

## **ENVIRONMENTAL AND TEST REQUIREMENTS FOR ELECTRONIC EQUIPMENT**

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### **PURPOSE AND SCOPE**

This document describes the technical requirements for User's equipment directly connected to the England and Wales Transmission system and located within NGET's busbar protection zone operating at nominal voltages of 400 kV, 275 kV, 132 kV and 66 kV unless otherwise agreed with the user as defined in the Bilateral agreement. The principles of this document applies to equipment connected at other voltages".

This Specification contains general requirements; the specific requirements are in the individual function specifications.

All electronic equipment supplied to the user for operational use in transmission locations must meet its specified functionality and performance as set out in individual Technical Specifications and under the relevant environmental conditions stated in this Specification.

### **PART 1 – PROCEDURAL**

#### **1 INTRODUCTION**

##### **Relationship with European Standards**

*Informative: This Specification generally references functional requirements and tests described in IEC or BS Standards. However, in some cases there are no standards that adequately cover the unique performance and functional requirements of an electricity supply system. In these instances specific requirements and tests are detailed in this document.*

- 1.1** CENELEC document Electronic Equipment for Use in Power Installations (BS EN 50178) gives minimum design and manufacture requirements with which control equipment within the scope of this specification must comply.

**1.2 This document specifies those performance requirements that must be met by electronic equipment.**

*Informative: This document is a generic specification and therefore when used to specify requirements for equipment to be purchased, the TS shall be supplemented by specific requirements relating to the equipment and application concerned. In most cases this will take the form, inter alia, of specifying which optional tests are to be applied and the test levels required for each port. This information will be contained in the corresponding functional specification or the contract documentation as appropriate.*

**2 GENERAL REQUIREMENTS**

*Informative: Electronic equipment for operational use is required to comply with specific environmental performance criteria. This document sets out the essence of these criteria, with particular emphasis on the testing required. Section 2 General Requirements states these criteria. Sections 3, 4, 5 and 6 Test Requirements, Define the tests required to prove that these requirements have been met under various ranges of environmental conditions.*

**Environment**

**2.1** The equipment shall be subjected to environmental factors such as electrical interference, supply voltage variations, nuclear radiation, dust, vibration, temperature, and salt mist. Where special equipment enclosures are required to satisfy these requirements, the supplier shall define its Degree of Protection by stating its IP Code as given in BS EN 60529.

**2.2** The following clauses define the conditions that the equipment shall meet with the performance being degraded.

**Temperature and Humidity**

**2.3** Equipment shall operate within its functional specification over the range of the specified atmospheric environmental classes, as defined in the Table 1, Temperature and Humidity Environmental Classes.

	Siting Conditions	BS EN 60654-1 Class	Ambient Temperature Range (Note (iii))	RH Limits
	Rooms having a closely controlled environment (Note (ii))	A1	+18 to 27°C	20 to 75%
	Control rooms and equipment rooms not fully air conditioned	B3	+5 to 40°C	5 to 95% (Note (iv))
	Plant areas and block houses away from high temperature plant and subject to greater extremes than Group 2	N/A	-10 to +55°C	5 to 95% (Note (iv))
	Outdoors	C2	-25 to +55°C	10 to 100%
	Adjacent to high temperature plant	N/A	-10 to +85°C	10 to 100%
	Normal transit and storage conditions (Note (i))	N/A	-25 to +70°C	20 to 95%

**Table 1 Temperature and Humidity Environmental Classes**

Note to Table 1:

- (i) Refer to BS EN 60068-2.
- (ii) Where equipment is required to continue functioning despite failure of air conditioning plant, the environment which would result from these conditions shall be ascertained and the class relevant to that environment specified instead. Fans and air conditioning plant may still, of course, be used to prolong the life of the equipment.
- (iii) Due regard shall be taken of the increase in the above temperature maximum when the equipment is mounted in enclosures, e.g. cubicles, boxes, etc without adequate ventilations.
- (iv) Some equipment (e.g. Protection) is only tested to withstand a RH of 93%.

- 2.4** Where any Class 1 or Class 2 item of equipment is to be mounted within an enclosure housing other items of equipment, it shall be capable of normal operation at a temperature 15°C higher than the upper temperature limit of the environmental class.
- 2.5** The temperature rise above ambient within an enclosure, when the equipment is operating normally, shall not exceed 10°C.
- 2.6** Equipment which can directly cause the operation of a circuit breaker shall operate within its functional specification over the Class 3 range of the atmospheric environmental classes, as defined in the Table 1, Temperature and Humidity Environmental Classes. The additional 15°C enclosure factor need not apply.

**Mechanical**

**Shock and Vibration**

- 2.7** Performance life shall not be affected by the Drop and Topple Test, where specified.
- 2.8** Where specified, equipment shall conform to the requirements of the Vibration Test.
- 2.9** Protection equipment, or any hardware platform that is specified for use for a protection application, shall conform to the requirements of the shock, bump and seismic tests.

**Self-generated Vibration**

- 2.10** Equipment shall not generate vibration at a level that could be damaging to its performance or that of other equipment or personnel.

**Electrical**

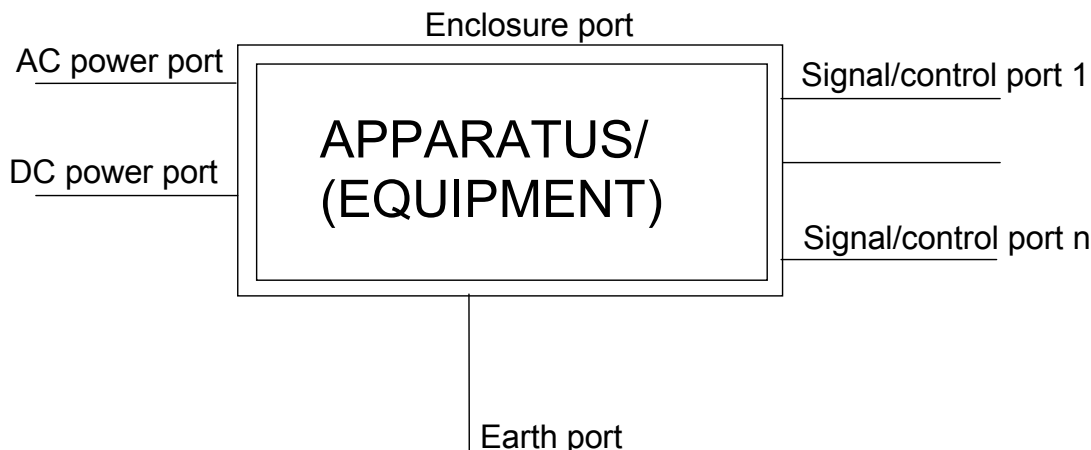
- 2.11** The equipment shall meet its specified functional performance under the supply and electrical environmental parameters detailed below.

**Supply Parameters**

*Informative: Equipment may operate from a variety of supplies. The supply parameters are defined in TS 1(RES), TS 2.12 (RES).*

## Interference Immunity

*Informative: The interference suffered by a "victim" equipment is dependent not only on the interference levels to which the equipment itself is directly subject but also the levels existing in the areas through which the cables connected to it pass. This concept is defined in BS EN 61000-6-1 Section 3.1 and Figure 1 is based on this definition.*



**Figure 1 Definition of Ports**

For a given apparatus the test levels to be applied to each of the above ports will depend on the environment to which the port will be subjected. These are defined in Table 4.

