

Thermography in Transformer and Motor Connection Boxes in Compliance with NR10 and NBR15572 Standards – Rev.4

This article exclusively addresses safety issues related to thermographic inspection of electrical connections of motors / generators and transformers, as well as oil leaks from bushings and the difficulties in carrying out such inspections.

The inspection of motor, generator and transformer connection boxes has evolved a lot, soon we will announce a great partnership in this market.

Thermography and visual inspection of the terminal box bushings, due to the constructive process of the transformers, are practically impossible to carry out.

Usually the terminal boxes of these assets have very heavy covers, many screws, they are heavy, usually installed in high positions, and due to this, removing these covers to perform the thermography is totally unsafe.

To perform safely, a small scaffold must be installed and the transformer disconnected when removing the cover, which is totally unfeasible.

Thus, as we have always emphasized in all the articles we have already published, item 10.2.1.1 presents the essence of all the recommendations contained in NR10.

“All parts of electrical installations must be designed and executed in such a way that it is possible to prevent, by safe means, the dangers of electric shock and all other types of accidents.”

As the engine/generator and transformer covers were designed to be opened only with the equipment de-energized, the installation of the Safety Windows for thermographic inspection complies with the provisions of the NR10 and standards.

On the other hand, the incidence of defects in these terminal boxes is not very high, however, there is a history that varies from 0 to 0.25% of the hot spots found in an operational unit.

As this equipment is large, the losses resulting from accidents are very high and directly impact the financial results of companies.

Recommendation of NBR15572 - Non-destructive tests — Thermography — Guide for inspection of electrical and mechanical equipmen.

Paragraphs 8.4; 10.3.2 and 10.3.3 of NBR15572 present the standardization of the use of windows in thermography in Brazil.

8.4 Direct observation of the component to be evaluated is recommended, without placing any barriers between it and the thermographic camera (with the exception of the infrared windows, which are devices that are transparent to the infrared). When this is not possible, consider the relevant implications. (...)

10.3.2 *In the case of powered panels that cannot be opened for safety or operational reasons, it is recommended to install infrared windows with proper positioning.*

10.3.3 In the presence of an IR window, and for cameras that do not have an offset setting, use the product of the component's emissivity times the transmittance of the window as the target emissivity..

The use of safety windows has revolutionized the inspection of motor/generator terminal boxes, as well as oil/dry transformers, they make the thermography of connections quick and safe.

Visual and thermographic inspection of oil and dry transformer connection boxes.

Visual inspection of oil-filled transformer terminal boxes can be done safely by installing crystal thermographic inspection windows - polycarbonate cover, and, with the aid of a flashlight, visualize the entire interior of the terminal box.

The photos in the sequence show examples of oil leaks in bushings of two transformers, identified in the same inspection, in the same customer.



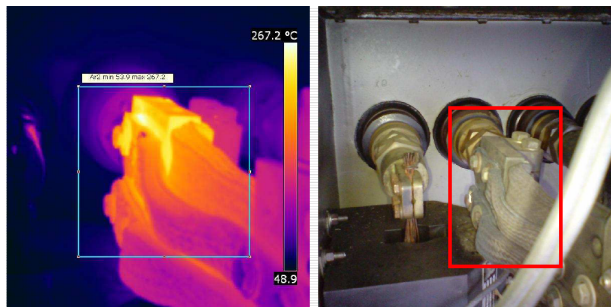
Examples of leaks in transformer bushings – inspection possible through windows with polycarbonate lids and glass lens (Images from JIT Brasil file).

Perhaps, poor electrical contact is the most serious problem that these assets present in a thermographic inspection.

