

AUSTRALIAN PROFESSIONAL THERMOGRAPHY ASSOCIATION INC. EST. 2011

There's more to Thermography than meets the eye.

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SCOPE OF WORK - ELECTRICAL THERMOGRAPHY

INSPECTION AND REPORTING OF EXCEPTION ITEMS

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Overview

The intention of this Scope of Work is to provide a reference for the client of a thermography service provider to better understand what is involved in carrying out an effective thermal inspection of electrical infrastructure.

The purpose of a thermal inspection is to identify and document apparent temperature anomalies or exception items, including those exceeding normal operating parameters. This includes, and is not limited to, high resistance electrical connections, current overload, faulty components and/or devices that have an internal defect.

The Thermographer

The Thermographer should be, as a minimum:

- Certified (not just trained) to a minimum Category 1 level in accordance with AS/ISO18436-7 "Condition monitoring and diagnostics of machines - Requirements for qualification and assessment of personnel Part 7: Thermography "1
- ✓ A licensed electrician; or
- \checkmark A technician accompanied by a licensed electrician; or
- ✓ A technician with training and experience to be competent in the removal and refitting of escutcheons on live electrical boards as well as having knowledge and understanding of the components which are inspected in both normal and abnormal conditions.

The Infrared Camera

To be suitable for electrical inspections the infrared camera:

✓ Must be able to record thermal images.



- ✓ Should have a minimum 320 x 240 matrix detector. This resolution is recommended to be able to identify faults on small electrical components.
- ✓ Should have the ability to manually focus the thermal image.
- ✓ Should preferably have a temperature range of up to 250°C.
- Should include a built-in visual (digital) camera to record visual images corresponding to thermal images. This camera should have sufficient low-light sensitivity and resolution to produce images that are suitably detailed to assist in identification of components. Alternatively, a separate digital camera should be used to record visual images for the report.
- ✓ Is preferable to have the ability to change the camera lens (and subsequently field of view, or "FOV") to cater for different types of inspections. Normal (e.g. 24°), narrow View (e.g. 7-12°) and wide angle (e.g. 40-45°).

The Inspection

A thorough and comprehensive Job Safety Analysis (JSA) and/or Safe Work Method Statement (SWMS) must be completed prior to the inspection, which would also include any specific site requirements. The inspection must follow the procedures written in the JSA/SWMS. The JSA/SWMS should also include due consideration for local/state based licensing/safe work regulations, and AS4836:2023 "Safe Work on or Near Energised Low and Extra Low Voltage Electrical Installations".

The inspection is performed when the site is operating under normal operating conditions and electrical loads. This ensures the best conditions for the detection of temperature anomalies (exceptions). Where possible, load shall be applied to a circuit or equipment which is not running at the time of the inspection, such as lighting in car parks during day light hours etc.

- A factory's mechanical loads will change with seasonal variation such as air conditioning in summer, and heating in winter.
- HVAC load in a large commercial building may account for approximately 30% of the total building load during warm weather. Inspections on chilled water plant and associated ancillary equipment and supplies should be undertaken during warm weather. Conversely load on electric heating ("VAV" or "electric duct" heaters) will be almost completely absent during warm weather and this equipment should be inspected during cooler months.



- A residential dwelling's loads may be higher in the early morning or late afternoon/early evening, depending on the occupant's situation, or higher when air conditioning/heating and white goods are running.
- In any case, any electrical load provided from other sources than the grid should be documented.
 Solar PV and other secondary supply can have a major influence on the load on the supply main switches/circuit breakers.

Infrared energy is detected on surfaces. It is not transmitted through acrylic (clear or opaque) or metal covers. Where safe to do so, switchboard covers are to be removed from switchboards to expose internal components.

Subject to the client's actual site requirements, the Thermal Inspection should include, and not be limited to, the following items:

- ✓ HV/LV supply Transformers; points of Attachment (external inspection).
- ✓ PV Solar supply and other secondary supply (PV panels and DBs).
- ✓ Main switchboards; bus bar and cable zones; power factor correction units.
- ✓ Metering and link boxes; distribution & sub-distribution boards; fuse panels.
- Standby power sources generator and automatic transfer switches (under load); batteries and UPS panels.
- ✓ Riser fuse boxes; mechanical services switchboards (MSSBs); chilled water plant, HVAC control panels, lift switchboards and control panels; tee-off boxes.
- ✓ Motor control centres (MCCs); variable speed drives (VSDs) PLC panels; pump control panels.
- \checkmark Any other critical plant or equipment as assessed by the client

The Thermal Inspection of these items should include, and not be limited to, the following components:

- ✓ Incoming supply; main and submain switches.
- ✓ Bus bars and cabling.
- ✓ Isolators, circuit breakers, RCDs/ELCBs/RCBOs; fuses and connections.
- ✓ Contactors & overloads; relays and PLC I/O blocks.
- ✓ Active, neutral, earth links and terminals.



