EXPERTISE BY

INFRARED TRAINING CENTER

INTRODUCTION TO THERMOGRAPHY BASICS

What you need to know about IR Science before going in the field.

And No more.

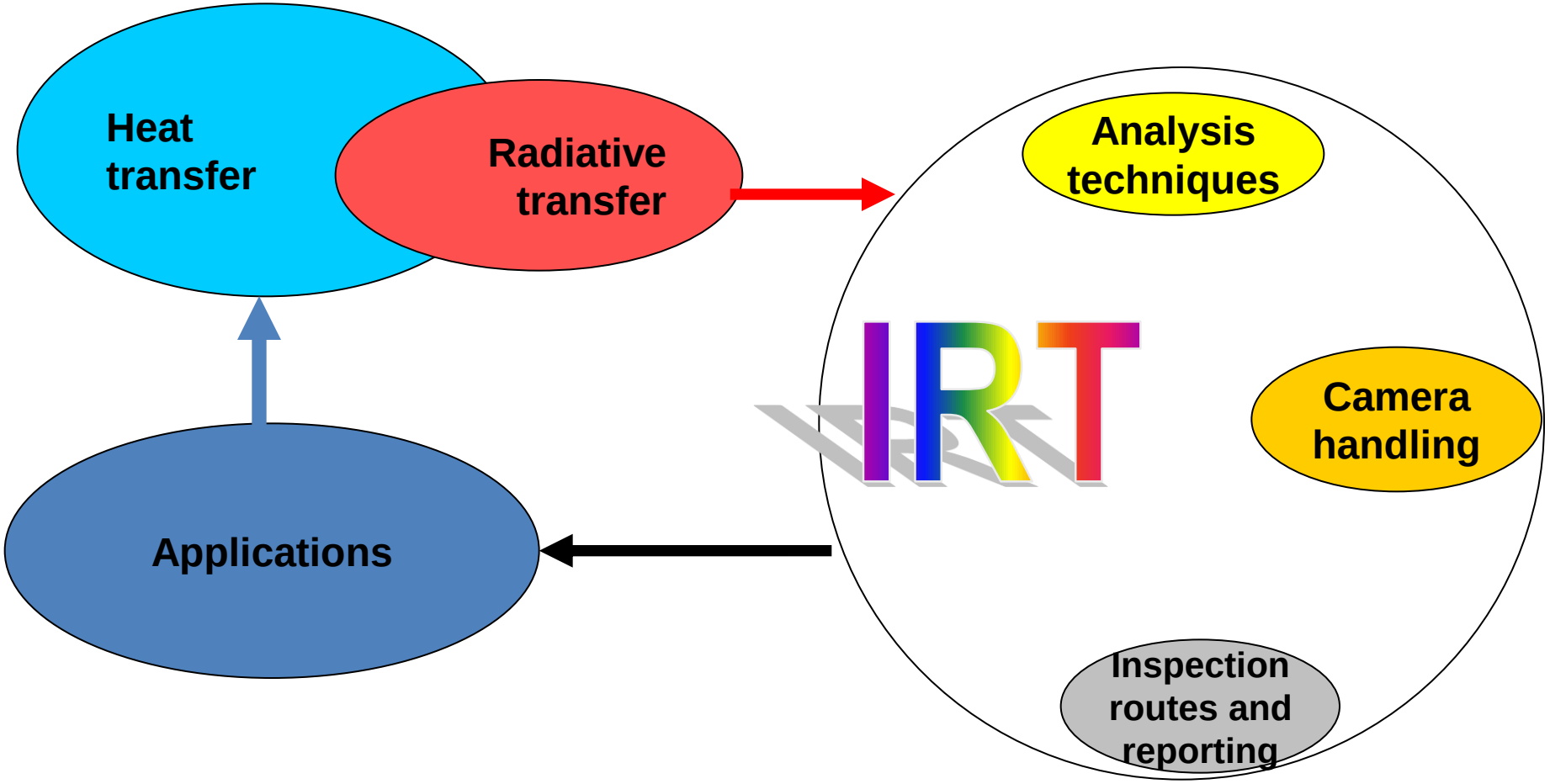
CONTENTS

- What is thermography?
- An infrared image
- Thermography vs. visible
- Emission & Reflection
- Emissivity
- Reflection
- Measurement rules

WHAT MAKES THERMOGRAPHY SO USEFUL?

- It is non-contact – uses remote sensing
  - Keeps the user out of danger
  - Does not intrude upon or affect the target
- It is two-dimensional
  - Comparison between areas of the target is possible
  - The image allows for excellent overview of the target
  - Thermal patterns significantly enhance problem diagnosis
- It is real time, or close to real time
  - Enables efficient scanning of stationary targets
  - High end cameras can capture fast moving targets
  - High end cameras can capture rapidly changing thermal patterns

