Loss prevention standards

Thermographic Surveys

As part of a proactive risk management programme, thermographic surveys can help identify potential electrical faults and ignition sources before an incident occurs.

Thermographic Surveys

Introduction

A structured and comprehensive thermographic survey programme, with proactive risk management, planned servicing and preventative maintenance, can reduce equipment and machinery failures along with the number of potential ignition sources. This can result in reduced costs and business losses, whilst improving the overall standard of risk management.

Harnessing the Power of Thermography

Electrical systems are at the heart of every business and functional building. Without it, or part of it, an integrated system or piece of equipment will probably be unable to operate. In addition, electrical faults are one of the primary causes of fires, applying equally to newly installed and older items of equipment. Anything that can improve electrical reliability and reduce the number of potential ignition sources is a powerful tool to utilise. As part of a broader joined up electrical and mechanical maintenance regime, thermographic surveys are one such tool that Aviva recommends for all sites.

Thermographic surveys can detect a wide range of defects and are an important part of any planned maintenance programme, not simply as a replacement for electrical testing and inspection services in respect of fixed wiring or portable appliances for example. Thermography is a non-invasive and non-destructive test (NDT) procedure that uses infrared technology to identify excessive temperature increases (hot spots that are usually invisible to the naked eye) caused by factors such as electrical faults, overloaded circuits, friction, under-rated equipment, loose connections and poor terminations.

What are the Risks?

An electrical fire has the potential to affect not just the equipment directly, but also any immediately adjacent, the wider building, the operation within, the supply chain and infrastructure network. Then, there's the impact of smoke damage and contamination, or worse, the fire spreading to adjacent combustible materials or construction.

Particular risks include:

- Older electrical installations where age-related failure rates can increase with time
- New electrical installations, which may not have been completed correctly or accepted appropriately
- Critical equipment, which is not duplicated (in separate fire compartments/buildings) or is exposed by non-critical equipment
- Where equipment/plant is located in remote or unoccupied premises, etc.

The business impact can be severe, and wider than first thought. Access to replace the damaged equipment may be difficult and the equipment or components may have a long lead-time. This can mean increased costs, delays in replacing key equipment and machinery, and a long period of business interruption. This emphasises the need to have robust, planned, preventative maintenance programmes and business continuity plans, to help reduce the risks.

The Business Benefits of Thermography

Aside from the direct impact of preventing a fire, there are wide-ranging benefits and savings of a strong maintenance programme that includes comprehensive thermography, such as:

- Provides improved reliability and greater availability of equipment, with less breakdowns and failures
- Reduces unwanted outages and unscheduled downtime. Equipment is repaired before it fails, damages or destroys itself or adjacent items – tests can be undertaken while the equipment is in use
- Reduces the impact on maintenance employees to react, providing a safer work environment
- Improves planning, effectiveness and availability of resource. Tasks can be planned and grouped for efficiencies – particularly for unoccupied or limited occupancy sites, etc.
- Reduces costs associated with immediate repair, out of hours response and emergency repair bills, etc. There are fewer costly (capital and business interruption) emergency situations
- Helps smooth spares' inventory and management as they are used in a more planned and scheduled environment
- Unforeseen reactive/breakdown repairs are less likely to occur, for unoccupied or limited occupancy sites, where a quick or immediate response to site is normally needed. This can help reduce the exposure to Liability and Motor Fleet risks. There is less of a need to dash to a site at any time of the day or night

How Does Thermography Work?

Thermal images produced by the thermographic camera software are visual displays of the amount of infrared radiation emitted, transmitted and reflected by an object(s). The object under inspection and its surrounding areas emit multiple infrared radiations in varying wavelengths and temperatures, which makes obtaining an accurate temperature of the object difficult. Therefore, the infrared camera software interprets the data and builds an image by using the multiple data sources received from the surrounding areas, to determine the approximate temperature of the object under scrutiny.

Infrared radiation in varying wavelengths is emitted from objects that have a temperature above -270^{o}C. By monitoring the levels of varying heat emitted via an infrared detector/camera, and with the results interpreted by an appropriately trained operator, the infrared equipment can identify most faults before a machinery/equipment failure or potential fire.

The majority of equipment using power will experience an increase in temperature prior to failure. Thermographic inspections can be used to survey:

• Electrical systems • Mechanical systems • Buildings • Mobile plant • Storage (rising temperature) • Insulated systems and poor insulation	• Hot or cold circuits: to measure heat loss or gain • Over heating • Corrosion • Cracks in materials or to detect metal fatigue • Fluid systems; water, liquid and gas leakages

Thermographic Cameras

There are numerous different thermographic cameras available, but in general the higher the image definition and the larger the format, the better the camera image. For example, cameras having a 640 by 480 resolution is one of the highest available for commercial use by trained and certificated thermographic surveyors. Cameras with lower resolutions will provide lower quality images, which may lead to mistakes in identifying defects.

Training Standards

A thermographic survey is of limited value if the equipment is not appropriate or it is in untrained hands. It is essential that the electrical engineers completing the thermographic survey are fully trained, competent in using the equipment and certificated. This should be by an internationally accredited certification body such as ISO 18436-7, which specifies the requirements for qualification and assessment of people who perform machinery and condition monitoring and diagnostics using infrared thermography.

The engineers should achieve a recognised Personnel Certification to at least Level 2. Although there are three levels of qualification, Level 2 is generally considered the minimum required for undertaking a survey. Ideally the engineer should also have an understanding of equipment and component failure mechanisms, general property and equipment loss prevention, the threat or exposure to the business from equipment failure, and a wider understanding to be able to interpret the potential impact of an incident in that area.