*Informative: Table 5 and Table 6, which refer to substation equipment and grid control centre equipment respectively.*

## Special Installation Measures

- 2.12** Equipment shall operate in the presence of interference generated by portable radios/telephones without maloperation or significant error.
- 2.13** Where it is agreed that equipment may be supplied which does not meet the user's requirement for immunity from radio generated interference, then the supplier shall affix a label to the equipment stating this fact. The label shall also specify the minimum distance from the equipment that radio transmitters can safely be operated. The label shall be conspicuous at all times, including maintenance.

## Conducted and Radiated Emissions

- 2.14** The level of conducted and radiated emissions produced by the equipment shall be quoted in its specification.
- 2.15** The earthing and cabling arrangements shall not exacerbate any interference caused by the equipment.

## Supply Interruptions

- 2.16** Equipment shall be capable of accepting supply interruptions of up to and including 10 ms or otherwise specified without the performance being affected.
- 2.17** No damage shall be caused to the equipment by supply interruptions of any duration, nor shall the equipment respond to an interruption in a manner that could lead to a trip output or cause danger to other plant or personnel.

### 3 GENERAL TEST REQUIREMENTS

*Informative: The tests specified in this section are intended to show that the equipment meets the general user's requirements for electronic equipment.*

Table 2 shows the basic testing classifications for equipment supplied to the user. These tests shall be applied to electronic equipment in the manner defined in this document.

Test	Comments
Type	To be carried out on a sample standard production equipment. These may include factory acceptance tests, integration tests, and system tests. These tests are normally carried out by the supplier, but may be witnessed in whole or part by the user.
Routine & Sampling	Intended for each item of production equipment, these may include factory acceptance tests, integration tests, and system tests. Some of these tests may be witnessed by the user.
Site Pre-commissioning	These tests take place after the equipment has been fully installed.
Energisation	These tests are only applicable to turnkey projects.

**Table 2 Test Classifications**

#### General

*Informative: If national or international specifications or standards apply to equipment, these may contain different or additional tests. These tests will be taken into account in deciding the testing required for a particular contract.*

#### Test Methods and Equipment

- 3.1 The test equipment and methods shall comply with ISO 10012-1.

#### Type Testing

*Informative: Type tests are intended to show that electronic equipment meets the requirement of its specification.*

- 3.2 If during the tests a failure occurs, adjustments are made, the test configuration is changed, alternative instrumentation is used instead of that agreed, the design of the Equipment Under Test (EUT) is changed, or any other change is made which could affect the test results in any way; the fact shall be noted in the test report.

*Informative: Depending on the significance of the event or change, the user may require the repetition of any or all of the tests.*

#### Reference Conditions

- 3.3 Unless otherwise specified in the appropriate source standard all type tests shall be carried out under the reference conditions quoted in Table 3 **Table 3 Test Reference Conditions**.

Variable	Limits
Ambient temperature	20°C ±2°C
Ambient relative humidity	≤70%
Supply voltage	Normal † ±1%
Supply frequency (for A.C. equipment)	50 Hz ±0.5% (no significant voltage waveform distortion)

**Table 3 Test Reference Conditions**

† Normal may not be the same as nominal. Where normal voltage is not quoted, nominal may be assumed.

### Measurement of Equipment Characteristics

- 3.4 Details of the equipment characteristics to be measured during the course of the test shall be given.

### Description of the Tests Required

*Informative: The following clauses give general details of the tests discussed in Clauses for Type Testing.*

*Informative: Particulars of the performance requirements and pass/fail criteria will be included in the individual equipment specification.*

### Non Maloperation Tests

- 3.5 For Non Maloperation tests the Equipment Under Test (EUT) is required to be performed to its specification in all respects while being subjected to the test conditions.

*Informative: For some equipment which is not concerned with Control, Protection and other continuous service facilities, it may not be necessary that error free operation continues during primary plant operations.*

### Protection Equipment

*Informative: The BS EN 60255 series of Standards are the product specific standards for protection equipment. As such they often contain reference conditions and acceptance criteria specifically designed for protection. Generally the tests and test levels specified in Table 4 are compatible with the IEC 60255 tests. For each test in this specification the appropriate BS EN 60255 standard, where it exists, will be indicated.*

- 3.6 In the case of protection equipment or any hardware platform that is specified for use for a protection application, the method of application and acceptance criteria for the tests as defined in the appropriate BS EN 60255 standard is definitive and shall take precedence.
- 3.7 In the case of protection equipment or any hardware platform that is specified for use for a protection application, the test levels required are stated in Table 4 and Table 5.

### Substation Control Equipment

*Informative: Substation Control Equipment comes within the scope of the BS EN 60870 series of standards. Specifically BS EN 60870-2-1 covers the power supply and electromagnetic compatibility requirements and BS EN 60870-2-2 defines the environmental requirements. They have been adopted by CENELEC as product family standards for this equipment. Table 4 relates the test levels called up by TS 3.24.15 (RES) with those required by BS EN 60870.*

### Performance Tests (Type Test)

- 3.8 Performance tests shall demonstrate that the equipment functions correctly in all performance aspects of its functional specification as defined in the appropriate functional TS(s).
- 3.9 With digital equipment, complete cycles of operation must be monitored, each cycle exercising each input and output and checking the correct operation of all performance characteristics.
- 3.10 The number of performance characteristics checked with digital equipment needs to be assessed carefully to ensure that no aspect of the performance is overlooked; this requirement includes its operation under fault conditions such as operator error, faulty inputs, etc.
- 3.11 Where relevant, the effect of supply interruptions and the start-up/shut-down performance should be checked at various points in the performance cycle of the equipment.

## 4 ELECTRICAL ENVIRONMENTAL TESTS

*Informative: The tests to be applied are summarised in Table 4 and Table 5, Substation Equipment and Table 6, Control Centre Equipment. They are required to establish that the equipment will perform in accordance with its specification in its working environment. The tables specify the levels of the tests to be applied to specific parts of the equipment. The port connections are more fully defined in Table 7. Not all the tests will be appropriate to every item of equipment.*

- 4.1** The tests in Table 4 are mandatory while those in Table 5 need only be called up if it is a specific requirement of the contract. However, it should be noted that certain of these tests are required in order to comply with BS EN 60870-2-1 (see Section on Substation Control Equipment). The test descriptions specify whether the equipment is required to function correctly during the test (non-maloperate) or whether the equipment is required to resist the specified test conditions without damage (withstand).
- 4.2** Unless otherwise stated in the appropriate TS for the EUT, equipment, when subjected to the non-maloperate tests, shall perform to specification during and after application of the tests. See also Section on Non-maloperation Tests.
- 4.3** Except where otherwise stated, the method of application for each test shall be as specified in the appropriate source standard as quoted in Table 4, Table 5 and Table 6.
- 4.4** The interference tests are designed to demonstrate that equipment is likely to be compatible with its environment. If specific measures on site are required to achieve the desired degree of immunity, full details of these measures shall be submitted to the user for assessment.

