Think Thermally®

Practical news for practicing thermographers

July 2003

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The Space® Blanket: How it "Thinks Thermally!"

The human body is a remarkable machine. We don't notice, and take for granted, so many things the body does all of the time. That includes the way the body regulates itself thermally. When we are too warm, we begin to sweat and are cooled by the resulting evaporation. A chill causes hairs to stand up straight, increasing the boundary layer around us and helping to reduce heat loss to the environment. When we get too cold, we automatically begin to shiver. This muscular activity burns stored energy and generates heat. If the body's temperature moves out of its very narrow "normal" range (which can vary slightly from one person to another) trouble—or even death—looms.

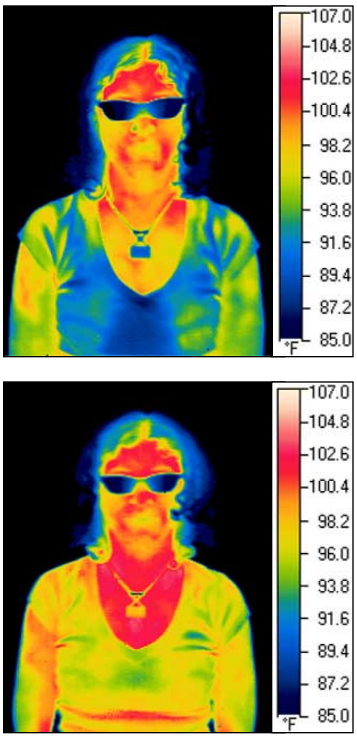
Some people voluntarily push their bodies to extremes. One example of this is running a marathon. The 26.2 mile race is named for the town in Greece where the run was first made by Pheidippides, a hemerodromo or a runner-messenger. According to legend, he arrived to the plains of Marathon and shouted, "Rejoice! We conquer!" then fell and died. Thousands of people run marathons each year, now, with much better results. Race times vary from two hours and ten minutes for the winner of the Boston Marathon to three-and-a-half or more than four hours for the average runner. Incredible quantities of energy—in the neighborhood of 3,000 Kcal—are expended in the process of the race. The racer's feet are lifted 37,000 times; think of that as lifting 20 million pounds!

A marathoner's body temperature gradually rises 3 or 4 degrees to 102 degrees. The body sweats and cools itself, acting as an air-conditioning system. Convection is also increased as the runner cuts through the air at approximately 7.5 to 12 mph, the equivalent of an otherwise refreshing breeze. It is interesting to note that running on a treadmill is much more tiring due to the reduction in convective cooling from the stationary activity.

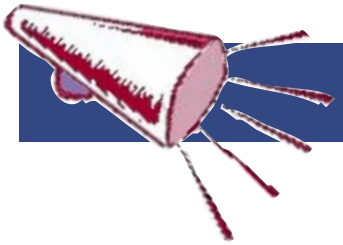
Many scientists have studied the physiology of running. Bernd Heinrich, whose books we have reviewed here in the past, has added to our understanding of the subject with *Why We Run* published by Harper Collins. Dr. Heinrich is an ultra-marathon runner—he has run 100 mile races, as well as having run 24 hours straight. He is also a legendary thermal thinker. His earlier book, *Winter World*, describes the countless ways animals have adapted to regulating temperature and includes examples of insects that can be dropped into liquid nitrogen and spring peeper frogs whose mating calls require expenditures of energy equivalent to a runner.

Snell Infrared's Sarah Spencer recently completed her third marathon. At the end of the race she was given a Mylar® blanket to wrap around herself. A danger faced by all long-distance runners is the rapid cooling of the outer skin, while the core temperature remains high. This ultralight material, weighing less than 10 ounces and 84" x 54" in size, has a very high reflectivity (almost as high as 80%) and high insulation efficiency. It can be used to reduce heat transfer in both directions, depending upon the circumstances. In Sarah's case the aluminum film reduced her radiant and convection heat loss to the environment. Also, any places where the foil was not in direct contact with her clothes or skin, it reflected her heat back to her. As you see in the example thermal images, the material is quite effective! This kept Sarah safe from the low temperatures and her own rapid cooling, and comfortable in her all-too-familiar thermal thought.

