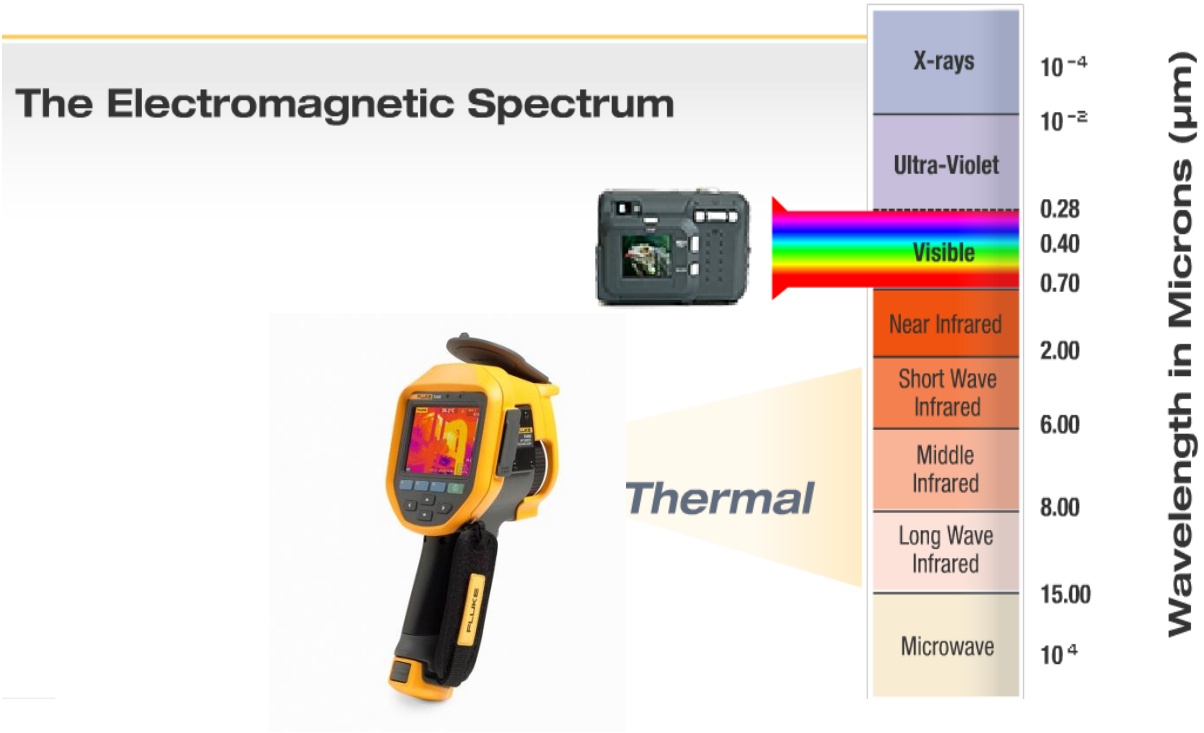
Electrical equipment
Qualitative inspection

with Thermal Imagers

The electromagnetic spectrum

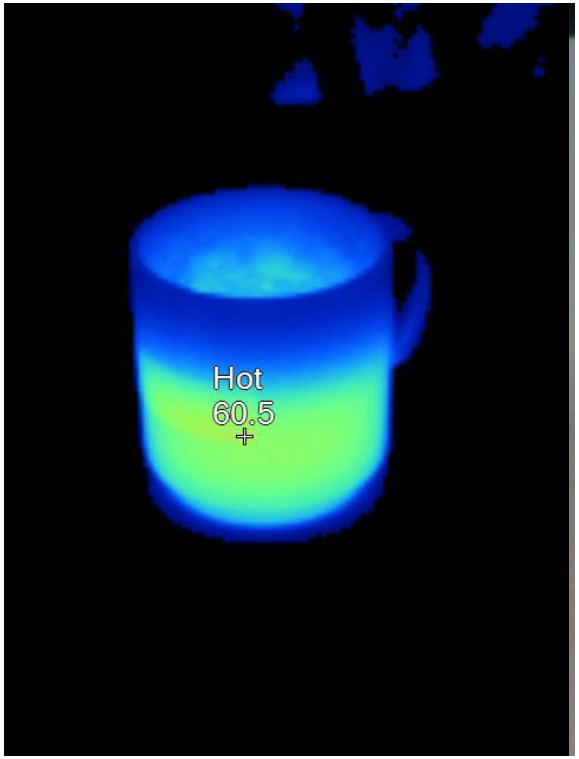
Thermography Introduction



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.