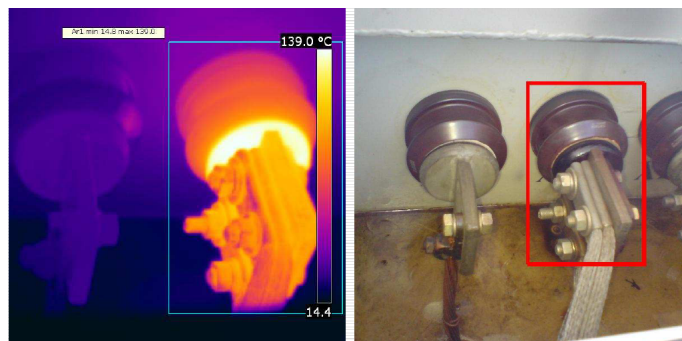
This problem is very common and is observed in all types of transformers (oil and dry).

The figures below show thermograms of defects identified in oil-filled transformer connections.

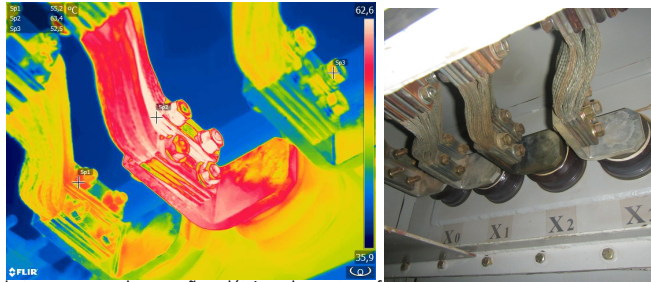
Problems with transformers are very serious and can stop an entire operating unit, since all power to the assets passes through them, and as far as we are aware there are no reserves ready for delivery.



Example of thermogram of electrical connections of a transformer (archive images from JIT Brazil).



Example of a thermogram of the electrical connections of a transformer with poor electrical contact in the internal connections and the photograph reveals a problem with a leak in the bushing that was overheating (archive images from JIT Brasil).



Exemplo de termograma de conexões elétricas de um transformador com mal contato elétrico nas conexões externas (imagens de arquivo da JIT Brasil).

The following figure shows an example of the installation of a thermographic inspection window in an oil transformer, as can be seen, depending on the size of the box, one to three thermographic windows are required for the primary and secondary transformers.

Advantages of installing Safety Windows for Thermographic Inspection



Exemplos de Janelas de segurança para inspeção termográfica instaladas na caixa de ligação dos transformadores (imagens do arquivo da JIT Brasil)

In recent years, the number of dry-insulated transformer applications has grown significantly, and accidents have in the same proportion.

As the name implies: an accident is something that happens in an uncontrolled and apparently unpredictable way, but thermography is a predictive tool that, if well applied, can reduce lack of control and unpredictability.

The photograph in the sequence shows an example of a dry transformer damaged as a result of a fire, where it was not inspected by thermography.



Dry insulation transformers damaged as a result of short circuit – without thermography (Image from JIT Brazil archive).

The photographs below show an example of thermographic inspection windows installed in a dry transformer. In this case, the number of windows will vary, depending on whether the customer wants to inspect the transformer closing connections.



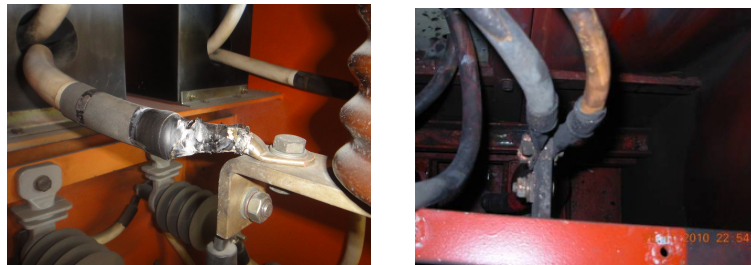
Example of thermographic windows installed in a dry transformer aligned with the internal connections (Images from the JIT Brasil archive).

Installation of Safety Windows in Motor/Generator Connection Boxes.

Accidents with engine/generator connection boxes are more frequent than you might think, and material damage/accident risks are also very high.

All these accidents could be avoided with frequent thermographic inspection, however, removing the terminal box covers with the motors energized is a high-risk activity and should not be done.