Thermography spans many subject areas…



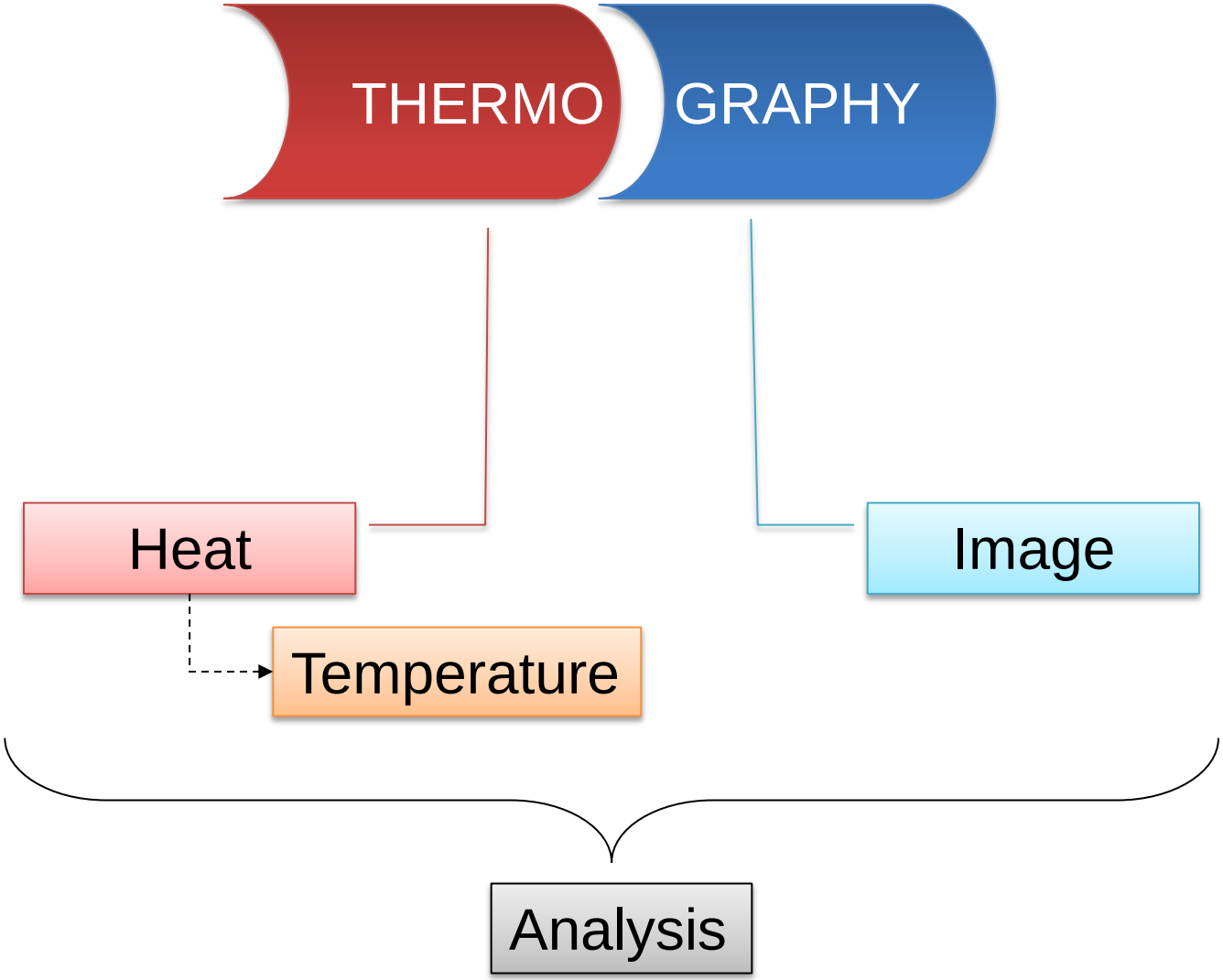
AN INFRARED IMAGE

Darker means cooler, brighter means warmer.
What does this image tell us?

WHAT IS THERMOGRAPHY?

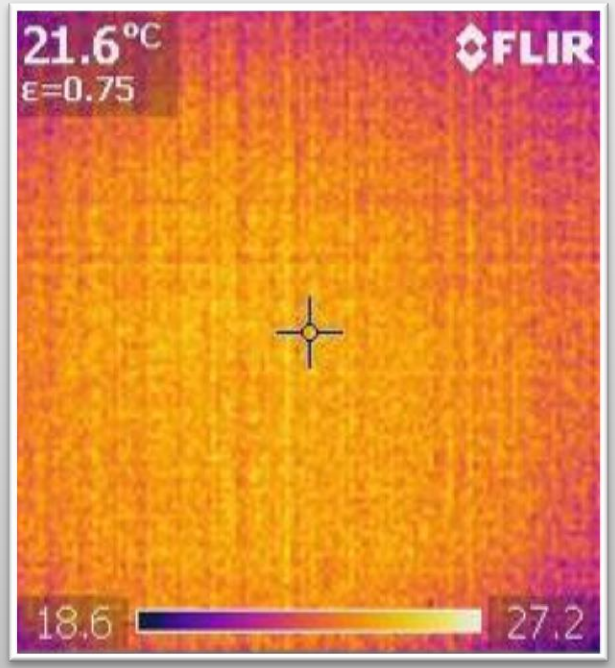
Infrared thermography is the process of acquisition and analysis of thermal information from non-contact thermal imaging devices.

WHAT IS THERMOGRAPHY?



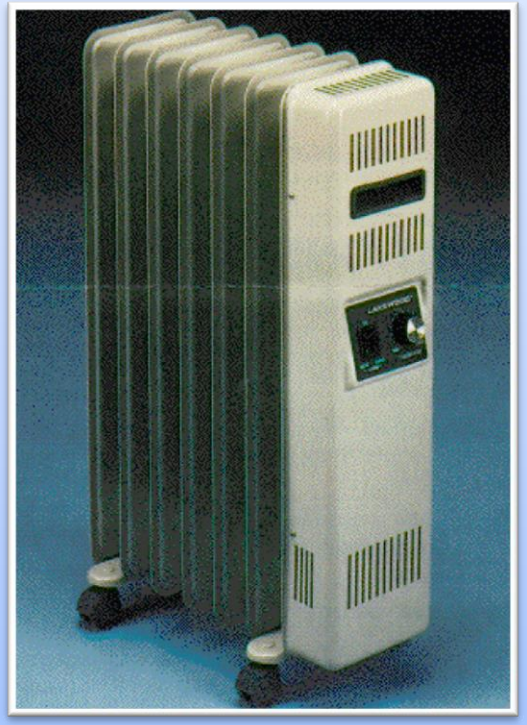
Heat is the energy exchanged between systems having different temperatures.