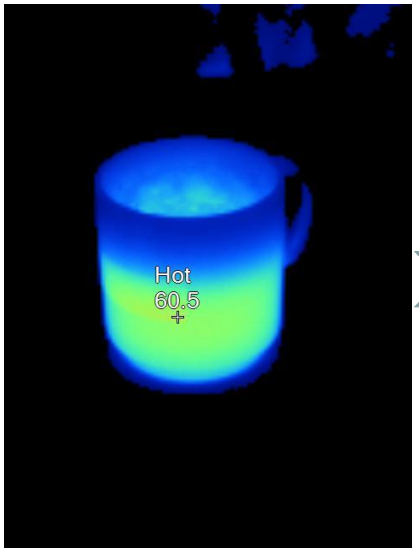
Visual Image



Same image in IR

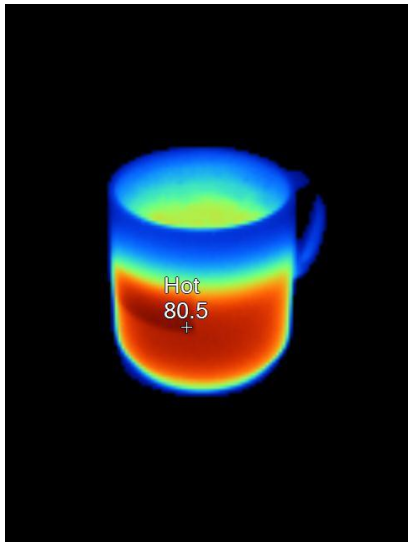
Radiation and Temperature

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



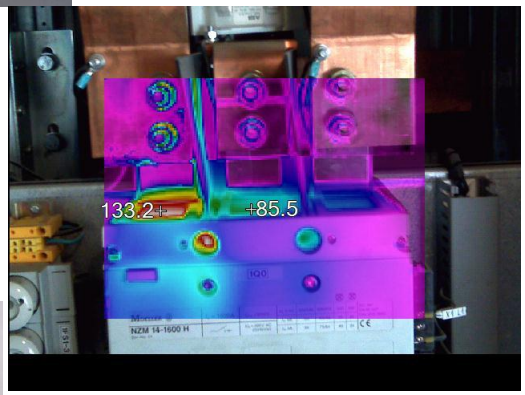
30 seconds in a microwave and

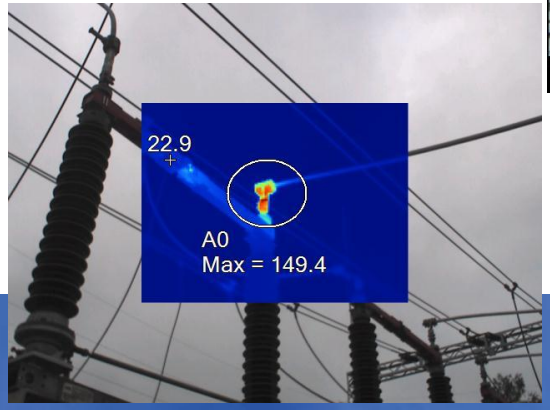
New image
new information



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



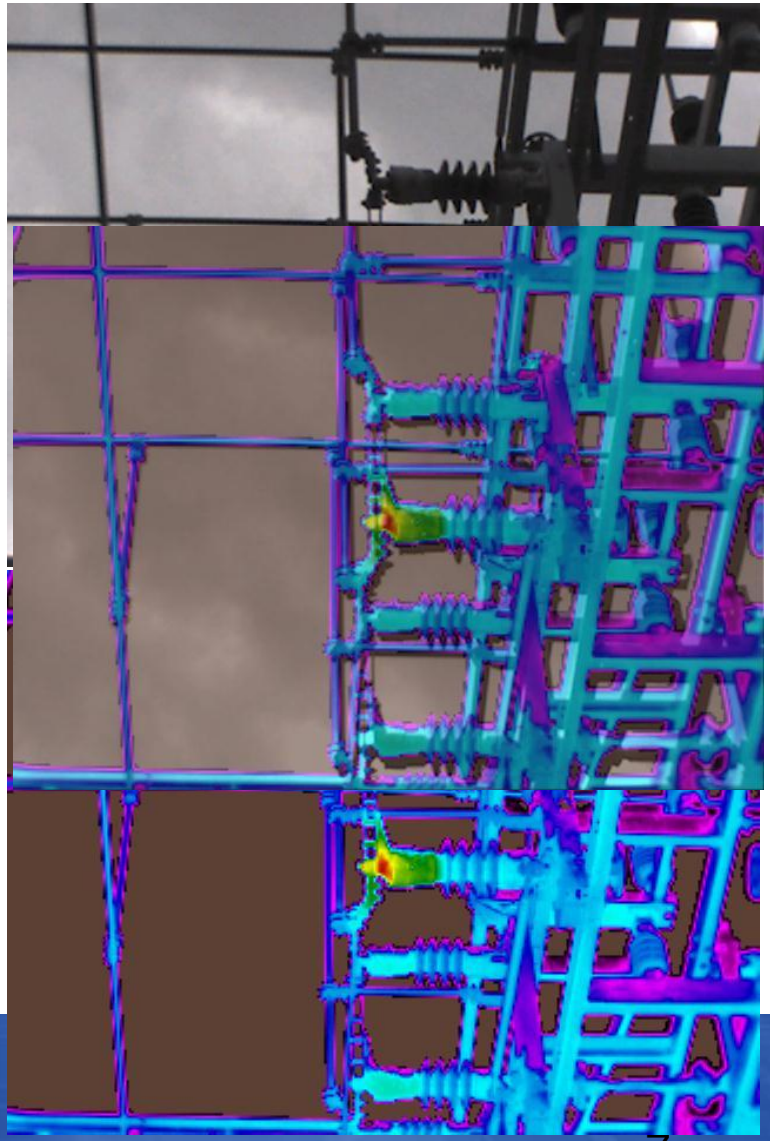


Benefits of using IR technology

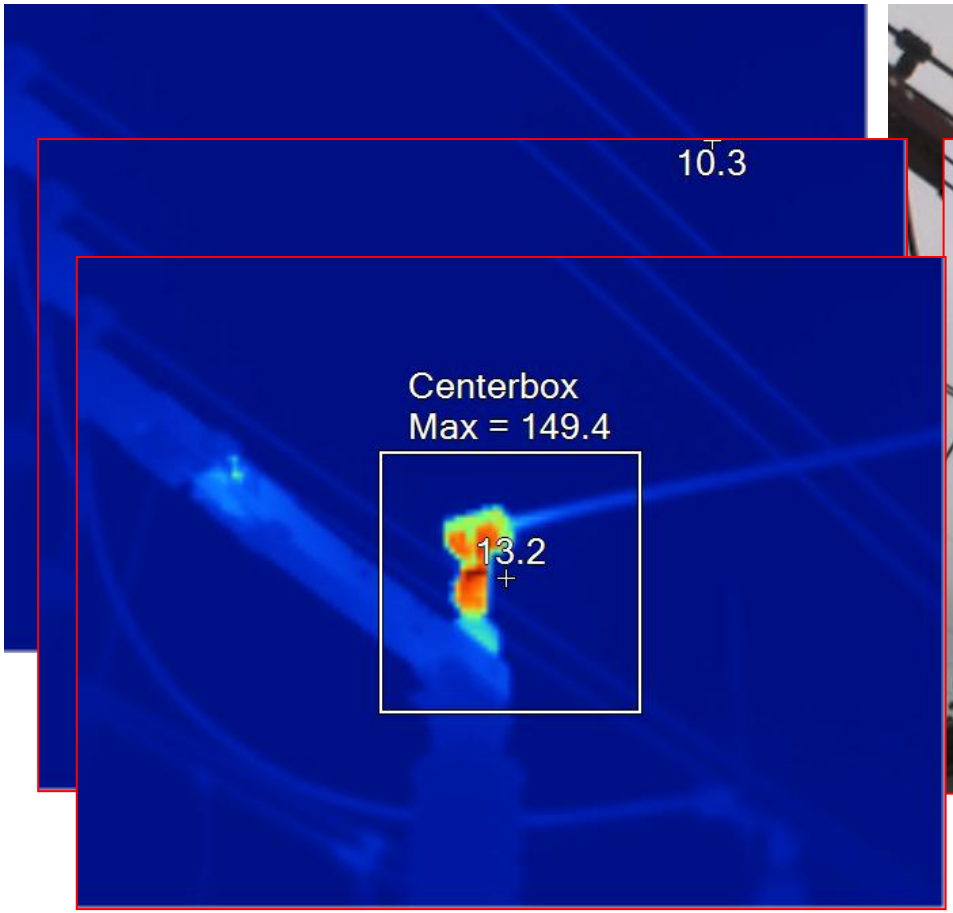
- Measurements are:
  - Non-contact from safe distance
  - Obtained without disturbing production
  - Very sensitive to problem characteristics
  - Detect defects before significant problem
  - Can scan large areas quickly
  - Identifies specific locations

Limitations of using IR technology

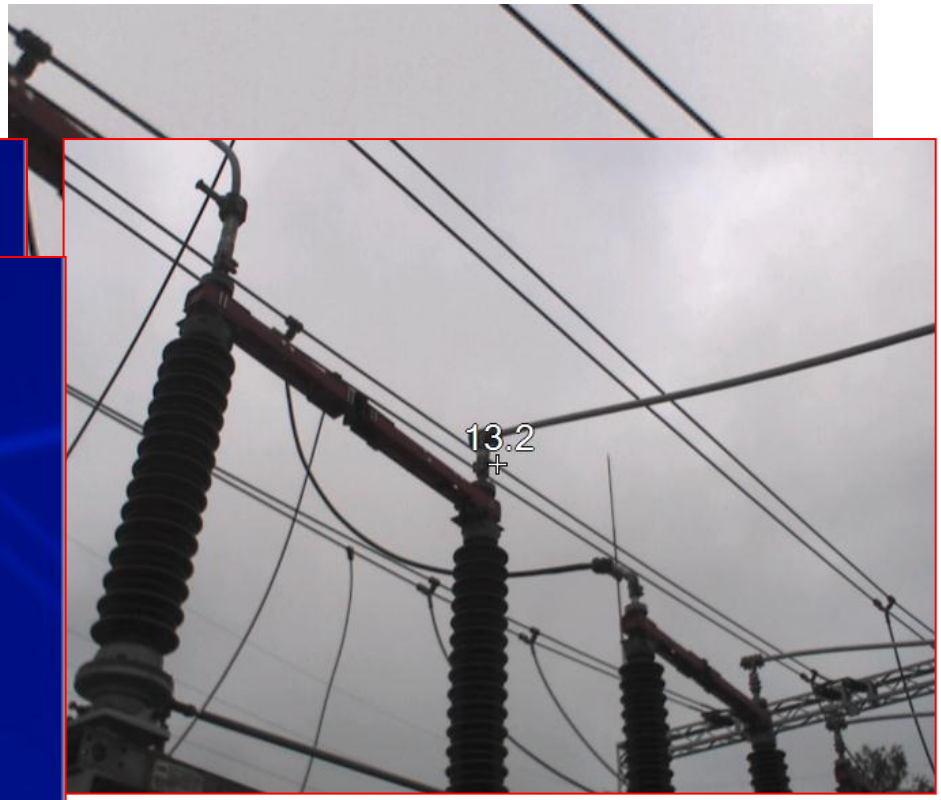
- Good ***Qualitative Measurements*** mean:
  - Safe distance- if needed use a tele lens to obtain the desired resolution
  - Inspected equipment should have enough load- minimum 40% of nominal load
  - In the case of faulty connections, the load has a very big influence on the fault's temperature.
  - 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

