



# Setting up and operating Electrical Test Installations



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We know about complying to EN 50191. After reading this book, so will you.





As a long established market leader in the design and development of electrical safety testing instrumentation, nobody is better qualified than Clare to advise on safety testing and the implications of EN 50191.

EN 50191 defines the requirements for the safe operation of electrical test equipment in the workplace. It is regarded as best practice advice for the provision of essential protective measures in most electrical testing environments and particularly where hazards exist with high voltage testing.

However, technological advances are making electrical products more sophisticated. In addition, modern manufacturing demands have put even greater pressure on productivity and quality control.

The pace of change has led to confusion. Many electrical manufacturers and hire companies have been left vulnerable in the event of electrical accidents.

This is where Clare can help. The company understands compliance standards and works very closely with the BSI and industry approvals agencies on a wide range of electrical safety issues.

This experience has led to the development of an extensive range of electrical safety products and

services that not only make your business more efficient and profitable, but also guarantees you meet all the necessary product and safety standards.

### Meeting standards

EN 50191 is a workplace safety standard that complements the product specific international technical CE standards under which all electrical and electronics products must be designed and manufactured.

These technical standards relate to various electrical safety and performance factors to ensure that products are constructed in accordance with good engineering practice and will not pose a danger to users. Products must adhere to the requirements of all relevant product safety standards, if they are to meet the requirements to bear the CE mark.

Examples include the Low Voltage and the Machinery Directive.

Clare's advanced test instrumentation solutions are designed to help manufacturers fulfil these obligations, whilst maximising productivity. Clare testers have applications in the laboratory for design verification and type approval testing and on the production line for functional and safety testing, as well as quality control and audit. Industry specific testers are also available that are tailored for checking the electrical safety of products provided for repeated hire and rental to the general public.

In all cases the effective integration of Clare testers with production line systems and service and hire workshops, not only ensures vital regulatory compliance but also significantly enhances productivity, product quality and litigation from electric shock.

### Versatile product range

Clare has been providing electrical safety testing solutions since 1953 and has become the supplier of choice in this important sector with a broad range of electrical safety and functional test instruments.

These include:

- Comprehensive electrical safety and functional testers
- Combination electrical safety testers
- Hipot testers (flash testers)
- Earth bond testers (ground bond testers)
- Power cord testers
- Cable and harness continuity and insulation testers
- Industry specific bespoke automated testers

In all cases flexibility is the key. Clare testers can be used as stand alone, single function safety testers or adapted and integrated for use in bespoke automated test systems.

All incorporate flexible safety interlocks and fail-safe protection routines to ensure that operators are not exposed to hazardous conditions, with output ports configured to drive high visibility beacons and a variety of warning devices to achieve compliance with EN 50191.

Clare's unrivalled technical expertise in electrical safety testing instrumentation is combined with engineering and system integration skills as part of a complete turnkey service that meets customers' exact test requirements.

For example, the ability to link the tester with purpose designed test fixtures and special enclosures means electrical test systems can be integrated effectively with production line processes and quality control requirements,

significantly reducing test times, guaranteeing quality and improving productivity.

As well as carrying out critical electrical safety tests, Clare systems can also offer an extensive range of function tests to further improve the automation of the process and dramatically increase production line productivity and quality.

In addition, in some cases the functional power requirements of some electrical and electronic products means that they cannot be tested directly using standard off the shelf equipment. Clare's bespoke service overcomes such problems and has been used to design and build systems for accurate functional load testing from milliamps up to hundreds of Amps, in both single and three phase applications, including line leakage measurement.

### **Traceability and Control**

In this way, electrical test solutions from Clare can help manufacturers of electrical and electronic products meet international technical standards, stringent agency approvals audits and ISO quality traceability needs.

Latest generation microprocessor controlled testers are capable of scanning product barcodes for pre-set automatic test routine selection, with results being stored against serial numbers in the tester's internal memory for output to a printer or for data exchange into a PC for further analysis.

Test systems can be linked to integral and proprietary industrial label printers for the immediate output of pass/fail test labels for attachment to products post test.

Networking of test stations with central control software and data management systems also

means that test data can be made available for full quality and product management control functions. Proprietary user interface software such as LabView has been incorporated into larger complex bespoke projects.

### **Comprehensive service**

As part of its comprehensive electrical test instrumentation design and development service, Clare reinforces this by offering full installation, commissioning, training and the high level of technical support that you would expect from the market leader.

Specifically for compliance with EN 50191 Clare also offers a 'one stop shop' audit service that provides free advice and safety assessments for electrical safety testing installations and locations.

# Choosing the correct solution couldn't be easier. Simply choose the solution that suits you.

## Production Line Testers

We offer three types of testers for production line environments - the Elite family, the HAL family and the SafeTest Manufacturing. The Elite is a powerful and fast 11 function automatic safety test, ideal for maximising production. The HAL is an advanced electrical safety tester with onboard database storage and automated test processes. It is the only isolated output tester on the market. The SafeTest Manufacturing is a cost effective design featuring 7 tests, onboard test result and sequence storage.



## Sector Specific Testers

For the hire and rental markets we offer our new SafeCheck 8 Desk Test & Tag system, designed to be cost effective and maximise production. Our B255 is the current industry standard as used by all the leading names because of its reliability and simplicity of use. The SafeTest Luminaire has been developed to meet the changes in the lighting conformance testing standards. Both AC Hipot tester and DC 500V insulation tester that allows electronic switchgear and ballast to be tested within lighting products.



## Cable Testers

The Horizon 1500 family is a rugged design that utilises touch screen controls and is expandable to 1024 points with high current (up to 1A) and Hipot testing capability up to 1500VDC and/or 1067VAC. Test capability includes fault location, automatic product learning and test programme generation.