When there is no temperature difference, the infrared image does not show any contrast and there is no possible analysis!

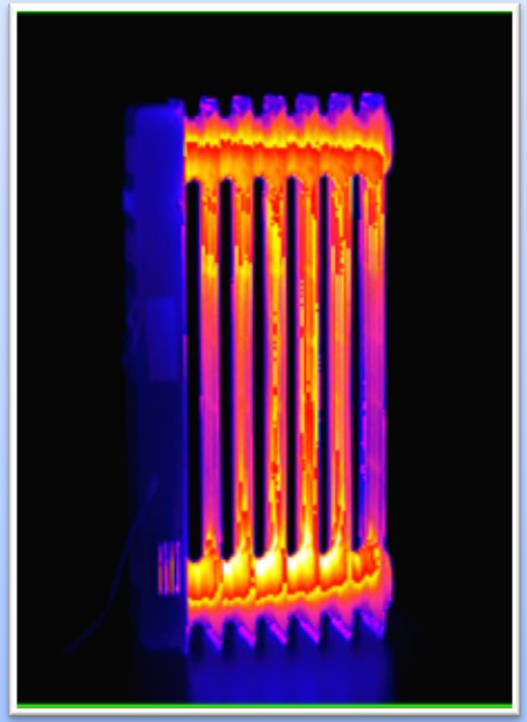


THERMOGRAPHY VS. VISIBLE

Visible



Infrared



We know what a visible image is.

We represent the world we see with our eyes in colors.

This radiator is grey-white on a blue background.

COLORS in the visible range express REFLECTION OF LIGHT.

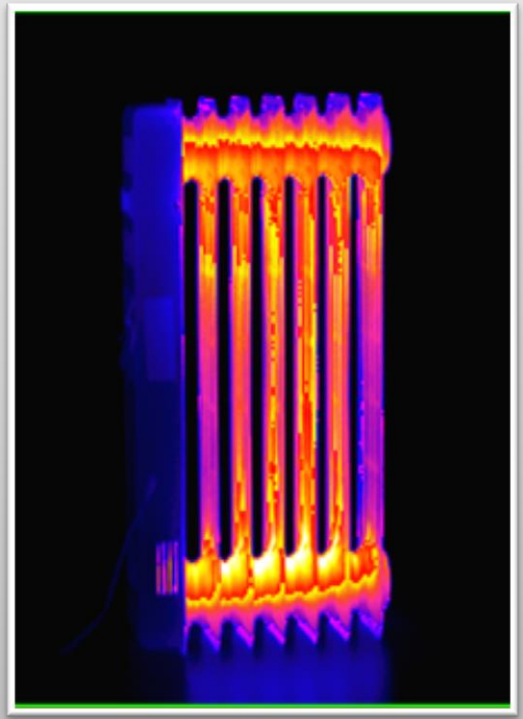
The radiator is grey-white because its surface reflects these components of white light, from the projector.

THERMOGRAPHY VS. VISIBLE

Infrared is similar to visible. An infrared camera also uses **colors** to represent the thermal world it sees.

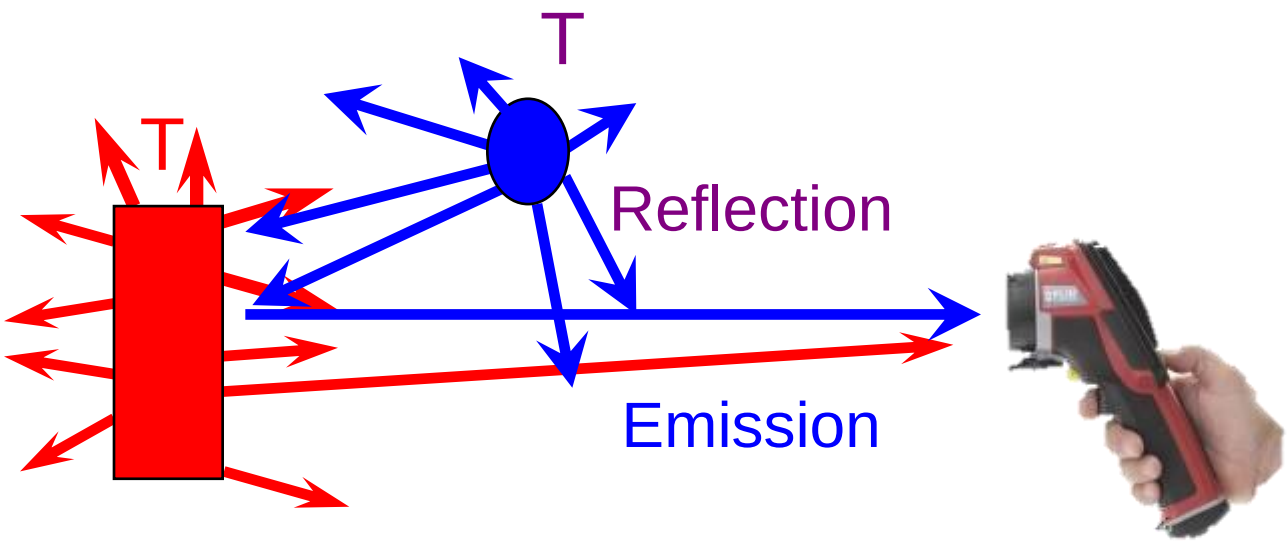
Big difference.
COLORS IN AN INFRARED IMAGE EXPRESS BOTH REFLECTION AND EMISSION.