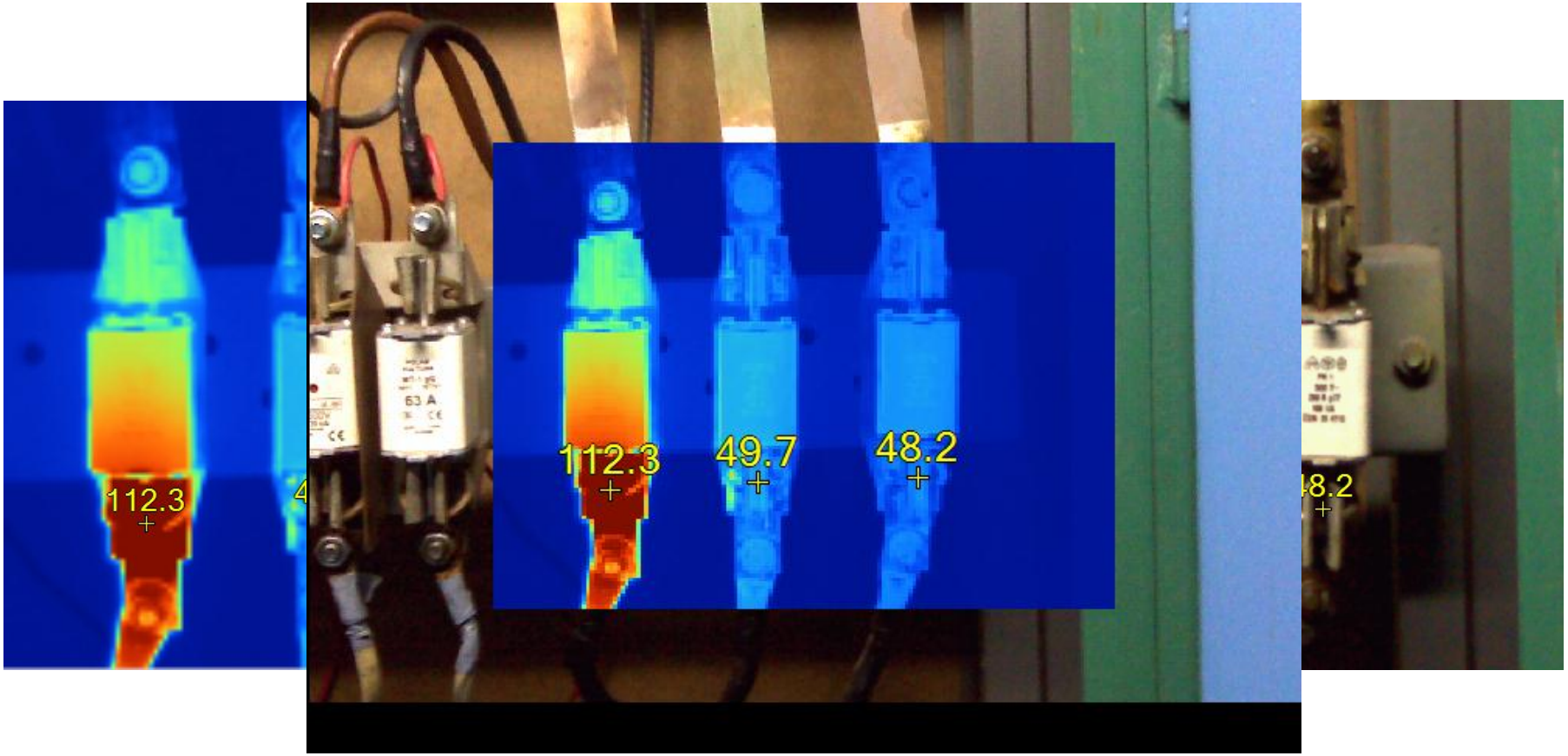


Center box

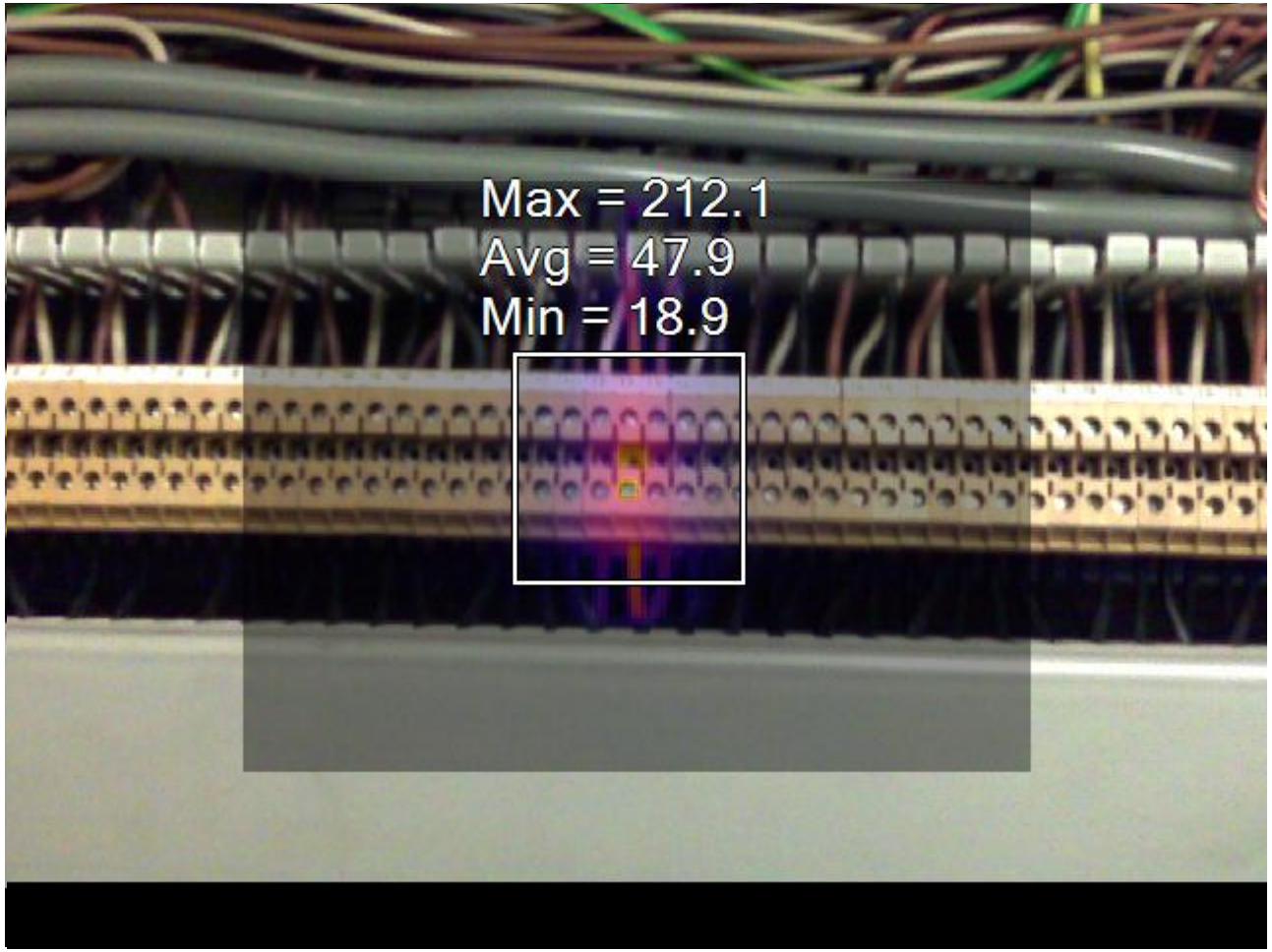


Or a larger scene

Presentation modes



New Installations



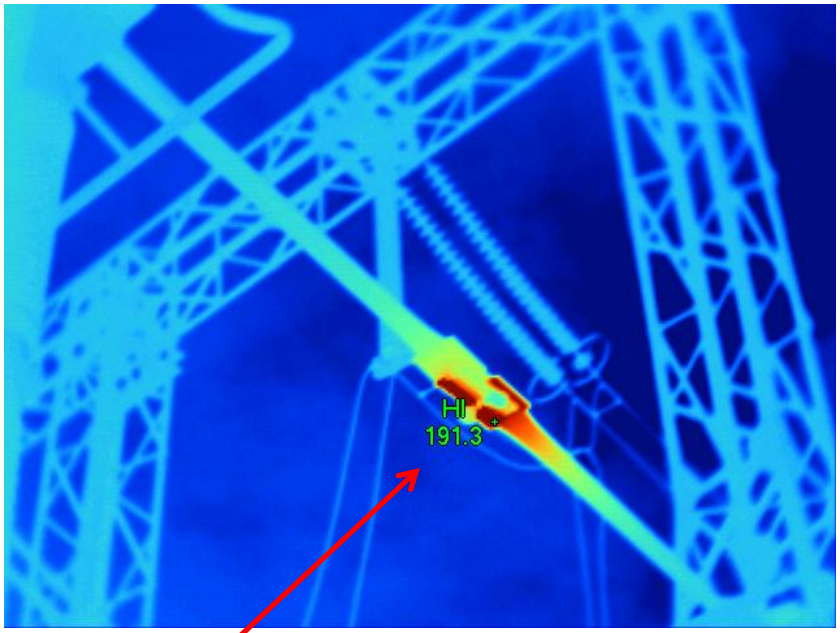
A perfect installation?

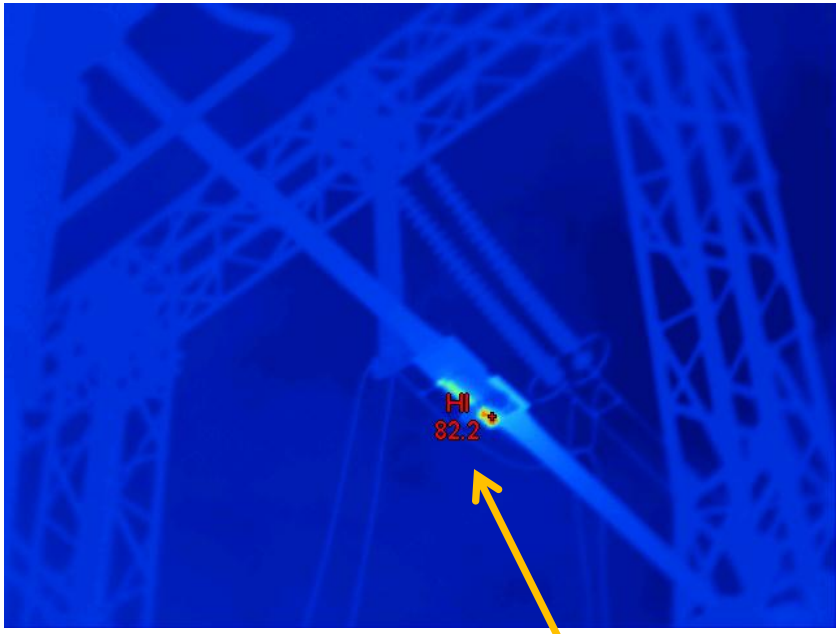
A hot connection!

A VERY hot connection!

OK, it is clear which cable !