Test	Reference Information			Test Levels							
	Source Standard	Nearest Equiv IEC 60255 Standard (Product Standard for Protection)	Test and Relevant Levels Called up in BS EN 60870-2-1	Enclosure	Local Connections See Table 7	Cross-site Connections See Table 7	HV Equipment Connections See Table 7	Telecomms Connections		A.C. Power Supply i/p	D.C. Power Supply i/p
								Across Site	Up to 20 metres		
<b>MANDATORY TESTS</b>											
Electrical Fast Transient/ Burst N = coupling/decoupling network C = capacitive clamp	BS EN 61000-4-4	BS EN 60255-22-4 Class A	BS EN 61000-4-4 3 2 kV 4 4 kV	N/A	2 kV, 5 kHz C	4 kV, 2.5 kHz N (for cables for analogue signals: C)	4 kV, 2.5 kHz N (for cables for analogue signals: C)	4 kV, 2.5 kHz C	2 kV, 5 kHz C	4 kV, 2.5 kHz N	4 kV, 2.5 kHz N
Damped Oscillatory Wave C = Common Mode D = Differential Mode	BS EN 61000-4-12	BS EN 60255-22-1	BS EN 61000-4-1 sic 3-4 2.5 kV	N/A	N/A	1 MHz 2.5 kV C 1 MHz 1 kV D 0.1 MHz 1 kV C 0.1 MHz 0.5 kV D	1 MHz 2.5 kV C 1 MHz 1 kV D 0.1 MHz 2.5 kV C 0.1 MHz 1 kV D	1 MHz 2.5 kV C 1 MHz 1 kV D 0.1 MHz 2.5 kV C 0.1 MHz 1 kV D See Note 2	N/A	1 MHz 2.5 kV C 1 MHz 1 kV D 0.1 MHz 2.5 kV C 0.1 MHz 1 kV D	1 MHz 2.5 kV C 1 MHz 1 kV D 0.1 MHz 2.5 kV C 0.1 MHz 1 kV D
Electrostatic Discharge Relay Rooms	BS EN 61000-4-2	BS EN 60255-22-2	BS EN 61000-4-2 3 6 kV (contact)	6 kV contact 8 kV Air 6 kV HCP & VCP	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Electrostatic Discharge Substation Control Rooms and Telecomms Rooms	BS EN 61000-4-2		BS EN 61000-4-2 4 8 kV (contact)	8 kV contact 15 kV Air 8 kV HCP & VCP	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Radiated Radio Frequency Electromagnetic Field	BS EN 61000-4-3	BS EN 60255-22-3	BS EN 61000-4-3 3 10 V/m 4 30 V/m	10 V/m 80% modulated 80 MHz -1GHz plus spot frequencies of 80, 160, 450 and 900 MHz See also 4.31	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Conducted Disturbances Induced by RF Fields	BS EN 61000-4-6		Refers to BS EN 61000-4-6 10 VRMS	N/A	150 kHz - 100 MHz 10 V plus spot frequencies of 27 & 68 MHz	150 kHz - 100 MHz 10 V plus spot frequencies of 27 & 68 MHz	150 kHz - 100 MHz 10 V plus spot frequencies of 27 & 68 MHz	150 kHz - 100 MHz 10 V plus spot frequencies of 27 & 68 MHz	N/A	150 kHz - 100 MHz 10 V plus spot frequencies of 27 & 68 MHz	150 kHz - 100 MHz 10 V plus spot frequencies of 27 & 68 MHz
Surge – Note that this is a non-maloperation test. See Note 1.	BS EN 61000-4-5		BS EN 61000-4-5 1.2/50 $\phi$ s 8/20 $\phi$ s 3 2 kV 4 4 kV	N/A	1.2/50 $\phi$ s 1 kV L to E; 0.5 kV L to L Inst Class 2 <sup>1</sup>	1.2/50 $\phi$ s 2 kV L to E; 1 kV L to L Inst Class 3 <sup>1</sup>	1.2/50 $\phi$ s 4 kV L to E; 2 kV L to L Inst Class 4 <sup>1</sup>	10/700 $\phi$ s 4 kV L to E; 2 kV L to L Inst Class 5 <sup>1</sup>	N/A	1.2/50 $\phi$ s 2 kV L to E; 1 kV L to L Inst Class 4 <sup>1</sup>	1.2/50 $\phi$ s 2 kV L to E; 1 kV L to L Inst Class 4 <sup>1</sup>
Mains Frequency Voltage	BS EN 60255-22-7 Pending release – see below	BS EN 60255-22-7 Class A		N/A	300 V CM & 150 V Differential for 10 sec	300 V CM & 150 V Differential for 10 sec	300 V CM & 150 V Differential for 10 sec	300 V CM for 10 sec OR 6A (60255-22-7)	N/A	N/A	300 V CM for 10 sec
Mains Frequency Voltage (levels to be used pending release of IEC 60255-22-7)	BS EN 61000-4-16			N/A	10 V continuous 100 V for 1 sec	30 V continuous 300 V for 1 sec	30 V continuous 300 V for 1 sec	30 V continuous 300 V for 1 sec	N/A	N/A	30 V continuous 300 V for 1 sec
Voltage Dips, Interruptions and Slow Variations	BS EN 61000-4-11 (A.C. supplies only)		BS EN 61000-4-11 1 30% 0.5s & 100% 10 ms 2 60% 0.5 s & 100% 0.5 s	N/A	N/A	N/A	N/A	N/A	N/A	Interruption: 10, 20, 100, 200, 500, 1000 ms	Interruption: 10, 20, 100, 200, 500, 1000 ms
Supply Variation	Not yet available		No method but classes: D.C. x (+25-10%) A.C. x ( $\pm$ 15%)	N/A	N/A	N/A	N/A	N/A	N/A	EUT to operate over range	EUT to operate over range
Dielectric and Insulation Resistance Test – Withstand	IEC 60255-5 EN not available		Ref A.6.1 but no test or level		See Sections 4.61 to 4.69		2 kV for 1 minute	See Sections 4.61 to 4.69		2 kV for 1 minute	500 V/2 kV for 1 minute
Conducted and Radiated Emissions	BS EN 55022			Class A						Class A	Class A

Note 1: For screened cables the method specified in IEC 61000-4-5 Fig 13 & 14 shall be used at a level to correspond with the installation class shown. Note 2: Applicable only to connections to Power Line Carrier

**Table 4 Substation Equipment – Port Test Levels – Mandatory Tests**



Test	Reference		When should test be called up?	Test Levels							
	Source Standard	Test and Relevant Levels Called up in BS EN 60870-2-1		Enclosure	Local Connections See Table 7	Cross-site Connections See Table 7	HV Equipment Connections See Table 7	Telecomms Connections		A.C. Power Supply i/p	D.C. Power Supply i/p
<b>ADDITIONAL TESTS TO BE CALLED UP AS REQUIRED</b>											
Damped Oscillatory Wave – Additional Frequencies C = Common Mode D = Differential Mode	Based on IEC 61000-4-12.		See Section Error! Reference source not found. & Section 4.22	N/A	N/A	10 MHz 2.5 kV C 10 MHz 1 kV D 10 kHz 1 kV C 10 kHz 0.5 kV D	10 MHz 2.5 kV C 10 MHz 1 kV D 10 kHz 1 kV C 10 kHz 0.5 kV D	10 MHz 2.5 kV C 10 MHz 1 kV D 10 kHz 1 kV C 10 kHz 0.5 kV D	N/A	10 MHz 2.5 kV C 10 MHz 1 kV D 10 kHz 1 kV C 10 kHz 0.5 kV D	10 MHz 2.5 kV C 10 MHz 1 kV D 10 kHz 1 kV C 10 kHz 0.5 kV D
Power Frequency Magnetic Field	BS EN 61000-4-8	BS EN 61000-4-8 continuous/ short duration 3 30/300 A/m 4 100/1k A/m (no specific requirement for CRT)	See Section Error! Reference source not found.	30 A/m continuous 300 A/m for 1 sec 12.8 A/m for display equipment	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Pulsed Magnetic Field	BS EN 61000-4-9	N/A	See Section 4.59	6.4/16 µs magnetic pulse 1000 A/m	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Damped Oscillatory Magnetic Field	BS EN 61000-4-10	BS EN 61000-4-10 3 30 A/m 4 100 A/m	See Section 4.60	0.1 and 1.0 MHz 100 A/m	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Radiated Electromagnetic Field from Digital Portable Telephones	ENV 50204 (to be included in IEC 61000-4-3)	Not included	This test is mandatory for any equipment which can directly cause the opening of a circuit breaker. But see Section 4.37	0.9 & 1.89 GHz 10 V/m	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Voltage Dips, Interruptions and Slow Variations	BS EN 61000-4-11	BS EN 61000-4-11 1 30% 0.5 s & 100% 10ms 2 60% 0.5 s & 100% 0.5 s	See Section 4.14	N/A	N/A	N/A	N/A	N/A	N/A	Dips: 30%: 10 & 20 ms 60%: 10, 50, 100, 250, 500 & 1000 ms	N/A
Voltage Dips, Interruptions and Slow Variations	BS EN 61000-4-11	BS EN 61000-4-11 Fast variation 1 ΔU = ± 8% 2 ΔU = ± 12%	This test is mandatory for any equipment which is intended for a protection application	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Ramping from 0% to 100% & 100% to 0% over 1 minute
Conducted Disturbances 15 Hz to 150 kHz	BS EN 61000-4-16	Not included	See Section 4.48 - Informative	N/A	10-1-1-10 V	10-1-1-10 V	10-1-1-10 V	10-1-1-10 V	10-1-1-10 V	10-1-1-10 V	10-1-1-10 V