Radiator seen in Infrared.



EMISSION & REFLECTION?

Emission of heat comes from the material itself.
Reflection comes from what is placed in front ;
that may sometimes include the operator.



Emission and reflection are complementary (A good emitter is a poor reflector.
A good reflector is a poor emitter.)

EMISSIVITY

The ability of a surface to emit heat is called EMISSIVITY.

It is the efficiency of a surface as an emitter of heat. Symbol is ε.
Value between 0 and 1.

EMISSIVITY

Most non-metals, thermal and electrical insulators are excellent emitters.

Measurement is not a problem.

Wood	Rubber
Plastic	PVC
Soil	Porcelain
Paper	Concrete
Painted surfaces	
Building materials	

Ok

Metals are poor emitters. Unless heavily oxidized, emissivity is rarely greater than 0.25.

Measurement is problematic.

Copper	Steel
Iron	Brass
Soil	Nickel
Zinc	Lead
Aluminium	
Chromium	

Not OK

EMISSIVITY

Emissivity may vary with:

- surface roughness,
- surface shape: cavities increase ε,
- viewing angle,
- the degree of oxidation of a metal,
- the temperature itself.

Do not exceed 45/50° from perpendicular

Fortunately it happens when the material is close to melting!

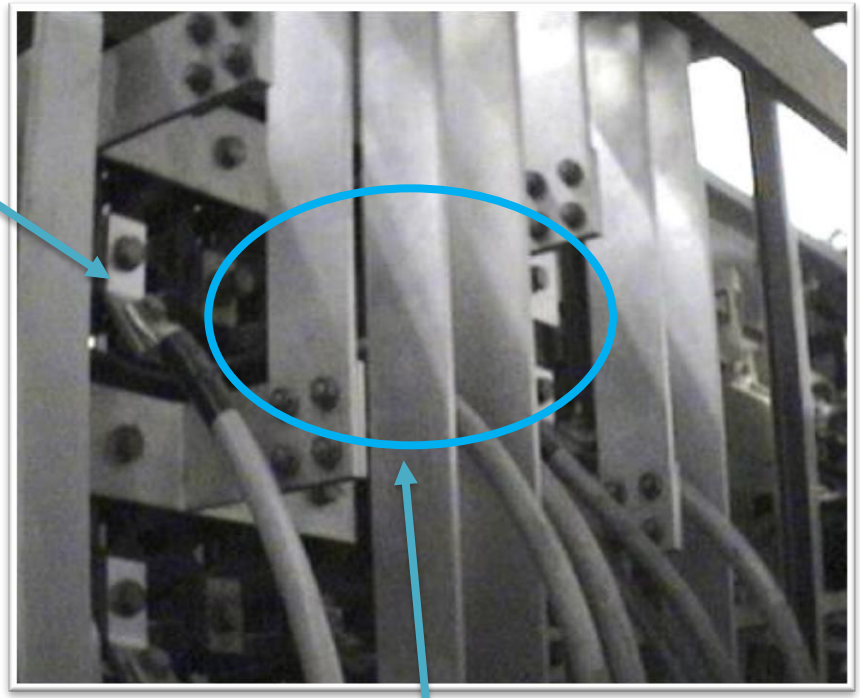
What reflects is called REFLECTED APPARENT TEMPERATURE.
It is often noted T_{Refl} technically, but called the “RAT” by thermographers!

There is always something reflecting!!!!
That is part of the thermographer’s life.

REFLECTION?

Reflection is a source of misdiagnosis.
Some real cases.

The problem is here.