After repair

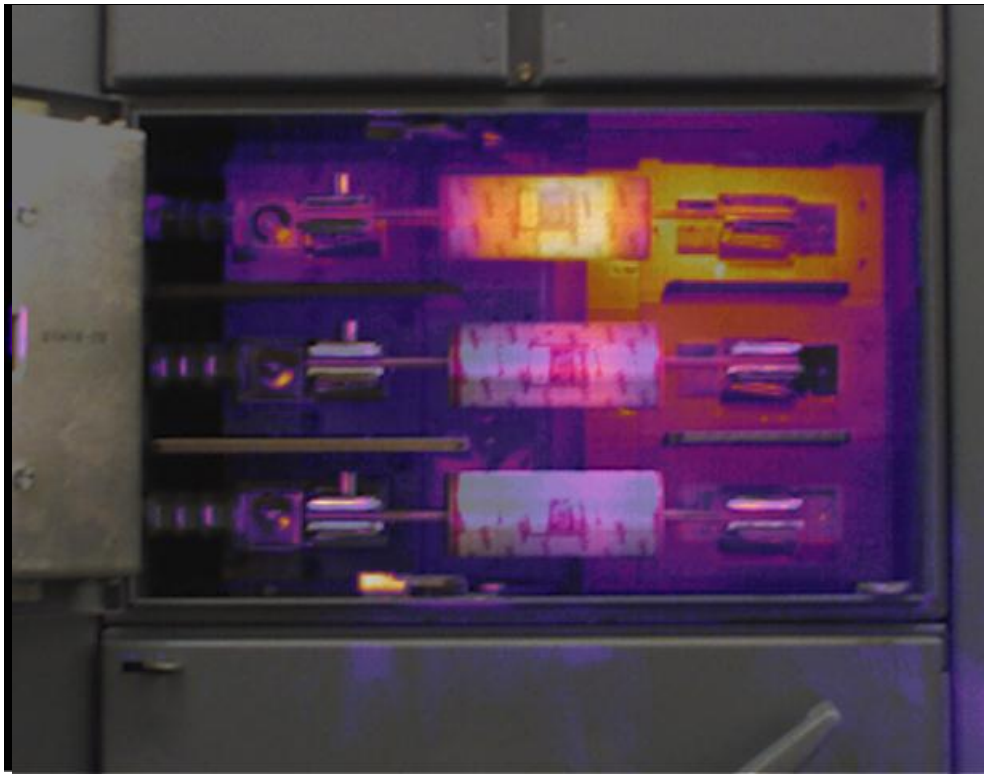




Before repair

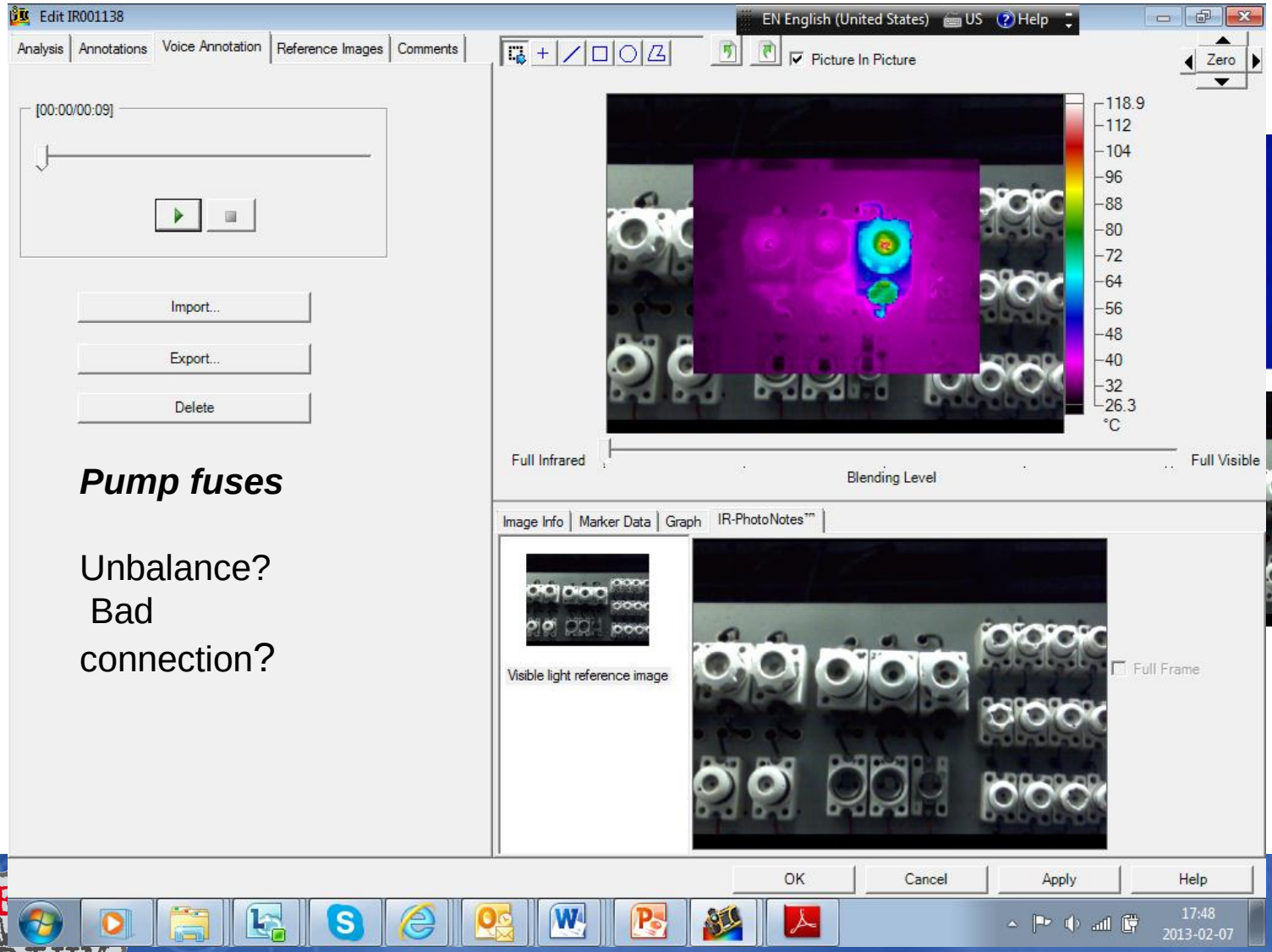
After repair.
Better but still showing overtemperature

Voice annotations



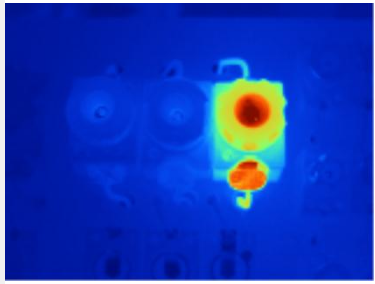
Knife connections and fuses
Voice recording a comment up to 60 sec with description of problem, current load, suggested repair priority, etc. will make your report easier and more reliable !

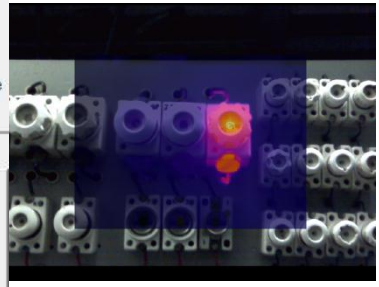
Preparing the report



Pump fuses

Unbalance?
Bad
connection?

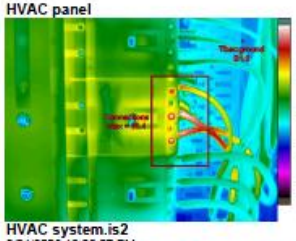




Multipage reports

THERMOGRAPHIC SURVEY

HVAC panel



HVAC system.is2
3/31/2006 12:06:57 PM
If the load increases or the ventilation stops working t
cable will get a temperature of more than a 100 C.
If both things happen then the temperarture can be as
as 130 C or worse depending on the actual cable
insulation.
There is a obvious risk of short circut under the
approaching hot season.
Clean and tighten connection, if posible before next
scheduled maintenance, check insulation before the h
season and keep under weely control.

Image Info

Image Time	

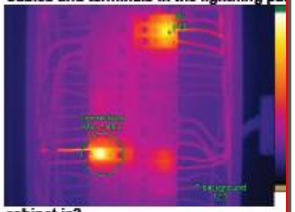
Main Image Annotations

Identification	

Ti Advanced training

THERMOGRAPHIC SURVEY

Cables and terminals in the lightning pa



cabinet.is2
1/4/2006 10:22:10 AM
Due to the low load, the actual temperature does no
the insulation on the cables.
But because during the winter period the load will o
increase we recommend to tighten the connections
control the cables' insulation at the next scheduled
maintenance , within 30 days.

Image Info

Image Time	

Main Image Annotations

Identification	
Ambient conditions	
Working Conditions:	
Analysis	
Classification	
Priority	
Interval	
recommended action	