Congratulations, Sarah, and thanks for sharing the thermal part of your experience with *Think Thermally*® readers!



Above, an image of Sarah Spencer before using the Space® Blanket. Below, an image after using the Space® Blanket for twenty minutes.



Call for Papers • Call for Papers • Call for Papers

Thermal Solutions®

January 26–29, 2004
Radisson Suite Resort on Sand Key
Clearwater Beach, Florida

Call for Papers: *Abstract due date July 31, 2003*

Snell Infrared is pleased to announce Thermal Solutions® 2004, a professional conference for infrared thermographers. This conference is open to *all* thermographers, regardless of equipment preference, previous training or company affiliation.

Condition Monitoring/Reliability

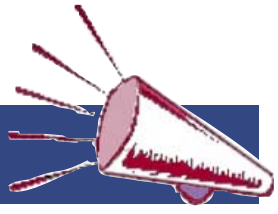
We are looking for papers in the following areas:

- **Condition monitoring**
- **Building diagnostics**
- **Applied R&D**
- **Spot radiometers**
- **Process monitoring using IR**
- **Program management**

Interested presenters should write a brief abstract and submit it for review by July 31, 2003.

We require all papers to be non-commercial in nature. All abstracts will be reviewed and selected by the conference steering committee. All papers will be published in a Proceedings and available at the conference. Details regarding format, presentation, etc. will be included in the author's kit you receive upon acceptance of your abstract. To compensate you for your presentation we will discount the conference fee from $995 to $295.

- Further information about the conference is available on the web at www.thermal-solutions.org. Please call 800-636-9820 or e-mail info@thermal-solutions.org if you have any questions.
- Send abstracts to: Thermal Solutions®, P.O. Box 6, Montpelier, VT 05601-0006 or e-mail abstracts@thermal-solutions.org



Call for Papers • Call for Papers • Call for Papers

So Many Problems, Which Ones to Fix?

Thermographers conducting electrical inspections often find so many anomalies that some mechanism must be employed to determine a priority for repairs. Various schemes based on the temperature of the anomaly have been used in the past. For many reasons, this approach is seriously flawed. Due to their low emissivity, radiometric measurements of electrical components are not the most reliable. Further, the temperature of the component is driven more heavily by load, convective cooling, ambient air temperature and other factors than by how close to failure it is.

Snell Infrared has always worked to develop alternate ways to evaluate the seriousness of the anomalies found. Our most recent refinements have resulted in a system that accurately and consistently predicts the probability of failure and provides a valuable tool to help managers determine appropriate repair strategies. The system is based on sets of questions, which will determine probability of failure and probable consequences of failure.

When an anomaly is found, the thermographer asks a series of Stage One questions. If any single question is answered YES, the finding is classified as having a high probability of failure. Any anomaly found on light voltage equipment should be scheduled for further investigation.

If none of the Stage One questions are answered YES, the thermographer proceeds to considering the Stage Two questions.

Stage One questions:

- **Is phase-to-phase ΔT >50˚F (24˚C)?[1]**
- **Is absolute temperature >200˚F (94˚C)?[1]**
- **Is convection >15 mph?[2]**
- **Is melting or severe discoloration evident?[3]**
- **Is component a shiny, flat or tubular bus?[4]**
- **Are thermal gradients large or moderate?[5]**
- **Are loads likely to increase by 3X or more prior to repairs?**

1. Measurements made on high emissivity surfaces near the point of heating using proper correction values.
2. Wind or air currents accurately measured near the anomaly.
3. Melted metal, burned insulation, or visible discoloration of any kind.
4. Assumes an accurate correction for emissivity is not possible and few cavity radiators are present.
5. Such as a bus stab, enclosed bus connection, motor terminal box, massive connection, or connections inside any oil-filled device.