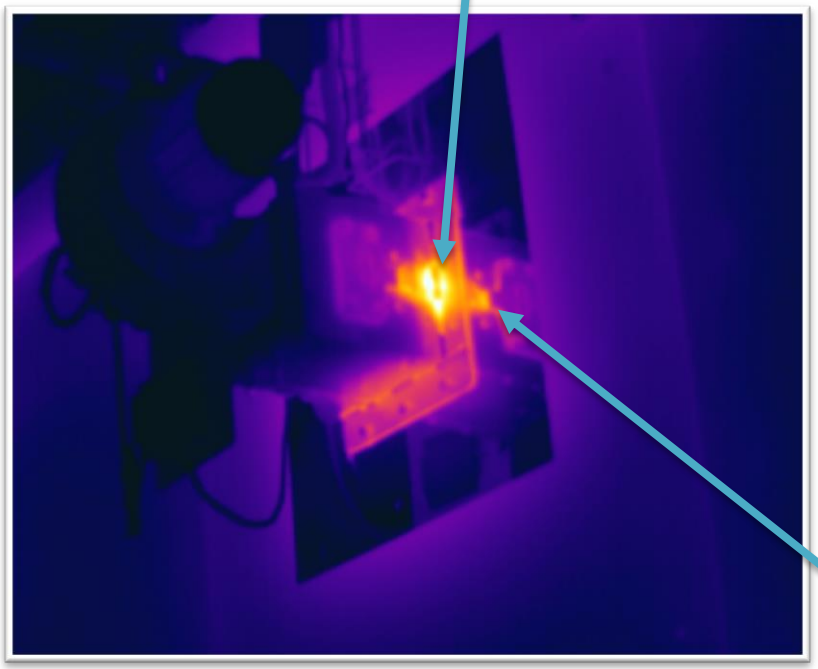


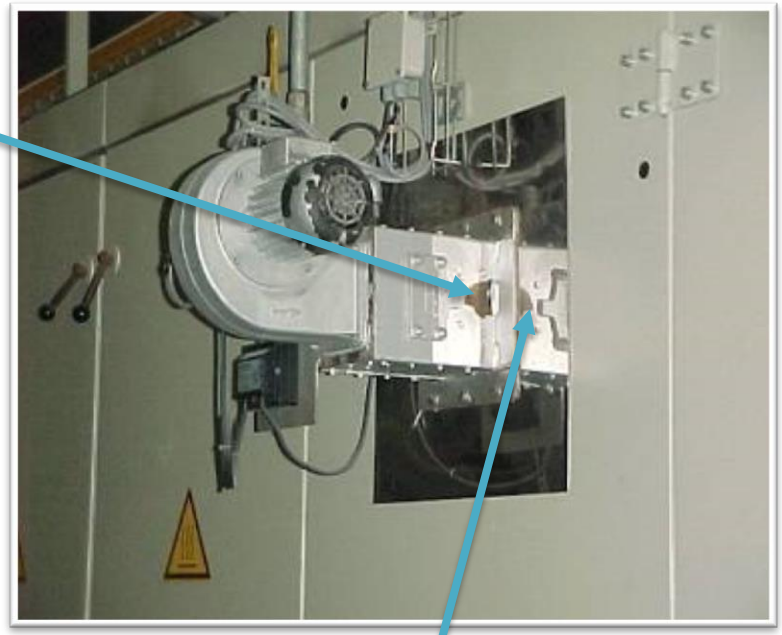
What you see here are reflections off copper bars. Not a problem.

REFLECTION?

Reflection is a source of improper interpretation.
Some real cases.

Is there a problem here? Actually NO. It is just that the emissivity is higher.

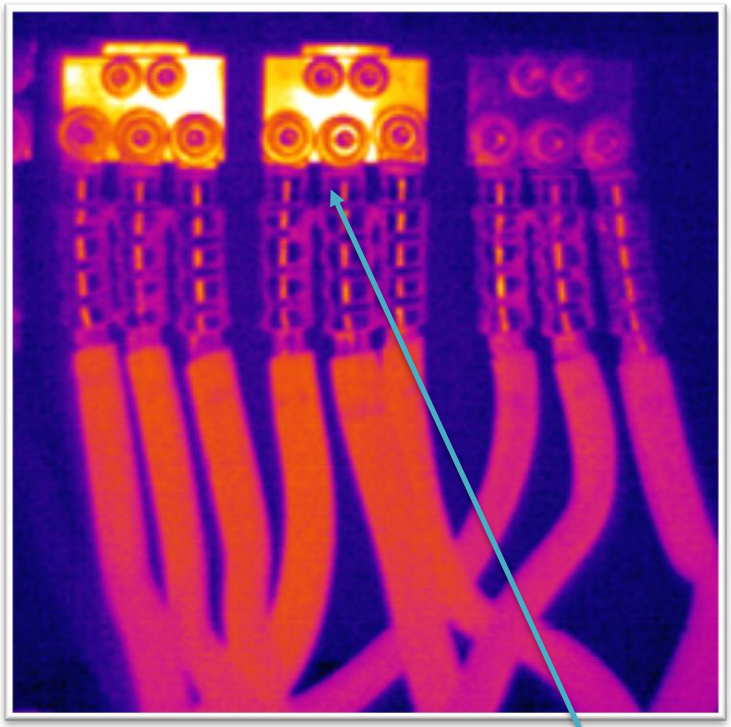


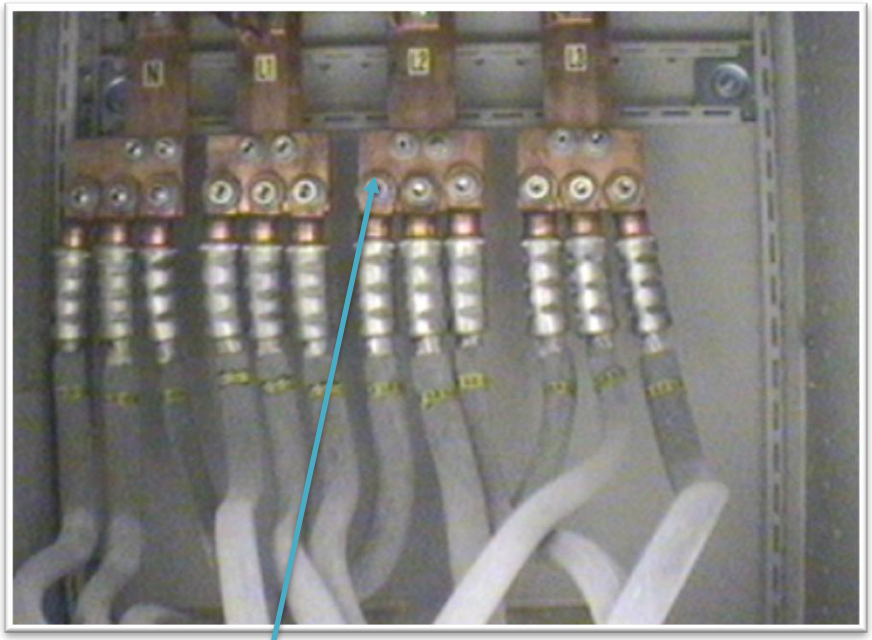


What you see here are reflections on the stainless steel plate. Not a problem.