Ti Advanced training

THERMOGRAPHIC SURVEY

Table Of Contents

cabinet.is2

Fuses.is2

HVAC system.is2

Ti Advanced training

FLUKE

Fluke

www.fluke.se

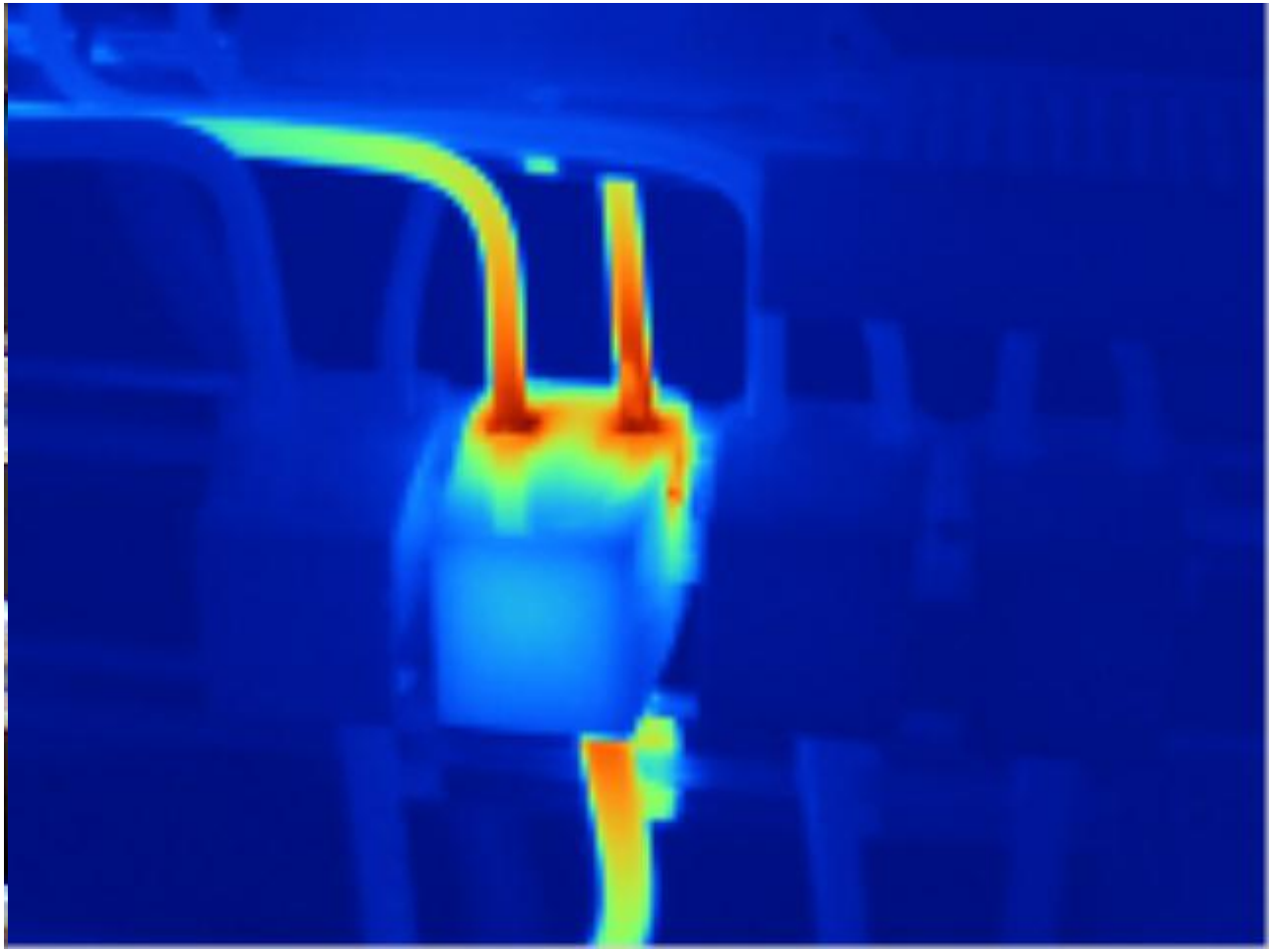
ELECTRICAL SURVEY

Thermographic inspection report

Prepared for:

Fluke Sverige AB
Färögatan 33
S-16451 Kista

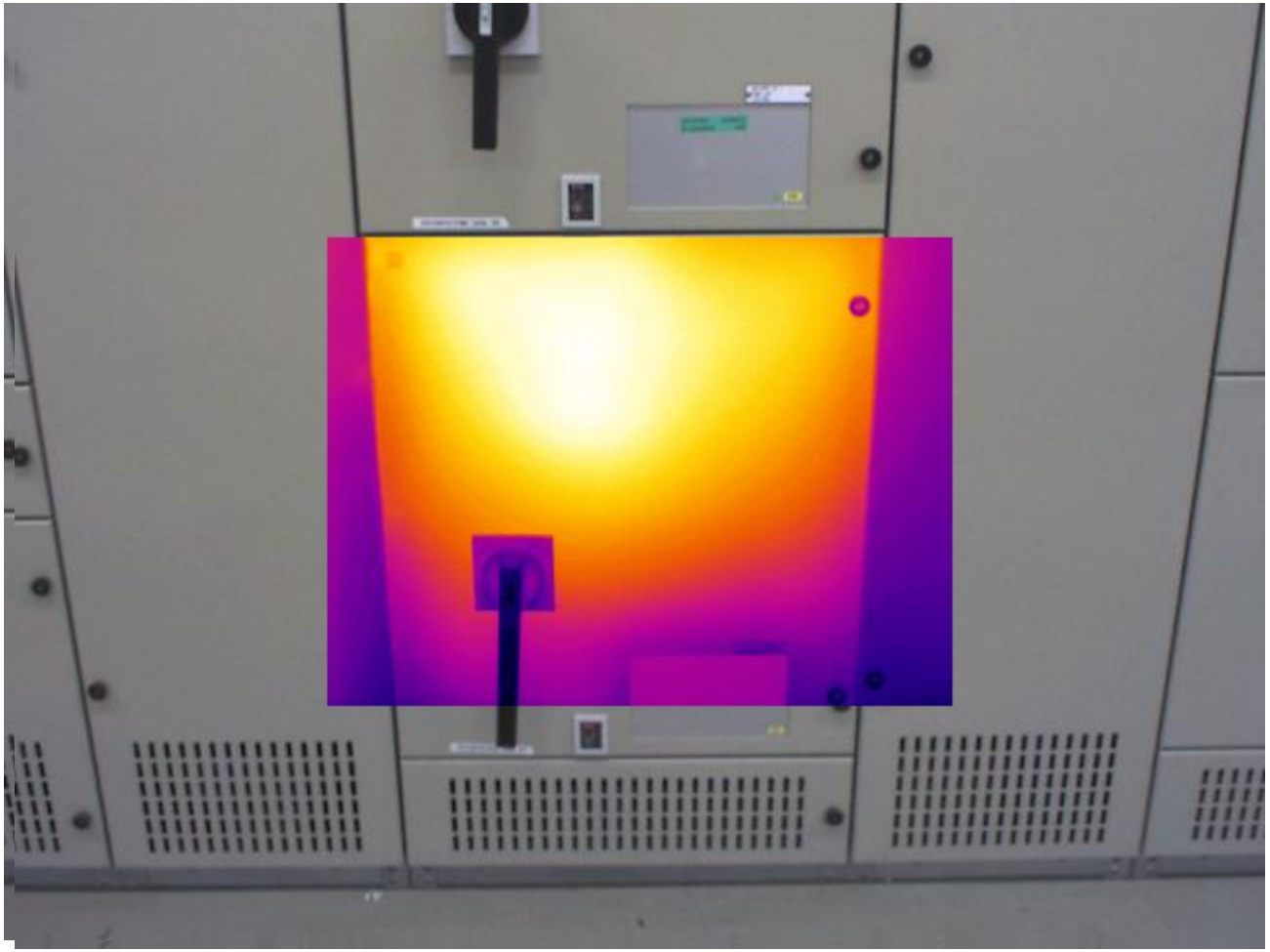
Plexiglas covers



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

Connection defect!

Hidden defects

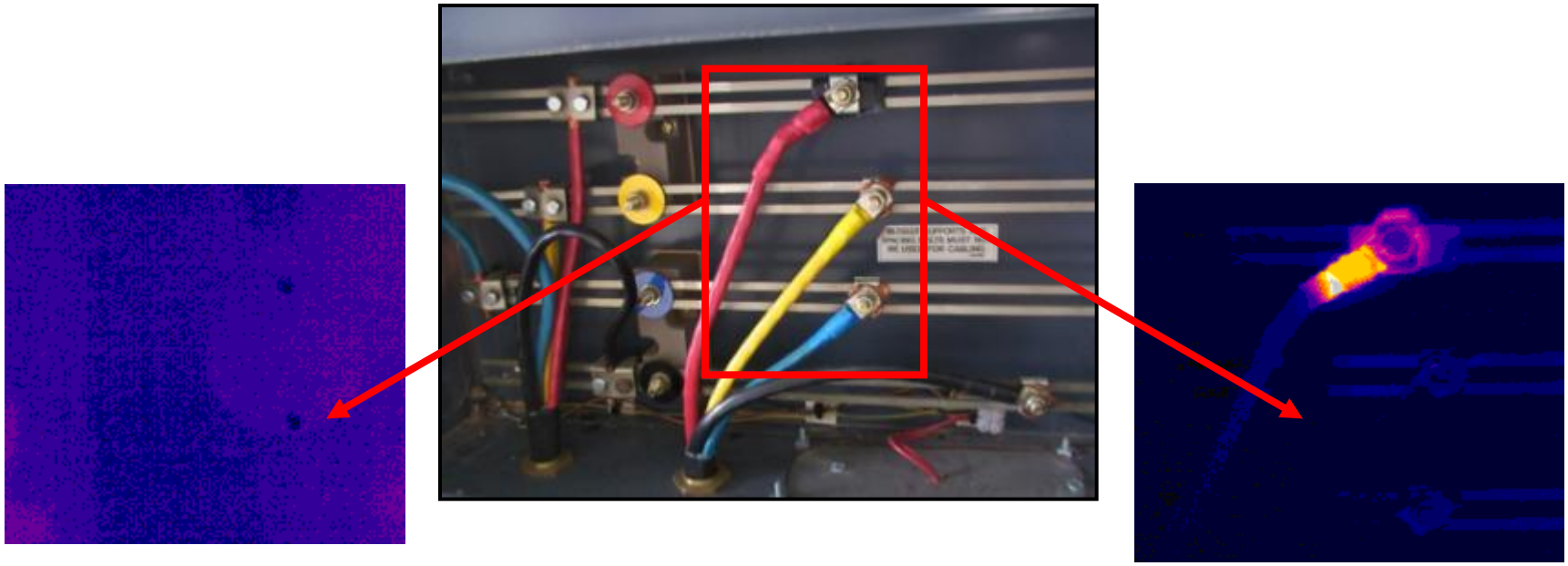


- Open enclosure doors, when possible.
- Be sure to comply with existing safety regulations when working around active panels.