- ✓ Voltage Transformers.
- ✓ Capacitors and shunt transformers in power factor correction units.
- ✓ Various other components and circuit wiring within the panels.
- All exception items are recorded with a thermal and visual Image. Field notes should include: location and name of panel; and description of the component and exception item with relevant comments

Serious faults are to be brought to the immediate attention of the client, and a list of all exception items should be provided and/or discussed with the client at the end of the inspection or at the end of each day.

The Report

The Thermal Imaging Survey/Inspection report shall contain a covering page showing:

- \checkmark Site location and date of inspection.
- ✓ Recipient's name and contact details.
- ✓ Thermographer's name, contact details, certification level and certification number.
- ✓ Other details as may be applicable.

From ISO 18434.1: "Condition monitoring and diagnostics of machines - Thermography - General procedures" The thermographer shall provide reports for all infrared inspections. Unless otherwise agreed with the customer, the report shall contain, but not be limited to, the following information:

- a) the name of each thermographer;
- b) the qualification of each thermographer;
- c) the name and address of the customer;
- d) the name of each assistant accompanying the infrared thermographer during inspection, if applicable;
- e) the manufacturer, model and date of calibration for the infrared equipment used;

f) a list of all the equipment to be inspected and notations of the equipment from the list that was not inspected;

- g) details of all thermal anomalies detected;
- *h*) details of the operating and environmental conditions for each machine at the time of inspection;
- i) the date(s) and time(s) of the inspection(s);
- j) the date when the report was prepared.

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- When performing a qualitative infrared inspection, the thermographer should provide the following information for each anomaly identified:

k) the exact location of each anomaly;

I) a description of each anomaly;

m) details of any attenuating media;

n) when significant, the environmental conditions surrounding the anomaly; e.g. the air temperature, wind speed, wind direction and the weather conditions;

o) hardcopies of thermogram(s) of the anomaly(-ies) and corresponding visible-light image(s);

p) details of any windows, filters or external optics used;

q) an evaluation rating or a statement of the importance of the anomaly to the safe and continuous operation of the system;

r) reference to, or statement of, the assessment criteria used;

s) any other information or special conditions that may affect the results, repeatability or interpretation of the anomaly.

- When performing a quantitative infrared inspection, the thermographer should provide the following additional information:

t) the distance from the IRT camera to the anomaly;

u) whenever possible, the maximum rated load of the item and its measured load at the time of the inspection;

v) the emissivity, reflected apparent temperature and transmission values used to calculate temperatures; w) when using ΔT criteria, the surface temperature of the item, the temperature of a defined reference, and their relative temperature difference.

In addition to the above technical content the report should also contain a notation of any unsafe conditions or practices observed and actions undertaken.

The report shall have a summary table of exception items.

Each thermal image reporting page shall contain the following:

- ✓ Name and location of panel/switchboard.
- \checkmark A thermal Image of the item and a digital visual image of the item.
- ✓ Component identification.
- ✓ A description of the condition.
- ✓ Apparent temperature indications of the item and if needed a reference temperature.



- \checkmark A temperature scale for the image to give an indication of surrounding temperatures.
- ✓ Comments on repair and recommended priority level for repair.
- ✓ The report shall include a statement which describes how repair priorities are determined:
- Priority levels are usually based on a description or numbering system. Generally, this will range from a low priority (e.g. # 5) which may be "continue to monitor" or "review at next inspection" through to urgent or the highest priority (e.g. # 1) which may require a shut down for repairs to be carried out immediately.

When establishing priorities, thermographers shall consider the following:

- ✓ The hotspot/anomaly temperature; and
- ✓ A relevant reference temperature (and subsequent temperature differential or "delta T"); and
- ✓ The ambient temperature; and
- \checkmark The electrical load at the time and the visual condition.

The report shall also include a list of all the items inspected including those which were not able to be inspected, for whatever reason.

The report shall be available in soft copy, and hard copy as/when requested by the client.

Responsibilities

The Thermographer shall:

- \checkmark Perform the inspection, in accordance with safety requirements; and
- \checkmark At a time when environmental and physical conditions favour the gathering of accurate data; and
- ✓ Have sufficient knowledge of the equipment to interpret the infrared images in both normal and abnormal conditions or be accompanied by a person with such technical and relevant safety knowledge.

The Client shall:

- ✓ Provide or assist in the development of a list of all equipment to be inspected; and
- ✓ Provide authorization and access to the equipment to be inspected; and
- ✓ Provide all necessary inductions and site safety information; and



✓ Provide where possible, the equipment operating under load for sufficient time to ensure optimum stable conditions for inspection.

¹"Certified (not just trained) to a minimum Category 1 to AS/ISO18436-7 Condition monitoring and diagnostics of machines -Requirements for qualification and assessment of personnel Part 7: Thermography" means

3rd party certified, after minimum 32 hours approved training and a passed training exam, followed by passing a 3rd party exam and proof of minimum 1 year of continued Thermography field experience.

Disclaimer: This document is presented as a guide. While AUSPTA has attempted to be thorough and comprehensive, it is based on generic content and format. It is recommended that the client and the thermography services provider give due consideration to any additional requirements to meet specific site needs. For further information please contact the Australian Professional Thermography Association by email: admin@auspta.asn.au

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