Table 5 Substation Equipment – Port Test Levels – Additional Tests

Test	Standard Reference	Test Levels – Reference BS EN 50082-2			
		Enclosure	Signal Lines and Control Lines	A.C. Power Supply i/p	D.C. Power Supply i/p
Electrical Fast Transient/ Burst N = coupling/decoupling network, C = capacitive clamp	BS EN 61000-4-4	N/A	0.5 kV, 5 kHz C	1 kV 5 kHz N	0.5 kV, 5 kHz N
Electrostatic Discharge	BS EN 61000-4-2	4 kV contact 8 kV Air 4 kV HCP & VCP	N/A	N/A	N/A
Radiated Electromagnetic Field	BS EN 61000-4-3	3 V/m 80% modulated 80 MHz -1 GHz	N/A	N/A	N/A
Conducted Disturbances	BS EN 61000-4-6	N/A	150 kHz - 100 MHz 3 V	150 kHz- 100 MHz 3 V	150 kHz- 100 MHz 3 V
Surge – Note that this is a non-maloperation test	BS EN 61000-4-5	N/A	1.2/50 $\mu$ s 2 kV common 1 kV difference	1.2/50 $\mu$ s 4 kV common 2 kV difference	1.2/50 $\mu$ s 500 V common and different modes
Power Frequency Magnetic Field	BS EN 61000-4-8	3 A/m CRT display interference allowed	N/A	N/A	N/A

**Table 6 Grid Control Centre Equipment – Port Test Levels**

Name	Environment/Source of Cable Connected to Port
Remote:	Equipment and connections to it, located in a benign electromagnetic environment eg Grid Control Centre – See Table 6
Local:	Connected to cables running in moderate electromagnetic environments which are of relatively short length (no more than twenty metres) and are related to communications in the same building
Cross-site:	Connected to cables which are intended to be connected to the low voltage control/controlled equipment of the plant within the same earth network
HV Equipment	Connected to cables which are connected to HV equipment such as circuit breakers, CTs, VTs, power line carrier or trip relays
Telecomms across Site	Control, Protection and other continuous service facilities are required to continue operating, error-free throughout the duration of the test. Other facilities may maloperate but must resume error-free operation automatically within 30 seconds of terminating the test
Telecomms up to 20 metres	
A.C. Power Supply i/p	Supplied from normal site 230 V A.C. mains
D.C. Power Supply i/p	Supplied from site D.C. supply (normally 48 or 110 V)

**Table 7 Port Environment Definition**

### **Surge – Non-maloperate (Type Test)**

*Informative: This test simulates overvoltages caused by switching and lightning transients. This is a non-maloperate test.*

- 4.5** The test shall be applied in accordance with BS EN 61000-4-5 including increasing test levels, application at various points on the voltage waveform etc.

*Informative: The impulse waveform is an aperiodic transient voltage without appreciable oscillations. There are two versions, the first, having a 1.2  $\mu$ s rise time and an exponential decay to half amplitude of 50  $\mu$ s (1.2/50  $\mu$ s) is used on power supply inputs and all isolated i/o. The second version is for telecommunications connections across site which should be tested with a 10/700  $\mu$ s version of the waveform.*

- 4.6** The source impedance of the test equipment shall be selected in accordance with the standard.

- 4.7** The test shall be applied to be applied both line to line and line to earth at levels as defined in Table 4, Table 5 and Table 6.

*Informative: Where a large number of identical interface circuits are used, this test may be restricted to a representative sample, as agreed by the user's test observer.*

### **Supply Variation – Non-maloperate (Type Test)**

- 4.8** The performance of the equipment shall be checked over the full range of the supply voltage as specified. See Section 2.11.

- 4.9** The supply voltage shall be slowly and smoothly varied over the full supply voltage range.

*Informative: Normally a gradual sweep over the range from minimum to maximum voltage for a period of one minute would suffice.*

- 4.10** In the case of equipment which has two alternative sources of supply, the procedure in Section 4.9 shall be followed with the other supply at each of its extreme values in turn.

- 4.11** A record shall be made of the maximum wattage and VA of the equipment when operating at normal voltage and frequency.

### **Voltage Dips, Interruptions and Slow Variations – Non-maloperate (Type Test)**

#### **A.C. Mains Powered Equipment**

- 4.12** For A.C. mains powered equipment the following tests shall be carried out at the periods given and in accordance with BS EN 61000-4-11.

- 4.13** The voltage dips and short interruption test shall be carried out in accordance with Table 2 of the standard at the 0% (i.e. 100% dip) test level for the durations listed in Table 4.

- 4.14** For equipment containing electro-mechanical devices such as disc drives, the 40% and 70% level tests (i.e. 60% and 30% dips) shall also be applied as in Table 2 of the standard for the periods listed in Table 5.

- 4.15** For the above “Voltage Dips, Interruptions and Slow Variations” tests two sets of Pass/Fail Criteria shall apply:
- (a) The EUT shall be required to operate without suffering any maloperation (i.e. perform entirely to specification) up to a predefined maximum test level/duration. This level/duration shall normally be 0%/10 ms unless otherwise stated in the contract documentation.
  - (b) Beyond this level/duration and up to the maximum as defined in Table 4, Table 5 and Table 6, the EUT may maloperate but must recover spontaneously after the test and must not have suffered any permanent or temporary deleterious effect nor behaved in a manner which could have led to a trip output being generated.
- 4.16** Protection equipment shall not cause an unwanted trip output to be generated during, and shall operate satisfactorily following, the gradual ramping up and down from 0% to 100% and 100% to 0% of nominal supply voltage over a ramp period of one minute.
- 4.17** If the EUT is always to be used on a supply supported by a UPS these tests may be omitted. However this restriction must be stated on the Type Registration Documentation for the EUT.

#### **D.C. Powered Equipment**

**4.18 For D.C. powered equipment the following shall be carried out:**

- (a) The supply to the EUT shall be interrupted three times at random for periods of 10, 20, 100, 200, 500 and 1000 ms. The combinations of the periods to be used will be related to the integrity required of the equipment when it operates within its working environment.
- (b) The minimum interval between interruptions shall be three times the period of the interruption.
- (c) For interruptions of 100 ms and above at least one minimum interval shall occur in the sequence.
- (d) The tests shall cover all modes of equipment operation.
- (e) The pass/fail criteria requirements as stated above shall apply.

