

## Periodic Inspection & Testing

### **Purpose:**

To provide for (so far as reasonably practicable):

- I. Safety of persons and livestock against the effect of shock and burns.
- II. Protection against damage to property from fire and heat.
- III. Confirmation that the installation is not damaged or deteriorated so as to impair safety.
- IV. The identification of defects and non-compliance with BS7671 which may give rise to danger.

For an installation under effective supervision, repair and maintenance by skilled persons under normal use, periodic inspection is not a requirement, but records of maintenance and tests must be kept.

### **Necessity:**

All installations deteriorate due to:

- I. Damage
- II. Wear and tear
- III. Corrosion
- IV. Excessive electrical loading
- V. Ageing
- VI. Environmental influences

As such, legislation requires that installations are maintained in a safe condition and must be periodically inspected and tested.

Licensing authorities and public bodies etc may also require periodic inspection and testing.

Periodic inspection and testing should also be considered in order to:

- Assess compliance with BS7671
- On a change of occupancy
- On a change of use
- After alterations or additions to the original installation
- Due to any significant change in the loading
- Where there is reason to believe that damage has been caused.

## **The Electricity at Work Regulations require:**

To prevent danger all systems shall be maintained.

There is no requirement to test the installation on every inspection.

The tester should consider whether any risks associated with dismantling and reassembly are justified. Noting that disconnection of cables etc carries a risk of unsatisfactory re-assembly.

## **Design**

The designer should originally recommend an inspection period based on the quality of maintenance to be specified (supplemented as necessary by testing).

## **Routine Checks**

You should not leave an installation without any form of check in between formal inspections.

On a domestic basis it is presumed that the occupier will notice any breakages or excessive wear and make any necessary arrangements for repair.

Routine checks would typically include:

- Breakages
- Wear/deterioration
- Signs of overheating
- Missing parts (screws/covers)
- Switchgear accessible
- Doors of enclosures secure
- Adequate labelling
- Loose fixings.

It should also include the operation of:

- Switchgear (where reasonable to do so)
- Equipment (on & off)
- RCD (test button)

The above need not necessarily be carried out by an electrically skilled person but by somebody who is able to safely use the installation and recognise basic defects.

## **Required Information (Formal inspection)**

The inspector should know or have available:

- Any criteria regarding the extent and limitations of the inspection
- Diagrams of the installation
- Design criteria for the installation
- Details regarding the electrical supply
- Details of the earthing arrangements.
- Any diagrams, charts and tables should indicate the type and composition of circuits, the identification of protective devices for shock protection, isolation and switching arrangements, method of provision of fault protection.

## **Frequency**

Factors which influence the frequency of inspection and testing include:

- Type of installation
- Its use and operation
- The frequency and quality of maintenance
- Any external influences

Although a designer will identify the first date for a periodic inspection the inspecting engineer may decide to bring forward, move back or leave the time period for the next inspection as was.

## **Recommended Frequencies**

GN3 table 3.2 p.63 makes recommendations for frequencies of periodic inspection and test. It is recommended that you view this document and make yourself broadly aware of recommendations within.

It should be noted that in making such recommendations installations have been sub-divided into three groupings:

- General
- Public
- Special

## Requirements for Inspection & Testing

### General Procedure

Where diagrams, charts, tables etc are not available there may be a need to:

Explore

Survey

Note should be made of:

- Any changes in environmental conditions
- Any changes to the building structure
- Any alterations or additions which have affected the suitability of the wiring for its current load and method of
- Any danger that might arise during testing with appropriate steps to be taken.

Remember - It is recommended that:

***Periodic tests should be undertaken in such a way so as to minimise disturbance of the installation and inconvenience to the user.***

If disconnecting it is necessary to:

- Agree with the user
- Take the minimum time necessary (organise your disconnection tests accordingly).

If it is deemed that I & T cannot be carried out safely without the provision of diagrams then they can be required to be prepared under the HASAWA 1974.

