity, reflectivity, and transmissivity. The sum of these three components= one. (E+R+T=1) You will always have emissivity and reflectivity. Sometimes you will have some transmissivity (e.g., IR radiation passing through thin plastic). The *true* temperature of the *target surface* is represented only by energy that is emitted, not reflected or transmitted. Reflected IR energy confuses the untrained IR camera "operator". The < -4° F reading of the chrome in the example above certainly is not accurate, and yet, a trained thermographer is not surprised or confused. He/she knows what adjustment to make in order to get a true reading. Think of it this way: the higher the emissivity, the more accurate the temperature reading; the lower the emissivity, the more misleading the temperature reading. Why? When the emissivity is high the reflectivity is low. When the emissivity is low the reflectivity is high. And, as demonstrated above, reflected IR radiation can result in a very misleading surface temperature reading. These are basic things that a thermographer understands due to his/her training. Let me repeat this important point: New concepts are sometimes difficult to understand without training. Thermography is not hard to learn. It does not require a scientific background or a math genius. It just requires good training and experience.

QUESTION: Does distance affect the accuracy of the temperature reading? This is another question that demonstrates the need for training. A trained thermographer will answer "Yes". It has to do with spatial resolution (IFOV) or what we refer to as "spot size". The temperature reading on a camera is the **average** temperature of the "spot size". Is the camera detecting the average temperature of a 1 inch area, 6 inch area, 1 foot area, 6 foot area? It depends on the specifications of the camera and camera lens and the distance from the target. Let's illustrate it this way. Turn on a projector and point it toward the wall. You see a rectangular shape of light. Pretend that this is the size of one detector in your IR camera. Notice the size of the projected rectangle. What happens as you pick up the projector and walk toward the wall? The projected rectangle of light becomes smaller and smaller as you approach the wall. As you walk away from the wall you notice that the rectangle grows larger and larger. So, the size of the rectangle or spot size is affected by your distance, right? The IR detector gives you an **average** temperature of the spot. So, as you stand back further you will get the **average** temperature of a larger area or "spot". If a customer is paying a thermographer for an

accurate temperature reading, the information provided may very well be inaccurate if the thermographer has not learned the basic concepts of emissivity, reflectivity, transmissivity and spot size (spatial resolution).

QUESTION: How many hours or days of training are required? It depends on how extensively you intend to apply infrared technology. It takes approximately an 8 hour day to adequately cover the basic physics of infrared and the basic principles of thermodynamics. Additionally, it would take at least another 8 hours to cover camera operation, building moisture investigations, building envelope investigations and allow time for some hands-on exercises. If you want to expand into roof investigations, mechanical investigations and electrical investigations and other industrial applications, you will probably need an additional 16 hours or more.

QUESTION: Who provides training? Restoration Consultants Inc provides training in the use of IR cameras for moisture investigations and building envelope investigations in two ways: (1) A two day class called Applied Thermography Training (ATT) and (2) an online course (BTT: Basic Thermography Training) that you can have access to for 30 days to review as many times as you wish. This course is convenient and allows you to absorb the information at your pace over the 30 day period. One can review all of the information in the BTT course in one day.

When you purchase your camera through Restoration Consultants you qualify for huge discounts on our training. The ATT retails at $795.00. But you pay only $95.00. Our BTT online course retails at $495.00. But you pay only $95.00.

QUESTION: What should I do after the training session? If you put the camera on the shelf and pull it out once a month I can guarantee you that you will forget many of the important principles of thermography that you learned in class. And if you forget the principles of how to collect and interpret IR images, you will be inclined to continue to leave the camera on the shelf. That would be a tremendous waste of the money spent on the camera and classes, not to mention the loss of revenue by not using the camera. It is very similar to learning to think in a new language. If you practice the new language everyday, soon you will find yourself thinking in that language. But if you fail to use it, you will lose it. Learn to think like the IR camera. Be a trained thermographer and not just a camera "operator".

Just bought an IR camera? Do you need training? What do you think?

Rod Hoff is a thermographer and instructor with Restoration Consultants Inc. He teaches a two day IR class in moisture and building envelope investigations as well as the BTT online course. He graduated from Florida State University with a degree in education. He received his formal training in thermography from Snell Infrared and RestCon Environmental.