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

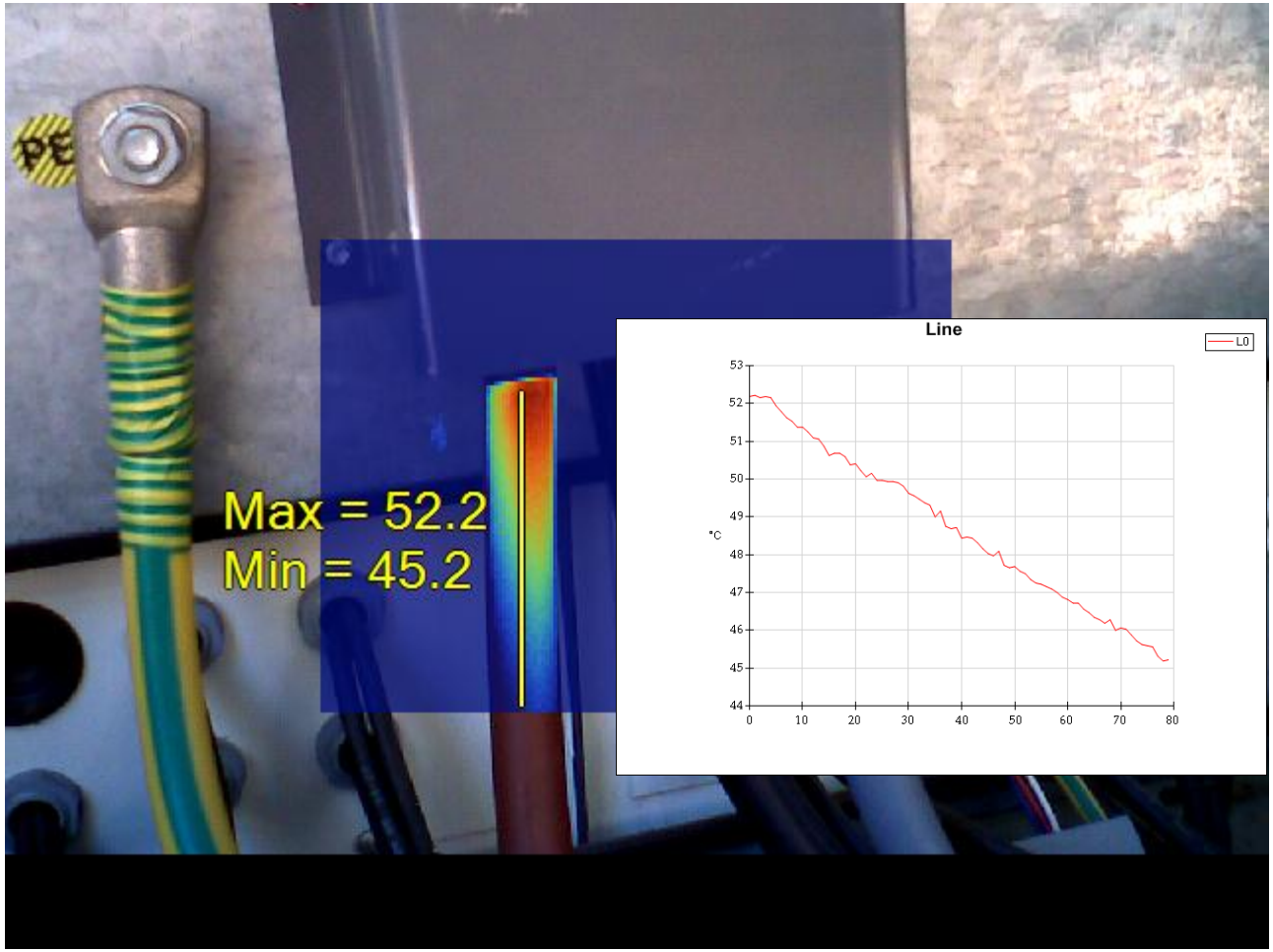
- SPEED

  No shutdown, no isolation, no cabinet opening or panel removal

- EFFICIENCY

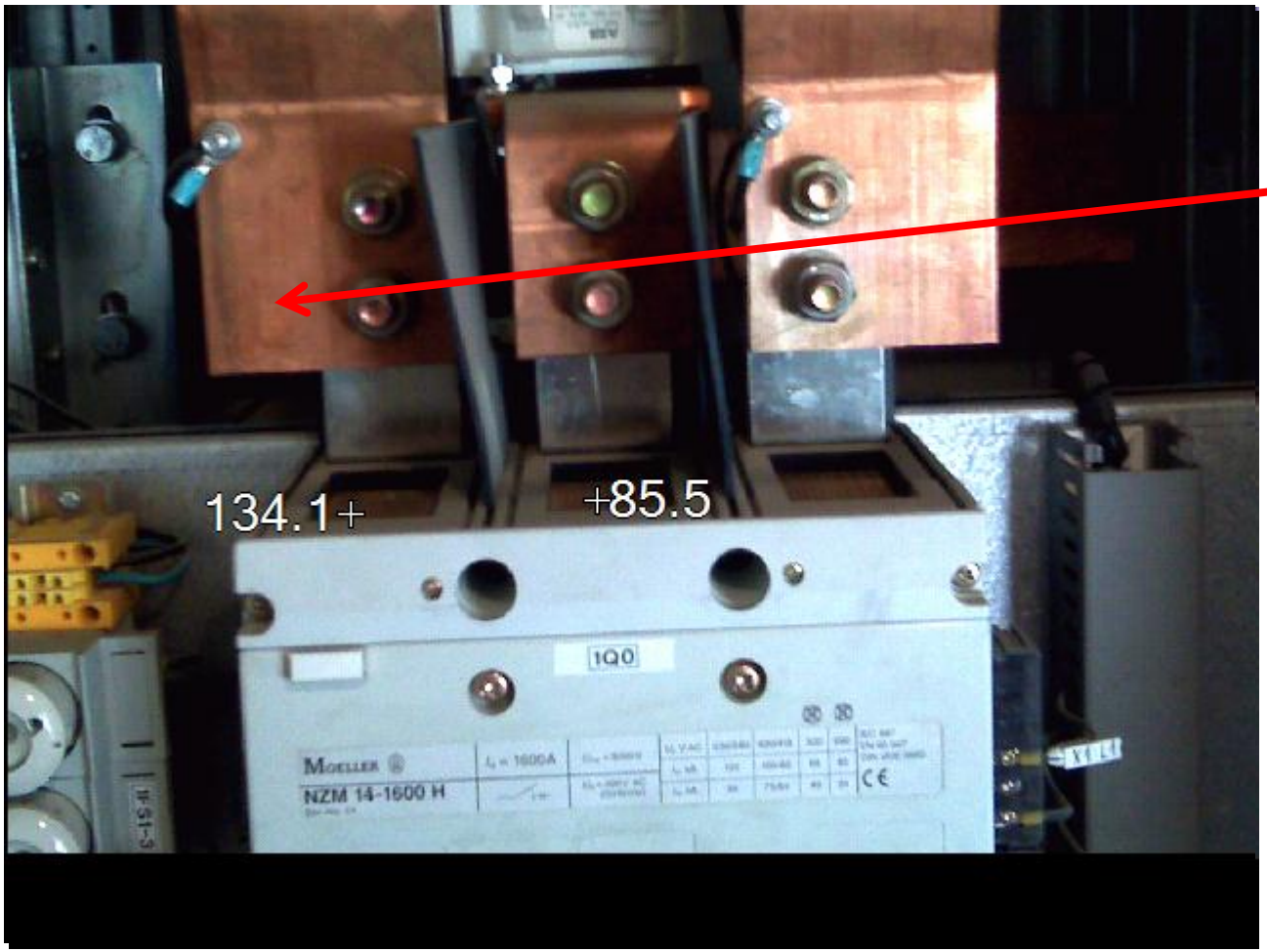
  Survey carried out at full load, no electrician required to accompany thermographer