# Applying EN 50191

## THE EN50191 STANDARD

The European Standard EN 50191, prepared at national level with the participation of interested CENELEC members, defines the requirements for the erection and operation of electrical test equipment.

The Standard incorporates provisions from eleven other European Norm Standards and other publications (see Appendix 1) as well as many existing national procedures and good engineering practices for safe operation when undertaking the testing of electrical equipment.

The application of the Standard will have an impact on those who have a statutory duty under the Health & Safety at Work Act, in particular the Electricity at Work Regulations and under the provision for use of Work Equipment and therefore on companies manufacturing electrical equipment where the testing of that equipment has to comply with these Standards.

### 1 – OBJECTIVES OF THIS GUIDE

The objectives of this Practical Guide are to provide relevant and necessary information to ensure the safety of test personnel whilst conducting electrical tests and to assist those personnel to manage the various types of test locations to prevent danger not only to themselves but to others who could be affected by their activities.

This guide does not replace the requirement for a person undertaking the testing of electrical equipment to be skilled or instructed and trained and continuously updated or retrained when necessary on the safety requirements, safety rules and company instructions applicable to their work.

### 2 – SCOPE AND APPLICATION OF THE STANDARD

#### A) Scope of the Standard

The format and the scope of the standard is based on the application of protective measures against direct contact with exposed live parts, which present a danger, by personnel undertaking the erection and operation of fixed and temporary electrical test installations. The power supply to the test equipment does not

come within the scope of the standard. Instead for erection of test equipment the standards of the series HD384 (for nominal voltages up to 1000V) or HD 637 S1 (for nominal voltages exceeding 1kV) should be applied, and for the operation of test equipment EN 50110 is applicable. These standards also apply where no requirements are given in the Standard.

#### B) Application of the Standard.

The Standard does not have to be applied where no danger is present when contact is made with exposed live parts. To determine if compliance with the Standard is not a requirement or on the other hand if compliance is a requirement and which section of the Standard is then applicable the flow chart Figure 1 “Applying EN 50191” should be actioned.

It will be noted from the flow chart that even if one of the below conditions has been satisfied and hence the requirements of the Standard do not have to be applied, other potential risks must be considered.

**NOTE: All numbers referring to sections in this Guide apply to sections in the Guide and not to sections in EN 50191.**

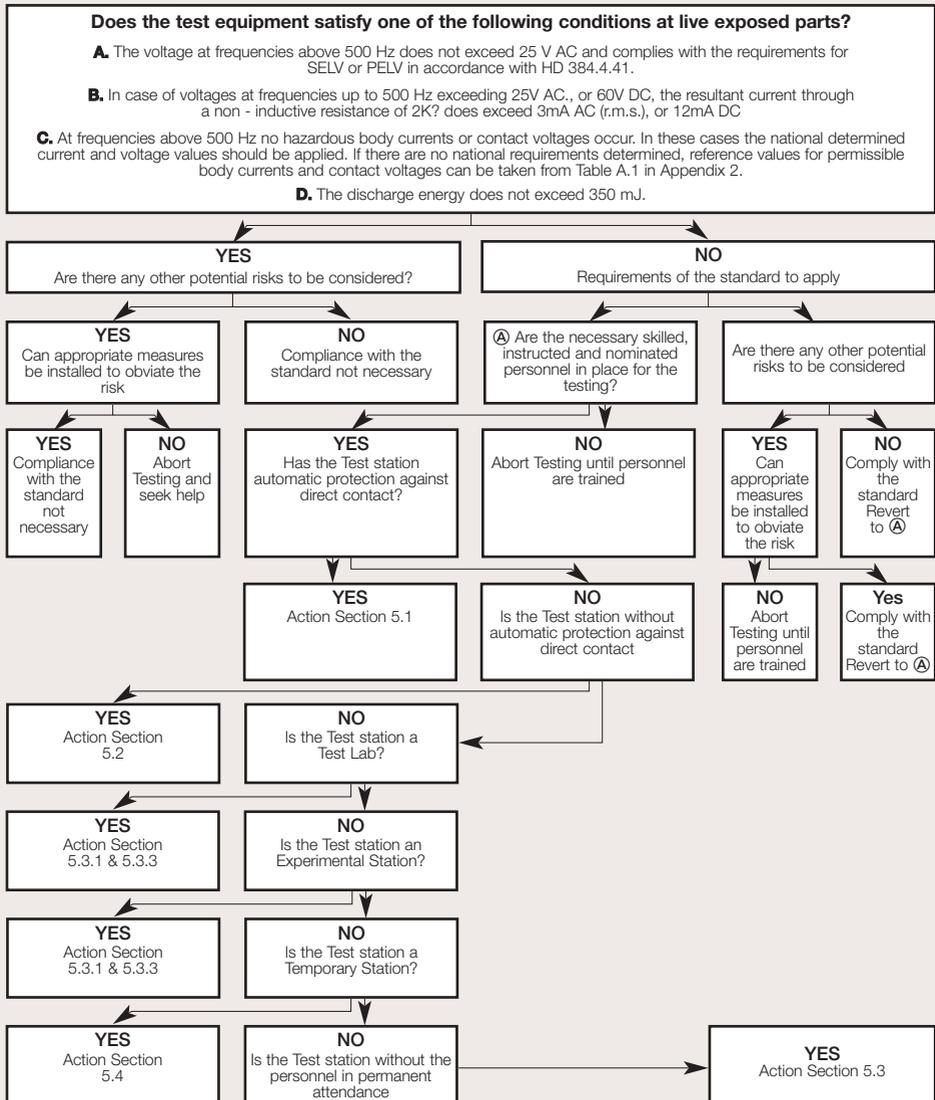


Figure 1. Applying EN 50191

## 3 – DEFINITIONS

The following are a number of definitions particularly applicable to the Standard. The implication and application of a Definition is detailed either under the Definition or in the Section in the text numbered against the definition.