#### **Electrical Fast Transient/Burst – Non-maloperate (Type Test)**

*Informative: The test is intended to simulate the effects of transient disturbances such as those originating from switching transients (interruption of inductive loads, relay bounce etc).*

- 4.19** The test shall be carried out in accordance with BS EN 61000-4-4 and the levels to be applied to the various ports are defined in Table 4, Table 5 and Table 6.

*Informative: Where the EUT has a large number of identical interface circuits, the test may be restricted to an agreed sample.*

#### **Damped Oscillatory Wave – Non-maloperate (Type Test)**

*Informative: This test is intended to simulate the effects of switching with restriking of the arc (e.g. disconnecter operation).*

- 4.20** The tests are to be applied in accordance with BS EN 61000-4-12.

*Informative: Where the EUT has a large number of identical interface circuits, the test may be restricted to an agreed sample.*

- 4.21 The 100 kHz and 1 MHz damped oscillatory wave test shall be applied at levels and to ports as defined in Table 4 and Table 5.
- 4.22 The damped oscillatory wave test shall be extended to include the 10 kHz and 10 MHz versions of these tests as per IEC 61000-4-18.

#### **Electrostatic Discharge – Non-maloperate (Type Test)**

*Informative: This test is particularly relevant as it simulates the effect of large transient currents flowing adjacent to susceptible equipment or in the casing of the equipment. Such common mode phenomena can occur in substations as a result of the operations of primary plant. For the substation environment therefore, the test should not just be regarded as a test that measures the susceptibility to discharges from personnel and furniture but as a test which gives an effective indication of the likely susceptibility of the equipment to the substation environment.*

- 4.23 The test is based on BS EN 61000-4-2. The level to be applied is dependent upon the environment in which the equipment is intended to be installed (see Table 4) and is to be applied while the EUT is energised.
- 4.24 The test shall be undertaken on fully installed items of equipment, within their enclosures.
- 4.25 The test is to be applied to all points which are accessible during normal use.
- 4.26 The test is also to be applied to all points which are accessible during maintenance by the user unless use of electrostatic precautions are provided for and mandated by an appropriate notice on the equipment.
- 4.27 Testing is to be carried out in accordance with the standard including the use of horizontal and vertical coupling planes where applicable.
- 4.28 The test voltage shall be increased from the minimum to the selected test level.

#### **Radiated Radio Frequency Electromagnetic Field – Non-maloperate (Type and Site Pre-commissioning Test)**

*Informative: The objective of this test is to evaluate the performance of the equipment when subjected to electromagnetic fields, primarily the transient fields generated by electricity supply plant but also the permanent fields generated by portable and base station radio transceivers.*

*Informative: As the test applies the interference as a swept frequency its effectiveness in simulating the transient interference from primary plant is limited. However this is the only standard radiated interference test which is available from the majority of test houses.*

- 4.29 The performance of the EUT shall be monitored throughout the test.
- 4.30 The frequency range to be covered shall be 80 MHz to 1 GHz which is chosen to complement (and slightly overlap) that covered by the Conducted Disturbances test (q.v.).
- Informative: The standard test as defined in BS EN 61000-4-3 covers frequencies up to 1 GHz, modern digital cellular telephones (particularly the proposed Universal Mobile Telephone System) extend up to 2.2 GHz.*
- 4.31 When assessing equipment for use in substations in the vicinity of a base station or where uninhibited use of mobile 'phones is allowed, a sweep test at 10 V/m from 1.7 to 2.2 GHz should be carried out in addition to the standard range of 80 MHz to 1.0 GHz.

- 4.32** The immunity to RFI is tested while the equipment is in its normal operating state with covers in place, and also with its covers removed for maintenance.
- 4.33** The testing shall be with the normal supply, input and output leads intended for the equipment.
- 4.34** The test method shall be the radiating antenna method detailed in BS EN 61000-4-3 but with test limits as defined in Table 4, Table 5 and Table 6.
- 4.35** The sweep rate shall be as specified in BS EN 61000-4-3, except that for digital equipment the rate shall be such that the EUT can perform 10 full operational cycles per octave.
- 4.36** At certain spot frequencies the EUT shall be required to carry out two full operational cycles. These spot frequencies shall be 80, 160, 450 and 900 MHz.
- 4.37** The addition of a further spot frequency test at 1.89 GHz will obviate the requirement to carry out the “Radiated Magnetic Field from Digital Portable Telephones Test”
- 4.38** An operational cycle shall include at least one transition of the EUT from one operational state to another.

*Informative: For example for protection equipment an operational cycle would include detecting a (simulated) fault condition and generating a trip output.*

#### **Conducted Disturbances Induced by RF Fields – Non-maloperate (Type Test)**

*Informative: This purpose of this test is to determine the immunity of the EUT to electromagnetic fields which act on the cables connected to the EUT.*

- 4.39** The test is to be applied in accordance with BS EN 61000-4-6.
- 4.40** The frequency range shall be by agreement but shall normally be 150 kHz to 100 MHz. The test is to be applied at levels and to ports as defined in Table 4, Table 5 and Table 6.
- 4.41** The sweep rate shall be as specified in BS EN 61000-4-6, except that for digital equipment the rate shall be such that the EUT can perform 10 full operational cycles per octave.
- 4.42** At certain spot frequencies the EUT shall be required to carry out two full operational cycles. These spot frequencies shall be 27 and 68 MHz.
- 4.43** An operational cycle shall include at least one transition of the EUT from one operational state to another.

*Informative: For example for protection equipment an operational cycle would include detecting a (simulated) fault condition and generating a trip output.*

#### **Mains Frequency Voltage**

*Informative: This test is intended to simulate the effect of an earth fault in the substation and to verify that the system is immune to any picked up mains frequency interference during non-fault conditions. The test method required is that specified in IEC 60255-22-7. This standard is based on IEC 61000-4-16 but includes a differential mode test, a current mode test for communication lines and uses different coupling capacitors and test voltages.*

- 4.44** A test shall be applied to demonstrate that the EUT does not maloperate when a 50 Hz voltage (in phase with the equipment supply for A.C. powered equipment) is applied via a capacitor.

**4.45** The method as specified in BS EN 60255-22-7 shall be used using test levels as specified in Table 4 and Table 5.

**4.46** The method of application shall be one of those illustrated in Figures 2 to 5 of BS EN 60255-22-7, selected to suit the type of port being tested.

*Informative: It should be noted that this test is not applicable to circuits for which 50 Hz inputs are normal. Where the EUT has a large number of identical interface circuits, the test may be restricted to an agreed sample.*

*Informative: The test shall normally be restricted to 50 Hz unless additional frequencies are called up as a specific requirement of the contract. Note that this would normally be appropriate for equipment which is to be used in the proximity of power electronic equipment such as Static VAR Compensators.*

**4.47** In the interim period, before IEC 60255-22-7 is formally issued, the method as specified in BS EN 61000-4-16 shall be used unless otherwise agreed with the user. The required test levels are defined in Table 4.

#### **Conducted Disturbance 15Hz to 150 kHz**

*Informative: This test simulates the effect of conducted disturbances which may be generated by power electronic equipment.*

**4.48** The test shall be carried out in accordance with BS EN 61000-4-16.

*Informative: Application of the test should be considered for equipment to be installed on sites incorporating power electronics e.g. SVCs.*

#### **Conducted and Radiated Emissions (Type Test)**

*Informative: This test is intended to ensure that the EUT does not generate emissions at a level that could cause other equipment to malfunction.*

**4.49** A conducted and radiated emissions test shall be carried out to check that the equipment meets the requirements of BS EN 55022. Normally the acceptable limits shall be taken as those applicable to Class A equipment.