REFLECTION?

Reflection is a source of improper interpretation.
Some real cases.

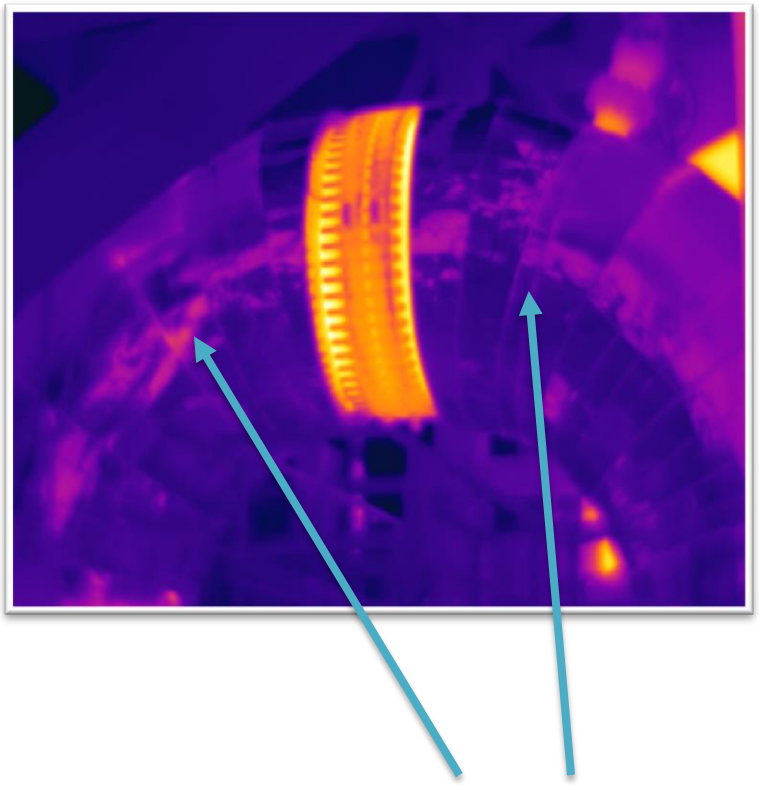


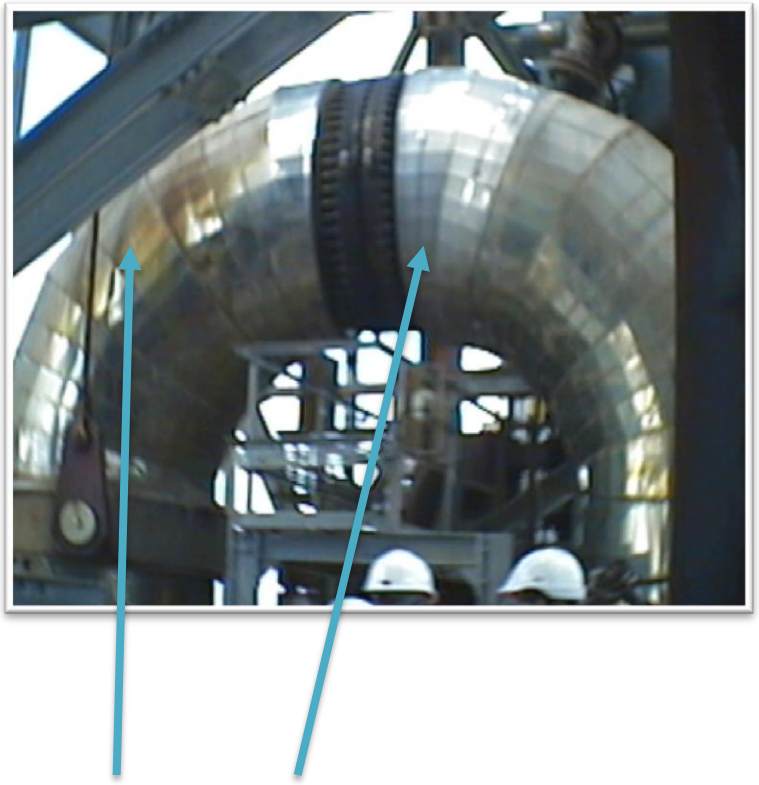


What you see here are reflections from the operator. Should it be a problem, the cable would also be warm.

REFLECTION?

Reflection is a source of improper interpretation.
Some real cases.





What you see here are reflections from the surroundings.

CONCLUSION

Emissivity and T_{Refl} are not automatically calculated.

It is the role of the operator to determine them and to enter the values manually in the camera.

(Later, we will give you the procedure.)

1) Get a good image FIRST. When it is out of focus, the measurement is wrong. How much? Depends on conditions, could be a little, could be a lot.

Focused

Error in this case is almost 3°C.