### 3.1 Electrical Test Installations

Test installations consist of all the test equipment and devices combined, (i.e. a test assembly) for undertaking and performing tests on electrical appliances and objects.

Test installations can be designed, constructed and installed as either;

**a) Test Stations;**

Either; 1) With automatic protection against direct contact (See 5.1) Or; 2) Without automatic protection against direct contact (See 5.2) (See also Definition No 3.3 below) or

**b) Test Laboratories or Experimental Stations** (See 5.3) or

**c) Temporary Test Stations** (See 5.4) or

**d) Test Stations without test personnel in permanent attendance** (See 5.5)

### 3.2 Test Area

A test area is the area around the assembled test equipment which is separated from the surrounding area.

### 3.3 Test Station

A test station is the identified test equipment in a clearly defined area e.g. electrical workshops, repair bays, etc. where one or two persons are generally engaged on testing duties.

### 3.4 Prohibition Zone

A Prohibition Zone is an area around live parts which should not be capable of being reached when full protection against direct contact with these parts is not provided.

The boundary of a prohibition zone is defined in Appendix 2 (Table B) which notes that the prohibition zone is dependent upon test voltages to earth.

In the case of voltages up to 1000V, the surface of the live parts is taken to be the boundary of the prohibition zone.

In the case of voltages exceeding 1000V, being capable of reaching the prohibition zone is considered equivalent to touching live parts.

For the minimum distance between barriers and prohibition zones see “Barriers 3.5”.

Any work activity undertaken in a prohibition zone (i.e. live working) must comply with the requirements of EN 50110-1.

### 3.5 Barriers

Where barriers are required to be installed, (See 4.3) they must separate test areas from work areas and passageways. They must be so designed as to:

- Prevent access to the test area by persons other than test personnel.
- Prevent persons other than the test persons reaching the prohibition zone.
- Prevent persons outside the barrier reaching operating devices of test equipment located inside the barrier.

The minimum distance between the barrier

enclosing the test area and the boundary of the prohibition zone or operation devices is defined with reference to Figure 2 and Table C Appendix 3. For grid barriers, the minimum distance at any opening between the barrier and the prohibition zone where it is possible to reach through the barrier, is defined in Table D, Appendix 3. It will be noted that the distance is related to the width of the opening.

Barriers made of conductive materials must be earthed or other means taken to prevent indirect electric shock in case of a fault.

### 3.6. Signal Lights

Signal Lights are red and green lights which are clearly visible from outside the boundaries of the test area.

**3.6.1** A green signal to indicate the operational status inside the test area, i.e. a “Ready for Operation” status, when switched on (see 3.9.2).

**3.6.2** A red signal to indicate “danger” for the test area whenever either the operational status “Ready to switch on” (See 3.9.3.) or the “In operation” status. (see 3.9.4) exists.

### 3.7 Indicator Lights

Indicator lights are lights adequate in number to indicate the switching status of control panels. They are used in addition to, and not as an alternative to signal lights (See 3.6).

### 3.8 Emergency Switch

An emergency switch is a means to cut off in an emergency all electrical energy to test equipment. The switching element should be red with an orange background.

### 3.9 Operational Status

The testing of electrical equipment and appliances comes under 4 stages of Operational Status.

These must be recognized and applied by personnel undertaking testing at all times. The 4 statuses are as follows:

**3.9.1 “Out of operation”** status is when:

- All electrical supplies, signalling and control circuits are switched off and secured against unauthorised switching on.
- All safety precautions necessary e.g. earthing, shorting-circuiting for voltages exceeding 1 kV have been undertaken before entering the test area.

**3.9.2 “Ready for operation”** status is when:

- The power supplies for the switchgear signalling and control circuits of the test equipment are switched on.
- The green signal lights, where these are required, as defined in Section 5, are switched on.
- All power supplies for the test voltage are switched off and secured against unintentional switching.
- All the safety precautions detailed in 3.9.1 above (“Out of operation”) are in force.

**3.9.3 “Ready to switch on”** status is when:

- All power supplies for the test voltage are switched off.
- All entries to the test area are closed.
- The red signal lights are switched on.
- The safety precautions specified in 3.9.1 above (“Out of operation”) are no longer in force.

**3.9.4 “In operation”** status is when:

- All entries to the test area are closed.
- The red signal lights are switched on.
- One or more power supplies for the test voltage are switched on.

**Except in the case of a Temporary Installation (see 5.4) before leaving a Test Installation the “out of operation” status must be established.**

### **3.10 Test Operating Personnel**

A **Skilled person** is a person with relevant education and experience to enable him or her to avoid dangers which electricity may create.

An **Instructed person** is a person adequately advised by skilled persons to enable him or her to avoid dangers with electricity may create.

An ‘in control of a work activity’ is the person nominated to take direct managerial control and responsibility for the work involved. Part of this responsibility may be delegated to other personnel as required.

**Note: Orders for switching operations in test stations may only be given by the nominated person ‘in control of the work activity’ who must ensure that instructions are correctly carried out before; a) equipment is switched on, in the case of voltages up to 1kV, and b) is made “ready to switch on” (See 3.9.3) in the case of voltages exceeding 1kV.**

#### **3.10.11. Index of Protection ( I.P ) IP3X**

The figure “3” indicates the ability of an enclosure

to withstand the ingress of solid objects exceeding 2.5 mm. The letter “X” indicates no classification against the ingress of water.

## **4 – SAFETY MEASURES FOR PROTECTION AGAINST ELECTRIC SHOCK**

The Standard covers a range of safety measures to provide protection against electric shock in the erection and operation of electrical test installations.

These safety requirements and methods are defined under definitions in Section 3 “Definitions” or in the erection and operational safety measures and procedures for Test Stations, Test Laboratories, Experimental Stations, Temporary Stations in Section 5.