Thermographic Surveys

For a thermographic survey to provide the most benefit, the item being tested should be at as high a loading as possible, as the test should be able to then identify any problems with the equipment which may otherwise go unnoticed. There is normally little value in testing it cold, or at half load, as hot spots may not be apparent when the equipment is not operating as intended.

A wide range of equipment, machinery and plant can be surveyed, for example:

• High and low voltage systems • Electrical distribution fuse boards • Switchgears and switchboards • Rectifiers • Control panels • Cable and bus bar systems • Lighting systems and fittings • Transformers • UPS/battery systems • Motors • Mobile plant • Trace heating and insulation	• Conveyor belts and moving surfaces • Bearings • Boilers and heaters • Pumps and compressors • Friction hot spots • Process valves • Pipeline flows and integrity • Storage tank integrity • Efficiency of insulation • Storage; changes in temperature • Room or building heat loss; temperature profiles, etc.

Risk Assessments

A risk assessment of all equipment, machinery or plant, based on actual experience or manufacturer's recommendations, should be completed. The risk assessment should focus on three key exposures:

- Its importance to the business if lost or down, and for how long – its business impact
- Its value
- If it catches fire, what it exposes, e. g. combustible occupancy or construction

This will help identify the most critical or exposed equipment, allowing these to be graded in importance to the operation. There should also be a focus on learning from experience and from the type of equipment in use, as this will help decide the schedule of inspections.

Once a thermographic inspection programme is in place, and after a number have been completed, the findings/reports can be compared to help build a record of the equipment and plant performance over time, enabling any trends to be identified.

In each case, a completion certificate and written report needs to be issued. The report should record the date of inspection, name of inspector, equipment inspected, together with the camera images, condition of equipment, what action is required and details of when the follow-up work is completed.

If the survey isn't carried out by a trained in-house resource, it is recommended that several quotations are obtained from specialist electrical companies/contractors making clear the purpose of the survey, the required timescales, and the equipment, machinery and plant, etc. that needs to be included in the survey. Examples of the reports provided by the specialist electrical companies/contractors should be supplied with the quotations.

Inspection Intervals

Thermographic surveys should be completed at every site, covering all equipment, machinery and plant, at least annually. However, these may need to be more frequent where there is a high risk due to business-critical equipment, a higher potential cost of failure to the organisation, or where items have been identified either by risk assessment, actual experience or from manufacturer's own recommendations.

The results of the surveys from specific areas of the site or equipment should be trended and compared to previous survey results. Methods of surveys, parameters and settings should be consistent to allow appropriate trend analysis. If repeated surveys show a trend that is not improving, then the frequency should be increased. If repeated surveys show no issues, then the frequency can be extended to, for example, every 18 months initially, and then after subsequent visits out to every two years. Changes to the frequency period should be based on learnings and trends.

If an appropriately trained in-house provision is in place, this should be benchmarked against an appropriately trained third party survey every three years, ensuring the in-house capability is competent and suitable.

Thermographic surveys should be completed on new electrical installations as soon as possible after the installation, and within the warranty period. This will help highlight any issues, enabling them to be resolved under the warranty.

If a business purchases a thermographic imaging camera not to perform formal thermographic surveys but to help assist with their general preventative maintenance, this can add an immense amount of value. However, this approach should not be confused with, or used to replace, a formal thermographic survey.

Checklist

A Thermographic Survey Checklist in Appendix 1 can be tailored to your own organisation.

Specialist Partner Solutions

Aviva Risk Management Solutions can offer access to a wide range of risk management products and services via our network of Specialist Partners who are reputable companies offering agreed discounted rates for Aviva customers.

For more information please visit:

Aviva Risk Management Solutions – Specialist Partners

Additional Information

Relevant Aviva Loss Prevention Standards include:

- Hot Work Operations

To find out more, please visit Aviva Risk Management Solutions or speak to one of our advisors.

Email us at riskadvice@aviva.com or call 0345 366 6666.*

*Calls may be recorded and/or monitored for our joint protection.

Appendix 1 - Thermographic Survey Checklist

Location	
Date	
Completed by (name and signature)	

	Thermographic Survey Checklist	Y/N	Comments
1.	Is there a planned and predictive maintenance regime in place?		
2.	Have you had a comprehensive fixed wiring test and inspection, and if so when was it last completed?		
3.	Do you have a formal portable appliance test programme? • Does this include new items before they are used? • Are all items without an up to date test withdrawn from use?		
4.	Is there a comprehensive asset register which identifies all equipment?		
5.	Have formal risk assessments of the equipment been completed, including their: • Business impact? • Value? • Exposure to surrounding occupancy?		
6.	Are all maintenance records maintained and trends established for failures and equipment incidents?		
7.	Has a thermographic survey recently been completed?		
8.	Is a thermographic survey completed at least annually for all areas of the site?		
9.	Is the thermographic survey completed by an appropriately trained person?		
10.	Is the thermographic survey completed in-house or by a third-party provider?		

	Thermographic Survey Checklist Contd.	Y/N	Comments
11.	If in-house, has this survey been benchmarked by a third-party provider in the last three years?		
12.	Are findings from the survey tracked through to completion? Have all findings from the last survey been completed?		
13.	Is the thermographic survey completed when the site is at full load?		
14.	Have any new electrical installations been installed since the last thermographic survey or are any planned in the next 12 months? If so, include these in the next survey.		
15.	If there are major projects planned on site is a thermographic survey included as part of the final project handover?		
16.	Are repeated thermographic surveys trended?		
17.	Are findings and learning from thermographic surveys shared within the wider company or group?		
18.	Additional comments:		

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23/07/20 V2.0

LOSS PREVENTION STANDARDS