**4.50** In the specific case where equipment is to be powered from a 48 V D.C. communication supply, self generated interference requirements are described by ETSI (European Telecommunication Standards Institute) standards ETS 300 132-2, and ETS 300 386-1 as follows:

- (a) Conducted emissions 25 Hz to 20 kHz ETS 300 132-2 Section 4.9
- (b) Conducted emissions 0.02 – 30 MHz ETS 300 386-1 Section 7.2.3

#### **Inrush Current (Type Test)**

*Informative: This test shall be carried out in order to ensure that the requirements for inrush are satisfied.*

**4.51** Measurement of the inrush current shall preferably be made using a Hall effect current clamp having a frequency response up to at least 3 kHz. Alternatively, the current may be measured using a low value series resistor, such that at peak current the voltage across it does not exceed 5% of the supply voltage.

**4.52** The tests shall be performed with the equipment operating under conditions of maximum power consumption.

- 4.53** An interval of several minutes shall be allowed to elapse between each test.
- 4.54** Every effort shall be made to ensure that the supply source impedance does not significantly limit the inrush current.
- 4.55** The current waveform shall be recorded after switch-on until it has reached a steady value, and a note shall be made on the trace of the points where peak and zero values of the waveform occur. For A.C. supplies, not less than ten measurements shall be recorded.

#### **Power Frequency Magnetic Field Immunity – Non-maloperate (Type Test)**

*Informative: This test would normally only be applied to equipment which utilises an electron beam (e.g. Cathode Ray Tube Monitors, Electron Microscopes etc) or to certain measuring instruments. However the test is also called up in BS EN 60870-2-1 and is therefore available as an additional test for other equipment at levels as specified in Table 5.*

- 4.56** The test shall be carried out in accordance with BS EN 61000-4-8 in all three planes of the EUT.
- 4.57** The continuous and short duration tests shall be applied to equipment which is to be located within 5 metres of any grid transformer. The test levels are specified in Table 5.

#### **Pulsed Magnetic Field – Non-maloperate (Type Test)**

*Informative: This test simulates the magnetic field generated by a) lightning strikes, b) initial fault transients and c) the switching of HV busbars and lines by circuit breakers. Research carried out for the user has concluded that the test is of most relevance in the case of a) above.*

- 4.58** The test shall be carried out in accordance with BS EN 61000-4-9 at test levels as specified in Table 5.
- 4.59** The Pulsed Magnetic Field test shall be applied to equipment which can directly cause the opening of a circuit breaker and is to be positioned in a high lightning risk area.

#### **Damped Oscillatory Magnetic Field – Non-maloperate (Type Test)**

*Informative: Damped Oscillatory Magnetic Fields are generated by the switching of HV busbars by disconnectors. The test as specified in BS EN 61000-4-10 requires oscillatory waves of 0.1 and 1.0 MHz. The user has evidence that 10 kHz and 10 MHz versions of this waveform are also often present in the spectrum of the interference emanating from primary plant (10 kHz in the case of AIS circuit breakers; 10 MHz from GIS disconnectors and circuit breakers and some AIS disconnectors). The field is confined to the vicinity of the current breaking device.*

- 4.60** The Damped Oscillatory Magnetic Field test shall be performed for equipment located within 10 metres of circuit breakers or disconnectors. When test equipment is available the test is also to be applied at 10 kHz and 10 MHz in addition to the 0.1 and 1.0 MHz specified in the standard. The test levels are specified in Table 5.

#### **Dielectric and Insulation Resistance – Withstand (Type Test)**

*Informative: The objective of these tests which are based on BS EN 60255-5 is to prove the integrity of the insulation and isolation between each circuit and exposed conductive parts (including earth) and between independent circuits. The tests involve the measurement of insulation resistance and the application of a dielectric withstand test as described below.*

- 4.61** The type test is only to be applied to isolation and safety barriers.



- 4.62** Other items (e.g. PSUs) are to be tested during the manufacturing process (routine and sample) before filters, over-voltage protection devices etc are installed. In this case, for type registration, evidence must be produced that the power supply unit conforms with, for example, IEC 478 Stabilised Power Supplies – D.C. Output.
- 4.63** For circuits operating at voltages of 110 V A.C. or D.C. and above, or where a circuit is energised via an instrument transformer, a dielectric withstand test of 2 kV A.C. and an insulation resistance test of 500 V D.C. shall be performed.
- 4.64** For circuits operated at voltages below 110 V A.C. or D.C. but above 55 V A.C. or D.C., a dielectric withstand test of 1 kV A.C. and an insulation resistance test of 500 V D.C. shall be performed.
- 4.65** For circuits operated at voltages of 55 V A.C. or D.C. and below, the test shall be restricted to an insulation resistance test of 500 V D.C. which shall also act as a dielectric withstand test.
- 4.66** When testing between circuits which have different operating voltages the test level shall be determined by the circuit with the higher operating voltage.
- 4.67** The dielectric withstand test voltage source shall be as described in IEC 60255-5 Clause 6.3 and be applied as detailed in IEC 60255-5 Clause 6.4.
- 4.68** During the dielectric test, no breakdown or flashover shall occur.
- 4.69** The insulation resistance test shall be applied as detailed in IEC 60255-5 Clause 7.2. The resistance values should generally exceed 100 M $\Omega$ , (or 20 M $\Omega$  where a number of circuits are involved, e.g. equipment handling a number of inputs and outputs).

## **5 ATMOSPHERIC ENVIRONMENTAL TESTS**

### **Dry Heat – Non-maloperate (Type Test)**

- 5.1** The dry heat test shall be carried out on individual subunits, units and, where applicable, on the complete equipment or assembly, with all doors and covers being in place and closed as in normal operation.
- 5.2** Test conditions shall be in accordance with BS EN 60068-2-2, test Bd at the upper temperature of the Environmental Class ( $\pm 2^{\circ}\text{C}$ , RH  $\leq 60\%$ ; see TS 1 Table 10) specified in the corresponding functional TS (RES) or the contract documentation.
- 5.3** For Class 1 or Class 2 equipment which is to be used in a cabinet not included in the EUT, the test shall be carried out at 15 $^{\circ}\text{C}$  above the Class temperature.
- 5.4** The EUT shall operate continuously during the test.
- 5.5** The duration of the test would normally be 16 hours (excluding acclimatisation time) except for equipment which can directly cause the opening or closing of a circuit breaker which shall be subjected to either 55 $^{\circ}\text{C}$  for 96 hours or 70 $^{\circ}\text{C}$  for 16 hours. (The additional 15 $^{\circ}\text{C}$  enclosure factor need not be applied).
- 5.6** Performance checks shall be made at least three times at regular periods while at the test temperature and repeated when the equipment has returned to ambient temperature.

### **Low Temperature – Non-maloperate (Type Test)**

- 5.7** The low temperature test shall be carried out on individual subunits, units and, where applicable, on the complete equipment or assembly, with all doors and covers being in place and closed as in normal operation.

- 5.8** Test conditions shall be in accordance with BS EN 60068-2-1, test Ad at the lower temperature of the Environmental Class ( $\pm 2^{\circ}\text{C}$ , RH  $\leq 60\%$ ; see TS 1 Table 10) specified in the corresponding functional TS (RES) or the contract documentation.
- 5.9** The EUT shall operate continuously during the test.
- 5.10** The duration of the test would normally be 16 hours (excluding acclimatisation time) except for equipment which can directly cause the opening or closing of a circuit breaker which shall be subjected to either  $-10^{\circ}\text{C}$  for 96 hours or  $-25^{\circ}\text{C}$  for 16 hours.
- 5.11** Performance checks shall be made at least three times at regular periods while at the test temperature and repeated when the equipment has returned to ambient temperature.