This Section 4 defines a range of more general but very vital protective safety measures. These are as follows:

### **4.1 Test assemblies**

**4.1.1** Safety of test assemblies must be satisfied and secured for protection against direct contact by the assembly being so constructed, arranged and designed to incorporate requisite insulation of live parts, covers, enclosures, obstacles or safe distances (For safe distances see 3.4 Prohibition Zone)

**4.1.2** Safety requirements can also be met if two-hand devices are used provided:

- a) They comply with EN 574 Type 11 or 111B and
- b) When more than one person is involved in a test, each member of the testing team must have a two-hand control device with all the devices so connected that all the two-handed devices have

to be operated before the test supplies can be energised.

**4.1.3** Two safety test probes satisfy safety requirements provided the probes:

- a) Have full protection against direct contact
- b) Have adequate insulation level for the applied voltages with no clamping devices being permissible.

**4.1.4** An isolation transformer, to EN 62558 must provide the supply to any measuring instrument or auxiliary appliance to Class 1 HD 366, such as cathode ray oscilloscopes, sine wave generators etc. where the protective conductor has to be broken during testing if the tests require the enclosure to be isolated from earth potential.

**4.1.5** The insulation of any supplying transformer must be rated to at least any voltage to earth which could occur when an enclosure and/or a circuit of a measuring instrument, which is designed for a mains connection, is connected to live parts of a test assembly.

**4.1.6** The design and arrangement of a test assembly must be such as to ensure that the transfer of voltages to extraneous conductive parts cannot occur.

#### **4.2 Prohibition Zone**

Prohibition Zones are clearly defined as per “3.4 Prohibition Zone”.

#### **4.3 Barriers Test Areas**

Applicable Barriers are installed as per “3.4 Barriers”.

#### **4.4 Emergency switching off**

Test Installations must be provided with means for

emergency switching off (See 3.8) in order to cut off all electrical energy which could result in danger. The devices or equipment must be in accordance with the requirements of EN 418. An adequate number of manual controls must be provided inside and outside the test area dependent upon the size of the area and complexity of its layout. Connection points, e.g. outlets of the general power supply within the test area, must be identified accordingly, if they are not interrupted by the emergency switching off equipment.

#### **4.5 Preventing unauthorised and unintentional switching-on**

Test installations must be secured against unauthorised and unintentional switching-on of test circuits. Manual controls must be clearly correlated to the respective test circuits.

#### **4.6 Preventing automatic energising**

Automatic energising of test circuits must be prevented when mains voltage recovers after a power failure.

#### **4.7 Protection against residual voltages**

Suitable devices and equipment must be provided for a safe discharge of energy if there is any likelihood of danger due to residual voltages after switching-off test circuits.

#### **4.8 Protective measures against other hazards**

Suitable means of protection must be provided, in cases where, besides dangers due to voltages, other hazards could be expected, e.g. due to arcs, noise, explosion, radiation, flying parts, formation of gas, fire and dangerous substances.

#### **4.9 Installation and enclosure of a measuring instrument**

Adequate external insulation of the enclosure of

a measuring instrument must be provided if the enclosure is connected to live parts of the test assembly, and if as a result, the enclosure is exposed to voltages exceeding 25V AC or 60V DC to earth.

#### **4.10 Assembly work and testing**

A dangerous situation could arise if assembly work and tests are undertaken simultaneously.

#### **4.11 Touching test objects after testing**

Before there is any touching of test objects which have been switched off, it must be ensured by earthing and short circuiting, that no dangerous voltages are present on any accessible parts.

### **5 – TEST STATIONS, TEST LABORATORIES, EXPERIMENTAL STATIONS, TEMPORARY STATIONS, STATIONS WITHOUT TEST PERSONNEL IN PERMANENT ATTENDANCE**

Test installations are designed, erected or installed and operated under the following categories (See 3.1):

**5.1** Test stations with automatic protection against direct contact.

**5.2** Test stations without automatic protection against direct contact.

**5.3** Test Laboratories and Experimental Stations.

**5.4** Temporary test stations.

**5.5** Test stations without test personnel in attendance.

#### **5.1 Test station with automatic protection against direct contact**

(see Drawing No 1)

**5.1.1** To provide the maximum possible safety for a person undertaking a test on an electrical object, a work station should have automatic protection against direct contact. Such protection will ensure that the object or appliance under test and all live parts of the test apparatus have automatically activated full protection against direct contact in an energised condition.

**5.1.2** Insulation of live parts, covers or enclosures must be arranged and designed for protection against direct contact with, in addition, at least a degree of protection “IP3X” as per EN 60529 which must include in all parts of the object under test.

**5.1.3** It must not be possible to switch on the test voltages until the means of protection are fully operational and functioning correctly. Opening the means of protection must disconnect the test voltage automatically. Residual voltages shall be automatically reduced to a non-hazardous level before live parts can be touched.

