



Sample Specifications for Maintenance Inspection Windows

General Description

This is a specification for Maintenance Inspection windows (commonly known as “Infrared Windows”). In most cases, maintenance inspection windows are installed in Motor Control Centers (MCC), low voltage switchgear, panelboards, transformers, medium and high voltage switchgear, and other electrical equipment panel covers and/or doors. Maintenance inspection windows are available in numerous designs: they can be round, rectangular, or custom made to any size or shape or dimension (including complete panel replacement). The need for maintenance inspection windows is driven by ANSI, CSA, IEEE, NETA, NFPA, OSHA, and other organizations that recognize that an arc flash can occur when panel doors are opened or covers are removed. maintenance inspection windows allow inspections to be completed with the following equipment:

- a. Infrared (IR) Cameras
- b. Ultraviolet (UV) Cameras
- c. Visual Inspection Cameras
- d. Airborne Ultrasound
- e. Partial discharge testers

The use of maintenance inspection windows allows inspection of the critical components inside an enclosure to be completed without opening and changing the electrical environment whilst maintaining an enclosed and guarded condition.

Note

Care should be taken to specify the targets of interest for inspection and to instruct the OEM to provide sufficient size and quantity of maintenance inspection Windows to allow clear field of view to the targets. Field wiring connections including cable termination points and bus splices should be priority for inspection followed by factory wired connections in the current path of distribution equipment. For some equipment, such as power factor correction equipment, variable speed drives and power converters, other critical components may be of interest including fuse holders, contactors, capacitors and line reactors.

Field of View (FOV) Calculation

The FOV of a maintenance inspection window is based on the actual viewing angles of the cameras and equipment using the system. Full consideration must be given to all internal obstacles such as phase dividers, internal cable routings as well as the physical designs of the doors and covers (reinforced doors, internal covers, etc...).

The typical FOV of an IR camera is 22 degrees in the horizontal and 16 degrees in the vertical. These Lens FOV figures should be used as a guide when calculating the required window size, the formula for calculating the size of inspection window is:

$$Ws = Ts - [(2 \tan(CVA / 2)) \times Dct \times 3]$$

Where:

Ws = Window Size (width or height)

Ts = Target Size (width or height)

CVA = Camera Viewing Angle (horizontal for width of window; vertical for height of window)

Dct = Distance from Cover to Target

Sample Calculation:

Enclosure with a distance from cover to internal components of 8 inches with an overall target width of 18 inches. To calculate the minimum window width:

$$Ws = 18 - (0.389 \times 8 \times 3) = 18 - 9.34 = 8.66 \text{ inches}$$

Minimum Window Width Required = 8.66 inches

Inspection Window Design Requirements

The inspection Window Assembly Materials Must:

1. Comply with the testing standard requirements for flammability, impact and load.
2. Comply with the OEM specifications for materials and color

The inspection Window Lens Cover Must:

1. Be attached to the window and not be removable to prevent the cover from being lost or misplaced.
2. Have a normal position of cover that is closed for a fixed and guarded condition.
3. Be lockable as an available option
4. Optional locking cover shall be made of the same material that holds the IR lens material in place.

The inspection Window Lens Materials Must:

1. Withstand **all** impact and load test requirements **with the cover open**
2. Have a fixed and stable transmission rate for the life of the unit
3. Transmit in the infrared, visual and ultraviolet wavelengths
4. Have an IR transmission Midwave and Longwave infrared ranges (3 – 12 microns)
5. Withstand prolonged exposure to vibration without cracking or degrading
6. Withstand prolonged exposure to direct sunlight without degrading
7. Not absorb moisture such as water (i.e. non-hygroscopic)
8. Be of an IP2X failsafe design
9. Be able to withstand temperatures up to 250 °C (482 °F)
10. Be resistant to light acids, alkalis, and water
11. Be non-carcinogenic and non-toxic and must not contain arsenic, barium, bromine, cadmium, chlorine, gallium, germanium, iodine, lead, lithium, mercury, selenium, sulfur, thallium, or zinc.

Inspection Window Certification Requirements

All inspection window must have all relevant certifications for the following:

1. UL 50V standard for Infrared Viewports
2. Environmental certifications
 - a. UL 50E Environmental Testing
 - b. IP Ratings
 - c. NEMA Ratings
3. UL945VA Flammability Testing
4. Impact and load test with covers removed per
 - a. ANSI UL 508A
 - b. IEEE C37 20.2 section a.3.6
 - c. UL 1558
 - d. UL 746C
 - e. CSA C22.2 No. 14-10 (for Canada)
5. Marine Certification Requirements
 - a. Lloyds of London Type Approval
 - b. American Bureau of Shipping (ABS)
 - c. Det Norske Veritas (DNV)

Performance Specification

- (1) Temperature
 - a. Must be able to operate in ambient environments up to 100°C (212°F) in line with hot surface working regulations
- (2) Arc Containment Testing
 - a. Tested for compliance to IEC 62271-200 for metalclad switchgear
 - b. Tested for compliance IEEE C37.20.7 Type 2B for Arc Resistant Switchgear
- (3) Infrared Lens Transmission Rate
 - a. Must have a fixed and stable transmission rate over their entire operating life
- (4) Inspection Equipment Compatibility
 - a. Must be useable with all makes and models of focusable IR cameras including cameras with dual visual digital and IR capabilities
 - b. Must have visual inspection capability
 - c. Must be compatible with all makes of Ultraviolet cameras
 - d. All provisions for ultrasound and partial discharge testing must be IP2X compliant

Warranty

Inspection Windows shall carry a lifetime **unconditional** warranty. inspection Window manufacturer shall repair or replace any inspection Window, or component thereof, with the same or next generation model, if the product has ceased to perform to the end user's expectations for any reason.

- (1) Term of Warranty: Lifetime
- (2) Exemptions Under Warranty: None
- (3) Products shall be eligible for replacement as long as they are used within specifications, and for intended use.