### Sampling

If all necessary documentation to support the installation is made available to the inspector, i.e. Electrical installation Cert, subsequent Periodic Inspection Reports, any Elec Inst Minor works Certs, any maintenance and repair records etc. then inspection and testing may be undertaken on a sampling basis. However, in the absence of some or all of these documents it would be necessary to increase the percentage of sampling inspection and testing and in some cases this could encompass 100% of the installation.

Other factors that may have a bearing on the size of sample I & T would be:

Age and general condition

Type and use of the installation

Ambient environmental conditions

Effectiveness of ongoing maintenance

Period of elapsed time between previous inspection/tests

Size of the installation

## Scope of the Periodic Inspection

The scope is decided upon by a 'Competent Person'. Such a person will often be known as the 'Duty Holder'. It must be noted that although their name/title in law is that of duty holder their legal status must be that of competent person.

BS7671 requires that:

An inspection incorporates careful scrutiny of the installation without dismantling or with partial dismantling as required. Together with tests (621.2) considered appropriate by the person undertaking the I&T.

In doing this they will take into account the availability of records and the use, condition and nature of the installation.

Consultation is considered necessary prior to the I&T in order to discuss degrees of disconnection as part of the planning process.

For safety it is necessary to carry out visual inspection of the installation before testing or opening enclosures, removing covers etc.

Visual inspection must verify that the safety of persons, livestock or property is not endangered.

A thorough visual inspection of all electrical equipment that is not concealed should be undertaken. This should also include the internal condition of accessible equipment samples.

The inspection should check on all electrical equipment and material with respect to:

- Safety
- Wear and tear
- Corrosion
- Damage
- Excessive loading (overloading)
- Age
- External influences
- Suitability

The inspection should take into account any known changes that may affect electrical safety, i.e changes to:

- Plumbing
- Extraneous conductive parts
- Structural changes

Where exclusions to part of the installation take place they must be recorded in limitations and should not be permanently excluded from I&T routines.

### **Isolation of Supplies**

In domestic situations whole installations can be isolated easily.

In other installations it is more practical to isolate d.b's separately for short periods of time to allow for internal inspection of live parts and examination of connectors.

*Where it is necessary to inspect live parts inside equipment the supply to the equipment must be disconnected.*

### **Individual Items to be Inspected**

See GN3 p.66 for detailed commentary on each of those items below.

Joints and connections

Conductors

Flexible cables and cords

Accessories and switchgear

Protection against thermal effects

Basic and Fault Protection

Basic Protection

Fault Protection

Protective devices

Enclosures and mechanical protection

Marking and labelling:

At origin - Periodic inspection, date of last, recommended next, RCD test quarterly.

For different voltages - for voltages exceeding 230v a label is necessary where you wouldn't normally expect to find such voltages.

Earthing & Bonding - BS951 labels as appropriate.

Earth free - Regarding equipotential bonding conductors not being connected to earth.

Caravan installations - connection and disconnection instructions

Non Standard colours - warning notice if more than one colour coding exists within the installation.

External Influences

### **Periodic Testing (General)**

This should be seen as supplementary to the inspection process previously covered.

The same range and level of tests is not necessarily required or indeed possible. Judgements can be made regarding extent based on available data from previous inspections or records.

The person carrying out such testing must be:

Competent in the use of the instruments employed

Have adequate knowledge and experience of the type of installation under test in order to prevent danger.

Sample testing can be carried out at the discretion of the tester (less than 10% is inadvisable). If such sample testing produces significantly different results from previous data then investigation is necessary. If the reason for any difference is clearly related to the sample then there is no need to extend the sampling otherwise sampling must be widened. Further failures should result in 100% tests.

### **Tests to be made**

Any tests considered to be appropriate by the tester should be carried out.

Note EFLI may be used to confirm continuity of cpc's at socket outlets and at accessible exposed conductive parts of other current using equipment and accessories.

#### Continuity of cpc's

EFLI tester is often most convenient. When testing MEB and SB conductors there resistance will typically be less than  $0.05\Omega$ .