#### **Damp Heat – Non-maloperate (Type Test)**

- 5.12** This test is undertaken on complete items of equipment in their normal operational mode. The test is based on BS EN 60068-2-78 Test Bc which is designed to avoid the formation of condensation on the EUT. The following conditions shall apply:
- (a) The test duration shall be 2 days except where noted below and unless a longer period is specified.
  - (b) The test conditions shall be  $40 \pm 2^{\circ}\text{C}$  with  $93 \pm 3\%$  RH; except for equipment which can directly cause the opening or closing of a circuit breaker which shall be subjected to either BS EN 60068-2-78 at  $40 \pm 2^{\circ}\text{C}$  with  $93 \pm 3\%$  RH for 56 days, or IEC 68-2-30 for 6 times 24 hour cycles of  $+ 25^{\circ}\text{C}$  to  $+55^{\circ}\text{C}$  with  $93 \pm 3\%$  RH.
  - (c) The initial performance check shall be made with the equipment under ambient conditions in the test chamber. In the case of tests to BS EN 60068-2-78, the equipment shall be switched off on completion of this check.
  - (d) In the case of tests to BS EN 60068-2-78 after test conditions have been achieved, the equipment shall be re-energised two hours before test conditions are allowed to alter and a further performance check carried out during the last hour at the elevated temperature and humidity. The equipment shall remain energised for the remainder of the test.
  - (e) Single chamber controlled recovery conditions shall be applied, after which the final performance check shall be made.

#### **Storage Temperature Test – Withstand (Type Test)**

- 5.13** Unless otherwise agreed, all electronic equipment shall be subjected to a withstand test to simulate the extreme temperature ranges which can be encountered during storage and transportation.
- 5.14** The equipment shall be subjected to a low temperature test in accordance with BS EN 60068-2-1 at  $-25^{\circ}\text{C}$  for 96 hours or  $-40^{\circ}\text{C}$  for 16 hours. The EUT shall also be subjected to a high temperature test according to BS EN 60068-2-2 at  $70^{\circ}\text{C}$  for 96 hours.
- 5.15** After ambient conditions are re-established a Performance Check shall be performed.

#### **Enclosure (Type Test)**

- 5.16** Unless otherwise agreed, tests shall be undertaken to confirm that the degree of protection provided by the enclosure of the equipment is as required. The appropriate enclosure classifications for the degree of protection (IP) are given in BS EN 60529.
- 5.17** Where the size of the enclosure is such that there is difficulty in carrying out the tests as specified, alternative test procedures may be adopted with the agreement of the user.

### **Salt Corrosion (Type Test)**

- 5.18** When required the salt corrosion test shall be carried out in accordance with BS EN 60068-2-52. At the end of the test there shall be no undue deterioration of metal parts, finishes, and materials.
- 5.19** The equipment shall be subjected to a performance check at the end of the recovery period.

### **Humidity Cycling (Type Test)**

- 5.20** Where required this test shall be carried out on an agreed number of samples of components, materials or finishes not already registered, or about which the effects of humidity are unknown.
- 5.21** The test shall be carried out in accordance with BS EN 60068-2-30 with the following conditions:
- (a) The upper temperature shall be 40°C.
  - (b) The number of cycles shall be 12.
  - (c) During the temperature-fall period consideration shall occur.
  - (d) Immediately after the end of the test the components or equipment shall be visually examined; there shall be no undue deterioration or corrosion and there shall be no significant change of electrical or mechanical characteristics.

### **Mould Growth (Type Test)**

*Informative: The test may be required on samples of components, materials and finishes where their resistance to mould growth is unknown or suspect.*

- 5.22** If required, the test shall be carried out in accordance with BS EN 60068-10.
- 5.23** After 28 days, the sample shall be examined and no mould growth shall be apparent to the naked eye, nor shall there be any significant change of electrical characteristics.

### **Industrial Atmosphere (Type Test)**

*Informative: This test may be required on samples of components, materials and finishes where they are not already registered or are of unknown performance.*

- 5.24** The test shall be carried out in accordance with BS EN 60068-2-42. The duration of the test will be 4, 10 or 21 days.
- 5.25** At the conclusion of the test there shall be no evidence of deterioration or corrosion, and tests shall be carried out to establish that there has been no significant change of electrical characteristics.

### **Soak Test**

Soak – Non-maloperate (Type Test)

- 5.26** Equipment shall normally be set up to simulate normal operating conditions and allowed to operate continuously for a minimum period of 100 hours. By agreement, this period may be broken down into shorter periods if compatible with the function of the equipment.

- 5.27** During the test, measurements and observations shall be made to demonstrate that the equipment fulfils its functional requirement, has adequate stability, and is capable of operating without frequent attention. The extent of performance monitoring required will depend upon the nature of the EUT.
- 5.28** If any failures occur or adjustments are made, full details shall be recorded for the user, who will decide whether the test may be restarted or shall be repeated.

## **6 MECHANICAL TESTS**

### **Drop and Topple (Type Test)**

*Informative: This test is for portable equipment, and units and sub-assemblies only. It is not intended that it be carried out on complete racks of equipment. The test is intended to reveal any weakness of assembly and to ensure that the component mountings are of adequate strength. It is not intended to check whether glass items, meters or similar items will break, therefore they may be removed before the test.*

- 6.1** Covers which have to be removed for servicing shall be removed after this test to inspect the equipment for damage. The equipment shall not be deemed to have failed the test if externally accessible components such as control knobs or connectors are damaged. Where agreed, some form of guard may be fitted to prevent such damage.
- 6.2** This test shall be carried out in accordance with IEC 68-2-31 Test Ec (BS 2011-2.1 Ec). The test will vary depending on the relative dimensions of the equipment.
- (a) If the height is the smallest dimension, the equipment shall be dropped on the four edges of the base, in accordance with Clause 3.2.1 of IEC 68-2-31, from a distance of 50 mm.
  - (b) If the height is the second largest dimension, the equipment shall be subjected to the topple or pushover test as described in Clause 3.2.3 of IEC 68-2-3, but be toppled about the two longer bottom edges only.
  - (c) If the height is the largest dimension, the test shall be as detailed in b) above, except that the equipment shall be toppled about each bottom edge.

### **Vibration (Type Test)**

*Informative: The vibration test is intended to reveal any part or components of the equipment which may be prone to any resonance severe enough to cause possible damage or maloperation. It is not intended to be carried out on complete racks of equipment, but on units and sub-units only.*

- 6.3** The test shall be carried out in accordance with BS EN 60068-2-6 The EUT shall be subjected to the vibration response test at severity class 1 and the vibration withstand test at severity class 1. These test levels are defined in the related standard BS EN 60255-21-1.
- 6.4** As far as possible, the equipment shall be mounted on its normal fixings and the vibrations shall be applied along each axis in turn. If necessary, to observe otherwise obscured parts, equipment sub-assemblies may also be tested. Equipment may be required to undergo a performance check while being subjected to a sweep frequency test.
- 6.5** When a resonance is detected, a search shall be made on either side of the resonant frequency so that the effects of the resonance may be assessed.
- 6.6** Any resonances liable to affect the performance or reliability of the equipment shall be reduced to an acceptable level by suitable modifications, and the test repeated.