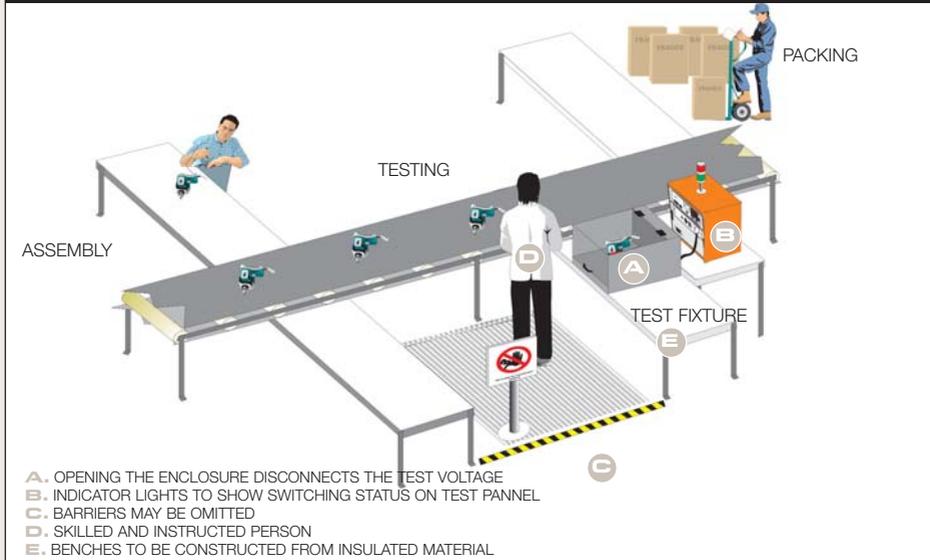
**5.1.4** Single fault conditions must not prevent the test voltages from being switched off when the means of protection are opened. It must be made impossible to switch the test voltages on again after the occurrence of the fault and likewise it must be impossible to bypass the means of protection in an easy manner.

**5.1.5** The degree of protection against direct contact IP3X may be omitted if the enclosure complies with the following requirements:

**a)** The means of protection for the automatic protection against direct contact must be solid walls or barrier grids (with side length or diameter of the openings not greater than 40 mm) and at least 1800 mm high.

## DRAWING 1

TEST STATION WITH AUTOMATIC PROTECTION



**b)** The test enclosure must be equipped with devices which do not permit doors to the test area to be opened until the test voltage has been switched off and then, either by such as earthing or short-circuiting, secured against being switched on again. It must not be possible to make these protective measures inoperative or disabled until the doors have been closed.

**[Note: In test stations with the degrees of protection defined in 5.1.5a) and 5.1.5b) all persons must leave the test area before the test station is switched on].**

**5.1.6** The degrees of protection defined in 5.1.2, 5.1.3 and 5.1.4 may be omitted in very exceptional cases.

This would only be the case if the object under test and all live parts are fully protected against direct contact and a measure for protection against indirect contact, in the event of a fault, is fully effective and efficient for the test object and the test equipment during the test.

**5.1.7** In Test Stations with automatic protection against direct contact, barriers in accordance with 3.5 and emergency switching off devices in accordance with 4.4 may be omitted.

## 5.2 Test Station without Automatic Protection against Direct Contact

(See Drawings 2 and 3)

**5.2.1** A test station without automatic protection against direct contact is a station in which parts of the test object or live parts of the test apparatus are not fully protected against live contact during tests. For example such test areas could include electric workshops, measurement and experimental areas.

**5.2.2** Test stations without automatic protection against direct contact must only be installed if erection of test stations with automatic protection against direct contact is deemed to be impractical.

Such situations would include:

- Frequently changing test duties
- Varying types of test objects
- Where test work would be seriously difficult to perform
- If the testing duties occur only very occasionally

**5.2.3** The following safety requirements are applicable for such test stations:

- a)** Barriers e.g. walls, grids, ropes, chains or bars should be installed as per 3.5 with barriers designed so that visual contact with the operator can be maintained from outside at all times.
- b)** At least one emergency switching device must be installed outside the test area.
- c)** Red signal lights and appropriate warning signs to indicate operational status must be installed.

**d)** Where test circuits are electrically connected to the general power supply system an RCD rated at 30mA must be installed. If the residual current includes DC components an appropriate RCD must be utilised.

**e)** Testing must be carried out on bench tops with insulating materials.

**f)** Working areas of the test stations must be designed so that movement of personnel is not impeded.

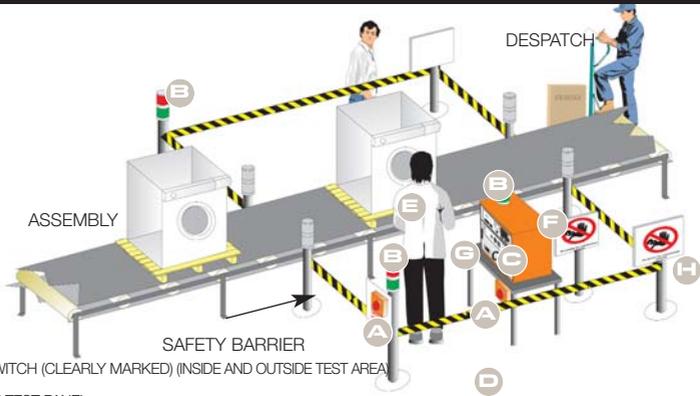
**g)** An effective protective measure for protection against indirect contact, in case of a fault, must be incorporated in the measuring instruments, variable resistors etc, of the electrical equipment. This also applies to the exposed conductive parts of objects under test unless tests involve such as insulation tests and/or earth leakage tests etc. on these parts of the object under test. The preferred method should be electrical equipment with protective insulation or the supply obtained from an isolating transformer.

**h)** When safety test probes are used with voltages greater than 1 kV, the high voltage side of the test equipment, the test probes and their leads and where practicable the object under test, must be electrically isolated from the supply mains and insulated from earth.

**i)** The r.m.s value of the leakage current (see IEC 60050-826) on the high voltage side of the test apparatus must not be greater than 3 mA. Even if a highly resistive connection is made between the high voltage side and earth, e.g. for adjustment of potential of a measuring instrument the value must not exceed 3mA.

