Loss Prevention Standards

Electrical Installations – Inspection and Testing

Introduction

Electricity is something generally taken for granted and not given much consideration unless something stops working as expected.

Electricity, however, is the second largest cause of fires in commercial and industrial premises in the UK. Poor connections can give rise to arcing, which can easily cause ignition. Insulation failure may occur when the cables or equipment are affected by heat or dampness, causing currents to track across the live phases resulting in high temperatures being produced which can lead to fires and/or injury. It is important that electrical systems are properly installed and maintained on a regular basis to prevent, as far as is reasonably practicable, possible danger arising.

Almost all buildings will have some form of electrical installation. Typically, a fixed electrical wiring installation will comprise the main supply intake, meter, transformers, switchgear, distribution boards, control panels along with circuits supplying power sockets and lighting. Regulations place duties on organisations and individuals who own, operate or have control over such equipment, to ensure, amongst other things, that the equipment is safe and suitable for the use intended. The quality of maintenance is a significant factor affecting safety and operational costs, and an effective maintenance programme will ensure the electrical installation is ultimately more reliable.

Regulations

The specific legal requirement to maintain fixed electrical installations comes from the Electricity at Work Regulations 1989 (EAWR) which lays out the laws in relation to the use of electricity within the UK. The EAWR is very high-level and does not go into a lot of detail but requires, in Regulation 4: '*As may be necessary to prevent danger, all systems shall be maintained so as to prevent, so far as is reasonably practicable, such danger*'. Due to the high-level nature of this legislation other documents are used in a court of law to demonstrate compliance, and these include:

- BS 7671: 2018 Requirements for Electrical Installations; British Standards Institution (BSI) and The Institution of Engineering and Technology (IET)
  Note: The 18th Edition of the IET Wiring Regulations came into effect on 1st January 2019
- IET Guidance Notes, including Guidance Note 3: Inspection & Testing
- IET On-Site Guide (provides practical information on applying the requirements of BS 7671)
- IET Code of Practice for In-service Inspection and Testing of Electrical Equipment

Therefore 100% compliance would mean compliance with all the above documents including EAWR, and a summary of a typical comprehensive compliance strategy is listed below:

1. Design and installation

- Compliant design of an installation (compliant with BS 7671)
- Compliant installation of electrical cables and equipment (compliant with BS 7671 and On-Site Guide)

2. Initial verification

- Initial verification as required in BS 7671 consists of 100% testing of 100% of the circuits and cables and is done before the system is handed over to the client/landlord
- An Electrical Installation Certificate (EIC) is produced confirming the installation is compliant at the point of installation
- Initial verification done throughout installation process and at final commissioning, e.g. cables are tested (i.e. Insulation Resistance and Continuity) after 1st fix before appliances are connected. Other tests are done only after energisation of the system and at final commissioning

3. **Planned preventative maintenance programme (including remedial repairs)**
   - Any defects identified should be fixed to ensure safety and compliance

4. **Portable appliance testing (PAT)**
   - Any defective items should be removed or replaced in line with the Code of Practice for In-service Inspection and Testing of Electrical Equipment

5. **Routine checks as detailed in Guidance Note 3**
   - Usually done in-house, this is a visual inspection of the electrical installation on an ongoing basis to identify obvious defects that may have arose since installation and initial verification
   - Any defects identified should be fixed to ensure safety and compliance

6. **Periodic inspection and testing to ensure compliance with BS 7671 and Guidance Note 3 - an Electrical Installation Condition Report (EICR) is produced**
   - You don't have to do all the tests, on all the circuits all the time. The percentage of testing can vary depending on the condition of the installation, extent of maintenance and previous records:

     '*the inspector must be familiar with setting both inspection and testing sample sizes, as carrying out 100% inspection and testing in many installations is unrealistic, uneconomical and unachievable*' (Guidance Note 3: 3.8.4)

   - Isolation from the supply to carry out some tests may not always be practical. This is particularly true where continuity of supply has health implications, as may be the case in hospitals and similar premises, or financial implications, as may be the case in banks, share-dealing and commodities markets and the like. Nevertheless, it remains necessary to confirm the continuing suitability of such installations for use. They must still be subject to Planned and Preventative Maintenance (PPM) or regular periodic assessment of their condition. In the case of an installation under an effective management system for preventative maintenance in normal use, periodic inspection and testing may be replaced by an adequate regime of continuous monitoring and maintenance of the installation and all its constituent equipment, by one or more skilled persons competent in such work. This may include Thermal Imaging (see below). Appropriate records must be kept

The EICR will record details of the inspection and testing carried out along with any defects, dangerous conditions or non-compliances. Any observations noted which require attention are coded according to their risk level, i.e.:

- C1 - Danger present and risk of injury. Immediate remedial action required
- C2 – Potentially dangerous. Urgent remedial action required
- C3 – Improvement recommended
- F1 - Further investigation required without delay

- Guidance of setting periodic inspection and testing samples can be found in Guidance Note 3 (Table 3.3):
  - Main switchgear external inspection: 100%
  - Main switchgear internal sections and cable terminations: 100% where practicable but not less than 20% and adjusted upwards if necessary, depending upon the results obtained
  - Main switchgear internal inspection of circuit breaker connections and control sections: ideally 100% but not less than 20% and adjusted upwards if necessary, depending upon the results obtained
  - Final circuit distribution boards: ideally 100% but not less than 25% (sample must be representative)
  - Final circuit accessories: 10%-100%. Less appropriate to apply small sample size to sockets compared to say lighting, as there is more risk from 'user equipment'. **100% of accessible socket outlets is therefore suggested, socket outlets being the point where people interact with the electrical system and so possess most risk**

Setting Inspection and Testing Samples

All inspection and testing should be fully documented. If there are no, or limited records of historical compliance as above, it is always recommended that clients have a **100% full test to create a base line,** following which they can then move to a sample-based programme. It is up to the duty holder to decide how often and how much inspection and testing is required, the main reason for this is the term 'reasonably practicable', as outlined within Regulation 4 of the EAWR, the duty holder has to maintain equipment in a safe manner 'so far as reasonably practicable'. This could mean they have a reasonable plan to achieve compliance over a period of time.

Reasonably Practicable

Generally, you should do everything 'reasonably practicable' to protect people from harm. This means balancing the level of risk against the measures needed to control the real risk in terms of money, time or trouble. However, you do not need to take action if it would be grossly disproportionate to the level of risk.

If the duty holder decides they want to do additional PPM and less intrusive testing, they could still demonstrate compliance, and equally if the duty holder decides it's not reasonably practicable to do some of the testing, that's their prerogative. However, they may find it difficult to justify in a court of law should something go wrong.

Unlike criminal law, in the event of a prosecution under the EAWR (Health and Safety at Work etc. Act 1974) it is up to the accused to prove their innocence. Offences committed under the EAWR can result in a fine up to £20,000 for each offence if dealt with in a Magistrates Court, or unlimited fines and/or prison sentences if dealt with by the Crown Court.

Not all electricians are equal, and the duty holder (MD/Director, etc.) cannot dissolve their duties and simply ask an electrician to provide them with a certificate. It must be ensured that the contractor is suitably qualified and familiar with setting sample sizes and locations which must be understood by and agreed with the duty holder. Depending on the complexity of the installation this may first need to include the inspector obtaining an overview of the system from diagrams, charts and past records.

A minimum though would be a simple walk around the premises and a need to establish:

- The approximate age and probable condition of the electrical installation
- Any work carried out since the last inspection
- Type and usage of the installation
- Ambient environmental conditions
- Effectiveness of any ongoing maintenance

Many contractors will quote on the basis that 100% of electrical circuits from every distribution board in the installation will be tested. Other contractors might offer only a sample of the circuits on each distribution board (typically 10%), and in effect offer a reduced level of service that will often be reflected in a lower price. The duty holder should be aware that this reduced level of service may not be sufficient to ensure compliance with the various regulations and recommendations.

Frequency of Periodic Testing

The frequency of periodic inspection and testing is not detailed in the EAWR but should be based on a risk assessment by a competent inspector who would take into consideration:

- The individual characteristics of the type of installation and equipment
- Its condition, use and operation, any damage and deterioration
- Any known maintenance and external influences
- The results and recommendations of any previous inspection reports

Guidance on the frequency of periodic tests is included in Guidance Note 3: Table 3.2, with key recommended frequencies indicated as follows:

- Industrial – 3 Years
- Offices – 5 years
- Commercial – Change of occupancy/5 Years
- Educational – 5 years
- Shops – 5 years

Routine Checks

In addition to formal periodic testing and inspection, routine checks of the electrical installation should be undertaken between these periods. These do not need to be carried out by an electrically skilled person but do need to be completed by somebody able to safely use the installation and recognise defects.

