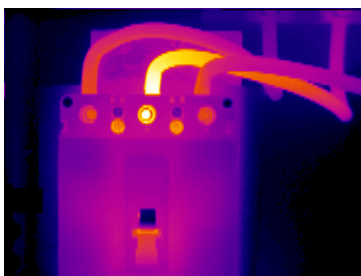


## Thermographic Survey as part of a Predictive Maintenance Program

### Thermographic ??

A thermographic survey is performed with a specialized camera that can take pictures in the Infrared spectrum. The Infrared scan will show the thermal reading of an object either hot or cold, without requiring operators to interrupt the normal operation of equipment. The readings can be displayed in either Celsius or Fahrenheit.



“B” Phase Connection Problem

### Training

By just using a thermographic camera, a person cannot necessarily produce an accurate report. Not all material is equal when performing a scan on it. The reason is that different materials will emit thermal energy differently. Depending on the type of material, a darker object may be better than a shiny object for taking readings on. Shiny objects, glass and Plexiglas will reflect thermal readings from other sources and will not give an accurate reading. This is the reason that the person performing the scan needs to be experienced and properly trained on how to conduct a scan and to interpret the thermal readings.

A thermographer who does scanning on structural buildings is not necessarily going to be able to perform an electrical scan. The thermographer must understand what the readings are telling them and how to perform that type of scan to get the most accurate readings. Some types of thermographic scans can require very specialized equipment to be able to perform the specified tasks and only a small number of people invest the resources and time in training on the specialized equipment.

### Common Items that can affect a scan

All equipment covers need to be removed so that an accurate scan can be performed. Even if you can see through

the safety covers, the Plexiglas safety covers will not allow a reading to be taken through them and will only reflect other sources of thermal energy back towards the camera. During the performance of the thermographic survey, reflections from thermal sources have to be taken into account and eliminated as a potential source of the Infrared reading.

In the case of electrical equipment, the equipment must be on line carrying load. The load level is important because if the equipment is lightly loaded then the equipment may not show a hot spot even if there is a poor connection point. Because of the load issue, the thermographer has to take amp readings to determine if the equipment will be able to show a connection problem.

Air currents can affect the surface readings of equipment. The air current can cool the surface of the equipment but not provide enough cooling to the internals of the equipment. This can lead to a missed problem if the equipment is not isolated from potential air currents during thermographic scans. If the air currents cannot be isolated then the thermal readings have to be compensated for by adjusting for air temperature and air speed, to arrive at an accurate temperature reading.

### Predictive Maintenance Programs

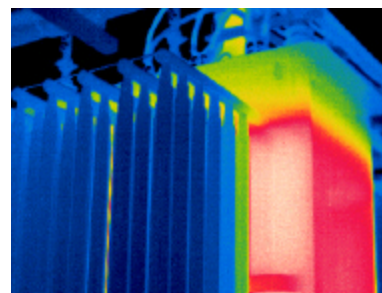
Companies use predictive maintenance programs to identify potential failure of components before the components have actually failed. The program allows the maintenance staff to repair components during a scheduled repair window by knowing that a piece of equipment is approaching its failure point. This allows the maintenance staff to be proactive instead of being in a reactive mode of fixing equipment only when it fails. By using this method, the maintenance staff can have on hand the proper tools and replacement parts needed to repair a piece of equipment without the equipment having to be out of service for extended periods of time.

Depending on the type of equipment being analyzed, the equipment may require different types of testing. Thermographic surveys can improve the predictive nature of maintenance programs by showing where the equipment is generating hot or even cold spots that are not normal in the operation of the equipment. A thermographic survey using a non-invasive testing routine allows

the equipment to remain on line in an operational mode. Once a potential problem has been identified, further testing by other means may be required to pinpoint the cause of the failure. With the data from the thermographic survey, during a scheduled maintenance window, the maintenance staff can then perform other types of testing that may require the equipment to be taken off line and test equipment connected. This allows the maintenance staff to make better-informed decisions and to ensure that potential problems are addressed in a timely manner.

### Cost benefits

The cost of having a thermographic survey performed can easily be out weighed by the potential failures that can be identified and corrected. A good thermographic survey can identify problems that could lead to overloaded equipment tripping offline or causing a fire. Motors and pumps can have potential bearing problems or shaft alignment problems identified before a motor burns up and has to be totally replaced instead of a minor repair preformed on the motor. In most cases, when a single problem is identified, the potential loss if that equipment was to fail would easily cost more than the thermographic scan plus the remedial maintenance.



