Whitepaper
Busway

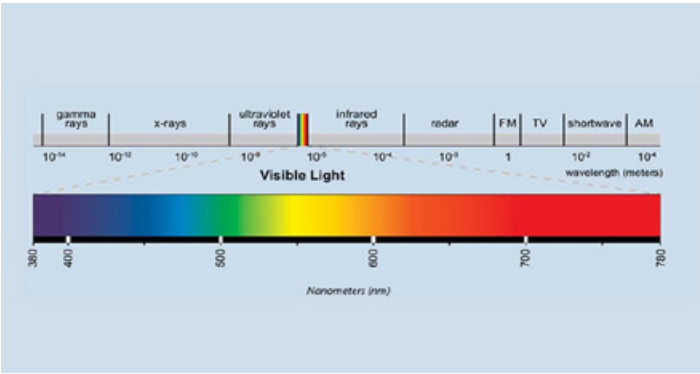
Infrared thermography in Busway

What is infrared thermography and how does it work?

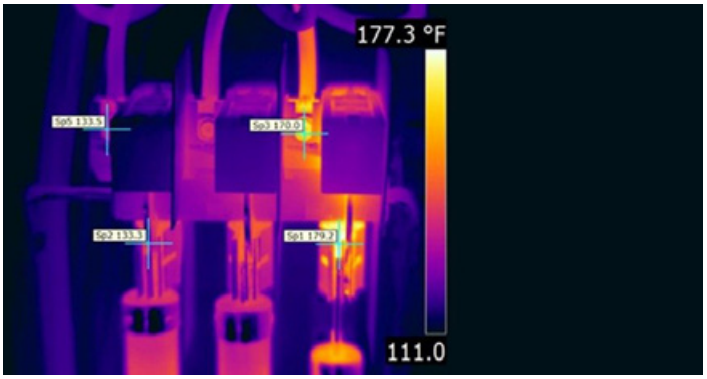
All objects give off infrared (IR) energy, which is radiation in the electromagnetic spectrum above the wavelengths of visible light. IR cameras use special lenses and detector circuitry to convert the IR energy into color-coded images, making it easy to see temperature differences between objects. Like objects, such as three phases of busway conductor connections with similar load current, should have the same approximate apparent temperature. A single conductor with a "hot" reading compared to the other two could indicate a loose electrical connection with high resistance.

Why use IR thermography as a condition-based maintenance tool?

IR thermography is a non-intrusive technique that detects subtle temperature differences between components and should be conducted while equipment is energized, ensuring no interruption to your operations. Along with visual inspection and ultrasound, it enables you to assess electrical equipment health. IR thermography can help you migrate from wasteful calendar-based maintenance to more efficient and effective condition-based maintenance and decision-making.



Electromagnetic spectrum



Hot conductor phase

Can actual target object temperatures be taken using an IR camera?

Actual quantitative temperatures of objects can be determined after fine-tuning camera settings for variables that can skew readings. Camera settings should be adjusted for distance to the target, ambient air temperature, relative humidity, target emissivity and transmission rate of the IR window (if applicable). Geometry of the targets can also make a difference in the apparent temperature readings. Certified thermographers are trained to make these camera adjustments to secure relatively accurate temperature readings.

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What is an IR window and how does it work?

An IR window enables safe and efficient access to electrical connections that may be prone to loosening over time and overheating. The IR window must comply with several equipment component standards related to mechanical strength, ingress protection rating and flammability, and it should be listed or recognized by UL® and/or CSA®.

The IR window keeps the equipment in an "enclosed and guarded" state even when the cover of the window has been opened for taking measurements. The NFPA® 70E standard does not require any special personal protective equipment (PPE) to be worn when performing IR thermography through an IR window. However, the standard does require PPE if a panel cover is removed or an equipment door is opened to expose live energized components.

The window utilizes a lens system with a material that enables most IR energy to transmit from the source through the lens media to the camera. Most plastics, glass and metals will NOT allow IR energy to transmit through. The Eaton Pow-R-Way III IR joint cover uses a special IR-transmissive, reinforced polymer optic lens that is tested to all relevant standards and carries a UL listing.

Are IR cameras expensive? Do I need training to use one?

The cost of IR cameras has come down dramatically in the past 10 years, especially mid-range handheld cameras. A mid-range camera enables both qualitative and quantitative measurements to be made. Some smartphones also feature a built-in IR camera with still and video recording capabilities. Low-end cameras may not have all the settings needed to get accurate temperature readings, but they enable good qualitative analysis.

It is recommended that maintenance personnel complete an accredited level 1 thermography training course before attempting to use an IR camera. Without proper training, there is a danger of both missing real problems and reporting false positives.

Why can't I just scan the joints from the outside of the equipment without the special IR joint cover?

You can attempt to compare sequential busway joints from their exterior to look for temperature variation, but the busway itself has significant thermal mass. A loose connection causing a 50 °C temperature rise inside the joint might manifest as only a 1–2 °C of temperature variance on the exterior of the joint — which can easily be missed. The joint cover, when opened for inspection, enables a direct field of view of the joint's internal connections, ensuring that any problem will be seen immediately.

How often should I inspect busway joints and what if there's a problem?

Scan to detect problems
At a minimum, we recommend an annual scanning of busway joints. In critical power applications such as data centers, hospitals, airports and some industrial applications, more frequent inspection may be prudent. In these segments, it is not unusual for inspections to be done on a quarterly basis. Follow the recommendations of NEMA BU1.1 for maintenance of Eaton busway.

Unusual temperature anomaly
An annual temperature scan of a joint is considered abnormal if there is a rise greater than 5 °C over the previous year's reading of the same joint. During a joint scan, note the ambient temperature of the room and if any changes were made to the electrical system, as a new load may affect operating temperatures of the busway. Different phases at one joint may also run at higher or lower temperatures than other phases at the same joint, depending on the load incurred by the individual circuit.

What should I do if I detect an anomaly?
Double-check your camera settings and record the time, location and temperature values of the suspect busway connection. Note which phase was manifesting as the source of the heat, if applicable. If an annual scan of a joint indicates a temperature rise greater than 5 °C from the year before, a visual inspection to check for any changes made to the busway during the last 12 months is recommended, and the busway may need to be de-energized to check the torque values of its bridge joints.

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Eaton
1000 Eaton Boulevard
Cleveland, OH 44122
United States
Eaton.com

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