Electrical equipment

Qualitative inspection

with Thermal Imagers
The electromagnetic spectrum

Thermography Introduction
What is infrared radiation?

- Infrared cannot be seen (but can be sensed by our skin)
- Everything emits infrared radiation
- A camera converts the “infrared image” to a visible picture
- Infrared allows you to “see” things that you normally can’t.

Visual Image

Same image in IR
Radiation and Temperature

- Visual image is *reflected*, thermal image is *emitted*!
- Radiation increases with temperature

30 seconds in a microwave and

New image
new information
Important to know:

- **We are only measuring the SURFACE:** Plexiglas covers need be removed, doors need to be open

- **Emissivity:** shiny surfaces will be hotter than their apparent temperature

- **Wind can also affect the measurement (Wind chill factor):** so you should take into account convective cooling in or outdoors
Benefits of using IR technology

- Measurements are:
  - Non-contact from safe distance
  - Obtained without disturbing production
  - Very sensitive to problem characteristics
  - Detect defects before significant problem
  - Can scan large areas quickly
  - Identifies specific locations
Limitations of using IR technology

- Good **Qualitative Measurements** mean:
  - Safe distance- if needed use a tele lens to obtain the desired resolution
  - Inspected equipment should have enough load- minimum 40% of nominal load
  - In the case of faulty connections, the load has a very big influence on the fault’s temperature.
  - Be aware that the temperature of the fault is also affected by the wind- avoid inspections if the wind speed is above 8 m/s (about 16mph or 29km/h)
Presentation modes

Center box

10.3

Centerbox
Max = 149.4

13.2

Or a larger scene

13.2

10.3
Presentation modes
New Installations

A perfect installation?

A hot connection!

A VERY hot connection!

OK, it is clear which cable!
After repair

Before repair

After repair.
Better but still showing overttemperature
Voice annotations

Knife connections and fuses
Voice recording a comment up to 60 sec with description of problem, current load, suggested repair priority, etc. will make your report easier and more reliable!
Preparing the report

**Pump fuses**

Unbalance?  
Bad connection?
Multipage reports

Thermographic survey

HVAC panel

If the load increases or the ventilation stop working, the cable will get a temperature of more than 180°C. If both things happen then the temperature can be as high as 150°C, or even higher depending on the actual cable insulation.

There is a risk of short circuit under the hot running hot season.

Clear and tighten connection, if possible before next scheduled maintenance, check insulation before the season start and keep under easy control.

Main image annotations

Identification

Ambient conditions

Warning conditions

Analysis

Classification

Priority

Interval

Recommended action

EElectrical survey

Thermographic inspection report

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Plexiglas covers

Note how the temperature decreases with the distance to the connection! This is a clear thermal signature of a Connection defect!
Hidden defects

- Open enclosure doors, when possible.
- Be sure to comply with existing safety regulations when working around active panels.
Fluke IR Window solution

- **Rugged**
  - Blast resistant & outdoor certified for Europe, US and Canada
  - 50kA Arc flash tested
- **Ease of Use**
  - Image with ANY camera, ANY voltage, ANY location
  - Easy, quick release cover with magnet
- **Superior Image Quality**
  - Crystal clear CLIRVU optic for maximum IR transmission
  - No moisture degradation
Simple & Safe method

Glass window

IR- window
IR Windows installed in metal-clad switchgear
Benefits of IR Windows

• **SAFETY**
  Minimize the risk of arc flash and serious injury

• **SPEED**
  No shutdown, no isolation, no cabinet opening or panel removal

• **EFFICIENCY**
  Survey carried out at full load, no electrician required to accompany thermographer
Temperature gradients in cables

Max = 52.2
Min = 45.2

Profile gradient
Reflective metal bars

Copper bus bars with hot connection on phase L1.
Inspecting with low loads

Fluke 381 clamp meter with flexible current probe and wireless technology
Qualitative vs. Quantitative

Qualitative
• You don’t need to know the temperature to see there is a problem
• No need to adjust emissivity
• Very intuitive
• Easy to see variations from the norm

Quantitative
• Requires radiometric (temperature reading)
• Ability to compare to established limits
• Track even slight variations
• Must measure under known conditions (loading, atmospheric)
Other applications: automotive industry

- Auto industry
- Rear window heater
- Heated seat
Other applications: Railway and trains

Railway:
- Heaters

Trains
- Hot capacitor
Other: Solar panels

Solar panels:

Installation in private home

Cells too hot to be working properly
Other applications: electronics

Electronic Industry
When to inspect

• When to make the inspections?
  ❑ Finding defects in newly installed equipment brings many advantages:
    o Avoids future problems like unplanned power shortages, short circuits and eventually fires
    o Increases equipment life time
    o Can be easily repaired while equipment is on warranty
  ❑ Inspecting after repair is one of the best ways to improve maintenance efficiency
    o Validate repair work
    o Test and improve repair procedures
What to avoid

• When should you avoid making inspections?
  ❑ With lower loads than 40% of the nominal load. The problems, hot connections etc. might be difficult to identify because Load has a big impact on the defects temperature.
  ❑ In outdoor inspection when the wind is blowing Moderate to Fresh breeze (~ 8 m/s~29 km/h~16mph) because heat losses by convection can make identification of defects difficult.
Next step

- **Download** for free our Analysis and report software **SmartView** from our website **Support/Software downloads**
- **Contact us** directly or your Fluke distributor and ask for a demonstration of our Thermal imaging cameras

*About us/Contact us*
Thank you!