Frequent Infrared Inspections of Electrical Cabinets Made Easy and Inexpensive with Newly Approved UL-Device

Is the cause of your next production stoppage behind door number one, door number two, or door number three? If you’re a plant manager concerned about the condition of electrical hardware, that can be a frustrating question. Today’s higher equipment utilization rates call for an aggressive infrared (IR) inspection program for electrical panels to head off disaster, but that has traditionally been a tough goal. One graphic example of how frequent IR inspections can save significant expense occurred recently at a gas enrichment plant in the western United States. Using a new lens and port technology that facilitates closed-door IR inspections, the plant’s maintenance team discovered overheated, failing connection leads to two 4,500-horsepower, methane compressor motors critical to the 24/7 operation. A similar electrical connection problem at the plant previously had caused an unscheduled outage that resulted in one million dollars in lost production. The timely finding enabled plant managers to correct the problems on a controlled basis, avoiding costly unscheduled downtime and damaged equipment.

Two Inspection Options, Neither Appealing

Up to now, the methods and options for performing a safe IR scan have not been appealing. Removing or opening electrical panels always poses a risk when high energy is involved. Human error, particularly for an inspector suited up in heavy personal protective equipment (PPE), equipment failure, and other factors can transform stable conditions in the cabinet into a dangerous environment for the inspector and anyone nearby. Preferably, an arc-flash assessment per NFPA 70E will be done first to determine safe boundaries. Certainly, the correct level of PPE should be worn. Regrettably, the heavy protective suits, gloves, hoods, and face shields that are sometimes required make this an arduous task, even in a cool environment, thus discouraging frequent inspections.

Closed-door inspection is safer and a better use of manpower, allowing the thermographer to work without the help of an electrician and with a greatly reduced level of PPE. Traditionally, this has required installation of costly and fragile IR-transparent windows (or sight glasses) which allow a small portion of a cabinet interior to be viewed through a camera. Metal mesh ports are also available.

From a thermographer’s standpoint, IR-transparent windows transmit only varying percentages of IR in different wavelengths, depending on the material. The resulting temperature measurements cannot be considered accurate.

IR-transparent windows used in sight glasses for electrical cabinets are made of various crystalline materials that allow light in the wavelength of 0.13 to 10...
microns to pass through. However, the range sensed by uncooled microbolometer cameras is 8-14 microns. If the sight glass only transmits up to 10.0 microns then the camera is NOT “seeing” 71.5% of the energy from the target. This reduction of signal/energy on the detector results in lower image quality and severely compromises temperature values based on camera algorithms established for energy from 8-14 microns. IR transparent windows are also expensive — hundreds of dollars for just a few square inches. They scratch and shatter easily if pressure is applied, so they are easily vandalized and a camera can’t be pressed against them.

Because only a limited area of the cabinet interior can be viewed through a sight glass even with a wide angle lens, it may take four or more sight glasses (at a cost of about $200 to $300 each) to make the interior of a typical panel viewable from outside. Sight glasses also require a relatively large hole in the cabinet door, which can be a safety hazard if the window breaks.

Metal screens can compromise safety if they fall into the cabinet or become bent or broken. They easily skew thermography by acting as both reflectors and emitters of IR radiation while obstructing an unknown percentage of radiation from the target of interest.

UL-Approved Device for Closed-Door Inspections

Another alternative has recently been developed for closed-door inspections that requires no IR-transparent window or metal mesh. It allows a thermographer to scan a panel looking through a tiny 0.50-inch opening in the door. This new system (Figure 1 and Figure 2) combines a viewport with a fisheye lens known as a SpyGlass™. The cone-shaped tip of the lens docks in the socket-shaped opening of the viewport to maintain a comfortable, steady position for the camera to reduce operator fatigue.

This combination of window-free port and fisheye lens makes company-wide standardization feasible and affordable because the less than $50 cost of the ports decreases as quantity increases. Industry leaders such as GE, Exxon Mobil, Boeing, Dupont and Cargill already have thousands of these ports installed. The patented viewports have received UL approval in the United States and in Canada, leading to a high level of confidence by early adopters.

The fisheye/viewport system enables closed-door thermal inspections of connected electrical switchgear, while maintaining the original safety rating of the cabinet. This applies to cabinets energized with 480 to 13,200 volts as well as motor junction boxes with 4,160 volts.
No IR Attenuation or Obstruction

The fisheye lens and viewport provide the clearest possible view and most accurate temperature measurement of electrical switchgear under load because the tiny port opening requires no IR-transparent window or metal mesh.

The viewport uses only a 0.50-inch aperture covered by a sealed, screw-on cap to maintain the integrity and safety rating of the cabinet when not in use. To prevent unauthorized access to the cabinet, a locking device for the viewport cap is available as well. Allowing an unobstructed view of a cabinet’s entire interior, the viewport is unaffected by moisture, dirt, UV, and corrosive environments that can degrade IR windows or penetrate metal mesh covers. It never needs cleaning or replacement.

In addition to the wide field of view provided by the lens, its tip works with the viewport like a ball-and-socket joint, allowing the camera to be rocked at different angles to look up, down, and to the sides as well as straight ahead.

The viewport is UL approved for installation at the OEM level or as a retrofit in the field on NEMA Type 1, 2, 3, 3R, 4, 5, 12, 12K, and 13 enclosures. Suitable for both low- and high-voltage applications, it can be installed on cabinets indoors or outdoors in either vertical or horizontal position.

A Broad Field of View

The fisheye lens, with its wide field of view (53° horizontal by 40° vertical, or 66° diagonal) allows easy scanning of the interior of the electrical cabinet through the viewport while providing a temperature measurement accuracy of ±3°C (Figures 4 and 5). Focusing from four inches to infinity (100 mm to infinity) and providing great depth of field, the fisheye lens reduces the need to refocus for different electrical cabinet depths. It is worth noting that it could easily take up to four IR sight glasses to cover this same area for inspection with a typical wide angle lens.
20-Minute Installation

The viewport can be installed by one person in 20 minutes or less. The electrical equipment should be de-energized before installation. To install, simply open or remove the cabinet door, use a Greenlee punch to create the aperture, drill the screw mounting holes, affix the viewport, and reinstall the door.

Figure 5 — A hot fuse clip, photographed with SpyGlass-equipped IR camera.

Versatile Applications

The viewport can be installed on any application where an expansive and unobstructed view behind a panel or door is desired, including mechanical rooms. Motor control centers, transformer terminal boxes, air circuit breakers, motor lead boxes, and a wide range of mechanical equipment can be outfitted with viewports.

Viewports are available with either a screw-on cap, a locking cap, or with an IR window and locking cap.

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