Enlighten TempScan In-House Calibration Report
Camera Calibration measurement for Reliability & capability

For

(Camera model & serial number)

Submitted by:
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1). Calibration Item(s)

A (camera model), distributed by Emitted Energy was calibrated to detect elevated body
temperature by the Emitted Energy engineering staff. A capability report was also completed
measuring the overall camera capability.

2a). Description of the calibration

This calibration of (camera model) included (3) measurements of the average body temperature
of 10 separate individuals. The data was recorded, and the MEAN was used to set the camera to
record an elevated body temperature 2º over the MEAN.

2b). Description of the capability study

This capability study of (camera model) included (30) measurements of (2) individuals rotating
every (5) thermal captures. The average body temperature of 10 separate individuals. The data
was recorded and calculated in Minitab to understand the overall capability and variability of
(camera model). Camera included in TempScan Package is calibrated at the distance of 18”
unless otherwise notified.

3a). Results of Calibration

The results of the calibration are shown in Table 1.

Table 1.
(Post statistical data here)

3b). Results of capability study.

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(Post Six pack (shown) below):

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**Additional Information**

There are a number of parameters that define the performance of an IR Camera. The most impactful include, accuracy, sensitivity, and spot size.

Accuracy: While typically the first specification most customers ask about; it is influenced by other parameters that need to be considered. Accuracy is simply the confidence in or potential error from the reading the equipment gives when compared to the real/true value, but it does not take into consideration the area or footprint of the reading.
Spot Size: The spot size (also sometimes expressed as spot size ratio and IFOV – instantaneous field of view), defines the area or footprint of the measurement being taken. The footprint of a single pixel cover is influenced by the distance to the target, the field of view (determined by the lens), and the resolution of the sensor. If a camera with a 320x240 sensor, a 45° horizontal FOV lens and is viewing a target at a distance of 1 meter, then a single pixel will cover an area that is 2x (TAN (45/2) x 1 meter) which equals a total horizontal field of view of 0.828m wide.

\[ X = \tan\left(\frac{45}{2}\right) \times 1 \text{ m} \]

With 320 pixels horizontally, then each pixel is 0.828m/320 pixels = 0.00268m = 2.68mm wide. While we could do the same calculation for the vertical, the pixel is square, so its footprint at 1 m is 2.68 mm x 2.68 mm.

If we move the camera out to 10m away, the footprint of a single pixel increases 10x to 26.8 mm x 26.8 mm. A sensor will typically have a handful of bad pixels, and in replacing those bad pixels, the 8 surrounding pixels are used to create a best guess, so there is the potential for a reading to be compressed to a 3x3 cell. Additionally, depending on the camera design, many auto hot spot readings are actually the average of a 3x3 or 4x4 grid of reading.

In the end, you have to assume that a reading could be from the reading of a 3x3 or 4x4 cell. Assuming a 3x3 cell is the smallest area the camera can resolve, then in the example above, at 1m a reading covers a 3x 2.68mm by 3x 2.68mm area which equals 7.77mm x 7.77mm. If the Target of
Interest is 10mm x 10mm, then at 1m the 3x3 measurement cell is smaller than the target, and we can get an accurate temp reading on the middle area of the target.

If the camera is moved back to the measurement cells expands to 77.7mm x 77.7mm, so on a 10mm x 10mm target, the camera will average the target along with the background and while the reading is still an Accurate Average of the reading coming from the entire 3x3 measurement cell, it no longer will reflect the true temperature of the 10mm x 10mm target, since the background is also being averaged into the reading.

Another important parameter is sensitivity (typically expressed as NETD), which is the smallest temp difference that the camera can resolve. This allows us to know that if looking at a target with uniform temperatures across its surface, that the reading from difference from pixel to pixel should be less than that sensitivity.

One method to improve the overall accuracy of the camera is to use a known reference within the overall field of view. By knowing that the reading being taken on that reference target is offset by a certain amount, we can correct that reading and at the same time, all other reading by that offset, greatly improving the accuracy. That new overall accuracy is impossible to truly specify as it is affected by the accuracy of that reference, it in theory could begin to approach the sensitivity of the camera.

There are still a number of other factors that can influence accuracy,

1) Emissivity - While the camera will correct for emissivity, the accuracy of the emissivity value used also needs to be considered. As an example, the emissivity of some materials will increase as the they oxidize, so the correct value may be influence by the level of oxidation.

2) Background Temperature/Reflected Temperature (TReflected) - Related to the emissivity. Errors in emissivity will cause errors in the Reflected Temperature corrections. Additionally, errors in the TReflected value will also affect the corrections

3) Air Temp and Humidity - The density of air changes with temperature, and the amount of signal attenuation (absorbing/filtering of iR energy) is affected by the Air Temp/Density, the moisture content (Humidity) and the amount of air (the distance) the signal must travel thru also effects the reading. There are compensations for those loses, but the accuracy of the parameters used can affect the reading/overall accuracy. (NOTE - Normally only affects reading at about 100’ in typical humidity or 50’ in high humidity situations.)