Plugged Cooling Fins on Transformer

### Planning for a Thermographic Survey

What equipment needs to have a thermographic scan performed on it? This can be a very hard question to answer. Two pieces of equipment can readily be identified. They are equipment that has recently been started up and equipment that is going to be shut down for an extended period of time.

Equipment that has recently been started up should always have a thermographic scan performed on them. This will provide two pieces of information. The first piece of information is that the equipment was installed properly and is working correctly. The second piece of information is what will be used over the life of the equipment and that is a thermographic base line of the equipment. In future thermographic surveys, the base line will be used to determine how much deviation has accrued and to point out excessive deviation that needs to be corrected.

By performing a scan on equipment that is going to be shut down, it allows the maintenance staff to verify that everything is operating properly before the shut down and requires no follow up testing. If a problem is identified then the maintenance staff can schedule repair during the shut down period and avoid having the equipment off line for repairs when the equipment is scheduled to be online.

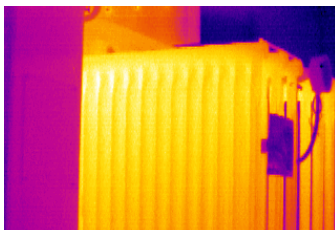
Other types of equipment that should be added to the thermographic survey are equipment that is never removed from service for maintenance due to the critical nature of the equipment. This is real important for checking cable connections and bus bars in electrical equipment and switchboards and to verify that all connections are tight and there is no corrosion causing a poor connection.

Additional types of equipment that may require a scan to be performed on it, is equipment that is exposed to vibration or mechanical movement. By conducting the thermographic survey, it can reveal both electrical and mechanical heating caused by loose connections, misalignments and worn out bushings.

UPS batteries can have a thermographic scan performed during a battery run down. The thermographic scan will help identify batteries with poor connections on the battery posts. A thermographic scan may also reveal hot spots or cold spots inside the battery showing that the battery is not performing as it should.

Power distribution units should have thermographic scans performed on them yearly. These units carry a lot of different loads and usually are never taken off line for maintenance. Not only can loose connections on the panel board breakers show up but the thermographic scan can show that the breakers are reaching a point where they are going to fail by showing hot spots internally in the breakers. The scan will also be able to inspect the transformer for any problems.

Once the equipment has been identified as requiring a thermographic scan then the staff needs to determine the time frame on when the scan should be performed. Yearly thermographic surveys should be performed as a minimum. Some equipment may require semi-annual surveys or more frequently based on the critical nature of the equipment or the failure rate of the equipment. Depending on the schedule for the operation of the equipment, some equipment may only be able to be done at certain times of the year and may require a separate visit by the thermographer. It is important to remember that the equipment having the thermographic scan needs to be operating under load for a period of time so that an accurate thermal reading can be taken. Once a thermographic survey has been performed and corrective action has taken place, another scan of the noted problems should be done to verify that the problems have been corrected and that no other problems still exist.



**Plugged Temperature Gauge on Transformer**

#### **Types of equipment to be scanned**

##### **Electrical equipment:**

- Switchboards
- Panel boards
- Panel boxes
- Switch disconnects
- Fuse disconnects
- Fuse holders
- Transformers, air and oil
- PDU's
- Bus duct
- Cable terminations
- Power Cabling
- Neutral cabling
- Batteries
- Control panels

##### **Mechanical equipment:**

- Pumps
- Motors
- Shaft couplings
- Air duct blockage
- Oil Cooling channels
- Vent cooling

##### **Piping and valves:**

- Water pipes
- Cooling pipes
- Steam pipes
- Material buildup in vacuum piping

##### **Structural and construction:**

- Roof leakage
- Wall Insulation
- Floor Insulation
- Ceiling Insulation
- Concert wall construction
- Weather seals

#### **Conclusion**

This paper was written to help remind managers and maintenance staff of the importance of performing thermographic surveys. It should also help to remind them to evaluate their current thermographic program to see if it requires any part of it to be updated.

Not all equipment needs to be included in a thermographic survey. Companies need to continually evaluate what equipment is included in their thermographic survey and to update the thermographic program for new equipment that has been added to the facility since the last survey was taken. Older equipment may not be as critical and used less so that it may no longer be required to be scanned and should be removed from the program. A thermographic survey needs to be continually updated and reviewed to insure that it is providing the best data possible.

By having an active thermographic program as part of the predictive maintenance program, the findings can help save companies money by helping to eliminate unplanned equipment outages and costly repair costs, not to mention business disruptions.

In these days of 24/7 continuous operations, performing a non-evasive test under normal operation will help eliminate potential problems and help maintain the uptime level of the facility.