 

A Practical Field of View Test

Every infrared camera defines its Field of View (FOV) across a horizontal/vertical axis. You have two ways to determine the Field of View (FOV) on your camera:

1. You can calculate the FOV
2. You can measure the FOV with a practical field test

The Practical FOV Test is a quick method to determine what can be seen at set distances with your camera, the lens, and IR Windows.

1. Find a long countertop or a 6 foot folding conference table. Lay a piece of plain butcher paper along the length of the table.
2. Set the camera on the table and mark a “zero” line across the table width. This zero line should be far enough on the table so that the camera cannot accidently fall off the table. The zero line is where the camera lens touches the line.
3. Draw a straight line the length of the paper along the center.
4. Intersect this line with lines at 6 inch increments from the zero line.
5. Label the lines from 0 to 36 inches. You can go further if you have a panel depth deeper than 36 inches, but usually 36 inches is sufficient.
6. Place the camera lens at the zero line with the straight line going down the center of the paper in the middle of the camera lens.

Now, it is time for a coffee break. You need two heat sources. Some people use coffee cups – good excuse for a break. You can use any known heat source. Some people use hot plates if they are in a lab, a griddle, or you can purchase inexpensive candle warmers.

7. Place the two heat sources at a distance from the camera that is typical of the targets you will monitor. For example, if your targets are 18 inches from the panel, then place the two heat sources at the 18 inch mark.
8. Move one heat source from the center until it appears just inside the edge of the image in the camera display.

9. Move the other heat source in the opposite direction until it appears just inside the camera display on the other side.

The distance between your two heat sources is the maximum FOV using your camera and lens. At the defined distance.

10. You can draw a line from each side of the camera lens at the zero line to the heat source on the same side. This gives you the FOV for any distance from the zero line to the heat sources.

11. If you are using an IR Window, subtract the camera lens diameter from the FOV. Next, add the diameter of the IR window. This gives you the Maximum Horizontal Window FOV. For example, you have a FOV at 18 inches on the center line of 8 inches. The camera lens is 1.75 inches. The camera FOV is then 6.25 inches. If you are using a 4 inch IR Window, then add 4 inches for a total Maximum Horizontal Window FOV of 10.25 inches.

You can repeat the above process with the camera lying on its side to determine the Vertical FOV. When finished, roll up the paper and save for future reference. You can create a table for the distances along the center line and the Horizontal and Vertical FOV for different window sizes in your plant. Also, while you are at it, use your heat sources to adjust the camera settings to compensate the IR Window transmission rate.

Simplified Transmittance Test

Equipment Required

- Calibrated infrared camera with inputs for Reflected Temperature and Emittance values.
- Blackbody simulator with an Emittance of ≥ 0.95 heated to at least 10ºC (18ºF above ambient temperature. An effective blackbody simulator may be constructed of a container such as a straight-sided coffee mug that has been covered with PVC electrical tape and filled with hot water.
- IR window that is semitransparent in the waveband of the infrared camera.

Method

1. Place infrared camera at an appropriate distance from blackbody simulator.
2. Aim and focus camera on blackbody simulator. Place crosshair on center of blackbody simulator.
3. Set camera's ε control to 1.0
4. Measure and compensate for Reflected Temperature.
5. Measure and note apparent temperature of blackbody simulator.
6. Place window directly in front of, and in contact with camera's lens. Note: Window optic must be larger than camera lens.
7. Without moving camera, adjust ε control until observed temperature matches value obtained in Step 5 above. The displayed ε value is the Transmittance percentage for this window with the subject camera.

For greater accuracy, repeat above a minimum of three times and average results. Adapted with permission from Infraspection Institute's Standard for Measuring and Compensating for Transmittance of an Attenuating Medium Using Infrared Imaging Radiometers.

Proper Installation of Infrared Windows

Proper installation of the infrared window is critical for the long-term use of the window and for the long-term performance of the panel and equipment enclosure. Although an infrared window is not as strong as the steel it replaces, installing an IR window is no different than many other modifications commonly performed on switchgear and other electrical applications. Therefore, if a company has a policy for modifications such as: replacing or adding an ammeter or similar device, installing a visual inspection pane or modifying a cabinet to add a new conduit run, then it is logical to include infrared windows under the same policies. For example, one would want to refer to any existing policies relating to: pre-planning, design/installation approval, installation best practices and post-installation inspection by an in-house or external authority.

Do Not Pass "Go"

Confirm the following prior to planning any modifications to an electrical equipment enclosure:

- Ingress Protection: Ensure that the NEMA or IP rating of the IR window or other component is rated for at least the same level of protection that the current enclosure is rated for. Never install an infrared window or any other component with a lower rating than the equipment onto which it is being installed.
- Tests and Certifications: Ensure that the IR windows have been tested and approved by the relevant certification bodies. Official test certificates and documentation should be easily obtained from the manufacturer.
- Explosion Ratings (if applicable): Enclosures located in intrinsically safe areas should never be modified in the field unless designs have been cleared with, and post installation inspection and re-certification will be performed by an Authority Having Jurisdiction prior to start-up.

Identify All Targets

Start the process by identifying specific targets on each piece of equipment. In addition to fuses and breakers, most infrared surveys focus on bolted connections within the gear, as these areas are considered the weakest points. These areas include:

- Cable connections
- Bus bar connections
- Isolator or circuit breaker connections

Make a quick inspection of the interior of the switchgear to identify these targets. Once identified, make every effort to standardize their emissivity while equipment is de-energized. Common methods include use of electrical tape, high-temperature paint or IRISS IR-ID labels. After emissivity standardization is complete, it is important to photograph each target since these photos will be used for report templates and future reference. On many switchgear models, it is advisable to install viewing windows in the front and back for better access to the main breaker and bus connections. Ask the manufacturer for drawings and suggestions regarding the critical inspection locations for your equipment. This information, along with the experience and knowledge of the site maintenance engineer, will prove useful when calculating window placements and quantities.

Labeling

Affixing information labels is an important final step in the installation process. One label should identify what the window is and how to use it. A second sticker should contain the following information that will be critical in performing a thorough and accurate infrared inspection:

- Each inspection window should be given a unique number. This will be invaluable, especially, if there are multiple windows on one electrical panel.
- Document the type of window (MW or LW) and the effective wavelength of the window.
- Record the transmission rate of the window, and the proper transmission compensation value for the MW and LW.
- Record all target data on the on the ID label. The most common method of documenting target location is the clock face method: i.e. bus bar connections at 4 o'clock. It should be noted that there may be multiple targets being surveyed through the IR window.
- Some cameras do not have the ability to adjust the external optics transmission; therefore, thermographers may use the emissivity settings on the camera to cover transmission and emissivity losses. Multiply the target emissivity by the transmission rate of the window.

Baseline

After the window installation is completed, the thermographer should conduct a benchmark inspection to set the base line. Data for each inspection point should be recorded in a spreadsheet or database for trend analysis over several surveys. There are software programs available to assist with database management and trending of infrared data.

Summary

1. Do your homework first. Check all applicable certifications and ratings.
2. Gather as much information as possible, while the equipment is de-energized.
    a. Take high quality digital pictures
    b. Standardize the target emissivity
    c. Make detailed measurements
    d. Note any internal obstacles
    e. Conduct any outstanding maintenance tasks
3. Complete a thorough Risk Analyses and Method Statement before starting energized installations.
4. If possible, complete a specialized training program dealing specifically with installation of infrared windows.
5. Remember to label the windows correctly, since this data will be used during future inspections.
6. Do a complete infrared inspection at the end of the window installation in order to create a benchmark/baseline for future inspections.