## DRAWING 2

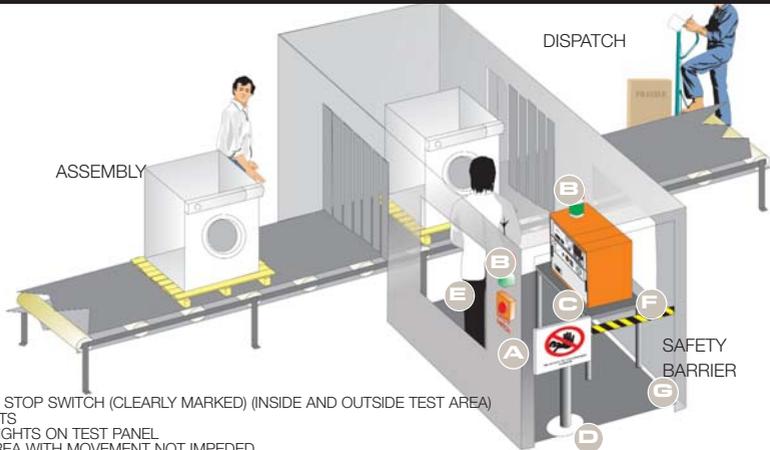
TEST STATION WITHOUT AUTOMATIC PROTECTION AGAINST DIRECT CONTACT



- A. EMERGENCY STOP SWITCH (CLEARLY MARKED) (INSIDE AND OUTSIDE TEST AREA)
- B. SIGNAL LIGHTS
- C. INDICATOR LIGHTS ON TEST PANEL
- D. WORKING AREA WITH MOVEMENT NOT IMPEDED
- E. SKILLED AND INSTRUCTED PERSON
- F. TEST INSTRUMENTS, WHERE CONNECTED TO MAINS MUST HAVE ADDITIONAL 30mA RCD PROTECTION
- G. BENCHES TO BE CONSTRUCTED FROM INSULATED MATERIAL

## DRAWING 3

TEST STATION FOR PRODUCTION LINE TESTING WITHOUT AUTOMATIC PROTECTION AGAINST DIRECT CONTACT



- A. EMERGENCY STOP SWITCH (CLEARLY MARKED) (INSIDE AND OUTSIDE TEST AREA)
- B. SIGNAL LIGHTS
- C. INDICATOR LIGHTS ON TEST PANEL
- D. WORKING AREA WITH MOVEMENT NOT IMPEDED
- E. SKILLED AND INSTRUCTED PERSON
- F. TEST INSTRUMENTS, WHERE CONNECTED TO MAINS MUST HAVE ADDITIONAL 30mA RCD PROTECTION
- G. BENCHES TO BE CONSTRUCTED FROM INSULATED MATERIAL

j) Where test stations in electric workshops, laboratory stands, measurement and experimental stands, barriers as per 3.5 and red signal lights as per 5.2.3.c may be omitted, provided that the safety of all personnel not engaged on the testing is fully ensured by means of the layout and the design of the test station and that the test equipment is reliably controlled by the person carrying out the tests.

k) As a safety measure during the operational status “ready to switch on” and “in operation”, at least one other person must be present in visual and audible contact with the person carrying out the testing and be in the position to recognise any dangerous conditions in the test station immediately and eliminate the danger by operating the emergency switching off device.

### 5.3 Test Laboratories and Experimental Stations

(See Drawing 4)

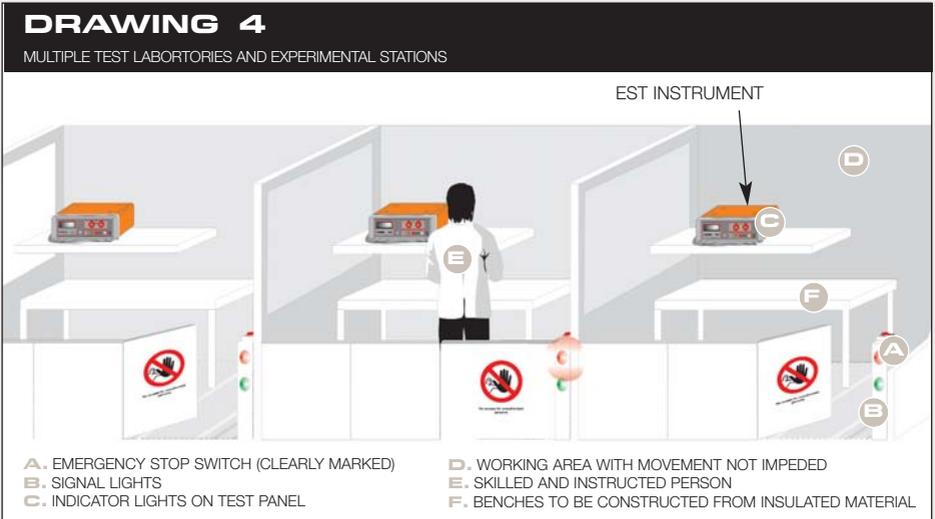
#### 5.3.1 Test Laboratories

A test laboratory has test equipment in a securely enclosed space or within an area separated from adjacent work areas, in which several persons are generally employed on test work on mainly larger objects.

#### 5.3.2 Experimental Stations

Experimental stations have test equipment for performing experiments or tests within the scope of research and development work. In general no routine tests are performed in experimental stations.

A variety of test assemblies as well as different hazards can therefore be anticipated in these two types of test stations.



### 5.3.3 Safety Measures applicable to Test Laboratories and Experimental Stations

**a)** The barriers as per 3.5 must be solid walls or grids (see table D) at least 1800mm high for voltages greater than 1000V and 1000mm high for voltages up to 1000V. Entrances must be provided with a warning sign **“No unauthorised persons beyond this point”** as per EN 61310-1.

With voltages up to 1000V, the barriers may also be ropes, chains or bars.

**b)** A sufficient number of red and green signal lights must be installed to indicate the operational status. Green signal lights are not required in case of voltages up to 1kV.

**c)** Test Laboratories and Experimental Stations may be divided into sections in which totally independent tests or experiments are performed. Where these separate areas exist:

- the operational status of each of the test areas must be indicated by means of signal lights
- red signal lights to indicate “danger” for the entire test laboratory or experimental station when the operational status “ready for operation” or “in operation” exists in at least one of the test areas.

