DRG INFRARED SCANNING OF ELECTRICAL SYSTEMS GUIDELINES

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

1. CAMERA OPERATION

The first step is the thermal image must be in **focus**, taken with the correct temperature **range**, and within an appropriate working **distance** to the target for the lens and infrared camera being used.

This is referred to as **FORD** (FOcus, Range, and Distance). The parameters in FORD are those that CANNOT BE CHANGED in post processing software, and so are critical to get right before saving your image.

Optical Focus: Just like with any camera you have to optically focus the image. An unfocused image looks unprofessional and within infrared cameras produce incorrect measurements. Below are the two ways to focus the FLIR camera:

A. Using the manual focus wheel adjacent to the lens by adjusting with your left index finger. This is used when scanning different objects to keep the camera focused while moving around looking for hot equipment.
B. Squeeze half way down on the capture image button and wait for camera to automatically focus then fully engaged button to take image. This is used on equipment that you have found while scanning and are now ready to get a fully focused thermogram.

Temperature Ranges: The equipment being analyzed must be within the Range setting required for the target. T640 models have three ranges:

-40˚F - 302˚F or -40˚C - 150˚C
212˚F - 1202˚F or 100˚C - 650˚C
572˚F - 3632˚F or 300˚C - 2000˚C

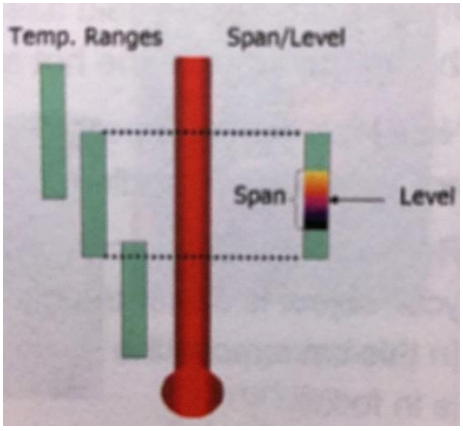
Note: When the temperature is outside of the set range an Asterisk will appear before the temperature as shown in the photo. This is a bad image and cannot be used because the range cannot be changed after taking the image.

To change the range on the camera select the following options by first touching the main screen:

1. Settings 
2. Device settings
3. Set up Camera
4. Camera temperature range

Distance: These cameras are calibrated to measure temperatures within a certain distance depending on camera type and FOV of the lens. Do not use the zoom because it makes the pixels bigger and this will distort the image. To accurately read temperatures the radial has to be completely filled with the object of interest. Adding a telescopic lens will measure smaller targets effectively.

Thermal Tuning = Manually Controlling the Level and Span: The span is NOT the range, it is the difference between the top and bottom numbers on the displayed scale. While the level is the mid point temperature of those numbers. Manually adjusting Span and Level in order to produce a thermogram where the colors are spread over the object of interest, so you can see fine thermal detail and identify thermal gradients.



Note: When using color palette "Above Alarm" it is important to make the span cover the temperatures that you are measuring by changing the max span just above the maximum temperature of the target. Then changing the low span just below the lowest temperature of the target you are measuring. This is done by manually tuning before or after the image has been taken.

Parameters: The parameters settings can be accessed from the main screen and need to be adjusted to match the conditions that exist for the target. These are very important and can give false temperatures readings if not calculated accurately.

To change the parameters on the camera select the following options by first tapping the main screen:

Parameters
Distance
Atmospheric temperature
Humidity
Reflective temperature
Emissivity

Temperature: There are two different temperatures units that can be used, Celsius or Fahrenheit. Check the camera is set to the correct temperature unit before starting.

To change the temperature unit on the camera select the following options by first tapping the main screen:

1. Settings
2. Device settings
3. Language, time & units
4. Temperature unit ➔ Celsius (˚C) or Fahrenheit (˚F)

2. SCANNING FOR HOT SPOTS

For scanning electrical equipment its best to use the color palette "Above Alarm" and setting the alarm temperature to the rise over reference of a Priority 4. This will change anything a red color that is above alarm temperature i.e. of 50˚F degrees hotter than the reference temperature and will stand out from the grey palette background. At the start of each day get the temperature of an electrical object and set the above alarm and change the parameters to match the conditions. Find the hot spots by scanning using the standard settings below:

Atmospheric temperature (use weather app)
Relative humidity (use weather app)
Emissivity =.95
Distance = 50
Reflective Temperature = 68˚ F

Start scanning all the electrical equipment from different angles while manually focusing the camera. When there is a spike in temperature always get a closer look and check the target from all angles because it may be getting hotter on the other side of the object. Always find the hottest side of the target to determine the source of heat. The image needs to be taken showing the source of the problem when possible.