#### Insulation Resistance

Isolate any equipment, disconnect any electronic equipment or test to earth from live conductors coupled. Check charts/diagrams and any notes for warnings of sensitive equipment. Can test whole installation or parts thereof.

#### Polarity

Usual tests. Establish if there has been any alterations or additions - if none the sample should include 10% of all single pole and multi-pole switching devices and 100% of ES lampholders and socket outlets.

If any fault is found increase rate to 100% of faulty circuit and 25% of other circuits.

#### Earth Fault Loop Impedance

Should be carried out:

At the origin, at each d.b, at all accessible socket outlets, at the extremity of radial circuits.

For motor circuits this test can be carried out on the supply side of the control gear with the continuity of the cpc between control gear and motor then necessary.

Where an RCD is incorporated into the circuit then compliance will be achieved if

$Z_s \times I_{\Delta n} \leq 50\text{v}$  for TN systems and if  $R_A \times I_{\Delta n} \leq 50\text{v}$  for TT systems.

Where items of stationary equipment incorporating a normal protective conductor current of  $\geq 3.5\text{mA}$  are utilised in an installation forming part of a TT system then:  $2R_A \times I$  (protective conductor)  $\leq 50\text{v}$

### RCD Operation

Effective operation to be verified by appropriate testing followed by the test button.

### Operation of overcurrent breakers

Should be operated manually to verify correct function (It is not practical to test auto trip mechanism due to the large currents involved). Any doubt as to their integrity must result in replacement.

### **Operation of devices for Isolation and Switching**

Operate to verify operation

Check labelling

Check for ease of access (kept clear)

Operation of every safety switching device verified. ( Where it is a requirement that the safety switch cuts the supply to all equipment it will be necessary to check between phase and neutral on the load side with approved test lamps in order to verify that this has occurred).

Check keys or handles are not interchangeable with others within the premises.

The integrity of all interlocking must be intact.

Check switching devices for isolation - Check the integrity of any device which prevents energising during isolation.

### **Periodic Inspection Report**

Requires that the results and extent of any periodic inspection be recorded on a 'Periodic Inspection Report' and provided to the person ordering the inspection.

The report must include:

Description of the extent of the work - including the areas covered by the inspection and testing.

Any limitations



Details of any damage, deterioration, defects and dangerous conditions and non-compliance with BS7671 which may give rise to danger.

Schedule of inspections

Schedule of test results.

Any immediately dangerous condition should preferably be rectified. If not, it should be reported immediately in writing to the employer or responsible employee.

Non-Compliances are indicated by a grading system as below:

Grade	Indication	Comment
1	Urgent attention	Unsatisfactory
2	Should be corrected	Sat/Unsat? Inspectors judgement
3	Further investigation	Sat/Unsat? Inspectors judgement
4	Does not comply	Sat/Unsat? Inspectors judgement

### **Thermographic Surveying**

Whilst where appropriate it is advisable to provide effective inspection by considered isolation and investigation, as installations become larger and more complex it can in some cases be difficult to achieve.

Thermographic surveying is a tool which can provide assistance towards inspection by a colour scale the temperature of connections and components within the installation. This in turn can identify poor connections (through heat build up) which may subsequently result in damage to insulation, associated components or even fire.

In some cases the use of such a tool will necessitate the bypassing of safety interlocks and systems providing basic protection and therefore it is a requirement that persons operating such equipment:

- Are sufficiently competent to prevent danger and injury
- Understand the system being worked on and its associated dangers
- Be able to identify items of equipment that will be live when the supply is on
- Implement all precautions to prevent injury in line with a pre-prepared risk assessment
- Maintain maximum possible distance from live parts at all times
- Maintain effective control over the area where the equipment and associated components are being utilised
- Ensure that subsequent to the inspection all safety measures, barriers, interlocks etc are appropriately reinstated.

Thermal surveying equipment should not be seen as a replacement for periodic inspection and testing but rather as an additional tool.