**d)** Emergency escape doors, gates, etc. must be capable of being opened from the inside of the test area. Any National Regulations on escape routes and emergency exits must be noted and applied.

**e)** Measures to prevent the entry of unauthorized personnel into test laboratories must not hamper personnel from leaving the stations.

**f)** Devices and means for earthing must be available in test laboratories and experimental stations with voltages exceeding 1 kV. (cf EN 50110-1 and EN 612219).

**g)** Where the test voltages are greater than 1 kV, all areas including those outside the test area where there is any possibility that capacitive charging could take place, must be separated by additional barriers for the duration of the testing. All additional barriers must be to the minimum as required for temporary test stations (See 5.4.2.a).

**h)** In experimental stations if, because of the type of construction, any of the safety measures defined 5.3.3.a to 5.3.3.g are inappropriate or cannot be applied the protection of personnel operating in the test areas must be ensured by equally effective other means or measures. For example, for the safety measure under 5.3.3.f, (the prevention of unauthorised entry) continuous supervision of access may be a requirement.

**i)** All persons other than test persons must leave the test area before the test equipment is:

- switched on, in the case of voltages up to 1000V
- made **“ready for operation”** in the case of voltages greater than 1kV

All persons must leave the test area before a test installation with voltages greater than 1kV is made **“ready to switch on”**.

**j)** In exceptional cases skilled persons may enter the test area in the operational status **“ready to switch on”** or **“in operation”**, but measures must be taken to ensure they cannot reach the prohibition zone. (EN 50110-1)

**k)** Personnel working in test laboratories and experimental stations must work only under the overall supervision of a nominated person in control of the work activities.

**l)** With voltages exceeding 1kV switching operations must only be performed by the nominated person or on the personal orders of the nominated person.

#### **5.4 Temporary Test Stations**

(See Drawing 5)

**5.4.1** A temporary test station is an installation erected for a short time to perform tests on individual test objects.

**5.4.2** Safety Measures Applicable to Temporary Test Stations:

**a)** Unauthorised persons must be prevented from access to temporary test areas by means of walls, grids, ropes, chains, bars or similar barriers. Entrances must be provided with a warning sign "No unauthorised persons beyond this point" as per EN 61310-1.

**b)** Escape facilities must be provided

**c)** Devices or means for earthing must be made available where voltages are greater than 1 kV, (cf. EN 50110-1 and EN 61219)

**d)** For tests with voltages exceeding 1kV, where there is a possibility of capacitive charging, the requirement in 5.3.3.g must be applied.

**e)** When safety test probes are used with voltages greater than 1kV, the requirement in 5.2.3.h must be applied.

**f)** Where a temporary test station is separated from generally accessible areas only by means of ropes, chains, or bars the following conditions must also apply:

**1)** The entire test assembly must be under surveillance during the test procedure. If this cannot be ensured by the person carrying out the test, a sufficient number of at least instructed persons shall be present to supervise the entire test area.

**2)** When test assemblies have several separate test areas, e.g. when testing installed cables, one person must guard each area and communication with the responsible skilled person must be ensured.

**g)** Personnel working in a temporary test station must work only under the overall supervision of a nominated person in control of the work activities.

#### **5.5 Test stations without test personnel in permanent attendance**

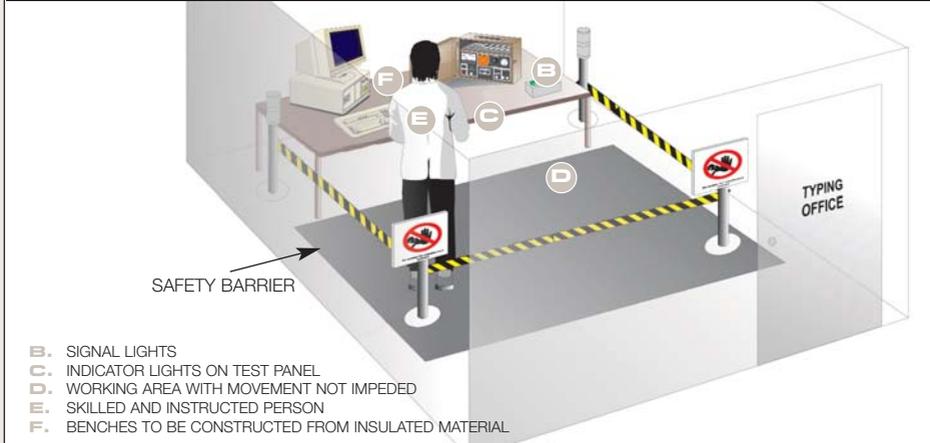
Where a test station is intended for operation without the permanent presence of test personnel (e.g. for endurance tests), it must be erected in compliance with 5.1 (test stations with automatic protection against direct contact) or 5.3.3.a to 5.3.3.g (test laboratories).

Emergency stop equipment in accordance with requirements of EN 418 with an adequate number of manual controls must be provided.

Prevention of automatic energising in accordance with 4.6 may be omitted, provided that this will not cause any hazards.

## DRAWING 5

TEMPORARY TEST STATION



### 6 – OPERATION OF TEST INSTALLATIONS

The Standard defines a range of requirements for the safe operation of test installations, the levels of personnel to be involved and the preparations for testing and switching in test stations.

The majority of these requirements have been included at the appropriate points elsewhere in the text of this guide but the following should be noted or further emphasised;

**6.1** Except in the case of test stations with automatic protection against direct contact all test installations must be operated under the control of a skilled person and only skilled or instructed persons must work with test installations.

**6.2** Operating instruments for the safe operation of test installations must be provided.

**6.3** Test installations must be regularly inspected and maintained; in particular the efficiency of safety devices and defects remedied.