Temperature gradients in cables



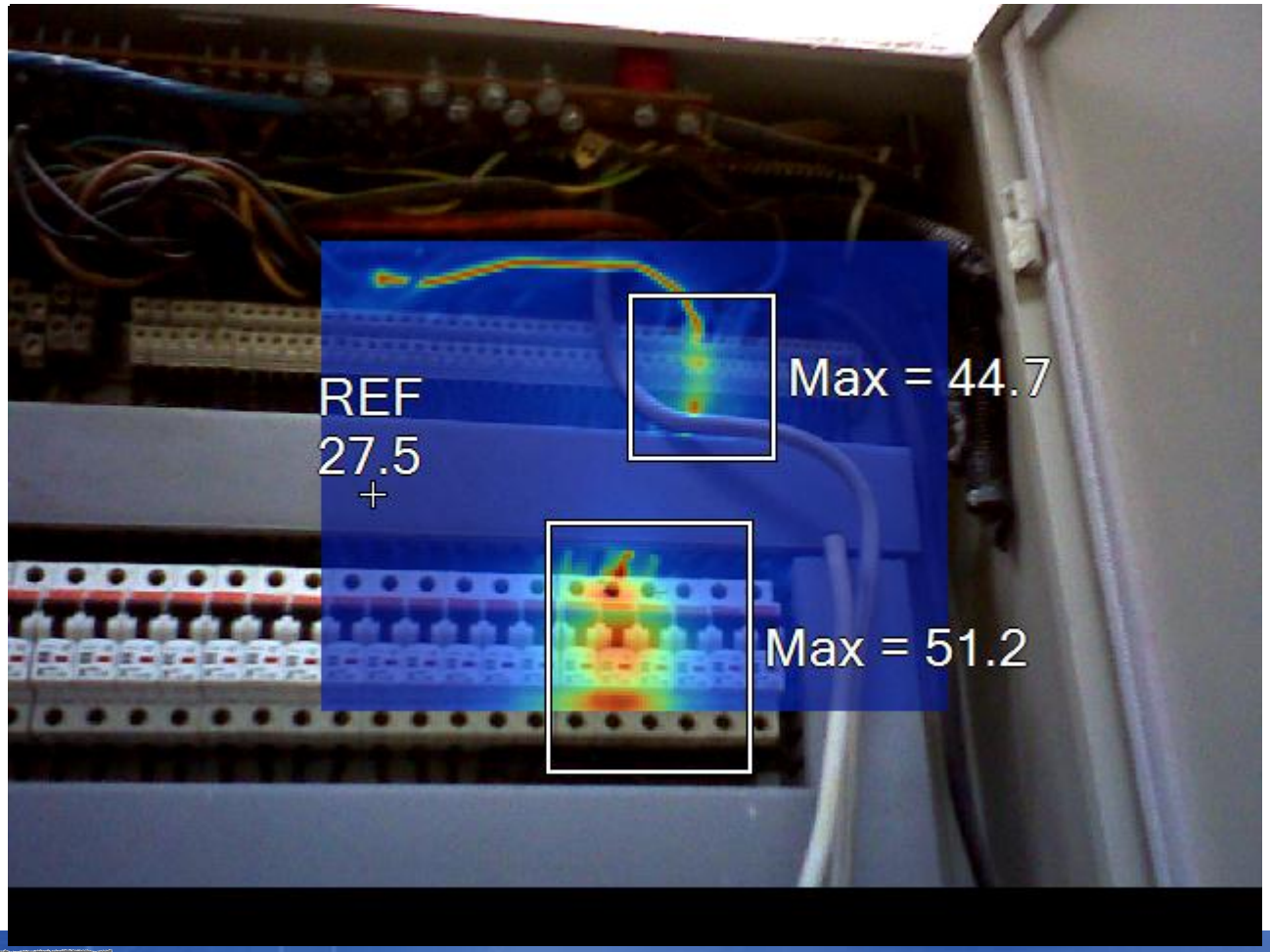
Profile gradient

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

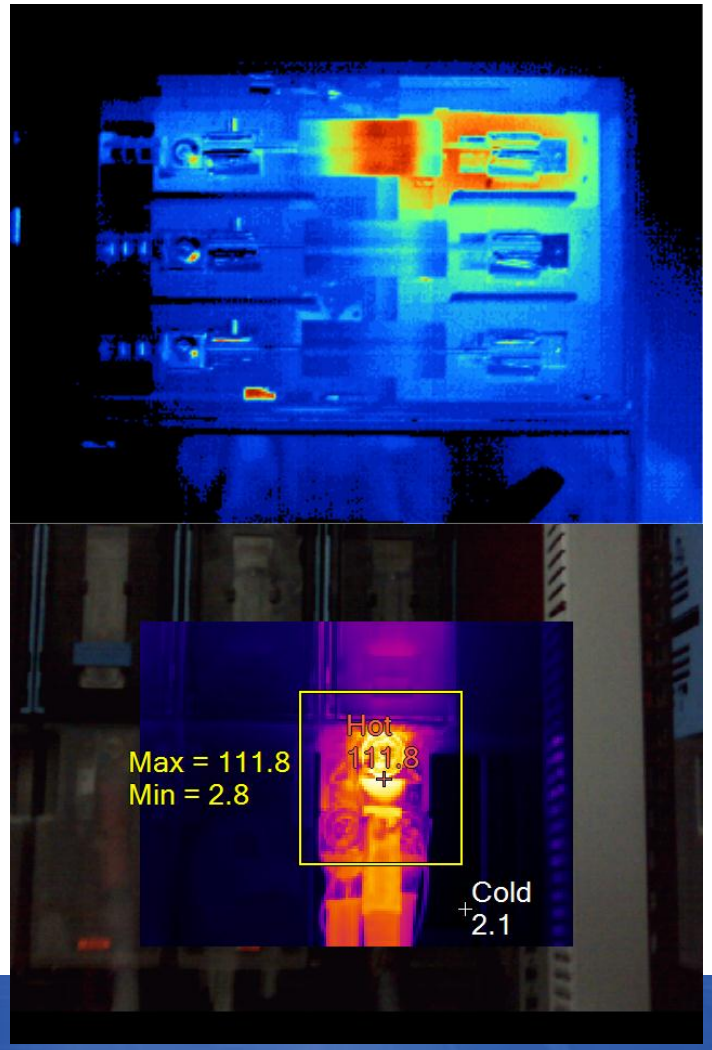
Qualitative vs. Quantitative

Qualitative

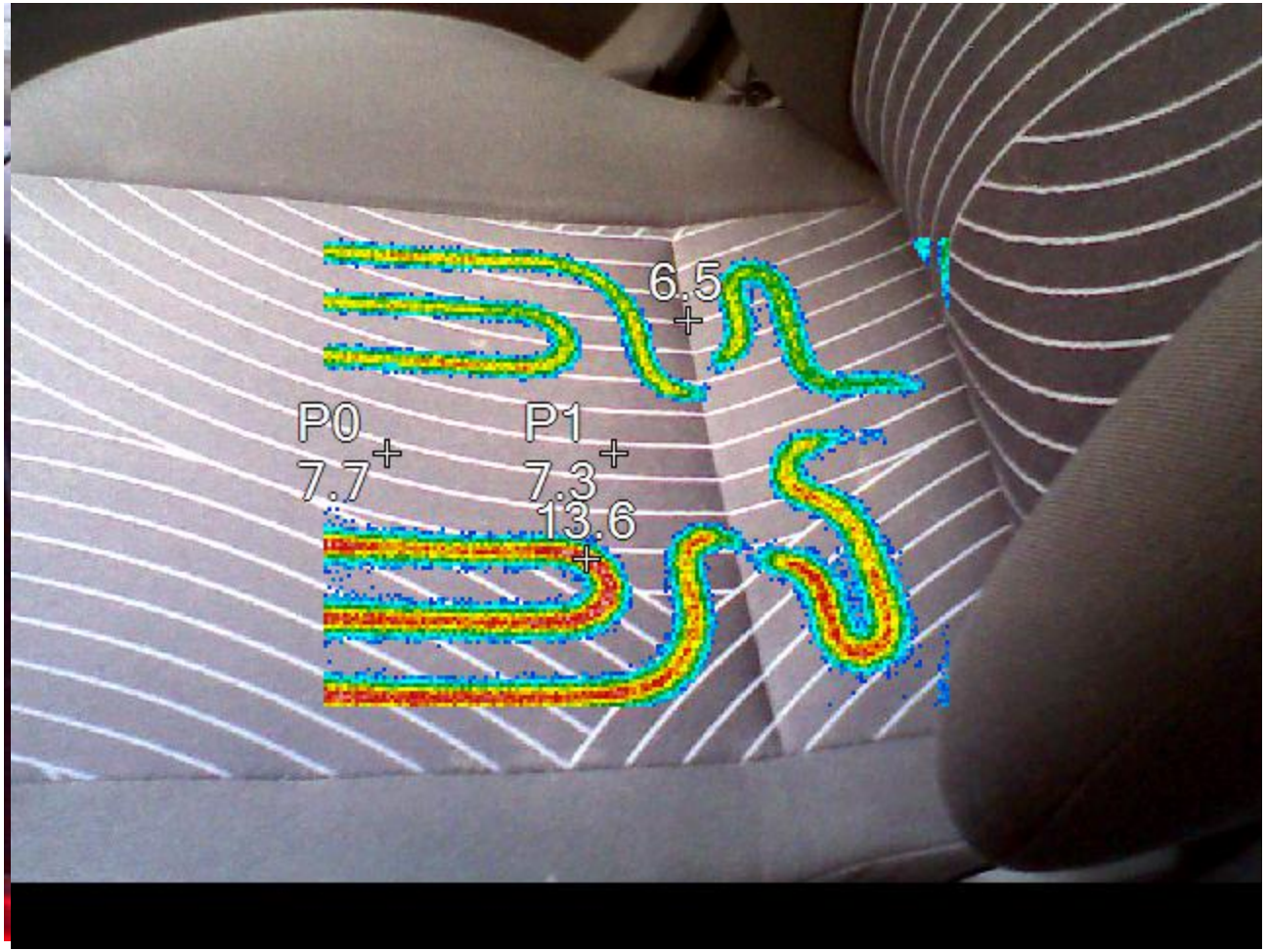
- You don't need to know the temperature to see there is a problem
- No need to adjust emissivity
- Very intuitive
- Easy to see variations from the norm