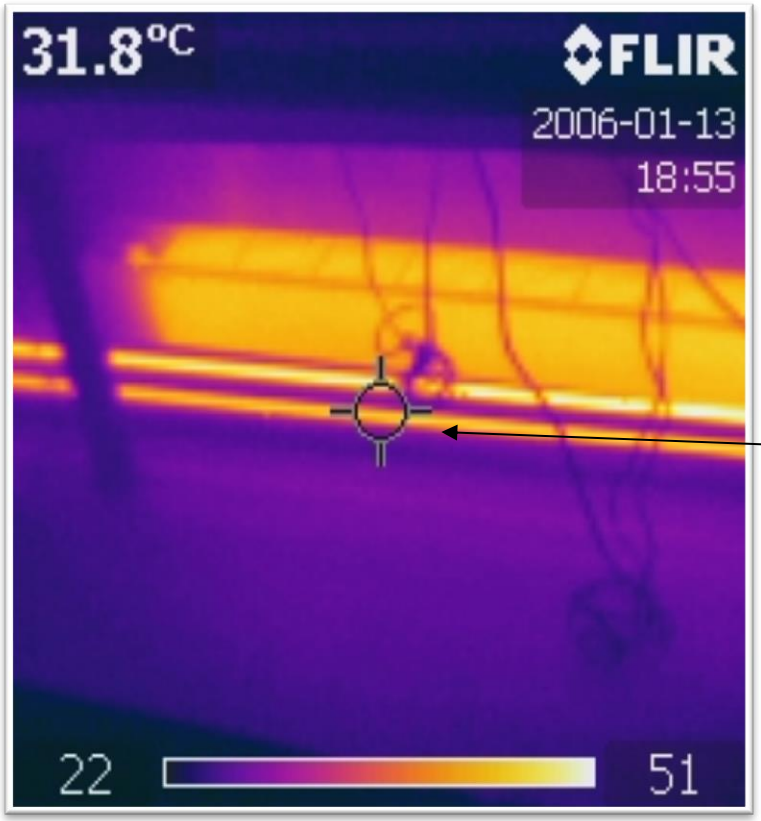
Unfocused

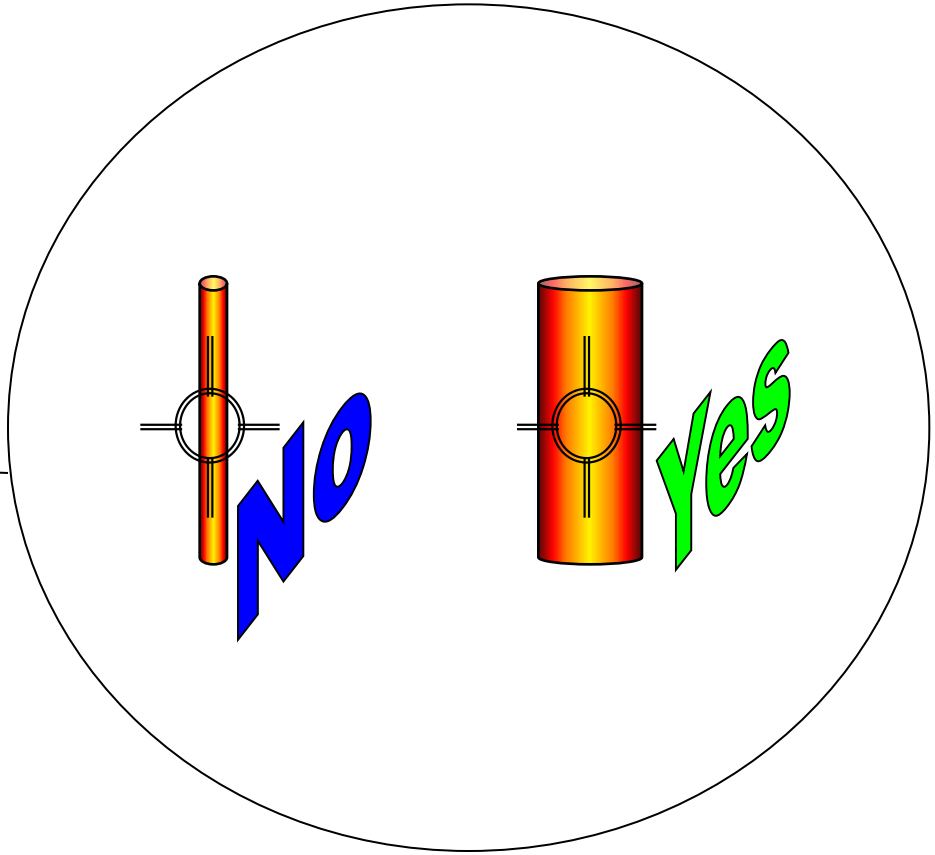
2) By default, most cameras thermally tune automatically. Use this mode first, but do not hesitate to adjust manually. Thermal tuning is critical for proper interpretation. You must get the best level and span before you save the image. Choose the right palette.

Manual mode

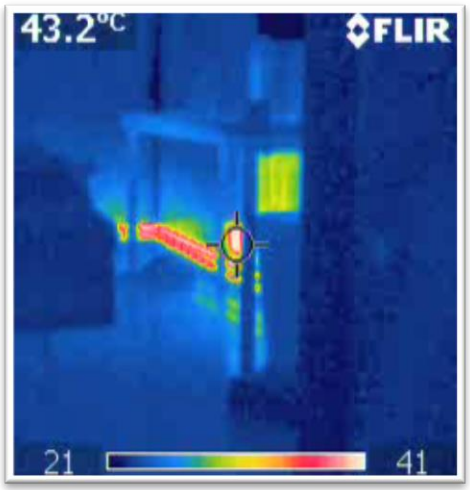
Auto mode

3) Desired target must cover the spot.