**6.4** Only personnel employed in test areas or other persons who have received instructions about hazards may enter the areas. Any other person can only enter a test area when accompanied with a skilled person and then only after all risks have been drawn to the attention of the person.

**6.5** Parts of an object under test and of the test installation itself which are not “live” during normal operation could be subjected to dangerous voltages in the event of a fault occurring during tests. If, because of an exceptional requirement, work has to be carried out on these parts suitable insulating devices and equipment and other auxiliary measures must be instituted (See 50110-1).

## APPENDIX 1

### NORMATIVE REFERENCES

- EN 50191** Includes provisions from other publications the normative references from which are cited in the appropriate places in the Standard and are listed as follows:
- EN 294** Safety of machinery; Safety distances to prevent danger zones from being reached by the upper limbs.
- EN 418** Safety of machinery; Emergency stop equipment; Functional aspects; Principles for design.
- EN 574** Safety of machinery; Two-hand control device.
- EN 50110-1** Operation of electrical installations.
- EN 60529** Degrees of protection provided by enclosures (IP Code) (IEC 60529).
- EN 61219** Live working - Earthing or earthing and short-circuiting equipment using lances as short-circuiting device - Lance earthing (IEC 60529).
- EN 61310-1** Safety of machinery; Indication, marking and actuation – Part 1 : Requirements for visual, auditory and tactile signals (IEC 61310-1).
- EN 61558** Safety of power transformers, power supply units and similar (IEC 61558 Series).
- HD 366** Classification of electrical and electronic equipment with regard to protection against electric shock (IEC 60536).
- HD 384** Series Electrical installations of buildings (IEC 60364 series, modified).
- HD 367 S1** Power installations exceeding 1kV AC.
- IEC 60050-826** International Electrotechnical Vocabulary – Chapter 826; Electrical installations of buildings.

## APPENDIX 2

**TABLE A**  
**Permissible body currents and contact voltages**

Table A below defines the reference values for permissible sinusoidal body currents and contact voltages at frequencies greater than 500 Hz.

It will be noted in condition C in Figure 1. 'Applying EN 50191' that at frequencies above 500Hz no hazardous body currents or contact voltages occur and that provided that these reference values are not exceeded, measures defined in the Standard do not have to be applied.

Frequency $f$	Permissible body current mA	Permissible contact voltage V
500 Hz $\leq f \leq 2$ kHz	1,75. ( $f$ / kHz) + 3,3	25
2 kHz $\leq f \leq 3,8$ kHz	1,4. ( $f$ / kHz) + 4,2	25

For values of frequency greater than 3.8 kHz see Table A-1 of EN 50191

**TABLE B**  
**Prohibition zone and test area**

Table B; Prohibition zone (s, being the distance in air from live parts) dependant on test voltages to earth(U)  
 For Alternating voltages > 40kV, Lightning impulse voltages > 200kV, and Switching impulse voltages > 1000 kV see Table A,2 of EN50191

Alternating test voltage 50/60 Hz (r.m.s value)		Lightning impulse voltage 1,2/50us (peak value)		Switching Impulse voltage 250/2 500 us (peak value)	
U kV	s mm	U kV	s mm	U kV	s mm
$\leq 1$	no contact	20	100	500	2000
3	20	40	175	600	2600
5	30	60	250	700	3300
6	35	80	325	800	4100
10	60	100	400	900	4900
15	85	150	550	1000	5800
20	115	200	700		
25	140				
30	170				
35	195				
40	225				

For Alternating voltages > 40kV, Lightning impulse voltages > 200kV, and Switching impulse voltages > 1000 kV see Table A,2 of EN 50191

## APPENDIX 3

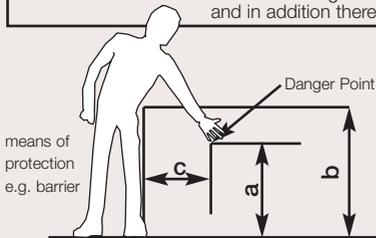
**TABLE C**

**Horizontal distance between the Barrier and the Prohibition Zone**

(in relation to the height of the barrier and the distance of the danger point from the floor). For distances greater than 1800mm of the danger point from the floor see Table A,3 of EN 50191. (Taken from EN 294)

Distance of the danger point from the floor, a mm	Height of the edge of the means of protection (barrier), b mm							
	1000	1200	1400	1600	1800	2000	2200	2400
	Horizontal distance c between means of protection (barrier) and the danger point mm							
2400	100	100	100	100	100	100	100	100
2200	600	600	500	500	400	350	250	
2000	1100	900	700	600	500	350		
1800	1100	1000	900	900	600			
1600	1300	1000	900	900	500			
1400	1300	1000	900	800	100			
1200	1400	1000	900	500				
1000	1400	1000	900	300				
800	1300	900	600					
600	1200	500						
400	1200	300						
200	1100	200						

Values below 1000 mm for edge b are not specified as this would not increase the arm's reach and in addition there would be a risk of falling into the test area.



- a** Distance between the danger point and the floor (danger point is the point on the boundary of the prohibition zone having the shortest distance from the edge of the means protection)
- b** Height of the edge of the means of protection
- c** Horizontal distance between the edge of the means of protection and the danger point

**FIGURE 2**

**Demonstration of the dimensions listed in Table C.** (Taken from EN 294).

Width of opening (diameter or side length) mm	Minimum distance from the prohibition zone mm		
	slot	square	circle
over 4 to 6	10	5	5
over 6 to 8	20	15	5
over 8 to 10	80	25	20
over 10 to 12	100	80	80
over 12 to 20	120	120	120
over 20 to 30	850	120	120
over 30 to 40	850	200	120
over 40 to 120	850	850	850

**Table D**

**Minimum distance between openings in the barrier and the prohibition in relation to the width of the opening** (Taken from EN 294).

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