### Shock (Type Test)

- 6.7 A shock test shall be carried out in accordance with BS EN 60068-2-27. The EUT shall be subjected to the shock response test at severity class 1 and the shock withstand test at severity class 1. These test levels are defined in the related standard BS EN 60255-21-2.

### Bump (Type Test)

- 6.8 A bump test shall be carried out in accordance with BS EN 60068-2-29. The EUT shall be subjected to the bump test at severity class 1. These test levels are defined in the related standard BS EN 60255-21-2.

### Seismic (Type Test)

- 6.9 A seismic test at severity class 1 shall be carried out in accordance with BS EN 60255-21-3.

## 7 FORMS AND RECORDS

Not applicable.

## PART 2 - DEFINITIONS AND DOCUMENT HISTORY

### 8 DEFINITIONS

- 8.1 EUT - Equipment under test.
- 8.2 Port - A particular interface of the specified equipment with the external electromagnetic environment (see Figure 2). For interference immunity tests, the level of test to be applied is specified on a port by port basis.
- 8.3 Enclosure Port - The physical boundary of the equipment which electromagnetic fields may radiate through or impinge on.

### 9 AMENDMENTS RECORDS

Issue	Date	Summary of Changes / Reasons	Author(s)	Approved By (Inc. Job Title)
1	October 2014	New document	Dechao Kong/ Ray Zhang/ Richard Poole	GCRP

#### 9.1 Procedure Review Date

5 years from publication date.

## **PART 3 - GUIDANCE NOTES AND APPENDICES**

### **10 REFERENCES**

This Specification makes reference to the following related specifications:

ISO 10012-1            Quality Assurance Requirements for Measuring Equipment – Part 1: Metrological Confirmation System for Measuring Equipment (BS EN 30012-1)

#### **IEC Standards**

IEC 61000-4 series    Electromagnetic Compatibility (EMC) – Part 4: Testing and Measuring Techniques (BS EN 61000-4 series)

IEC 60255 series      Electrical Relays (BS EN 60255 series)

IEC 61000 series      Electromagnetic Compatibility (EMC)

IEC 68-2 series        Basic Environmental Testing Procedures - Part 2 series

#### **European Standards**

BS EN 61000-6-1      Electromagnetic Compatibility (EMC) - Part 6-1: Generic Standards - Immunity for Residential, Commercial and Light-industry Environments

BS EN 50178            Electronic Equipment for Use in Power Installations

BS EN 55022            Information Technology Equipment - Radio Disturbance Characteristics - Limits and Methods of Measurement

BS EN 60068 series    Environmental Testing Procedures

BS EN 60068-2-1      Part 2-1: Tests - Test A: Cold

BS EN 60068-2-2      Part 2-2: Tests - Test B: Dry heat

BS EN 60068-2-6      Test 2-6: Tests - Test Fc: Vibration (Sinusoidal)

BS EN 60068-2-10     Part 2-10: Test - Test J and Guidance: Mould Growth

BS EN 60068-2-27     Part 2-27: Tests - Test Ea and Guidance: Shock

BS EN 60068-2-29     Part 2-29: Tests - Test Eb and guidance: Bump

BS EN 60068-2-30     Part 2-30: Tests - Test Db: Damp Heat, Cyclic (12 hour+12 hour cycle)

BS EN 60068-2-31     Part 2-31: Tests - Test Ec: Rough Handling Shocks, Primary for Equipment-type Specimens

BS 2011-2.1 Ec        Basic environmental testing procedures Part 2.1 Tests – Test Ec: Drop and topple, primarily for equipment-type specimens

BS EN 60068-2-42     Part 2-42: Tests - Test Kc: Sulphur Dioxide Test for Contacts and Connections

BS EN 60068-2-52     Part 2-52: Tests - Test Kb: Salt Mist, Cyclic (Sodium Chloride Solution)

BS EN 60068-2-78     Part 2-78: Tests - Test Cab: Damp Heat, Steady State

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BS EN 60255-21-1	Electrical Relays - Part 21: Vibration, Shock, Bump and Seismic Tests on Measuring Relays and Protection Equipment - Section 1: Vibration Tests (Sinusoidal)
BS EN 60255-21-2	Electrical Relays - Part 21: Vibration, Shock, Bump and Seismic Tests on Measuring Relays and Protection Equipment - Section 2: Shock and Bump Tests
BS EN 60255-21-3	Electrical Relays - Part 21: Vibration, Shock, Bump and Seismic Tests on Measuring Relays and Protection Equipment - Section 3: Seismic Tests
BS EN 60654-1	Industrial-process measurement and control equipment – Operating conditions – Part 1: Climatic conditions
BS EN 60870-2-1	Telecontrol Equipment and Systems Part 2: Operating Conditions Section 1: Power Supply and Electromagnetic Compatibility
BS EN 60870-2-2	Telecontrol Equipment and Systems Part 2: Operating Conditions Section 2: Environmental Conditions (Climatic, Mechanical and Other Non-electrical Influences)
BS EN 61000-4-1	Part 4-1: Testing and Measurement Techniques - Overview of IEC 61000-4 series
BS EN 61000-4-2	Part 4-2: Testing and Measurement Techniques - Electrostatic Discharge Immunity Test
BS EN 61000-4-3	Part 4-3: Testing and Measurement Techniques - Radiated, Radio-frequency, Electromagnetic Field Immunity Test
BS EN 61000-4-4	Part 4-4: Testing and Measurement Techniques - Electrical Fast Transient/Burst Immunity Test
BS EN 61000-4-5	Part 4-5: Testing and Measurement Techniques - Surge Immunity Test
BS EN 61000-4-6	Part 4-6: Testing and Measurement Techniques - Immunity to Conducted Disturbances, Induced by Radio-frequency
BS EN 61000-4-8	Part 4-8: Testing and Measurement Techniques - Power Frequency Magnetic Field Immunity Test
BS EN 61000-4-9	Part 4-9: Testing and Measurement Techniques - Pulse Magnetic Field Immunity Test
BS EN 61000-4-10	Part 4-10: Testing and Measurement Techniques - Damped Oscillatory Magnetic Field Immunity Test
BS EN 61000-4-11	Part 4-11: Testing and Measurement Techniques – Voltage Dips, Short Interruptions and Voltage Variations Immunity Tests
BS EN 61000-4-12	Part 4-12: Testing and Measurement Techniques - Oscillatory Waves Immunity Test
BS EN 61000-4-16	Part 4-16: Testing and Measurement Techniques – Test for Immunity to Conducted, Common Mode Disturbances in the Frequency Range 0 Hz to 150 kHz
BS EN 61000-4-18	Part 4-18: Testing and Measurement Techniques – Damped Oscillatory Wave Immunity Test
BS EN 60529	Degrees of Protection Provided by Enclosures (IP Code)

BS 6527	Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment
ETSI ETS 300 132-2	European Telecommunications Standards Institute (ETSI): Equipment Engineering (EE); Power Supply Interface at the input to Telecommunications Equipment; Part 2: Operated by Direct Current (dc)
ETSI ETS 300 386-1	European Telecommunications Standards Institute (ETSI): Equipment Engineering; Public Telecommunications Network Equipment Electromagnetic Compatibility (EMC) Requirements; Part 1: Product Family Overview, Compliance Criteria and Test Levels

#### **National Grid TS (RES) Documents**

TS 1 (RES)	Ratings and Requirements for Plant, Equipment and Apparatus for the National Grid System
TS 2.12 (RES)	Substation Auxiliary Supplies
TS 3.24.15 (RES)	Environmental and Test Requirements for Electronic Equipment

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