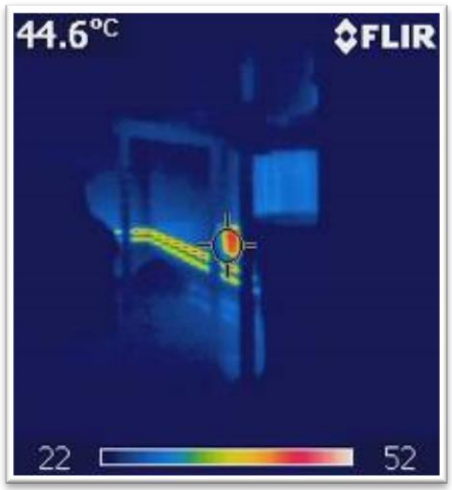




3) Desired target must cover the spot. Get closer if necessary.



About 12 feet

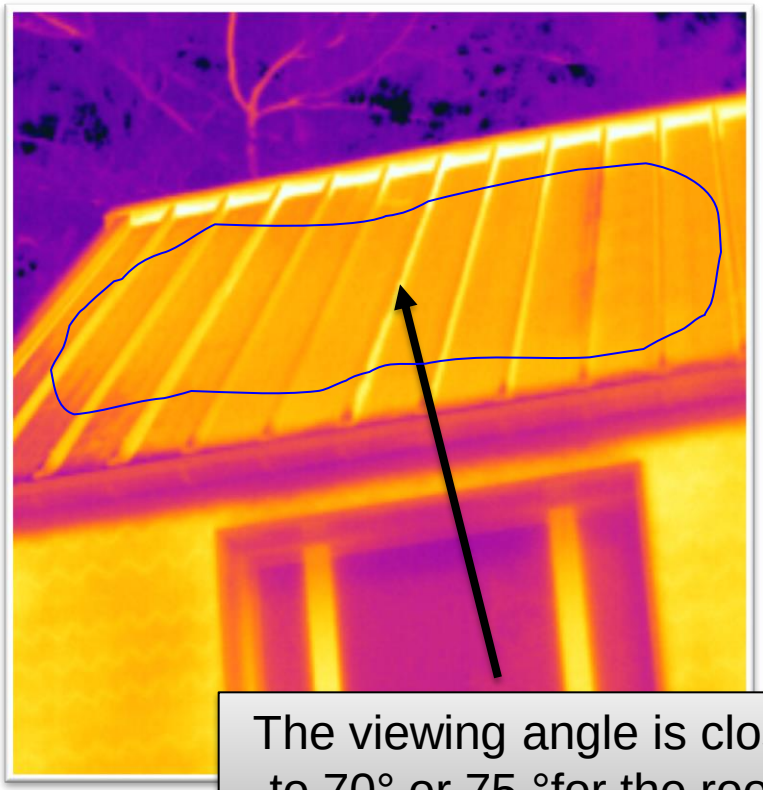


About 9 feet

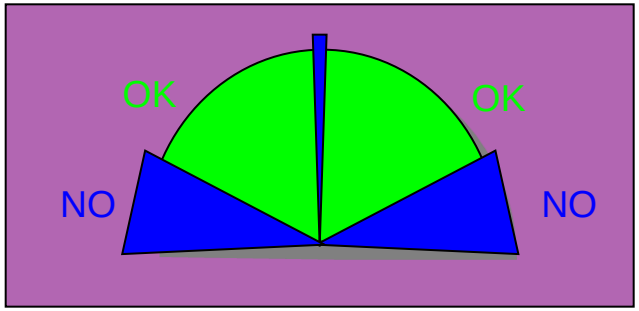
About 4 feet

Safety is #1.
Beware of energized components

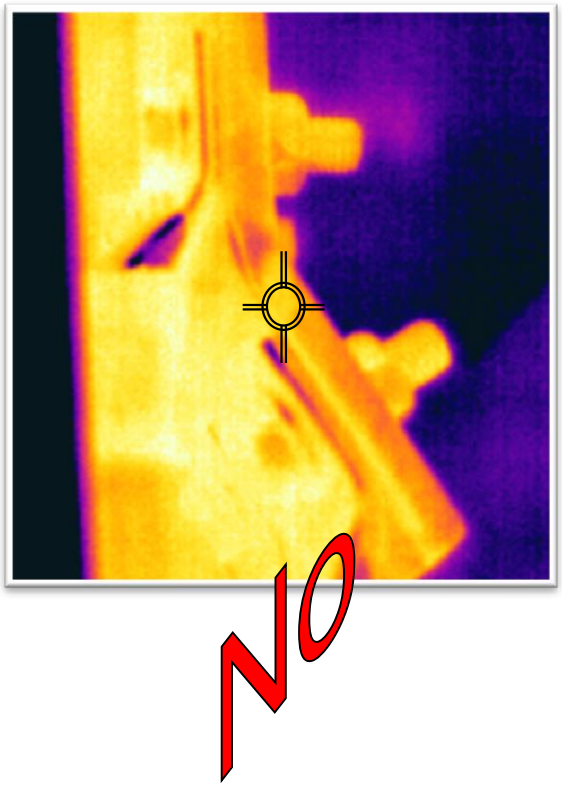
4) Do not aim with an angle greater than 45/50°. Be also careful that at perpendicular, you may yourself be a major source of reflection.



The viewing angle is close to 70° or 75 °for the roof.



5) Choose an area of high emissivity to do the measurement.



MEASUREMENT RULES

6) Enter the correct emissivity and T_{Refl}

7) Save the infrared image. Also save a visible image.

Questions?