Stage Two questions:

- **Are phase-to-phase DT >20˚F (9˚C)?[1]**
- **Will convection decrease significantly?[2]**
- **Is the component subjected to a harsh or heavy duty cycle?[3]**
- **Is it likely that loads will double prior to repairs?**
- **Will air temperatures increase by more than 50˚F (24˚C) prior to repairs?[4]**
- **Does the component have a low-mass?[5]**
- **Is the component made of aluminum?**
- **Is there a history of previous failures for this or similar components?**

1. Measurements made on high emissivity surfaces near the point of heating using proper correction values.
2. Wind or air currents accurately measured near the anomaly will likely drop to little or none prior to repair.
3. Subject to excessive vibration, dust, dirt, corrosives, or load swings.
4. Air temperature at the component or inside the enclosure prior to repairs.
5. Such as control wiring or fuses, or any wire smaller than #8.

If any two or more Stage Two questions are answered YES, the problem is rated as having a moderate probability of failure. If one or none of the Stage Two questions is answered YES, the problem is given a low probability of failure.

Once the probability of failure has been evaluated using the above questions, another set of questions is asked in order to determine the *Probable Consequence of Failure.* The thermographer is often involved in this part of the process, but these questions are generally best answered by a scheduler or manager who is more knowledgeable of the entire system within which the problem component functions. The precise questions used can vary, but there are typical areas of concern. *(see box on next page)*

Knowing the probability of failure and the probable consequence of failure, an appropriate action level can be determined. Typical actions may include any of the following:

1. repair immediately
2. repair during next available period
3. repair during next scheduled period
4. increase monitoring
5. continue monitoring at same frequency
6. perform additional diagnostic testing
7. reduce load on component
8. reduce ambient air temperature
9. increase convective cooling of component
10. continue running as is until component fails
11. re-evaluate as conditions change

continued on next page

Specialty Courses

Snell Infrared has expanded their schedule of Specialty Courses. There are now four classes, each focussing on a specific application. Each of the offerings—Mechanical Applications, Electrical Applications, Building Applications and Analyzing Products & Processes—was a great success last year.

These two-day courses are for thermographers who have had training or extensive experience and want more insight and in-depth knowledge of a particular set of applications. The focus of the course is not theory, nor camera operation. The Specialty Courses concern themselves with:

- Focused application information
- Safety considerations related to procedures, methods and the personal protective equipment for that type of inspection
- Specific inspection methodologies
- Problem severity assessment and prioritization
- Program establishment, continuity and success
- Other related diagnostic technologies

Other benefits that we have experienced in the classes are the synergy and contributions of the students. Being present in a class of trained thermographers who are there to learn more about an application creates the opening to discuss specific problems and opportunities with your peers. More than once a problem encountered by one student has been solved by another who said, "I've seen that problem with that type of equipment and this is what we found…"

These courses have also been enormously popular as on-site offerings. Any company that has five or more thermographers who need this training should contact us to see how an on-site course can be a cost-effective solution.

If you are looking for focussed, effective, synergistic, affordable and convenient courses, these are for you. Review the schedule and determine which course best meets your needs, then call us today to register!

So Many Problems, *continued from previous page*

With training and experience, a problem can be evaluated in a very brief time. Used properly, the inaccuracies and inconsistencies found in the systems previously used are virtually eliminated. We have found this new approach can correctly and accurately predict repair priorities in a large percentage of the situations.

Determining Probable Consequence of Failure

- **What is the likelihood someone may be injured if equipment fails?**
- **What is the criticality of the equipment at this time?**
- **What is the probable cost of a failure compared to a planned repair?**
- **Will a failure result in unacceptable environmental consequences?**
- **Are personnel and parts available for a repair at this time?**
- **Can the likelihood of failure be successfully managed by other means, such as reducing loads?**
- **Can equipment continue to operate until an outage, either scheduled or otherwise?**

Remaining 2003 Specialty Courses

Mechanical Applications:

• San Diego, CA	September 23–24
• Detroit, MI	October 7–8

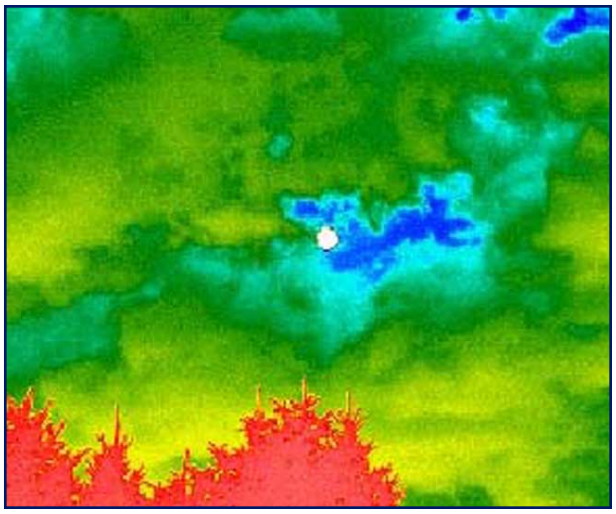
Electrical Applications:

• Detroit, MI	September 23–24
• Phoenix, AZ	October 7–8

Building Applications:

• Toronto, Canada	November 12–13

All courses can be presented on site at your facility— call 800-636-9820.



Moonlight in Vermont…

New Wind Chill Isn't as Chilly…Cook Up a Little Physics…Where there's smoke, there's infrared!…

an Imaging System or a Spot Radiometer?

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Web Site:
www.snellinfrared.com

A Little White Lie…Why upgrade?…Should You Buy

INFRARED TIPS OF THE WEEK

Monday:

One sure way to accelerate your learning is to share it with others. Look over the work you have done in the past six months. Pick out one or two good finds and write a case history about them. You should definitely include color photographs, thermograms and cost savings information. You might also want to include a plug for the repair crew!

The easiest way to get the report visible is to post it on the bulletin board. With management support, you can go further and get it published in a magazine or present it at a conference.

Tuesday:

Welding robots, found in large numbers in the automotive industry, can be inspected for high-resistance connections, cable breakdown and cooling blockages. Getting close enough to inspect the welder automatically creates the danger of the lens coating being damaged by sparks. Re-coating the lens is costly.

Some companies sell special "spark guards" which are essentially low-cost neutral density filters, but these are not readily available for all camera models.

Wednesday:

Your Lens Cap: Use it—Don't Lose It! Lens caps are vital to protecting the delicate coating that covers the surface of a lens. They are also remarkably easy to lose. One way to solve this problem is by using Velcro®. Attach one side to the back of the cap and the other to the camera. That way the cap can be stored in a convenient place and you will always know exactly where it is!

Snell Infrared 2003 Remaining Course Schedule

Level I ($1,495)

Montpelier, VT	July 21–25
Lebanon, OH	August 11–15
Seattle, WA	September 8–12
St. Louis, MO	September 22–26
Pittsburgh, PA	October 6–10
Charlotte, NC	October 20–24
Toronto, Canada	October 20–24
San Antonio, TX	November 3–7
Edmonton, Canada	November 17–21
Montpelier, VT	December 1–5

Level II ($1,495)

Indianapolis, IN	September 15–19
Toronto, Canada	October 27–31
Edmonton, Canada	November 3–7
San Antonio, TX	November 3–7

Level III, Best Practices ($995)

Montpelier, VT	September 23–25

Thermal Solutions® 2004
Clearwater Beach, Florida
January 26–29, 2004

To register, call us at 800-636-9820

Specialty Courses ($750)*

Mechanical Applications:

San Diego, CA	September 23–24
Detroit, MI	October 7–8

Electrical Applications:

Detroit, MI	September 23–24
Phoenix, AZ	October 7–8

Building Applications:

Toronto, Canada	November 12–13

* Level I or extensive thermographic experience is a recommended pre-requisite for these two-day Specialty courses.

(Courses in Research & Development, Process Monitoring, NDT/NDE of Materials & Prep Course for ASNT Level III T/IR Exam are available. Call for details!)

Find out how you can present at Thermal Solutions®... call us for details!

Snell Infrared

Training, Certification and Support for Thermographers

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