The example in the photos below shows evidence of damaged terminals and cables in the motor boxes.

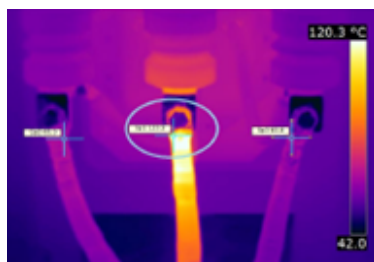


Examples of damaged terminals in motor terminal boxes
(images from the JIT Brasil file).

Thermography, without a doubt, is the best tool for predictive inspection of electrical motor / generator junction boxes. However, most companies do not carry out any thermographic inspection of these assets, due to the risk of accidents in carrying out.

According to our own experience, with numerous surveys carried out in the field, 35% of electrical assets - including high voltage cubicles and panels, motor / generator and transformer connection boxes, are not inspected, and 100% of motors and transformers are not inspected. are inspected by thermography.

The Figures below show a hot spot on a terminal in the connection box of an electric motor at 120.3°C. The cost of repairing this engine alone would be enough to pay for all the windows to be installed in this operating unit.





Example of a thermogram with a hot spot in an electric motor connection box, and an open box for repair (images from the JIT Brasil file).

JIT Brasil was a pioneer in Brazil in the application of Windows in connection boxes for electric motors/generators and transformers of any power and voltage level. The windows can safely be applied to any power and supply voltage.

Thermographic inspection windows are low cost and do not require any specialist to assemble them.

The following photos show some examples of engines with installed windows.



Examples of thermographic window installation in electric motors (images from the JIT Brasil file).

To install on motor connection box covers, care must be taken to prepare the surface of the cover, mainly removing embossed marks.



Examples of installation on terminal box covers for motors of various powers. (Image from JIT Brasil file)

Examples of installation in connection boxes and barrel ducts of medium and large generators.

Generating companies are increasingly adopting thermographic windows in the barrel region of generators and other associated assets up to the generator output transformer. Also in the case of PCHs, the number of companies that began to see the need for inspection of this equipment to reduce the fixed staff in the maintenance and operation of these assets is increasing.



Example of PCH generators with windows installed in the generator connection boxes (Image from JIT Brasil file).



Example of installed windows for internal inspection of Barrel generator and pipeline connections (Image from JIT Brasil file).



Advantages of installing Safety Windows for Thermographic Inspection

- Reduction of Operational and Occupational risks.
- Increased Operational Reliability.
- 20 to 30% increase in time between failures (MTBF).
- 30 to 50% reduction in repair time (MTTR).
- 70% reduction in thermographic inspection time.
- Reduction in the cost of corrective maintenance.
- It is known that Corrective Cost = 20 x Predictive Cost = 5 x Preventive Cost.
- Reduction of corrective maintenance time.
- it is known that Corrective Time = 12 x Predictive Time = 6 x Preventive Time.
- Reduction in the cost of spare materials.
- Fewer overtime hours.
- Smaller stock of spare materials.
- Direct cost reduction of the value of the company's insurance policy.

*In addition to the advantages listed above, Security Windows contribute to reducing the **Company's Carbon Footprint**.*

A lower number of catastrophic breakdowns and consumption of spare parts generate, as a direct consequence, less use of raw materials, inputs and energy for the manufacture of spare parts

In addition to greater productivity - increased processing capacity without investing in new plants, lower consumption of inputs and energy.

Vantagens exclusivas da JIT Brasil

- ❖ Assistance to customers in the preparation of a draft for counting windows and installation points. No cost to the customer.
- ❖ Turney Key Projects - in case the client does not have a team for the installation.
- ❖ Customized windows according to customer demand. Example: large rectifier rooms.
- ❖ Only manufacturer in Brazil - Design and Manufacture.

Bibliographic references:

1. NR10 - Safety in Electricity Installations and Services.
2. NBR15572 - Non-destructive tests — Thermography — Guide for inspection of electrical and mechanical equipment.