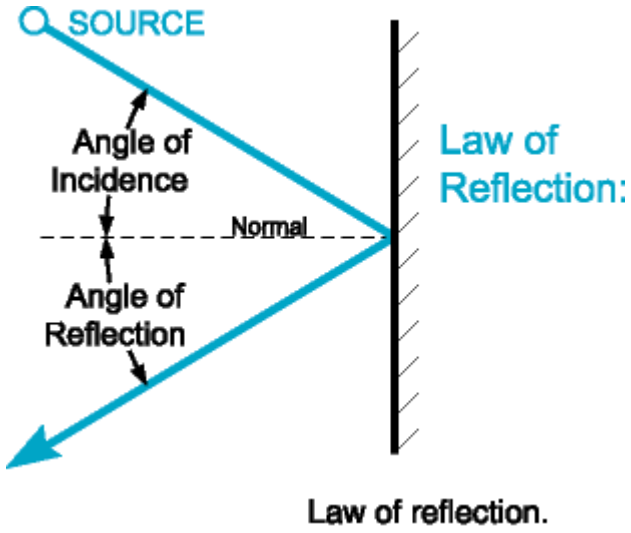
3. CAPTURING THE IMAGE

It is important to get the accurate temperature reading by setting the parameters for each individual target. First calculate all the parameters using the camera.

Atmospheric temperature (use weather app)
Relative humidity (use weather app)
Emissivity = calculate the emissivity of the objects material and finish
Distance = the distance from camera lens to the target
Reflective Temperature = the average temperature of the objects the target is reflecting.

4. REFLECTIVE TEMPERATURE

The "reflected" apparent temperature is the apparent temperature of objects whose radiant energy is reflected off the target into the camera. Surfaces with lower emissivity values will be effected more by reflections. There are two methods to finding the reflective temperature. The first is the foil method and the second is the direct method which is done by directly looking at the source of reflection with the camera. In both methods you want to set the emissivity to 1.0 and distance to 0. The area average measurement mode is recommended. The law of reflection is true on flat surfaces but changes depending of the shape of the object you are analyzing.



5. EMISSIVITY

Emissivity can have a value from 0 (shiny mirror) to 1.0 (blackbody). Calculating the emissivity of an object in the air is almost impossible so an educated guess is in some cases the best thing to do. Sometimes equipment with the same materials can have different values due to weatherization. The best way would be to go out and calculate the values when possible and practical. Below is an example of an approximate emissivity chart from a project that the values where calculated.

Material	Equipment Type	Approximate Emissivity
Aluminum	New Conductor	0.66
	Weatherized Conductor	0.89
	New Connector/ Jumper	0.66
	Weatherized Connector/ Jumper	0.89
	New Splice	0.66
	Weatherized Splice	0.89
Copper	Conductor	0.87
	Connector/ Jumper	0.87
	Splice	0.87
	Ground	0.87
Polymer	Pin Insulator	0.91
	Post Insulator	0.91
	Expoxilator	0.87
	Lightning Arrester	0.87
	Pothead	0.87
Porcelain	Pin Insulator	0.81
	Post Insulator	0.81
	Dead End Bells	0.81
	Bushing (Primary)	0.81
Steel	Switch	0.83
	Fuse Bracket	0.80
	Bushing (Secondary)	0.85
Grey Paint Coating	Transformer	0.90
	Capacitor Bank	0.90
	Regulator	0.90
	Recloser	0.90
	Fuse Barrel	0.90
Rubber, black	Insulated Conductor	0.93

6. BACKING UP RAW IMAGES

FLIR images are saved with a certain format and changes when you insert the IR image into Rover. The original FLIR raw image is required in order to open in the FLIR software. These are requested by the client sometimes and needed to analyze and troubleshoot the results. It is important to back up all the raw images from the FLIR camera into a folder created for each particular project. When you wipe the memory card make sure to cut and paste all the raw images into the RAW IMAGE folder.