Typically, the checks would include:

- Ensuring that any previous reported defects have been rectified
- A visual inspection looking for signs of breakages, wear, overheating, loose fixings, etc.
- Ensuring that switchgear, etc. is unobstructed
- Ensuring switches have been operated (on/off)
- Functional testing of RCDs, etc. (using the test buttons)

Key recommended frequencies in Guidance Note 3: Table 3.2 include:

- Educational – 6 months
- Shops – 1 year
- Commercial – 1 year
- Industrial – 1 year
- Offices – 1 year

Thermal Imaging

Thermal imaging is not an alternative to the periodic inspection but should be considered as part of a comprehensive maintenance regime to highlight defects that cannot be discovered by visual inspections alone. An example being loose connections that can lead to heat build-up and eventually fire. Annual thermographic surveys are a good addition to the routine checks between periodic inspections.

Refer to the Aviva Loss Prevention Standard on Thermographic Surveys.

Arc Fault Detection Devices

Electrical fires caused by arc faults typically occur at loose connections, poor terminations, in damaged leads and cables, or through old, weak and failing insulation.

Arc Fault Detection Devices (AFDDs), can decrease the likelihood of electrical fires from these conditions by detecting the arcing conditions before the overheating and ignition of flammable materials. In countries such as the USA, where AFDDs are regularly used, there's been a reported reduction of 10% for this type of incident.

In BS 7671:2018 Requirements for Electrical Installations 18th Edition, it is now recommended that AFDDs conforming to BS EN 62606 General Requirements for Arc Fault Detection Devices, are used as a means of providing additional protection against fire caused by arc faults in AC final circuits. It is not required to retrospectively fit these devices, but you may want to discuss introducing them with your electrical contractor, as a proactive measure to further prevent the risk of electrical fire.

Specialist Partners

The Aviva Specialist Partners listed below are well established and proven companies, who Aviva believe will give you great quality and value:

Electrical Inspections

Bureau Veritas are a highly experienced team of experts providing bespoke electrical management schemes, including inspection and testing whilst taking into consideration your operational demands.

Bureau Veritas

0345 6001828

Thermal Imaging Equipment and Training

PASS stocks a huge range of thermal cameras from the world's leading thermal imaging manufacturer; FLIR. With PASS' leading thermography training, you can learn how this equipment operates and how to use them effectively.

PASS

01624 626142

For more information on any of the above solutions or to contact our Specialist Partners, please call the Aviva Risk Helpline on **0345 366 6666** - available 9am-5pm Monday - Friday.

Checklist

A generic Electrical Installations – Inspection and Testing Checklist is presented in Appendix 1 which can be tailored to your own organisation.

Additional Information

- RISCAuthority – Free Document Library
- BSI - SHOP
- The Institution of Engineering and Technology
- Electrical Safety at Work – Health and Safety Executive
- The Electricity at Work Regulations 1989 – Guidance on Regulations: HSR25 – Health and Safety Executive
- Electricity at Work – Safe Working Practices: HSG85 – Health and Safety Executive

Further risk management information can be obtained from Aviva Risk Management Solutions

Appendix 1 – Electrical Installations – Inspection and Testing Checklist

Location	
Date	
Completed by (name and signature)	

	Electrical Installations – Inspection and Testing	Y/N	Comments
1.	Is there a manager responsible for the electrical installation(s)?		
2.	Is there a formal method of keeping all relevant records relating to the electrical installation(s) including: • Electrical Installation Certificates? • Single line drawings/schematics? • Minor Electrical Installation Works Certificates? • Electrical Installation Condition Reports?		
3.	Is there an effective system in place for managing inspections, testing, servicing and maintenance activities?		
4.	Is there an effective mechanism in place for ensuring the frequencies for inspection, testing, servicing and maintenance activities are appropriate, based on regulatory requirements, manufacturer/OEM, industry standards, site experience and learning, risk to the business, insurers guidance, best practice, etc.?		
5.	Does the management system enable you to prioritise tasks? If so, who is responsible and how would tasks be prioritised?		
6.	Does the management system enable you to identify task completion rates and measure this against the tasks due, based on the: • Priority of the task? • Number of tasks? • Length of time outstanding, etc.?		
7.	Does the management system enable all personnel to feedback any issues noticed with the electrical installation and record any actions needed/taken?		
8.	Are periodic inspections up to date for all areas and have all actions been dealt with in line with the report recommendations?		

	Electrical Installations – Inspection and Testing Contd.	Y/N	Comments
9.	Are there processes in place to ensure the competency of all electrical contractors is checked before any work is carried out, and are records of the checks held?		
10.	Have sample sizes and locations for periodic inspections of the electrical installation(s) all been discussed, fully understood and agreed?		
11.	Have routine checks been undertaken? • All previously reported defects rectified? • Visual inspections carried out looking for signs of breakages, wear, overheating, loose fixings and switchgear kept clear? • Have switches been operated (on/off)? • Functional testing carried out for RCDs, etc.?		
12.	Additional comments:		