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

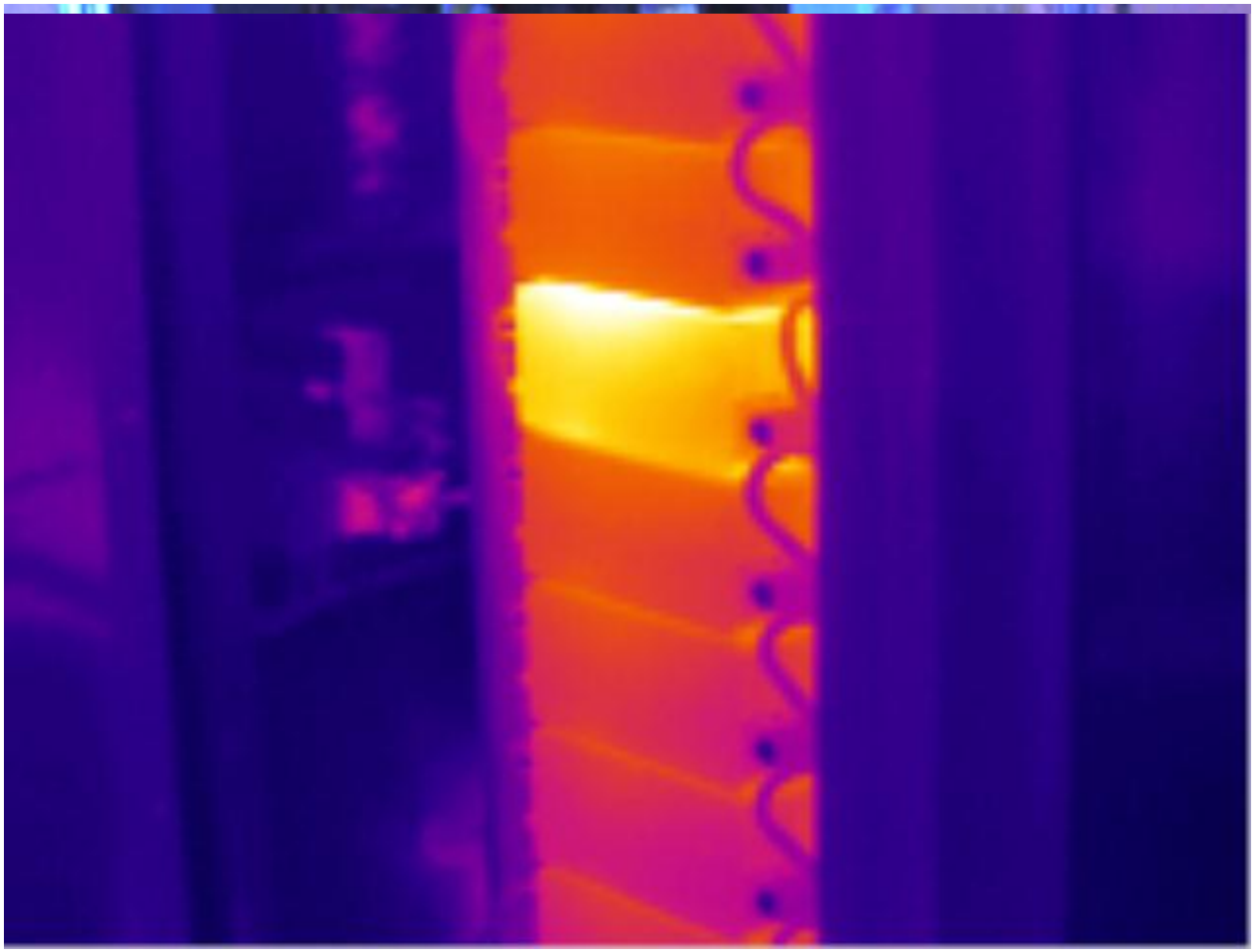


Auto industry

Rear window heater

Heated seat

Other applications : Railway and trains



Railway:
Heaters

Trains
Hot capacitor

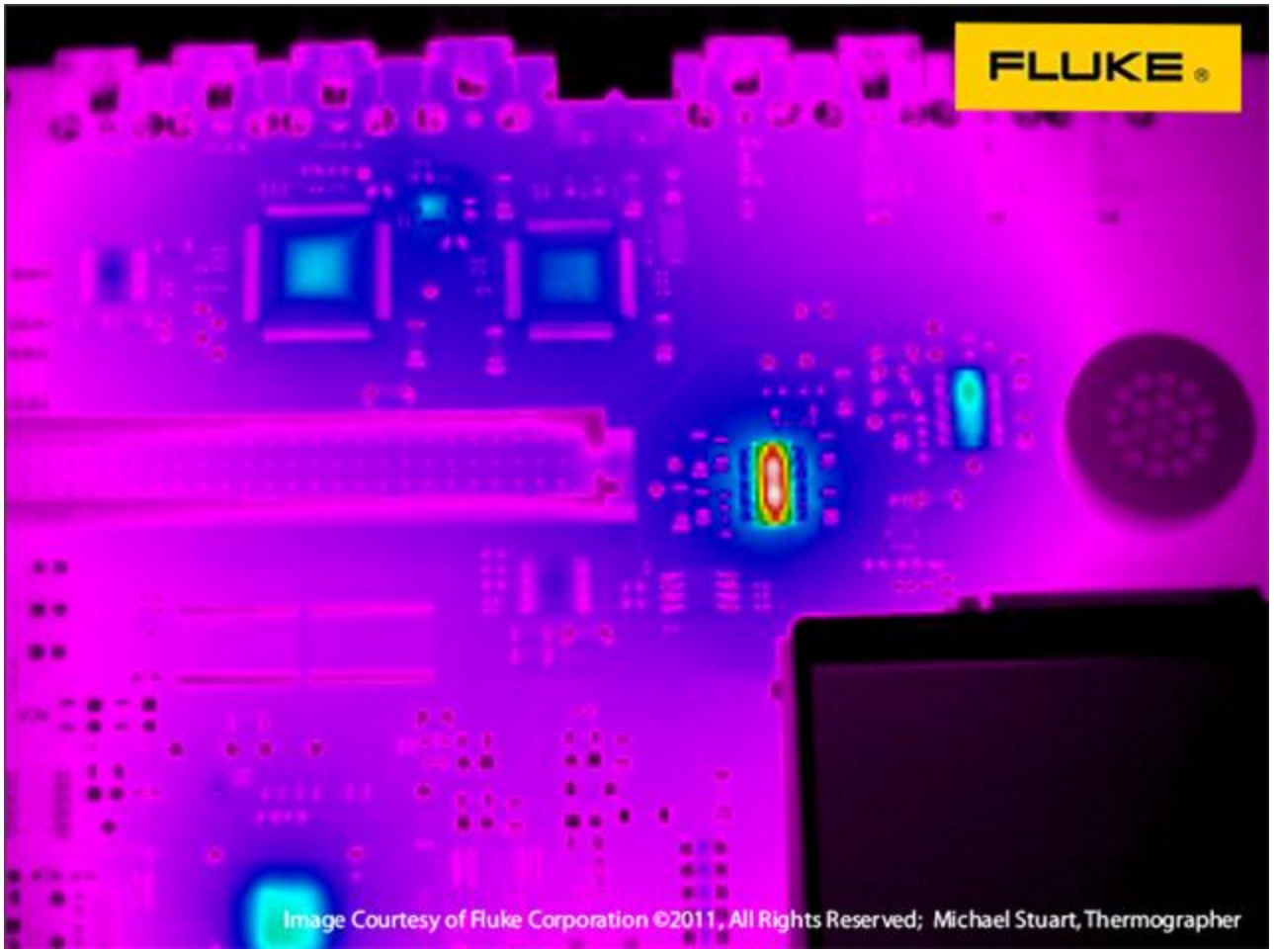
Other: Solar panels

Solar panels:

Installation in private home

Cells too hot to be working properly

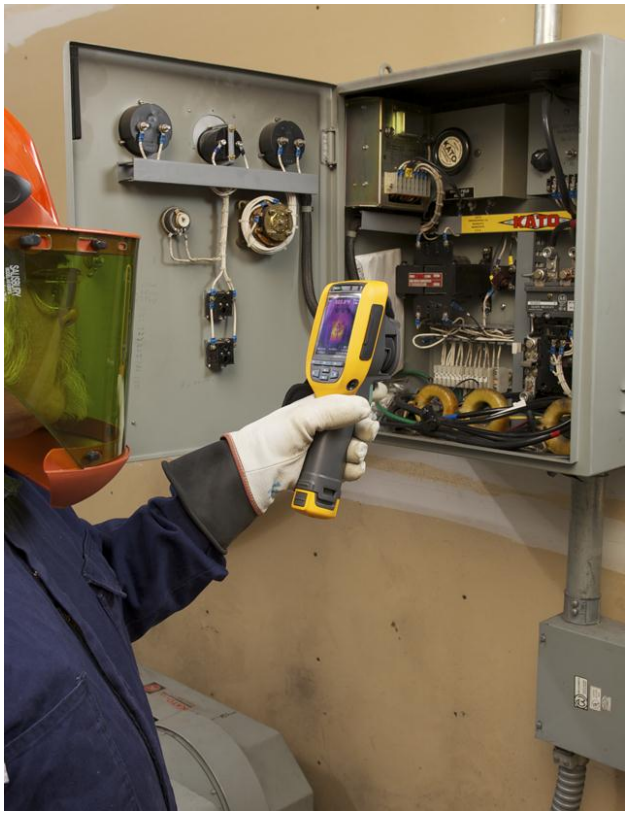
Other applications: electronics



Electronic Industry

When to inspect

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



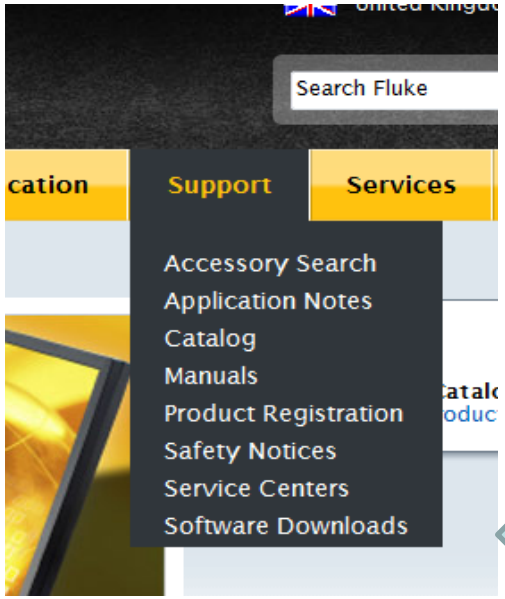
What to avoid

- 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!